



Ca' Foscari
University
of Venice

**Master Degree Programme
in Innovation and Marketing**

Final Thesis

**Artificial Intelligence in the future of the
world of work:
the shift from specialized technical skills to
human-centric general skills**

Supervisor
Prof. Giovanni Vaia

Graduand
Caterina Forcelli
878637

Academic Year
2024 / 2025

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Chapter 1

Introduction

1.1 Presentation of the topic

Artificial Intelligence (AI) is rapidly transforming the landscape of contemporary labor markets. Once limited to automating routine and repetitive tasks, AI systems have evolved to perform highly specialized, knowledge-intensive activities, tasks traditionally thought to require advanced human expertise and professional judgment. This technological advancement is driving a profound structural shift in the world of work, progressively dissolving the clear-cut boundaries between human and machine capabilities.

At the core of this transformation lies a dual dynamic: technological substitution and human augmentation. On one hand, AI technologies are capable of replacing certain job functions, particularly those that are predictable and data-driven. On the other hand, they are simultaneously enhancing the value of uniquely human skills — such as creativity, empathy, ethical reasoning, and complex decision-making — that remain difficult for machines to emulate. This evolving interplay between automation and augmentation is redefining not only what work entails, but also what it means to be a skilled worker in the age of intelligent systems.

This thesis focuses on one of the most critical dimensions of this transformation: the automation of specialized technical tasks by AI and the concurrent rising demand for human-centric, generalist skills such as creativity, emotional intelligence, and communication. As Machine Learning models and Natural Language Processing systems achieve unprecedented levels of accuracy and autonomy, tasks traditionally performed by professionals in fields such as medicine, law, finance, and engineering are increasingly subject to automation.

At the same time, the limitations of AI in replicating empathy, ethical judgment, and social reasoning have brought renewed attention to the irreplaceable role of human capabilities in collaborative, service-oriented, and leadership contexts. [wef, 2020] This emerging asymmetry between machine efficiency and human depth reveals a paradigm shift unfolding across work environments globally. While AI excels at structured, data-driven, and logic-based operations, it falters in contexts that demand ambiguity management, interpersonal dynamics, or culturally situated judgment.

This evolving landscape is reinforcing the strategic importance of transversal competencies — those that span multiple domains and disciplines. These include not only soft skills but also integrative abilities such as critical thinking, adaptive problem-solving, and ethical discernment, which are becoming central to innovation and responsible technology use. Understanding and responding to this shift is essential for policymakers, educators, and labor market stakeholders aiming to design inclusive and future-ready workforce development strategies in the age of AI.

1.2 Objectives of the research

The fundamental objective of this thesis is to examine how Artificial Intelligence is transforming the structure and nature of work, particularly through the automation of specialized technical tasks and the concurrent reshaping of the profile of in-demand skills. The research explores how recent advances in AI have enabled the automation of high-skill, knowledge-intensive activities across a wide range of sectors, and investigates the types of human-centric skills that are gaining prominence in response to this technological shift.

A central concern of the study is to understand in which economic sectors this transition from technical to generalist competencies is most evident, and what consequences it holds for employment patterns, occupational mobility, and the future configuration of professional roles. In doing so, the thesis also addresses the question of how workforce development strategies and educational frameworks can evolve to support workers in navigating and adapting to these emerging conditions.

By engaging with these themes, the thesis aims to provide a comprehensive overview of the new division of labor between human workers and intelligent systems. It draws on a multidisciplinary literature base — spanning labor economics, sociology of work, technology studies, and human resource development — as well as institutional reports from bodies such as the Organisation for Economic Co-operation and Development (OECD), International Labour Organization (ILO), and World Economic Forum (WEF).

A secondary aim of the research is to investigate the conceptual frameworks that illuminate the growing value of generalist, human-centered capabilities in an AI-mediated economy. These include models such as T-shaped professionalism, theories of emotional and relational labor, socio-emotional intelligence frameworks, and the paradigm of lifelong learning. Through the examination of these perspectives, the thesis seeks to contribute to a broader scholarly understanding of how human labor can remain resilient, adaptive, and meaningful in the face of rapid technological disruption.

1.3 Methodology and structure of the thesis

This thesis adopts a primarily qualitative and interpretative methodology, aimed at capturing the complex and multifaceted ways in which Artificial Intelligence is reshaping the world of work. The research is grounded in an extensive review of academic literature, institutional publications, and contemporary case studies that document the application of AI across a range of occupational sectors. Key sources include sector-specific reports from global organizations such as the OECD, ILO, the World Economic Forum, and UNESCO, alongside peer-reviewed journal articles that explore the implications of AI for the future of employment and skill development. Where relevant, the study incorporates quantitative data — such as job forecasts, skills gap metrics, and AI adoption rates — to support and contextualize the qualitative analysis. The structure of the thesis reflects a progression from conceptual foundations to applied insights.

Chapter 2 offers a conceptual and historical overview of Artificial Intelligence, tracing its technological evolution and examining how AI systems have increasingly been adopted within workplace settings. Particular attention is paid to the ways in which AI has begun to automate highly specialized tasks that were once the exclusive domain of trained professionals.

Chapter 3 turns to the human dimension of this transformation, analyzing the shifting demand for labor in light of AI's limitations. It highlights the rising importance of generalist

and human-centric competencies — such as creativity, emotional intelligence, and communication — and explores the theoretical underpinnings of these skills within models of human–AI collaboration.

Chapter 4 provides a sectoral analysis, focusing on industries where AI is already exerting a significant impact on professional roles. It presents case studies from the technological, creative, and service-oriented fields to illustrate how work is being reorganized in practice, and to identify the emerging patterns of hybridization between human expertise and machine intelligence.

Finally, Chapter 5 offers a synthesis of the key findings, articulates their broader implications for workforce development and policy design, and outlines potential directions for future research.

This structured approach allows the thesis to move from foundational definitions to sector-specific implications, offering both a theoretical framework and empirical grounding for understanding how AI is transforming the world of work.

Chapter 2

Artificial Intelligence and the World of Work

2.1 Definition and overview of Artificial Intelligence

Recent developments in the field of Artificial Intelligence (AI) make its rise and its increasingly frequent use in the most diverse fields undeniable. As a result, its potential impact on the world of work is something that can no longer be underestimated.

To fully understand the scope of discussion, it is first necessary to provide a clear definition of Artificial Intelligence. This section aims to do so by summarizing different definitions from authoritative sources. In addition, the section will explore the definitions of the main subcategories related to the world of AI and, finally, a brief analysis of the historical evolution of the technologies that today we define as Artificial Intelligence will be conducted.

2.1.1 Defining Artificial Intelligence: perspectives from authoritative sources

In the analysis of the definition of AI one cannot fail to mention Alan Turing, who first laid the foundations for the definition of Artificial Intelligence. In *Computer machinery and intelligence* (1950), Turing proposes the "imitation game" (also known as the Turing Test), to determine whether a machine is capable of thinking. The test consists of behavioral benchmark for intelligence: if a machine is able to imitate a human in a textual conversation, to the point of being indistinguishable from a human interlocutor, then the machine can be considered intelligent. [Lawrence Livermore National Laboratory, 2021]

Although this cannot be considered a definition in the strict sense of the term, the conceptualization of this test gives us an idea of what Turing believed the characteristics of an intelligent machine are and gives us an idea of the interest that was developing among the scientific community around the topic.

Just a few years later John McCarthy provides one of the first definitions of AI that we can find in the literature. At the time professor in Dartmouth College, in 1956 John McCarthy chose the name "Artificial Intelligence" for a project developed during the Dartmouth conference. The aim of the project was to delve deeper into the topic of what until then had been called "thinking machines". In this context, Artificial Intelligence is defined as the development of machines capable of «using language form abstractions and concepts, solve kinds of problems (...) reserved for humans and improve themselves». [Lawrence Livermore National Laboratory, 2021]

This definition, even if pioneering, surely emphasizes the willingness to create entities able to emulate human cognitive abilities. Its importance lies in laying the foundation for more sophisticated conceptualization of AI that followed.

Finally, an additional definition of AI that comes from real pioneers in the field, is the one of Marvin Minsky. In 1968, in fact, the mathematician provides his definition of Artificial Intelligence: «the science of making machines do things that would require intelligence if done by men». [Dennis, 2025] A view that highlights the anthropocentric nature of AI, anchoring its understanding to human cognitive skills.

Moving the focus of the analysis to more modern times, one relevant definition comes from the Organization for Economic Cooperation and Development (OECD), which defines Artificial Intelligence as «a machine-based system that, for explicit or implicit human-defined 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». [Organisation for Economic Co-operation and Development, 2019b]

Taking into consideration another authoritative institution at a global level, it is possible to analyze the statements in terms of the definition of Artificial Intelligence that are provided to us by the International Labour Organization (ILO). The ILO does not provide a univocal definition of AI, but in various publications it provides insights that can help to better understand the topic.

According to the ILO, Artificial Intelligence is a central theme in the modern world of work, as it is already transforming it at an unprecedented pace, bringing with it both opportunities and challenges. [European Economic and Social Committee and International Labour Organization, 2025]

In general, ILO distinguishes two main applications of AI in the world of work: one with the aim of automating single tasks, the other aimed at automating managerial functions through the use of algorithms (known as "algorithmic management"). [International Labour Organization, 2025] In short, it can be said that the ILO vision presents AI as a set of tools capable of replicating human cognitive skills and innovating work processes, the introduction of which must be managed in such a way as to maximize its productive and employment benefits while avoiding new risks or inequalities.

An additional definition relevant to our scope is provided by the World Bank. It defines AI as «the ability of the software systems to carry out tasks that usually require human intelligence: vision, speech, language, knowledge, and search». [Farooq and Sołowiej, 2021] Moreover, the World Bank highlights that Artificial Intelligence offers many opportunities for governments to enhance service delivery, improve efficiency, and enforce policies. However, it also acknowledges several challenges in the adoption of AI in the public sector, such as limited digital skills, insufficient digital infrastructure, and a lack of data and AI awareness and it is clear how this aspect may potentially widen the gap between rich and poor nations. [World Bank, 2025]

A significant contribution to the debate on the definition of Artificial Intelligence comes from the Association for the Advancement of Artificial Intelligence (AAAI), formerly known as the American Association for Artificial Intelligence and one of the leading international scientific organizations in the field of Artificial Intelligence.

In the context of its symposia a significant vision emerges, as illustrated by Pei Wang. According to Wang, intelligence can be conceived as the general capacity to adapt to the environment in conditions of insufficient knowledge and resources. This definition implies that an intelligent system must be able to operate with limited temporal and computational resources, tackle non-predefined tasks, adapt in real time to new stimuli and learn from experience. [Wang, 2006]

The AAAI also highlights the importance of a close integration between Artificial Intelligence

and cognitive science, suggesting that AI should focus on the development of generalist systems, equipped with adaptability and the ability to manage uncertainty and information scarcity. [Wang, 2006]

Another key contribution in the discussion on Artificial Intelligence is the International Joint Conference on Artificial Intelligence (IJCAI), a non-profit corporation with the aim of spreading information about Artificial Intelligence. [International Joint Conferences on Artificial Intelligence Organization, 2025] Although IJCAI does not offer an unique definition of AI, many of the papers presented over the years provide valuable insights into the various dimensions that Artificial Intelligence comprehends. For instance, Legg and Hutter (2005) define intelligence as «an agent's ability to achieve goals in a wide range of environments», emphasizing the fact that adaptability is one of the key factors that allow us to consider a machine as "intelligent". [Legg et al., 2005]

In a similar way, in another important contribution, Russell and Subramanian (1997) describe Artificial Intelligence as the challenge of «designing systems that do the right thing», focusing on rational machines capability of perceiving their environment and acting based on predefined goals. [Russell, 1997] Despite the fact that these definitions differ in some of their approaches and perspectives, they both highlight a fundamental aspect of Artificial Intelligence: the ability of a system to interact effectively with the external world, learning and adapting to complex and often unpredictable situations.

The analysis just carried out of various definitions of AI, highlights recurring themes such as the execution of human tasks, the replication of human intelligence, continuous learning and decision-making. At the same time, however, we can notice how there are also differences between the different sources. The earliest sources, in fact, those that take us further back in time, maintain the focus of the analysis on the replication of human intelligence. More recent definitions, on the other hand, shift the focus towards the practical functionality of Artificial Intelligence tools and real-world applications. In general, we can say that, despite the differences in the approach of conceptualization itself, a fundamental characteristic of Artificial Intelligence that emerges is that linked to the concept of endowing machines with cognitive capabilities. Furthermore, analyzing the evolution of definitions over time, it is possible to notice an ever-increasing approach of research to a practical impact on the real world.

2.1.2 Core subcategories of Artificial Intelligence

In order to gain a comprehensive understanding of the field of Artificial Intelligence, it is also necessary to briefly explore its main subcategories. In particular, a brief analysis will be conducted on: Machine Learning, Deep Learning, and Natural Language Processing, followed by a short explanation of other relevant topics.

Starting from the definition of what is considered the foundation of modern AI, we begin the analysis with Machine Learning. Based on the World Bank's definition, «Machine Learning is the ability of the computer algorithm to learn from data and improve automatically». [Farooq and Sołowiej, 2021]

It involves the use and training of algorithms to analyze a large number of data with the objective to identify patterns and make predictions. [National Institute of Biomedical Imaging and Bioengineering, 2025] More in detail, we can summarize three main types of Machine Learning processes: supervised learning, which uses labeled training data; Unsupervised learning, which uses unlabeled data. As a consequence, in this case the final output is not known in advance. Reinforcement learning, which involves learning via trial-and-error through rewards. [Google Cloud, 2025] In general, we can say that ML underpins many of AI's practical applications

today.

An additional important subcategory of AI is Deep Learning (DL). Deep Learning is a subset category of Machine Learning and it uses multi-layered neural networks to analyze vast and complex datasets. [National Institute of Biomedical Imaging and Bioengineering, 2025] DL has revolutionized fields such as image recognition, Natural Language Processing, and speech recognition, thanks to its ability to learn directly from raw data.

A third relevant technology related to Artificial Intelligence is Natural Language Processing (NLP), focused on the understanding of human language. It can be defined as the «ability of an AI algorithm to read a text, convert speech into text, or vice versa». [Farooq and Sołowiej, 2021] As a result, some of its application include language translation, sentiment analysis, text summarization, information retrieval, and chatbot development.

Finally, some additional relevant terms useful to the scope of understanding the world of Artificial Intelligence are: Computer vision, which «uses Machine Learning and neural networks to teach computers and systems to derive meaningful information from digital images, videos and other visual inputs — and to make recommendations or take actions when they see defects or issues». [IBM, 2025]

Robotics, which refers to the «use of machines (robots) to perform tasks done traditionally by human beings», for instance, in fields like automobile manufacturers or in environments considered potentially dangerous for humans. [Encyclopædia Britannica, 2025b]

Expert systems, defined as «a computer program that uses artificial-intelligence methods to solve problems within a specialized domain that ordinarily requires human expertise». [Encyclopædia Britannica, 2025a]

2.1.3 Historical development of Artificial Intelligence

As explained in Section 2.1.1, from an historical point of view the fundamental moment considered the birth of Artificial Intelligence as a field of study is the Dartmouth Conference of 1956, a summer research workshop where the term was coined by computer scientist John McCarthy. [Stanford University, 2016] In these first years of research the optimism was high and the research focused on symbolic AI, trying to create systems able to mimic human reasoning. These are the years when pioneers like Newell and Simon developed programs such as the Logic Theorist and General Problem Solver to tackle mathematical proofs and puzzles. Unfortunately, progress soon stalled and by the 1970s and early 1980s, the main limitations of the field, like, for instance, the lack of common sense of the systems created up to that point or their inability to learn from data, started to emerge. As a consequence, the field started to lose interest and fundings and began the period that is now known as "AI winter". [Stanford University, 2016]

In the following decade, the increasing computation power and the growing availability of digital data allowed some important developments and Artificial Intelligence started to regain some of the lost interest. By the mid-1980s and into the 1990s, in fact, the field experienced the use of new approaches and the focus moved from manually coded rules to Machine Learning and data driven techniques. We can affirm that this is the era in which AI transitioned from abstract, symbolic problems, to more grounded, real-world applications. [Stanford University, 2016]

In this significant period for AI there are two key events that should be remembered. First, the IBM's Deep Blue supercomputer defeat of the world chess champion Garry Kasparov in 1997, which demonstrated the potential power of specialized AI in a complex domain. In addition, only a few years later, in 2011, IBM's Watson system used AI to win the Jeopardy challenge,

showcasing advances in knowledge retrieval and natural language. [Stanford University, 2016] Both these events were able to capture global attention and to show how AI could imitate human expertise in certain fields.

Moving on to the 2010s, primarily due to the advancements in the Deep Learning field, we saw a new wave of rapid developments in Artificial Intelligence. In 2012, for example, a deep neural network known as AlexNet achieved a dramatic leap in image recognition accuracy, starting the Deep Learning revolution in computer vision. In addition, these are also the years in which we have witnessed significant developments in speech recognition and language modeling and, by the late 2010s, AI systems were not only recognizing patterns but also beginning to generate content. Research progressed in this field and we saw the increasing development of large-scale generative models. The most significant example in this area is undoubtedly the OpenAI's release of GPT-3 in 2020, which contained 175 billion parameters and could produce human-like text across different topics. [Alarcon, 2020] This order-of-magnitude was much larger than previous language models and highlighted how far neural network scale had progressed. Since then, progress has not stopped and in 2022 OpenAI's ChatGPT reached 100 million users within just 2 months of its launch, underlying the always more adoption of Artificial Intelligence in many fields of human life. [Ilzetzki and Jain, 2025]

With this analysis of the main historical stages of the evolution of Artificial Intelligence technologies, it is possible to notice how the focus moved from its speculative origins to the modern era of Deep Learning and Generative AI, proposing new solutions to the problems of today and transforming numerous heterogeneous aspects of technology and society.

2.1.4 Current economic and industrial impact of AI

The analysis of the historical developments of AI show how, nowadays, Artificial Intelligence can be considered a general-purpose technology, and this aspect has profound economic implications. [Filippucci et al., 2024]

AI's versatility, in fact, is one of its key characteristic and it clearly enables it to be applied virtually in every sector, opening up to endless possibilities of use. The aim of this section is therefore to provide a global overview of AI's impact on several major industries, taking as examples the manufacturing, healthcare, finance and logistics sectors. To reach this objective, the analysis will focus on how Artificial Intelligence is deployed in these sectors and how its use is leading to economic changes.

The first sector we take into consideration for the aim of the analysis is manufacturing. The modern "smart factory" is now a central theme and represents the perfect exemplification of how AI is employed in the manufacturing sector. In particular, in this field Artificial Intelligence has been used primarily to enhance efficiency, quality and flexibility on the factory floor. The classical industrial robots are now often equipped with AI vision and control systems and have become able to handle intricate assembly tasks or dangerous processes with increasing precision. In addition, the field also uses AI-driven analytics to help optimize workflows and supply chains. An example of the benefits of integrating AI in the manufacturing field comes from the company Foxconn. The company reports a boost in productivity by 25% thanks to the adoption of AI in assembly lines. Moreover, Foxconn also reports a reduction in defects by 15% and a significant cut in operational costs. [Hastings, 2022] In a similar way, automakers have long used AI in quality control. In this specific field, machine vision systems are employed to inspect components and products in real time in order to automatically flag defects. Clearly, this function can widely improve consistency and speed in quality assurance. [Schoenberger, 2024]

Moving on with the analysis, another relevant field in which AI is bringing significant positive outcomes is healthcare. The potential applications in health care are numerous, for instance, we can see impacts on clinical practices, diagnosis and health management. If we take diagnosis into account, it is not difficult to imagine how many potential applications AI could have. Thanks to modern advanced algorithms, in fact, it is now possible to use AI to analyze medical images like X-rays, CT scans, or MRIs and detect diseases with remarkable accuracy. Data show that, in some cases, AI diagnosis tools now meet or exceed the performance of expert physicians in specific tasks. [Bajwa et al., 2021] An example of application of AI in diagnosis is the system for breast cancer screening developed by Google Health, which achieved 94.5% accuracy in identifying malignant tumors, outperforming human radiologists in a controlled study. [Hastings, 2022] In addition, similar AI models have shown expert-level detection for pneumonia in chest X-rays and melanoma in dermatology. [Bajwa et al., 2021] But diagnosis is not the only application of AI in the healthcare field. For example, it is employed by clinicians to analyze large datasets of patients, supporting them in finding patterns or recommended treatments. In addition, in the hospitals AI is also used to boost operational efficiency. Predictive algorithms can in fact forecast patient admissions, optimize staff schedules, and manage supply inventories, thereby reducing waiting times and improving resource allocation. This is the case of Cleveland Clinic in the U.S., which uses AI-based predictions to adjust bed capacity and staffing in real time, reportedly increasing operational efficiency by about 20%. [Hastings, 2022]

Another significant area of application of AI technologies is surely the financial sector. This sector was one of the first adopter of AI systems and continues to invest heavily in it. As shown by the World Economic Forum in the *Artificial Intelligence in Financial Services* paper, in 2023 alone, financial services firms worldwide spent an estimated \$35 billion on AI, with investments projected to reach \$97 billion by 2027 [World Economic Forum, 2025b] The main applications of AI in the field vary from process automation to risk management and customer experience improvement. A first example is algorithmic trading in stock and commodities markets: AI models are able to analyze market data at high speed and execute trades in split seconds. Similarly, banks and insurance companies use AI for risk modeling and fraud detection. Machine Learning algorithms can examine vast transaction datasets to identify anomalies or credit risks far more efficiently than human analysts.

According to the World Economic Forum, around one-third of the work performed in banking, insurance and capital markets could feasibly be fully automated with current AI technology, and another third of tasks could be largely augmented by AI, underscoring the significant impact on financial workflows. [World Economic Forum, 2025b]

Finally, an additional AI application in the financial sector can be identified in personalized financial services. Banks started deploying AI recommendation engines to offer customers tailored advice or product offers based on real-time analysis of their behavior and needs.

To conclude our analysis, we take into account the transportation and logistics sector, another field in which AI tools are widely adopted with the aim of improving efficiency, safety, and reliability in the movement of goods and people.

One significant application is route optimization. AI-driven navigation systems (like those used by Google Maps, or logistics-specific tools) can process real-time traffic, weather, and network data to find the most efficient delivery routes. A notable example of this specific application is UPS's ORION system, which uses AI algorithms to optimize delivery routes for the company's fleet; ORION has cut 100 million miles from UPS routes and saves an estimated \$400 million annually in fuel and logistics costs through more efficient routing [Hastings, 2022]

Another significant application of AI technologies in the sector is in supply chain management,

in which AI is employed to forecast demand, manage inventory levels, and detect bottlenecks. An example comes from DHL, that uses AI analytics in its warehouses to predict shipment volumes and allocate resources, improving operational efficiency by about 20% [Hastings, 2022]

Collectively, all these AI-driven improvements in routing, vehicle automation, and supply chain management are yielding faster delivery times, cost savings, and enhanced safety in global transport and logistics networks.

2.1.5 AI and the automation of specialized tasks

The analysis of the current application of AI in different sectors allows to notice how automation of tasks plays a significant role in the current evolution of the world of work. In particular, we can notice how nowadays AI is becoming always more able to automate also those tasks that were once seen as highly specialized or uniquely human.

If we take into consideration earlier generations of automations, such as robotics in manufacturing during the 20th century, we can affirm that the target of the automation were routine, repetitive tasks. In contrast, with the implementation of modern AI technologies in the world of work, we are assisting at the replacement of cognitive and non-routine tasks, expanding automation into new domains of white-collar and creative work. In other words, AI is not just automating physical work; it is increasingly automating intelligent work.

As explained in the OECD's paper *The impact of Artificial Intelligence on productivity, distribution and growth*, AI can be considered a general-purpose technology and a "method of invention", meaning that it has the potential to drive innovation in many fields and to also invent new solutions and ideas. [Filippucci et al., 2024]

These considerations show how AI has now the capacity to create and generate solutions, and is not anymore a mere executor of predefined tasks. Clearly, this ability arises from the technological advancements that, as also shown in previous sections, have augmented AI's capability of handling complex data and patterns. Modern AI can analyze text, images, and sounds, make informed decisions under uncertainty, and generate original content. As a result, tasks ranging from drafting legal documents to diagnosing illnesses or designing basic graphics can now be done by AI to different degrees. An example of these abilities comes from Large Language Models like GPT-4, systems able to write essays or articles, write computer code, or answer customer queries with a level of proficiency that can be indistinguishable from human performance. These models, in fact, leverage Deep Learning to predict and generate text, essentially automating aspects of communication and knowledge work that previously required human intelligence.

In addition, AI has seen applications also in the creative arts, where AI systems can produce music or visual art, for example generating paintings in the style of human artists, demonstrating that even artistic tasks are no longer exclusive to humans.

A significative example that shows the conquering of AI of a domain characterized by expert human skills is the DeepMind's AlphaGo mastering the game of Go. In 2016, in fact, AlphaGo, an Artificial Intelligence developed by Google DeepMind, was able to beat Lee Sedol, the world champion of Go, a game considered thousands times more complex than chess. This event showed AI ability to develop strategy and foresight via self-learning and marked a symbolic turning point, highlighting how AI could acquire tacit knowledge and develop creative problem-solving abilities that were once thought to be uniquely human.

Moving the focus to the workplace, we can find many analogous examples: as already explained, AI algorithms now analyze legal contracts, scan pathology slides for cancer, optimize architectural designs, and perform customer service through conversational agents. Tasks that

involve recognizing complex patterns or making predictions based on large data sets and that due to these characteristics are particularly suited to AI automation. An additional example comes from the economic and financial sector, where AI is employed for predictions and fraud detection.

At this point of the analysis it seems crucial to highlight that the rise of AI-driven automation does not necessarily mean a wholesale replacement of human labor; instead, research suggests a more nuanced impact on jobs. Many AI systems, in fact, excel at specific tasks but not at entire occupations. We can affirm that many occupations will be partially automated rather than fully automated. This is the point of view also suggested by the International Labour Organization, that affirms that most jobs and industries are only partially exposed to automation and are thus more likely to be complemented rather than substituted by AI. [Gmyrek et al., 2023b] This implies that AI will almost certainly take over routine or data-intensive components of work, augmenting human workers who will then be able to focus on the interpersonal, strategic, or creative aspects of their jobs that AI cannot easily replicate.

A practical application of this aspect could be the scenario in which a worker uses an AI system to generate a first draft of a report or translate a document to save time and then uses its own human knowledge to refine the nuances and ensure quality. In the healthcare sector, instead, AI could be used to identify abnormal test results or assist in the diagnosis identification, while a Doctor makes the final judgment and interacts with the patient. Again, in customer service, AI chatbots handle FAQ-style queries instantly, handing off more complex issues to human agents. Empirical data support this augmentation view: one survey of financial services firms found that while around 34% of tasks could potentially be fully automated with AI, an almost equal share of tasks were estimated to be better performed through human-AI collaboration, combining AI's efficiency with human judgment. [World Economic Forum, 2025b]

That said, the scope of AI-based automation is widely expanding as the technology advances. All those roles that include a wide use of routine cognitive processing (like, for example, clerical and administrative roles) are identified as some of the jobs most at-risk of substitution due to automation. For instance, AI-enabled software can now handle data entry, invoice processing, scheduling, and other back-office functions at high speed and, as noted by the ILO, this trend could disproportionately affect clerical workers (often a female-dominated workforce in many countries). [Gmyrek et al., 2023b]

On the other hand, the study shows that professions requiring a high degree of social intelligence, creativity, or manual dexterity in unstructured environments (e.g. teachers, nurses, craftsmen) are currently less exposed to full automation, though the job will likely evolve alongside AI tools. As a consequence, we can affirm that policymakers and economists view AI as a double-edged sword for the evolution of the world of work: without a doubt it can boost productivity and free workers from mundane tasks, but, at the same time, it also demands significant workforce adaptation and raises concerns about jobs displacement in certain sectors.

In summary, AI's definition has surely broadened over time to encompass a suite of powerful technologies capable of human-level cognition in specific domains. From its inception in the 1950s to the Deep Learning breakthroughs of the 2010s, AI has advanced to a stage where it is an integral part of the global economy and is becoming always more employed in everyday's jobs. Its major subcategories, like Machine Learning, Deep Learning, and NLP, provide the building blocks for applications that impact different industries as manufacturing, healthcare, finance, and logistics. In addition, AI's capacity to automate specialized intellectual tasks marks a significant shift in the nature of work, blurring the lines between human and machine capabilities. The following sections will delve deeper into how these developments in AI are influencing labor markets, job structures, and economic policy in the context of the future of

work.

2.2 Evolution of Artificial Intelligence in the workplace

As previously analyzed and explained, over the past decades AI has progressed from narrow, rule-based systems to powerful data-driven tools able to either automate or augment a wide range of work tasks.

In the first years of research, AI studies focused on developing specialized and rule-based systems that encoded specialist knowledge into the if-then logic. These early systems achieved breakthroughs in laboratory and niche domains. For example, medical diagnostic tools like MYCIN (1970s) and industrial configuration experts like the R1/XCON system at Digital Equipment Corporation in the 1980s, emulated human experts' decision rules. In manufacturing, instead, the first industrial robots (for example, Unimate in the 1960s) began to perform rigid, repetitive tasks on automotive assembly lines. This kind of systems worked only in highly structured settings with well-defined rules and could «only follow rules specified by programmers». [Organisation for Economic Co-operation and Development, 2025]

It is in this period that computing platforms, like mainframes, and later PCs and client-server architectures, expanded, enabling the first practical applications of Artificial Intelligence in the workplace. Nevertheless, limitations in technology as computer speed, memory and narrow knowledge bases meant that these "expert systems" often failed to scale beyond their original domains. This section aims at examining the evolution of the application of AI technologies in the workplace, tracing their early applications and highlighting the growing complexity and capabilities of modern systems. In addition, the section explores the expanding role of AI across various industries, where it is increasingly employed to automate specialized and high-value tasks.

2.2.1 Rise of data-driven and Machine Learning systems

From an historical point of view, we can attribute the real development of the field of Artificial Intelligence to the years from 1990 to 2010, when statistical learning methods and data-driven algorithms replaced the previous rule-based approaches. It is in this period that classical Machine Learning techniques (e.g. decision trees, support vector machines and Bayesian classifiers) began to analyze large datasets and identify patterns without requiring manual rule encoding.

We can identify many examples of the rising use of AI that characterized that period in many sectors. For instance, in finance, statistical trading models early emerged and by the 1990s quantitative hedge funds and brokerages were fitting predictive models to market data. Algorithmic trading, defined as the use of «a computer program that follows a defined set of instructions (an algorithm) to place a trade» [Seth, 2023] grew rapidly by the 2000s and by 2021 «approximately 70% of the total trading volume in the U.S. stock market was executed through AI algorithmic trading». [Michigan Journal of Economics, 2025]

In manufacturing, instead, the 2000s saw the rise of "digital factories" and Industry 4.0. Sensors on equipment began streaming real-time production data, so that Machine Learning technologies could predict machine failures (predictive maintenance) and optimize schedules. In addition, quality-control processes also became more automated: computer-vision systems using ML started inspecting parts for defects faster and more consistently than human inspectors. Finally, in healthcare, we saw the rise of computer-aided detection. For example, softwares in

the 2000s used pattern-recognition to flag anomalies on radiology scans.

Despite all these initial advancements, AI in this era was still limited to structured or narrowly-scoped tasks. As noted by the OECD, classical automation required "codified environments" and machines could only follow rules specified by programmers. As a consequence, this kind of automation could only replace routine activities, while complex, unstructured decision-making remained in the human sphere. [Organisation for Economic Co-operation and Development, 2025]

We can affirm that in this period, many of the technologies considered AI, were really advanced analytics or automation of explicit processes. For example, robo-advisors in finance (launched by firms like Betterment and Wealthfront after 2008) applied algorithmic portfolio selection using mean-variance models and fixed rules, rather than Deep Learning.

2.2.2 Deep Learning and Generative AI: new frontier

As analyzed in Section 2.1.3, in the 2010s and especially in the early 2020s, AI technologies leapt forward with Deep Learning (DL) and, most recently, Generative AI. The availability of big data and the technological advancements (as, for instance, the introduction of always more powerful GPUs) enabled deep neural networks to transform tasks related with image, speech and language. An example of these extraordinary advancements comes from the healthcare sector. By the mid-2010s, in fact, convolutional neural networks dramatically improved computer vision and achieved radiologist-level accuracy in tasks like tumor detection on X-rays or MRI. [Avanzo et al., 2024]

We can find another significant example in manufacturing, where Deep Learning brought a significant impact on machines and robots used in factories. They started to become more intelligent, now able to recognize, for example, irregular parts and assemble them rather than just fitting identical components.

As we move forward in time, we can consider the period from 2022 to 2024 as the Generative AI era: a breakthrough innovation that allowed the creation of models that can produce humanlike text, code and even images. Clearly, the potential uses in the modern workplace are endless: tasks like documents summaries, email writing, report production, code writing, or translation become a matter of minutes.

A report from McKinsey & Company, defines this shift a "cognitive industrial revolution" with the «potential to be as transformative as the steam engine was to the 19th-century Industrial Revolution». [McKinsey & Company, 2025a] In addition, the research estimates the long-term AI opportunity at \$4.4 trillion in added productivity growth, highlighting remarkable prospects for the modern world of work. [McKinsey & Company, 2025b]

Although Generative AI holds significant potential and offers a wide range of possible applications in the workplace, it is important to recognize that it remains a nascent and evolving technology, with limited adoption among firms so far. From an analysis conducted in early 2025, it in fact emerged that only a small fraction of companies consider themselves "AI-mature" with "mature" meaning that «AI is fully integrated into workflows and drives substantial business outcomes». [Mayer et al., 2025]

This shows how we are still in the early stages of AI integration in the world of work and highlights how the field is still uncertain. With the aim to try to predict future outcomes, we can continue basing our analysis on what is already occurring in different sectors and, based on this analysis, propose possible future development. With this precondition, the following section will analyze practical cases of actual applications of AI that we are witnessing in different sectors.

2.2.3 Case studies: AI applications

The analysis of the main current application of Artificial Intelligence in the workplace starts with the financial sector, an early adopter of AI innovations. Algorithmic trading originated in the 1980s and has become ubiquitous: quantitative models now execute the vast majority of stock market trades and, as noted, about 70% of U.S. equity trading by volume is algorithmic. [Michigan Journal of Economics, 2025]

These algorithms range from simple rule-based momentum strategies to complex Machine Learning-driven high-frequency trading models. In addition, another significant application of AI is found in fraud detection and financial crime prevention. For example, global banks process billions of transactions daily with the aim of identifying potential activities at risk. HSBC reports using AI to screen almost 1.35 billion transactions per month across 40 millions customer accounts for suspicious activity and explains how its AI system, co-developed with Google, has multiplied detection rates and cut false positives by about 60%, significantly reducing manual review time. [Calvery, 2024]

In a similar way, also insurance companies deploy AI to flag fraudulent claims by learning patterns of abuse from historical data.

Wealth management has been also disrupted by robo-advisors. First launched around 2008–2010, companies like Betterment and Wealthfront automated portfolio design and rebalancing with algorithmic strategies. These tools use modern portfolio theory combined with customer risk profiles to give low-cost automated investment advice. While early robo-advisors followed fixed formulas, newer ones increasingly use ML to refine recommendations based on market conditions. Across banks, AI also supports customer insight and decision-making: scoring loan applicants by analyzing large sets of financial and demographic variables, or flagging risky transactions. The OECD's firm-level surveys in finance report that, even today, data analytics and fraud detection are the most common AI applications in financial firms (52% and 50% of adopters, respectively) [Lane et al., 2023]

In short, it can be stated that financial AI has moved from narrow rule-based systems to sophisticated data-driven analytics and now toward predictive and generative tools.

From the analysis it also emerges how the financial sector exemplifies the rapid evolution and deep integration of AI in the workplace, transitioning from early rule-based systems to advanced, data-driven and increasingly autonomous technologies that enhance efficiency, accuracy, and decision-making across a broad range of critical operations.

Moving the focus of the analysis to a different relevant sector, we can study the manufacturing field. Clearly, because of the inherent nature and features of the sector, manufacturing has seen one of the deepest deployments of AI and automation during the years. Industrial robots were in fact introduced as early as the 1960s, but adoption surged in the 1990s and 2000s with more affordable controllers and programming interfaces. Today, factories around the world use robot arms for a wide range of different functions, like assembly, welding, painting and packaging. Global robot installations exceeded 550,000 units in 2022, a 5% annual, and totals stand near 4 million units worldwide (all companies). [of Robotics, 2023] The natural evolution of this process has been the introduction of AI to enhance these robots: vision-guided robots are able to inspect parts and align them, while collaborative "cobots" work safely alongside humans on certain tasks.

Beyond robotics, AI in manufacturing is also used for predictive maintenance and process optimization. With this aim, sensors on equipment are used to collect data about vibration, temperature or load, and ML models learn to predict impending failures days or even weeks in advance.

This approach brings many benefits in the organization of work, reducing unplanned downtime and maintenance costs in many plants. For example, Siemens uses AI-driven predictive maintenance to schedule repairs only when needed, cutting downtime and boosting throughput. For example, Siemens leverages AI-driven predictive maintenance systems to schedule repairs only when necessary, significantly reducing downtime and increasing production throughput. Beyond maintenance, AI also plays a critical role in enhancing quality control processes. Advanced camera systems powered by Deep Learning algorithms are capable of scanning products at high speed, identifying defects that would be invisible to the human eye, thereby ensuring higher standards of product consistency and reliability. [DigitalDefynd, 2025] Moreover, AI is transforming smart supply chains by enabling manufacturers to accurately forecast demand, streamline operations, and optimize inventory levels, improving efficiency and responsiveness across the entire production and distribution network.

Overall, as highlighted by the OECD, this integration of AI extends well beyond isolated use cases. Modern factories now embed AI technologies throughout the entire production lifecycle — from planning and execution to quality assurance. Manufacturing surveys confirm this trend, revealing that AI is most commonly applied in "production processes" (60% of adopters) and "maintenance tasks" (40%), reflecting its growing role as a core enabler of industrial performance and innovation. [Lane et al., 2023]

Healthcare has also been a fertile field for AI, especially in diagnostic and clinical support systems. For example, already in the 1960s-1970s researchers built expert systems like MYCIN and DXplain to aid diagnosis, encoding medical knowledge in rule engines. In this case neural networks were used for the detection, classification, or segmentation of malignant lesions in medical images. [Avanzo et al., 2024] These systems had limited adoption but have been useful for establishing the value of computerized decision support.

In recent decades, AI has revolutionized medical imaging: deep neural networks can now interpret X-rays, CT scans, and MRIs with accuracy comparable to specialists. [Avanzo et al., 2024] For instance, a 2023 clinical trial found that an AI model reading mammograms matched the sensitivity of two radiologists reading the same images, suggesting AI could double-check or even replace one human reader in breast-cancer screening. In addition, many FDA-approved AI imaging tools are now in use for lung nodule detection, diabetic retinopathy screening, and pathology slide analysis.

An additional current use of AI in the healthcare system regards the simplification of hospital workflows. As one recent review notes, AI «optimizes operational efficiency, streamlines administrative tasks, and improves patient flow and scheduling» in hospitals. [Davenport, 2018]

For example, machine-learning models help predict patient admissions and discharges, enabling better staffing and bed management. Natural-language tools transcribe clinicians' notes, reducing clerical burden. AI-driven decision support (e.g. recommending diagnoses or treatment plans based on patient data) is increasingly embedded in electronic health record systems. In telemedicine, instead, chatbots screen symptoms or handle after-hours patient questions. In summary, the application of AI in healthcare has progressed from limited expert systems to a diverse range of advanced functions. Contemporary implementations include enhanced diagnostic imaging through improved precision and efficiency, data-driven personalization of treatment plans, and the optimization of clinical operations such as scheduling and resource allocation.

To conclude the analysis, we can take into account the customer service sector, another field transformed by Artificial Intelligence. Historically, service centers used simple automated phone menus (IVR) and scripted responses. In the 2010s, rule-based chatbots appeared on web-

sites and messaging apps, but these often had problems with complex queries. The introduction of more sophisticated conversational AI has changed this dramatically. Modern virtual assistants (using NLP models) can in fact handle multi-turn dialogs, answer customer questions, and even process transactions. For example, insurance and telecom companies now deploy chatbots that use ML to interpret intent and continuously improve from new transcripts. Retailers use AI agents for order tracking and returns.

Surveys indicate that the vast majority of consumers have already interacted with a chatbot: one industry analysis reported that by 2023 some 88% of customers had used an AI chatbot for service inquiries. [Botpress, 2025] These systems are able to take on routine inquiries, freeing human agents for more complex problems. Furthermore, voice-based assistants (such as Alexa or Google Assistant) also provide customer support interfaces in some contexts.

In short, this field has also undergone a notable transformation: customer service AI has evolved from basic menu-driven systems to advanced NLP-powered chatbots and virtual assistants capable of automatically handling a wide range of standardized customer inquiries.

The analysis highlights how the adoption of Artificial Intelligence across a range of sectors clearly demonstrates its transformative impact on the modern workplace, fundamentally reshaping operational processes and decision-making dynamics. From algorithmic trading and fraud detection in the financial sector, to predictive maintenance and quality control in manufacturing, from diagnostic imaging and workflow optimization in healthcare facilities, to the automation of customer interactions through conversational agents in service industries, AI applications have expanded significantly. What once consisted of narrow, rule-based expert systems has now evolved into sophisticated, data-driven technologies capable of learning, adapting, and in many cases, autonomously performing tasks traditionally carried out by humans.

These advancements not only improve efficiency, precision, and scalability, but also contribute to a profound redefinition of job roles, skill requirements, and organizational structures. As AI continues to permeate all areas of economic activity, its growing centrality signals a critical need for both enterprises and professionals to adopt continuous learning strategies and invest in reskilling initiatives. The integration of AI is not merely a technological shift, but a structural transformation that challenges existing paradigms of work and requires society to rethink the relationship between human and machine labor.

2.3 Automation of specialized technical tasks

As seen in the previous section, the progress in the Artificial Intelligence field allowed it to rapidly overcome the simple automation of routine work, moving forward to the execution of highly specialized technical tasks traditionally performed by expert professionals. Examples come from the most diverse fields: from medical diagnostics to legal document analysis, and from financial modeling to scientific research and engineering design, it is emerging how AI systems are increasingly capable of matching or exceeding human capabilities in highly specific tasks.

The aim of this section is to analyze the employments of AI to automate these specialized tasks across key domains. The analysis will take into consideration the following fields: medicine, law, finance, scientific R&D, and engineering.

Data on AI adoption in these sectors is presented to highlight the global trend toward AI adoption in high-skilled occupations.

In addition, the analysis will focus on examining benefits, challenges and global implications of these developments. Specific examples and case studies will be used to illustrate the state of

adoption.

The discussion highlights that while AI-driven automation can generate many positive outcomes, like improved efficiency and consistency, it also brings up issues about job displacement, ethical use, transparency, and the emerging need to upskill and reskill the workforce.

2.3.1 Medicine: AI in diagnostic imaging and beyond

One of the most prominent and impactful examples of AI automating specialized tasks is found in the field of medicine, particularly in diagnostic imaging. Machine Learning algorithms — most notably deep neural networks — have demonstrated exceptional capabilities in interpreting complex medical images, including X-rays, CT scans, and MRIs. These diagnostic tasks, which were traditionally the exclusive responsibility of radiologists and other highly trained medical professionals, are now increasingly supported or even partially automated by AI systems. In various clinical applications, these systems can identify tumors, fractures, lesions, and other abnormalities with a level of accuracy that, in some cases, approaches or even matches that of experienced human experts. Moreover, AI offers the potential to enhance diagnostic consistency, reduce human error, and accelerate the analysis process. For example, AI tools for chest X-ray analysis can identify signs of tuberculosis or pneumonia, often as well as radiologists, and do so in a matter of seconds.

In 2021, the World Health Organization endorsed the use of AI-based image analysis for tuberculosis (TB) screening in high-burden countries, after studies showed AI could screen chest X-rays for TB with sensitivity and specificity comparable to expert physicians. [World Health Organization and others, 2024] This has led to deployments in regions with shortages of radiologists. In parts of South Asia and Africa, for instance, portable X-ray machines equipped with AI software now help frontline clinicians perform rapid TB screening in remote communities, with results available in minutes and without the need for an on-site radiologist. [World Health Organization and others, 2024] Such examples illustrate AI's potential to democratize access to specialized medical expertise on a global scale. By enabling accurate and timely diagnoses even in resource-constrained environments, AI systems can help bridge the gap between highly developed healthcare infrastructures and underserved regions. In these kind of areas, where access to trained radiologists or medical specialists is limited or nonexistent, AI-driven diagnostic tools can provide critical support, allowing for earlier detection and treatment of diseases that might otherwise go unnoticed.

At the same time, AI is also reshaping diagnostic practices within advanced healthcare systems. Adoption in radiology, in particular, is accelerating: by 2023, approximately one-third of radiologists reported using some form of AI in their diagnostic workflow. [Hall, 2023a] Hundreds of AI algorithms for medical image analysis have been developed and vetted; in the United States alone, over 200 AI-based medical imaging tools had received FDA clearance by 2023 for clinical use in detecting conditions ranging from strokes to cancers. [Hall, 2023a] These tools function as a form of "augmented intelligence" — supporting radiologists by flagging suspicious findings, such as potential tumors, or by prioritizing urgent cases to streamline clinical decision-making.

For example, AI triage software can analyze stacks of CT scans and immediately alert doctors of a possible hemorrhage in the brain, potentially saving critical time in emergency care. In other diagnostic specialties, such as pathology and dermatology, AI systems are being employed to recognize disease patterns in microscope slides and skin lesion images, enhancing both speed and diagnostic accuracy. A notable milestone in the broader biomedical AI landscape was achieved in 2020 with DeepMind's development of AlphaFold. Although not a

diagnostic tool in the strict sense, AlphaFold successfully automated the highly complex task of protein structure prediction — a longstanding challenge in molecular biology with important implications for biomedical research. AlphaFold was able to predict the 3D structures of about 200 million proteins encompassing virtually all known proteins across a wide range of organisms. These predictions were subsequently made publicly accessible, marking a major contribution to the global scientific community. [Callaway, 2022] This AI-driven breakthrough in structural biology is now accelerating drug discovery and our understanding of complex diseases, tasks that traditionally required time-consuming and highly specialized laboratory experiments conducted by expert biochemists (see Section 2.3.4). Taken together, these advancements demonstrate that AI is not only capable of assisting with, but in some cases performing, some of the most specialized tasks in medicine. By interpreting complex biomedical data and imaging with unprecedented speed and scale, AI systems are reshaping the frontiers of medical research and clinical practice.

Building on these capabilities, real-world case studies from around the globe highlight both the transformative potential and the implementation challenges of medical AI. In India and Thailand, diabetic retinopathy screening programs have begun using AI to analyze retinal photographs for early signs of diabetic eye disease, expanding screening capacity to rural areas with few ophthalmologists. Meanwhile, in high-income countries, hospitals are beginning to integrate AI-driven diagnostic decision support into clinical workflows. For instance, an AI system might integrate a patient's imaging, lab results, and medical records to suggest possible diagnoses or flag anomalies for further review.

Early results from these applications are encouraging and point to improved efficiency and diagnostic reach. However, they also reveal a persistent tension in clinical adoption: many physicians remain cautious about fully trusting so-called "black box" algorithms. The lack of transparent reasoning in many Deep Learning models means that a radiologist might see an AI mark a tumor on a scan without understanding the reasoning behind that decision. This opacity has led to growing calls for explainable AI in healthcare and for rigorous clinical validation. Despite these concerns, the trend is clear: AI is increasingly embedded in the medical diagnostic process, augmenting specialized expertise and handling more technical analytic tasks allowing human professionals to focus more on nuanced clinical judgment and direct patient interaction.

2.3.2 Law: AI in contract analysis and legal research

The legal sector also offers significant examples of how AI is being used to automate specialized tasks. Although the legal profession is traditionally regarded as a domain requiring personalized human judgment, there is a growing trend toward the adoption of Artificial Intelligence for specific, well-defined activities.

In particular, all those tasks that involve document review and analysis are very well suited for this purpose. Legal work in fact often involves analyzing dense textual materials like contracts, case law or regulations, which makes it well suited to the recent advances in Natural Language Processing. The modern technologies appear perfect for this kind of tasks, and AI-powered contract analysis platforms are now used to automate what junior lawyers and paralegals traditionally did: review contracts for specific clauses, flag inconsistencies, and identify potential legal risks, thereby enhancing both speed and accuracy while reducing the burden of routine legal work. In addition, modern systems are also able to rapidly identify key provisions (for instance, termination clauses or indemnities) and flag anomalies or non standard language across thousands of pages within minutes, clearly simplifying a task that would take hours of expert

human time to complete. Studies show that this practice is increasingly adopted. By early 2024, 41 of the world's top 100 law firms (the "Am Law 100") were actively using AI tools to complete tasks like document analysis, contract drafting assistance and due diligence in transactions. [Yang, 2024] Furthermore, the study also reveals that prominent legal firms, like, for instance, Lackam & Watkins, Clifford Chance, and Allen & Overy, have positioned themselves at the forefront of the integration of AI into legal services. Their early and strategic adoption underscores the rapid diffusion of these practices across the sector, signaling a broader shift toward AI-augmented legal work.

One significant example in the sector is JPMorgan's COIN (Contract Intelligence) program, an in-house AI system developed to review commercial loan agreements. The system proved to be extremely powerful and is in fact able to analyze contracts in seconds. A surprising result, considering that the same job previously took legal teams 360,000 hours per year to complete manually. [Yang, 2024] The advantage of the integration of AI in this case appears very clear: what expert reviewers previously made in hundreds of thousand of hours can now be executed almost instantly, demonstrating the power of AI in the automation of specialized legal tasks. In a similar way, AI based e-discovery tools have become standard in litigation. These tools screen and analyze millions of documents and emails in order to find traces of relevant evidence really quickly. This kind of technology has proven to be much faster and, in some cases, also more reliable, than teams of lawyers.

An additional practical example of the use of AI in the legal field is the use of systems like ROSS Intelligence. It is a Generative AI model built on IBM Watson that, together with other Generative AI models, is used in legal research to answer legal questions or summarize case law, automating aspects of the research that entry-level lawyers or law librarians once performed autonomously. For instance, recent evaluations have tested Large Language Models (LLMs), including those developed by OpenAI, on bar exam questions and legal reasoning tasks. These tests have yielded impressive results, demonstrating the potential of LLMs to support legal brief drafting, issue spotting, and argument development. By 2025, in fact, numerous law firms report experimenting with LLM-based chatbots to generate first drafts of contracts or to produce preliminary legal arguments, which are then refined and finalized by legal professionals. This trend suggests a growing integration of Generative AI in the legal workflow, with the aim of enhancing productivity while preserving the central role of human legal judgment.

The benefits of AI in legal practice are clearly emerging. Studies have found that AI can equal or outperform human lawyers in some narrow tasks: in one study, for example, an AI reviewing non-disclosure agreements identified 94% of risks on average, whereas experienced lawyers found 85%. [Yang, 2024] AI was not only slightly more accurate but also much faster, completing the task in minutes and not hours. Such performance gains clearly translate into cost savings and faster turnaround for clients. It is therefore not surprising that adoption is accelerating. A survey by the American Bar Association found that AI usage in law firms nearly tripled in one year – from 11% of firms in 2023 to 30% in 2024 – with larger firms leading the way in implementation. [Ambrogi, 2025] Among firms with over 100 attorneys, 46% reported using AI-based tools in 2024. [Ambrogi, 2025]

The primary driver cited in the study was efficiency, as these tools can automate the routine "grunt work" of legal practice and free up lawyers for higher-value advisory and advocacy activities. Global law is also leveraging AI for multilingual capabilities: advanced platforms can analyze contracts in dozens of languages, assisting with cross-border transactions by automating translations and consistency checks [Yang, 2024] Notably, despite fears, AI has not replaced lawyers in court or negotiation; rather, it is employed as a highly competent and specialized assistant. As law professor Gillian Hadfield observed, AI in legal drafting allows lawyers to «shift

their focus from routine activities to high-value work involved in shaping strategies and navigating complex legal problems». [Yang, 2024] This evolving human–AI symbiosis suggests that, even as AI takes on increasingly specialized and technical tasks, the need for expert legal judgment, strategic thinking, and contextual understanding remains indispensable. Rather than displacing legal professionals, AI is reshaping their roles, augmenting their capabilities and allowing them to focus on higher-order legal reasoning and client-focused advisory work.

2.3.3 Finance: AI in risk modeling and algorithmic trading

The financial services sector was an early adopter of AI and continues to pioneer automation of technical tasks such as risk assessment, trading, and financial analysis. Large banks and investment firms deal with enormous volumes of data – from market price feeds to customer transactions – and AI techniques have become indispensable in extracting insights and automating decisions at scales and speeds impossible for human analysts. In the area of risk modeling, Machine Learning is increasingly employed to evaluate credit, market, and operational risks in a more adaptive and data-driven manner. For example, AI-driven credit scoring algorithms can analyze a borrower’s creditworthiness by considering thousands of data points (including non-traditional data like online behavior or utilities payment history) that go well beyond the scope of classical credit models. [Lee, 2023] A notable example is the fintech lender Upstart, whose AI model was reported to approve 27% more loan applicants than a traditional model at the same level of assessed risk, while also offering lower interest rates for those approved. [Lee, 2023] This case illustrates how AI can expand access to credit by better distinguishing between high- and low-risk borrowers – a complex predictive task that has traditionally relied on the judgment of experienced credit officers.

Beyond credit risk assessment, AI is also transforming other core areas of financial services, most notably algorithmic trading. In this domain, AI and automated algorithms now dominate many markets worldwide. By 2024, it was estimated that 60–75% of stock trading volume in the U.S. and other major markets was driven by algorithmic trading systems. [Fortrade, 2024] These systems make split-second decisions to buy or sell assets based on streaming data and complex strategies, including Machine Learning models that detect patterns in market movements.

Hedge funds and investment banks deploy AI algorithms not only for high-frequency trading but also for portfolio optimization and long-term investment planning, effectively automating tasks that once required large teams of analyst. Moreover, algorithmic trading has expanded beyond equities to include other asset classes – for example, about 20% of institutional foreign exchange trading volume is now executed algorithmically. [Dantuluri, 2024]

In addition, AI in financial forecasting helps institutions anticipate market trends or client behavior: banks use AI to predict fraud in real time, to model portfolio risk under various scenarios, and to optimize asset allocations, tasks that were traditionally quantitative analyst roles.

The adoption of AI in finance is not only widespread but also accelerating. A global survey by McKinsey in 2023 found that 60% of financial services companies had embedded at least one AI capability in their operations, compared to about 40% of companies across all industries. [Lee, 2023] Banks are investing heavily in AI – according to the World Economic Forum, financial services firms spent an estimated \$35 billion on AI in 2023, and this figure is projected to nearly triple by 2027 as firms expand AI usage across banking, insurance, and capital markets.

The motivation behind this investment is clear: AI offers both top-line growth opportunities and bottom-line efficiencies. On the revenue side, institutions are developing new AI-driven

financial products and personalized client services. On the cost side, automation delivers substantial savings. One industry analysis projected that global banks could save \$447 billion by 2023 through AI applications, with the largest efficiencies in front-office customer service and middle-office processing tasks. [Lee, 2023] For example, AI chatbots now handle routine customer inquiries at scale (reducing the load on call centers), and robotic process automation (RPA) bots streamline compliance and reporting tasks. In trading and asset management, AI can monitor and execute across markets 24/7, a capability that human traders simply cannot match.

While the financial sector has rapidly embraced AI, it also exemplifies the challenges and risks associated with automation. Financial AI systems, especially in trading, can behave in unpredictable ways. A notable example is the "flash crash" phenomenon, where automated trading algorithms collectively caused sudden and severe market declines without clear human oversight. These kind of events have raised concerns among regulators and risk officers about the potential systemic vulnerabilities introduced by complex, and sometimes opaque AI models.

Further, the use of so-called "black box" algorithms in areas such as credit scoring and lending poses ethical and legal risks. Without adequate transparency and auditing, AI systems may unintentionally perpetuate or exacerbate biases — for example, by discriminating against certain demographic groups — thereby undermining principles of fairness and compliance. These concerns are addressed in greater detail later in this section.

Nonetheless, the overall trajectory is that finance professionals like traders, risk managers and analysts are increasingly working in collaboration with AI tools that perform specialized, high-volume analytical tasks. As a result, the role of the human expert is shifting more toward oversight, scenario analysis, and making judgment calls that algorithms cannot, while the number-crunching and pattern-recognition heavy lifting become largely automated.

2.3.4 Scientific research: AI in drug discovery and R&D

AI's impact on highly technical tasks is perhaps most dramatic in scientific research and development, where it is enabling breakthroughs in drug discovery, chemistry, and related fields. Discovering a new therapeutic drug is an extremely complex, knowledge-intensive process that traditionally takes years of work by chemists and biologists. In recent years, AI systems – particularly those using Deep Learning and generative models – have been developed to automate significant portions of this process, from identifying promising biological targets to designing novel molecular structures with desired properties. This is a paradigm shift: instead of manually testing thousands of compounds in wet labs, researchers can have AI models predict which compounds are likely to be effective, thereby focusing experiments on the most promising candidates.

A notable case in the field is Insilico Medicine, whose AI-designed drug candidate for fibrosis (INS018_055) progressed to human clinical trials in 2021 – reportedly one of the first fully AI-discovered drug molecules to do so. [Shah-Neville, 2025] Around the same period, the British startup Exscientia, in collaboration with pharmaceutical companies, brought multiple AI-designed small-molecule drugs into Phase I clinical trials, targeting diseases like obsessive-compulsive disorder and oncology. [UK Research and Innovation, 2023]

By 2023, the pipeline of AI-generated drug candidates had grown substantially. A comprehensive analysis by Jayatunga et al. (2024) identified 67 AI-discovered drug candidates in various stages of clinical development worldwide. [Quantum Biospace, 2025] Although these represent only about 1% of all drugs in the clinical pipeline, the increase is significant, given that a

decade earlier the figure was essentially zero, signaling that AI is rapidly becoming a standard tool in pharmaceutical research and development. [Quantum Biospace, 2025]

Importantly, preliminary data suggest that AI-designed drug candidates may not only be discovered more efficiently but also exhibit higher quality in early-stage testing. In Phase I trials, AI-derived molecules demonstrated success rates on the order of 80–90%, substantially higher than the historical average success rate of 50% in Phase I. [Quantum Biospace, 2025] This suggests that AI can not only accelerate discovery but also improve the quality of candidates by using predictive modeling to avoid many of the compounds likely to fail. Integrating these improved Phase I outcomes with typical later-stage success probabilities, the study estimated that the overall probability of a drug advancing from idea to approval could roughly double (from 5–10% traditionally to 9–18%) with AI-assisted discovery approaches. [Quantum Biospace, 2025] Such gains, if sustained, would represent a profound boost in productivity for the pharmaceutical industry, potentially translating to more therapies reaching patients faster and at lower cost.

Beyond small-molecule drug discovery, AI is also driving broader innovation across biotechnology and related scientific domains. The aforementioned AlphaFold by DeepMind, which predicts protein structures, is now used by drug researchers to understand targets and design drugs that fit them – a task that once required years of x-ray crystallography or other lab work. Moreover, AI models also help in identifying patterns in genomic data, suggesting new biological pathways to target for intervention.

In parallel, AI is proving valuable in materials science and chemistry. Machine Learning models can propose alternative synthesis routes or suggest entirely new compounds with desirable physical or chemical properties, thereby reducing the reliance on trial-and-error experimentation. For example, Machine Learning models can predict how tweaking a molecule's structure might affect its efficacy or toxicity, guiding chemists on which modifications to prioritize.

Building on these capabilities, the adoption of AI in scientific R&D has become mainstream among leading organizations. A 2024 industry survey found that 81% of pharmaceutical and biotech companies were using AI in at least one stage of drug development. [Chmielewska and Caruso, 2024] Major pharmaceutical companies have invested heavily in in-house AI teams and startups; many have active partnerships with AI firms to co-develop drugs. For instance, Pfizer, Novartis, and others have alliances with AI-driven drug discovery startups, and governments and research institutions are funding AI-driven biomedical research programs.

The COVID-19 pandemic further underscored the value of AI in accelerating biomedical discovery. During the crisis, researchers used AI models to identify existing drugs that could be repurposed for COVID-19 treatment. For example, AI-assisted literature and molecular database analyses helped flag Baricitinib as a viable therapeutic candidate, which later demonstrated clinical effectiveness.

Nevertheless, this domain also highlights important limitations. Despite the promise of AI, the validation of AI-generated hypotheses still requires extensive lab work and clinical trials, and there have been cases where AI predictions did not translate to real-world success, reminding us that biological systems have complexities that models may not fully capture. Moreover, regulatory bodies like the U.S. FDA are still developing frameworks for evaluating AI-designed therapeutics and diagnostics. Obviously, regardless of whether AI is used in their development, the final products must still meet established standards of safety and efficacy.

Overall, though, the direction is unmistakable: AI is not only accelerating the pace of innovation but also transforming the nature of scientific work. By automating and augmenting some of the most specialized and time-intensive tasks in research, AI is reshaping the workflows of experts and redefining the boundaries of what is possible in biomedical discovery.

2.3.5 Engineering: AI in design optimization and simulations

In engineering and technical fields, AI has begun to automate tasks that involve complex design decisions and simulations – areas once thought to require a high level of human intuition and expertise. One major development is the use of generative design algorithms. Generative design, often powered by AI optimization techniques, takes engineering requirements as input (for example, the loads a structure must bear, the space constraints, and material strength properties) and automatically produces design alternatives that meet those criteria. This essentially inverts the traditional engineering process: instead of an engineer drafting a design and then checking if it meets requirements, the AI drafts numerous designs that all meet the requirements, and some of these designs may be novel or non-intuitive solutions that a human might not have conceived.

A classic case study is Airbus's design of a "bionic" partition for the A320 aircraft. Using Autodesk's AI-driven generative design software, Airbus engineers in 2015–2016 generated a partition panel with an intricate lattice structure inspired by organic forms. The result was a partition that is 45% lighter than the traditional design (a reduction of 30 kg) while maintaining equal strength. [Airbus, 2016] This weight savings is enormously valuable in aviation, translating to fuel savings and CO2 reductions; applied fleet-wide, Airbus estimated hundreds of thousands of tons of CO2 could be saved per year with such designs. [Airbus, 2016]

This case exemplifies the potential of AI algorithms to take on highly complex and specialized engineering tasks, such as structural design optimization — traditionally the domain of senior engineers. More importantly, it demonstrates that AI is not only capable of replicating human expertise but can also extend it, delivering innovative solutions that redefine performance limits and expand the creative possibilities in technical design.

Similarly, in the automotive industry, Generative AI has been used to create lighter and stronger components. General Motors, for example, employed AI-driven design to reinvent a small but critical part (a seatbelt bracket) and managed to consolidate what was originally an assembly of multiple pieces into a single 3D-printed part that was 40% lighter and much stronger, meeting all safety requirements. These successes have encouraged broader adoption: many engineering firms now use AI optimization in product design, from consumer product companies designing ergonomic equipment to civil engineers optimizing the topology of bridges for material efficiency.

Although precise adoption rates in engineering are difficult to quantify (since AI may be embedded in software tools without being separately tracked), industry surveys indicate a growing embrace of AI. For instance, a 2022 IEEE survey of manufacturing and engineering professionals found a majority were exploring AI for design or predictive maintenance tasks. Further reinforcing this trend, Gartner has projected that by the mid-2020s, a large fraction of new product design in industries like aerospace and automotive will involve Generative AI or AI-assisted simulation.

Closely related to generative design is the growing use of AI in engineering simulations and predictive modeling — another area where AI is transforming traditionally expert-driven processes. Complex simulations (such as computational fluid dynamics for aerodynamics, finite element analysis for stress testing, or climate and weather modeling) can be extremely computation-intensive, sometimes requiring days of processing on high-performance computing systems. To address this bottleneck, AI is being used to create surrogate models or reduced-order models – essentially AI approximations of these simulations that run much faster.

For example, engineers have developed neural network models that can predict the outcome of a fluid dynamics simulation in real time after being trained on a set of traditional simulations.

This means design engineers can instantaneously see how changes in a car body shape might affect drag, rather than waiting hours for a CFD run. Early applications by companies like Siemens have shown that AI can cut down simulation times by orders of magnitude in certain cases, enabling a far more iterative and exploratory design process.

In parallel, the rise of digital twin technology further exemplifies AI's role in engineering optimization. A digital twin is a dynamic virtual representation of a physical system — such as a wind turbine, aircraft engine, or manufacturing plant — that is continuously updated with real-time sensor data, AI models integrated within these twins can simulate system behavior, predict failures, and recommend performance adjustments. For instance, an AI algorithm might assess temperature anomalies in a turbine component and simulate potential outcomes, providing maintenance teams with predictive insights. In this way, AI effectively automates aspects of diagnostics and forecasting traditionally performed by experienced engineers, enhancing both operational efficiency and system reliability.

Given the high stakes of engineering applications — where many tasks intersect with safety-critical decisions — the integration of AI into this field has been gradual and largely augmentative. While AI systems can generate designs or run predictive simulations, human experts typically retain final responsibility for validation, especially when a design is intended for real-world production. Engineers increasingly rely on AI-generated suggestions, but the final decision remains subject to expert review and judgment.

As AI becomes more embedded in engineering workflows, the profession itself is evolving: knowing how to use AI-driven CAD (computer-aided design) tools or how to interpret AI simulation results is becoming a core competency for engineers. In response, universities and professional training programs have begun incorporating AI into engineering curricula, preparing future professionals to work effectively alongside intelligent systems.

The overall benefit is that engineers can evaluate many more design options and can manage more complex systems than before, by leveraging AI as a co-designer and simulator. As the technology matures, we expect AI to become a standard part of the engineer's toolkit, handling much of the heavy computational lifting and allowing human experts to focus on defining problems and interpreting results.

2.3.6 Benefits of automating specialized tasks

The automation of specialized technical tasks through Artificial Intelligence represents a significant transformation across various industries, offering concrete and impactful benefits.

One of the most notable advantages is clearly the increase in efficiency and speed. AI systems can process information and perform complex analyses much faster than human experts, drastically reducing the time required for tasks that were traditionally labor-intensive. A striking example of this is JPMorgan's COIN platform, which reduced around 360,000 hours of annual contract review work to just a few seconds. [Yang, 2024] In the medical field, AI-powered image analysis can process thousands of scans in the time it would take a radiologist to manually read only a few. This kind of acceleration allows professionals to handle larger workloads or to focus on activities that truly require human insight and expertise. In finance, decisions that previously depended on overnight or weekly data analysis can now be made in real time, thanks to AI — enhancing responsiveness and the ability to seize opportunities. Increased efficiency often translates directly into cost reduction: fewer hours spent per task lower labor costs and allow for expert time to be reallocated to higher-value functions. For instance, global banks are projected to save nearly \$447 billion primarily through the automation of routine operations. [Lee, 2023]

Another significant benefit is scalability and the ability to manage large volumes of work. AI makes it possible to scale specialized services to levels previously unimaginable. A single AI system can simultaneously perform the work that would otherwise require large teams of professionals. In the legal domain, an AI platform can review every contract in a major merger or acquisition in parallel, eliminating the need for weeks of work by dozens of junior lawyers. In healthcare, automated screening programs powered by AI can assess millions of diagnostic images — such as chest X-rays for national tuberculosis screening programs — enabling widespread and timely evaluations. This scalability is especially valuable in regions where expert personnel are scarce. In such contexts, AI effectively multiplies the reach of existing specialists. For example, diagnostic AI tools are being used in low-income countries to expand healthcare access, allowing a single doctor to supervise automated analyses for many patients and ensuring at least a preliminary expert review reaches remote populations. [World Health Organization and others, 2024] Similarly, in finance, algorithmic trading systems can manage enormous portfolios and execute countless transactions in parallel, something beyond the capacity of individual human traders. AI thus empowers organizations to address problems at much larger scales than before.

A further advantage of AI automation is the consistency and accuracy it brings to specialized tasks. Human performance, no matter how skilled, is inherently variable. Experts can have off days, make errors due to fatigue, or be influenced by cognitive biases. In contrast, once trained and validated, AI systems perform tasks in the same way every time and are not subject to exhaustion. This level of consistency reduces the likelihood of errors — for instance, an AI reviewing contracts will not overlook a clause because of tiredness, unlike a human reviewer. Moreover, AI can often achieve higher levels of accuracy by identifying subtle patterns or correlations that may be invisible to the human eye. In medical imaging, AI has demonstrated the ability to detect minute anomalies in scans or recognize complex feature combinations indicative of early disease stages — insights that might elude even experienced radiologists. In a study on NDA reviews, AI systems identified more potential issues on average than human lawyers. [Yang, 2024] In finance, algorithmic trading systems respond consistently and dispassionately to market signals, unlike human traders who might be influenced by emotion. In scientific research, AI's objective and repeatable approach to data analysis helps eliminate observational bias, contributing to more robust findings. Properly designed AI systems thus bring a level of standardization and reliability that enhances the overall quality of specialized work.

Importantly, AI often does not aim to replace human professionals but rather to augment their capabilities. Experts can use AI to access deeper insights and make better-informed decisions. For instance, an engineer using AI simulation tools can test highly complex designs, relying on the system to handle intricate calculations. A doctor with an AI-powered diagnostic assistant might consider a broader range of potential diagnoses, including rare conditions flagged by the AI based on subtle indicators. This type of augmentation allows human professionals to expand the boundaries of their work, achieving results that would have been impractical due to cognitive or time limitations. Many professionals report that AI relieves them from repetitive or tedious tasks, allowing them to concentrate on more creative, strategic, or interpersonal dimensions of their roles — areas where human expertise remains irreplaceable. This shift in focus contributes not only to improved outcomes but also to increased job satisfaction. Moreover, automation can make expert services more accessible and affordable. By enabling certain tasks to be performed efficiently and at scale, AI allows legal advice, medical screening, and other specialized services to reach broader audiences, including underserved communities. This democratization of expert knowledge could have far-reaching implications for equity and social progress.

Finally, AI's capacity to analyze large volumes of data fosters innovation and the discovery of new insights. Beyond improving efficiency, AI enables new ways of understanding complex systems. In finance, AI might uncover previously unknown indicators of financial risk, contributing to more effective risk management strategies. In healthcare, Machine Learning algorithms can detect novel disease risk factors through the analysis of electronic health records, guiding public health interventions. In drug discovery, AI can predict unconventional mechanisms of action for molecules, potentially sparking entirely new research directions. These breakthroughs are made possible by AI's ability to find patterns that would be difficult or impossible for humans to detect unaided. As highlighted by institutions such as the OECD and the World Economic Forum, AI represents a general-purpose technology — comparable in its transformative potential to the steam engine or electricity — with the power to boost productivity and innovation across all sectors. [Organisation for Economic Co-operation and Development, 2023] If applied thoughtfully, the automation of specialized tasks through AI could not only optimize current workflows but also drive scientific, economic, and social advancements that define the future of expert work.

2.3.7 Challenges and risks of automating specialized tasks

Despite the many benefits, the rise of AI automation in expert domains brings substantial challenges and risks that must be addressed. One of the foremost concerns is job displacement and shifts in the labor market. Unlike previous waves of automation, which predominantly affected routine manual labor, AI is now encroaching on traditionally white-collar professions — doctors, lawyers, financial analysts, and more — raising the possibility of widespread disruption in high-skill employment. The World Economic Forum's Future of Jobs Report 2025 found that 40% of employers anticipate reducing their workforce in areas where AI can autonomously perform tasks. [Leopold, 2025] This trend is particularly alarming for entry-level roles. These positions have long served as stepping stones for new professionals to gain experience through relatively simple tasks such as document review or initial data processing — precisely the types of work AI is rapidly automating. If these roles disappear, the pipeline through which novices develop into seasoned experts may break down. Bloomberg, for instance, reports that AI could potentially replace over 50% of the tasks performed by market research analysts and over 60% of those done by entry-level sales representatives, far more than the proportion for senior managers. [Leopold, 2025]

As automation expands, firms may increasingly hire fewer junior lawyers, radiologists, and other professionals, and even some senior experts may become redundant if their specialized niches are fully automated or if one AI-augmented expert can do the work of many. While some economists argue that AI will primarily augment rather than replace skilled professionals, others warn of a transitional period marked by painful job losses and restructuring. Historically, technological change has often created new roles even as it rendered others obsolete, and AI could do the same — creating jobs like AI ethicists, data curators for medical AI, or AI maintenance specialists. Nonetheless, this transition is unlikely to be smooth. Institutions such as the International Labour Organization (ILO) and the OECD underscore the need for policies to manage these shifts through strategies like lifelong learning and social protection. While current data show no net job losses among professionals due to AI so far, the acceleration of Generative AI since 2022 introduces considerable uncertainty for the future, making preparation essential. [Organisation for Economic Co-operation and Development, 2023]

Closely tied to job displacement is the need for upskilling and reskilling. As AI systems take over more routine aspects of expert work, the human roles evolve to emphasize what AI

cannot do — applying complex judgment, managing interpersonal dynamics, making ethical decisions, and solving novel problems. Professionals will need to adapt. Tomorrow’s doctors, for example, must become adept at interpreting AI-generated diagnostics and integrating them into treatment plans. Lawyers will need to understand how to audit and correct AI-produced drafts. Financial analysts may have to shift toward oversight of AI models and interpretation of their outputs. This calls for widespread upskilling: training existing professionals in areas like AI literacy, data analytics, and communication skills. Simultaneously, those whose roles are rendered obsolete will require reskilling into new domains, potentially outside their original professions.

Encouragingly, there is already evidence that such transitions are underway — high-skilled professionals in AI-exposed sectors have largely maintained employment by shifting into new, AI-related tasks. In response, governments and institutions are taking action. The OECD advocates for policies that equip workers to «take advantage of the new technology» and avoid obsolescence. [Organisation for Economic Co-operation and Development, 2023] Professional associations are updating their training requirements; for instance, medical schools are introducing AI modules, and law schools are creating legal tech clinics. On the corporate side, companies like PwC have announced internal training programs to upskill all employees in AI and data analytics. Similar initiatives are spreading through banking, manufacturing, and other sectors. Still, the challenge remains vast: as AI evolves, workers may need to update their skills multiple times throughout their careers. Ensuring equitable access to these opportunities is crucial. Without it, those unable to adapt risk being pushed into low-wage work or unemployment. Some analysts argue that society may require a new social contract centered around continuous learning to navigate the AI-driven transformation of skilled work.

The ethical and legal implications of AI automation in expert domains also demand serious attention. One pressing issue is accountability. When an AI system makes a consequential error — failing to diagnose cancer in a scan or triggering a market crash through faulty trading algorithms — who bears the responsibility? Is it the developer, the deploying institution, or the regulatory body? These questions are difficult to answer and can erode trust in AI technologies, especially in high-stakes applications. Bias and fairness represent another concern. AI systems trained on historical data can inherit and perpetuate the biases embedded in that data. For example, a legal AI tool might prioritize certain case types or precedents in ways that reflect longstanding systemic biases, while credit-scoring algorithms might unintentionally discriminate against minority applicants if historical lending data was biased.

To address these risks, careful auditing, transparent design, and possibly new regulatory frameworks are needed to ensure fairness and justice in AI-supported decisions. Privacy concerns are also heightened: many specialized tasks involve sensitive information — medical records, financial histories, or confidential legal documents — and the use of AI introduces questions about data security and informed consent. If an AI is trained on millions of such documents, how do we ensure that no data is leaked or misused? Ethical dilemmas also arise from AI’s decision-making capabilities. Should AI systems be allowed to override human judgments if statistical evidence suggests they are right? In healthcare, if an AI detects a rare condition missed by a doctor, who decides which course of action to follow? These situations require the development of new ethical frameworks.

Many institutions are responding. The European Union, for example, is developing the AI Act, which will impose strict requirements on high-risk AI systems, including those in healthcare and law. These include mandates for transparency, human oversight, and rigorous risk assessment. At the professional level, ethical codes are being updated to reflect AI’s growing role. The American Medical Association (AMA), for instance, has issued principles for the use

of "augmented intelligence" in healthcare, emphasizing safety and transparency. The shared consensus is that AI must remain a tool to support, not replace, human experts — particularly in decisions affecting health, justice, and financial well-being. [Organisation for Economic Co-operation and Development, 2023]

Another major concern is the opacity of many AI systems, especially those based on Deep Learning. These "black box" models can generate highly accurate outputs without offering clear explanations of how conclusions are reached. This lack of transparency is problematic in expert domains, where decisions need to be justified and scrutinized. A judge or lawyer cannot accept a recommendation simply because "the AI said so" — they must understand the legal reasoning behind it. Similarly, a physician has an ethical obligation to explain treatment decisions to patients. If AI-generated insights are unintelligible, they may be distrusted or, worse, blindly followed without proper scrutiny.

This challenge has led to growing interest in explainable AI (XAI), which aims to accompany AI decisions with human-interpretable justifications. Advances are being made: for example, visualization techniques can show which areas of a medical image the AI focused on, helping doctors validate the result. In legal applications, researchers are developing methods to extract rule-based approximations of AI reasoning. However, there is often a trade-off — more complex models tend to be more accurate but less interpretable. This tension between performance and explainability is especially pressing in professional contexts where trust and accountability are paramount. Regulators are increasingly requiring that AI systems, particularly in sensitive sectors, be both auditable and explainable. Professionals trained to think critically and demand evidence may resist opaque AI tools that don't align with their standards. For now, many applications use AI in a supportive role, where human experts retain final decision-making authority. This mitigates risk but can reduce efficiency gains. Finding the right balance between trust, transparency, and performance remains an urgent area of research and policy development.

Lastly, the reliability and safety of AI systems must be guaranteed, especially as society becomes more dependent on their correct operation. If a diagnostic AI tool malfunctions, the consequences could be serious — misdiagnosed patients, incorrect treatments, or lost lives. In finance, a faulty trading algorithm can trigger major market disruptions, as demonstrated in previous flash crashes. In engineering, overreliance on AI-generated designs could lead to structural failures if the AI overlooks critical edge cases. These risks make it essential to implement robust validation and monitoring practices for AI systems, especially in mission-critical environments. Traditional quality assurance methods must evolve to assess how well AI performs not just on training data, but also on real-world data with unforeseen variations.

Moreover, AI systems can be fragile. Slight deviations in input data may cause dramatic and unexpected behavior, especially if the system was never exposed to similar examples during training. In high-stakes settings, such brittleness can be dangerous. For instance, an AI might misclassify an unusual tumor because it never encountered such a case before, while a human doctor might reason through it based on broader knowledge. Ensuring reliability often means keeping a human in the loop — at least until AI systems prove their robustness over time. For this reason, many current deployments use AI for decision support, rather than full automation. As AI matures, and perhaps learns to recognize its own limitations, we may see more autonomous applications. Until then, caution is necessary to avoid costly or harmful errors.

In summary, the automation of specialized technical tasks through Artificial Intelligence presents a multifaceted dynamic, offering both significant opportunities and substantial challenges. On the one hand, AI holds the potential to deliver transformative gains in efficiency,

cost-effectiveness, and quality across high-skill domains such as medicine, law, finance, engineering, and scientific research. On the other hand, it poses risks to established professional trajectories, raises complex ethical and legal considerations, and introduces novel forms of technical and systemic vulnerability.

These developments are global in scope. No country or industry is immune. Advanced economies could face professional restructuring, while developing nations might simultaneously benefit from AI's reach and struggle with its labor market disruptions. International organizations such as the OECD and the International Labour Organization (ILO) emphasize the need for proactive governance: investments in human capital, updated regulatory frameworks, and inclusive dialogue between stakeholders are essential to navigate this transition. [Organisation for Economic Co-operation and Development, 2023]

If managed thoughtfully, AI has the capacity to augment human expertise and contribute to a new era of innovation-driven prosperity. However, if neglected or mismanaged, it may exacerbate existing inequalities, erode critical skill sets, and undermine public trust in essential societal institutions.

The remainder of this thesis will examine these socioeconomic implications in greater depth and explore strategic pathways to maximize the benefits of AI integration in the world of work, while actively mitigating its associated risks.

Chapter 3

The shift in the world of work: from specialized technical skills to general human-centric skills

3.1 The growing automation of specialized technical tasks

Artificial Intelligence (AI) is increasingly expanding into tasks that once required advanced training, expert judgment, and years of professional experience. While earlier waves of automation mainly affected routine or low-skill occupations, recent AI advancements target high-skilled cognitive work in fields like medicine, law, finance, and engineering. [Euronews, 2023] According to the OECD's Employment Outlook 2023, professionals in these sectors – including radiologists, lawyers, financial analysts, and engineers – may «suddenly find themselves at risk of automation from AI». [Euronews, 2023]

In other words, tasks traditionally performed by highly educated professionals are now being partially or fully automated by sophisticated algorithms. This shift marks a significant evolution in the nature of work and challenges long-held assumptions about the immunity of knowledge-intensive professions from automation.

This section examines the growing capacity of AI to perform specialized technical tasks, the technological drivers enabling this transformation, real-world use cases across industries, and the implications for professional roles and labor markets on a global scale.

3.1.1 Technological enablers of specialized task automation

Several AI technologies have reached a level of maturity that now enables the automation of expert-level tasks across multiple domains.

Among the most significant of these technologies is Deep Learning, which utilizes multi-layered neural networks to perform advanced pattern recognition on complex datasets. This capability forms the foundation of AI's performance in fields such as medical imaging and engineering design. For example, Deep Learning models have demonstrated the ability to detect intricate features in radiological scans with superhuman accuracy. [Hall, 2023b] One study reported that an AI system achieved a 99% sensitivity in identifying abnormalities on chest X-rays, far surpassing the average 72% sensitivity rate of human radiologists. [Hall, 2023b] Such performance is made possible by the capacity of neural networks to learn from vast amounts of data, enabling the detection of subtle patterns often imperceptible to human observers.

Another critical technological enabler is Natural Language Processing (NLP), which allows AI systems to interpret, generate, and interact using human language. Recent advances in Large Language Models (LLMs) — such as GPT-4 — have significantly enhanced AI's fluency, contextual understanding, and ability to reason across complex linguistic inputs. This makes it feasible to automate tasks traditionally dependent on language-intensive expertise like legal research, report writing, and financial analysis. A recent experiment demonstrated that an advanced LLM could review legal contracts and pinpoint issues with accuracy comparable to junior lawyers, completing the task in seconds rather than hours. [Martin et al., 2024]

These capabilities are enabled by transformer-based Deep Learning architectures trained on extensive corpora, which allow LLMs to internalize patterns of expert knowledge in a statistical form. As a result, such models can not only draft coherent and contextually appropriate documents but also answer domain-specific questions and provide informed recommendations across professional fields.

Another foundational technology enabling the automation of expert-level tasks is the use of expert systems and knowledge graphs. These systems encode domain-specific rules or facts and have historically been used for decision support in fields like medicine and engineering. Early expert systems (e.g. MYCIN in medical diagnosis) demonstrated that codified expert knowledge can drive automated reasoning. Modern AI often combines this approach with Machine Learning – for instance, by integrating learned models with rule-based frameworks for added interpretability. While expert systems themselves require manual knowledge engineering, they paved the way for today's hybrids that use learned models to mimic expert decision-making.

Crucially, it is the convergence of these technologies – Deep Learning for perception, NLP for language understanding, and the accumulated "knowledge base" of expert systems – that enables AI to take on specialized tasks. This technological synthesis is further supported by advances in high-performance computing and scalable cloud infrastructure, which have dramatically expanded the availability of computational power and data storage. [Lane, 2021] With massive datasets (e.g. medical images, legal texts, financial records) and powerful algorithms, AI systems can now make predictions or recommendations in complex scenarios that previously demanded human expertise. [Lane, 2021]

3.1.2 AI applications in medicine, law, finance, and engineering

As previously explained, Artificial Intelligence is no longer confined to routine or low-skill tasks, but is instead increasingly performing specialized functions that were once considered the exclusive domain of highly trained professionals. From healthcare to law, finance, and engineering, AI technologies are automating expert-level work, transforming the nature of professional practice across multiple sectors.

Medicine - diagnostics

AI's impact in healthcare is particularly visible in the domain of medical diagnostics and imaging. In radiology, AI algorithms are now used to analyze X-rays, CT scans, and MRIs with remarkable accuracy. These models have demonstrated the ability to match or even surpass human specialists in certain diagnostic tasks. For instance, an autonomous AI system for chest radiograph analysis achieved 99.1% sensitivity in detecting abnormalities, significantly outperforming radiologists, who demonstrated a sensitivity of 72.3% in a multi-center trial. [Hall, 2023b] Such systems are capable of detecting minute lesions or patterns that may elude human

observers, enabling earlier detection of conditions such as cancers, fractures, or lung diseases. Importantly, these tools are often used to augment radiologists' work rather than replace it. In practice, AI can rapidly triage normal from suspicious images, prioritizing the latter for human review. This significantly streamlines radiologists' workflow and allows them to concentrate on more complex or ambiguous cases. A study by Andersen et al. (2023) found that their chest X-ray AI could autonomously clear a subset of normal chest X-rays, potentially reducing radiologists' workload by about 8-12% in certain clinical environments. [Hall, 2023b]

Beyond radiology, AI is being applied to other medical specialties as well. In pathology, it assists in the analysis of microscope slides; in dermatology, it supports the classification of skin lesions; and in predictive diagnostics, it leverages electronic health records to generate personalized risk scores. Together, these applications demonstrate how AI is performing increasingly technical medical tasks — tasks that previously required years of clinical training.

Law - legal research and document review

Parallel developments are occurring in the legal sector, where AI is automating many of the labor-intensive tasks traditionally performed by attorneys and paralegals. NLP-powered legal research platforms can instantly search and summarize vast corpora of statutes, case law, and legal opinions – a process that would consume countless hours of manual reading.

Similarly, Machine Learning is employed in e-discovery and document review for litigation: algorithms sift through thousands of emails or documents to identify those relevant to a case. One landmark example is JPMorgan Chase's COIN (Contract Intelligence) system, which interprets commercial loan agreements using a ML model. COIN can review 12,000 contracts in seconds, work that previously took legal teams 360,000 hours per year. [Sullivan, 2019]

According to Bloomberg, the AI not only vastly accelerated contract review but also reduced errors in interpreting complex agreements improving the accuracy of complex contract interpretation. [Sullivan, 2019]

Startups have also developed AI tools for contract analysis, risk assessment, and automated drafting of standard agreements. Recent advances in LLMs have further expanded these capabilities: a 2024 study by Martin et al. found that a state-of-the-art LLM could match or exceed junior lawyers in accuracy for certain contract review tasks, while operating at 1% of the cost and completing the work in a fraction of the time. [Martin et al., 2024]

Unsurprisingly, AI adoption in the legal industry is surging: usage among legal professionals increased from 19% in 2023 to 79% in 2024. [Ambrogi, 2024]

Moreover, the survey estimated that up to 74% of time spent on routine billable legal tasks (e.g. information gathering, drafting, and basic research) could be automated with AI, allowing lawyers to redirect their time to higher-value activities. [Ambrogi, 2024]

In practice, law firms are increasingly integrating AI into client intake via legal chatbots, conducting due diligence through AI-powered contract analytics, and using predictive models to estimate case outcomes. These applications illustrate that even the highly specialized cognitive tasks of legal professionals — analyzing legal texts, formulating arguments, applying case law — are now being partially automated.

Finance - forecasting and analysis

The financial services sector has long been at the forefront of automation and continues to lead in AI adoption. Today, AI systems handle tasks that were once the exclusive domain of seasoned financial analysts and traders. Financial forecasting, in particular, has been revolutionized by AI algorithms that process vast amounts of historical data, market indicators,

and even alternative data sources, like, for example, social media sentiment, to predict market trends or corporate performance.

In the realm of trading, hedge funds and investment banks have embraced algorithmic strategies powered by Machine Learning. These models can execute trades in milliseconds, responding to subtle market fluctuations far more quickly than any human. Unlike traditional rule-based systems, AI-driven trading models continuously learn and adapt to emerging patterns, and in some cases, they outperform strategies devised by expert human traders.

AI is also redefining risk assessment practices. Banks use ML models to evaluate credit risk of loan applicants by analyzing vast datasets of borrower history, macroeconomic trends, and transaction patterns, improving accuracy over rule-based credit scoring. Similarly, AI plays a critical role in fraud detection, where real-time monitoring systems flag suspicious transactions based on behavioral anomalies and historical patterns, offering enhanced protection against financial crime.

The scope of AI extends further into areas such as portfolio management and financial advisory. AI-powered robo-advisors now deliver personalized investment recommendations with minimal human oversight, democratizing access to financial planning services. Even in financial reporting and auditing, AI tools are automating data entry, reconciliation, and anomaly detection, reducing the need for junior accountants to perform these technical tasks. [Daloopa, 2023]

A particularly illustrative example of AI's power in finance — merging with the legal domain — is again JPMorgan's COIN platform, which on the finance side helped cut loan processing errors and dramatically sped up loan agreement reviews. [Sullivan, 2019] This also highlights how AI technologies can create efficiencies across traditionally separate domains.

Overall, the integration of Deep Learning and big data analytics allows AI systems to detect patterns and make informed predictions in financial data more efficiently than human analysts in many contexts. This has led to notable gains in productivity, accuracy, and speed in decision-making processes related to forecasting, trading, and client services. However, these advancements are not without challenges. The increasing reliance on opaque, complex algorithms raises concerns about explainability, regulatory compliance, and systemic risk, especially in volatile or high-stakes market environments.

Nonetheless, across banking, insurance, and asset management, a growing number of specialized financial tasks — from stock selection and risk modeling to underwriting and compliance — are being automated or augmented by AI. This shift is not only improving operational efficiency but also redefining the roles and skill sets required within the financial profession.

Engineering and design

In the engineering domain, AI is enabling new levels of efficiency and creativity in design, simulation, and optimization. One breakthrough application is generative design, in which AI algorithms generate optimized designs based on given objectives and constraints. Engineers traditionally had to iterate designs manually, drawing on experience and intuition to meet requirements (e.g. minimizing weight while maintaining strength). Now, generative design software can explore thousands of design permutations algorithmically — often discovering innovative solutions that a human might not conceive.

As already briefly explained, a notable example is Airbus's use of Autodesk's generative design AI to create a new partition wall for the A320 aircraft. The AI software evaluated countless design options under weight, strength, and safety constraints, and ultimately produced a partition design 45% lighter than the conventional version yet just as strong. [Freist, 2019] Airbus

engineers reported that the algorithm proposed many novel geometries «that a human designer would probably never have come up with», before they selected the optimal solution. [Freist, 2019] This AI-designed part was then produced with advanced manufacturing (3D printing), demonstrating a new paradigm in engineering: human experts define the problem and constraints, and the AI tool generates and tests solutions at superhuman scale.

Beyond aerospace, similar generative or algorithmic design approaches are emerging in architecture and civil engineering – for instance, AI tools that lay out floor plans or optimize urban planning designs based on parameters like traffic flow and energy efficiency. In mechanical engineering, AI-driven topology optimization creates component shapes that minimize material use while satisfying performance criteria (leading to the almost organic-looking designs now seen in some lightweight automotive parts).

AI also plays a growing role in simulation and analysis. Tasks such as computational fluid dynamics (CFD) and finite element analysis (FEA), which once required time-consuming human effort and access to high-performance computing, are being accelerated through AI-driven surrogate models. These models can approximate simulation results in real time, enabling rapid iteration during the design phase.

In parallel, digital twin technology — virtual models of physical systems updated in real time with sensor data — is powered by AI to predict failures and optimize system performance. These twins simulate behavior under different conditions, allowing engineers and technicians to make proactive decisions. In software engineering, tools like GitHub Copilot illustrate how AI is even automating aspects of programming, from code generation to bug detection.

Across all these applications, the role of engineers is shifting. Rather than manually executing every technical detail, they now curate design objectives, interpret AI-generated results, and refine final outputs — effectively collaborating with AI as a creative and analytical partner.

3.1.3 Transforming job profiles and skill requirements

As the analysis conducted by far suggests, the growing automation of specialized tasks is reshaping job profiles in fundamental and far-reaching ways. Rather than making human experts obsolete, AI tends to transform the nature of their work — shifting responsibilities toward oversight, interpretation, and the integration of AI systems into existing workflows. Empirical studies suggest that, in most cases, AI will augment professional work rather than fully automate entire occupations. [Gmyrek et al., 2023a]

For example, even though an AI system can handle the bulk of routine image analysis in radiology or drafting in law, humans are still needed to verify AI outputs, handle exceptional cases, and provide context and judgment. This dynamic is leading to the emergence of hybrid roles that combine deep domain expertise with the ability to supervise, interpret and collaborate with AI.

Successful organizations are already responding to this shift by "strategically reimagining" existing roles to enhance the synergy between human and machine capabilities. [Analytics, 2025] This transformation is not limited to the modification of existing jobs: entirely new occupational categories are emerging to support the growing ecosystem of AI applications. Examples include roles such as AI workflow manager, data ethicist, and Machine Learning operations specialist. All positions that focus on ensuring responsible, efficient, and context-aware deployment of AI systems within professional environments.

This shift toward hybrid roles is not merely theoretical — it is already visible in the evolving day-to-day practices across multiple professions. Medical specialists such as radiologists or pathologists are moving from primarily performing analyses to also monitoring AI systems

that perform analyses. A radiologist now might spend more time checking AI-flagged images and correlating them with patient history, intervening when the AI is uncertain or potentially mistaken. As noted in a recent report, AI can «reduce the workload of radiologists by doing monotonous tasks in less time, freeing up clinicians to focus on more complex cases that require human interpretation». [Healthineers, 2025]

As also studied in the previous section, a similar transformation is underway in the legal profession. As one industry report highlights, «automation can offer firms the space to focus on tasks that require a human touch – high-level legal strategy, advocacy, and client relationships – while routine work is handled by AI». [Ambrogi, 2024] Junior lawyers who once spent days on document review might pivot to interpreting AI-generated research memos and focusing on creative legal arguments.

In the financial sector, analysts increasingly rely on AI-driven analytics tools and are needed to translate AI insights into strategic decisions or to oversee algorithmic trading systems (for instance, managing the risk parameters and intervening in unusual market conditions).

Even in engineering, the impact is evident. Designers now spend less time on drafting basic components and instead focus on validating and refining AI-generated designs, applying human intuition to select the best solution from AI-proposed options.

Across these domains, AI is not replacing professionals but reshaping their work — elevating the human role toward higher-level judgment, critical thinking, and strategic oversight.

One consequence of this shift is a reduced demand for certain entry-level or routine aspects of specialized roles. If an AI can perform 70% of a junior accountant’s tasks (like reconciling statements or flagging anomalies) or a junior attorney’s tasks (like reviewing standard contracts), organizations may clearly hire fewer people for those functions. For instance, law firms may need fewer paralegals for document review as e-discovery software takes on that work.

A survey of workers in companies using AI found a significant share fearing that they «could lose their job to AI in the next 10 years», even among highly educated employees. [Atillah, 2023]

At the same time, the demand is rising for skills that complement AI – such as data interpretation, quality control, and interdisciplinary fluency. Professionals who can "speak AI" (understand the workings and limitations of AI tools) while also applying domain-specific expertise will be especially valued. The emerging human–AI collaboration models require workers to exercise judgment in tandem with AI outputs.

Far from making human judgment obsolete, the integration of AI often highlights the areas where human insight is indispensable – be it ethical reasoning, empathetic communication, or creative problem-solving beyond the AI’s scope.

Notably, entirely new specializations are appearing as well. There is growing demand for roles like AI trainers (who fine-tune AI models with domain knowledge), AI auditors (who evaluate algorithms for bias or errors), and prompt engineers (experts in crafting inputs to get optimal results from Generative AI). These roles often bridge technical AI know-how with traditional industry knowledge – a prime example of hybrid skill sets.

A global analysis of AI’s labor impact concluded that «the most important impact of the technology is likely to be augmenting work – automating some tasks within an occupation while leaving time for other duties – as opposed to fully automating occupations». [Gmyrek et al., 2023a] In other words, most jobs will not vanish, but nearly all jobs will change to some degree. Workers at all levels will need to adapt, continuously learning to work effectively with evolving AI tools.

3.1.4 Broader labor market implications

The accelerating automation of specialized tasks by AI carries broad implications for labor markets around the world.

One concern is the potential for job polarization to deepen. Historically, technological change tended to hollow out middle-skill jobs, while increasing demand for high-skill and some low-skill jobs – contributing to wage inequality. AI's impact could potentially extend this trend into high-skill domains: if AI enables a small number of highly skilled experts to accomplish what used to require larger teams of professionals, the employment growth in top-tier jobs might slow even as those roles become more productive. At the same time, roles that are non-automatable (often lower-paying service jobs requiring manual work or personal interaction) might remain in demand, resulting in an even more polarized job distribution.

Some analysts caution that the diffusion of AI might widen inequality by primarily benefiting those with the right skills to use AI while displacing others. [Lane, 2021] In an AI-rich economy, highly skilled AI developers and overseers could command a premium, whereas specialists whose tasks are automated may see stagnant or falling demand. Without intervention, the gains from AI could be unevenly captured by highly skilled or capital-owning groups, exacerbating income gaps across society.

On a more optimistic note, AI is also expected to create new jobs and increase the need for certain skills, potentially offsetting some employment losses. Just as past technological revolutions eventually led to net job growth (through new industries and increased productivity), AI could spur new economic activity. The World Economic Forum projects a net positive job growth globally by 2027, with new roles in data analysis, AI engineering, and sustainability expected to grow, even as some roles decline. [University, 2025] Crucially, many of the new roles will be those that involve human-machine collaboration – blending technical and soft skills. For example, jobs like "AI-assisted healthcare technician" or "legal technologist" are emerging, which require understanding AI outputs and maintaining the human elements of the service. These hybrid roles exemplify the broader shift toward what is increasingly referred to as "collaborative intelligence": the synergistic interaction between humans and AI systems. Studies show that teams composed of both human experts and AI tools tend to achieve better performance outcomes than either could alone. [Wilson and Daugherty, 2018]

Rather than replacing workers, AI is often reshaping the tools they use, augmenting their capabilities and enabling them to focus on higher-value tasks. This transformation can lead to improved productivity and, in many cases, enhanced job satisfaction. Recent surveys indicate that a majority of workers who use AI in their daily tasks report better job performance and a greater sense of fulfillment, largely because AI relieves them from repetitive, monotonous work and allows them to concentrate on the more creative or intellectually rewarding aspects of their roles. [Atillah, 2023] This points to a future where human-AI teaming becomes the norm across a wide range of professions. In medicine, for instance, the best diagnostic accuracy has been achieved when doctors and AI systems work together, catching errors or oversights that the other missed. [Healthineers, 2025] Similar human-AI partnership models are developing in fields from finance (AI suggests strategies, humans make final decisions) to engineering (AI generates design options, humans choose and refine).

However, realizing the positive potential of these trends – while mitigating the negatives – requires proactive adaptation by institutions. Workforce development and training systems need to keep pace. Many workers will need to reskill or upskill to thrive in hybrid roles. According to the World Economic Forum (WEF), 60% of workers will require some form of training by 2027 due to AI and other trends, yet currently only about half have access to ade-

quate training resources. [University, 2025]

This underscores a critical challenge for governments, companies, and educators: to provide learning opportunities so that displaced specialists can transition into new roles (e.g. a radiology technician learning to operate and validate AI diagnostic tools, or a finance clerk learning data analytics).

In this context, lifelong learning and adaptability will become essential features of professional life across sectors. Public policy will play a critical role in supporting these transitions. Measures such as strengthened social safety nets, job transition assistance programs, and financial incentives for companies to invest in employee training could help smooth the impact of occupational shifts, especially in professions experiencing partial or full automation.

Only through coordinated, forward-looking efforts can societies harness the benefits of AI-driven innovation while ensuring that workers are not left behind in the process.

Beyond questions of access to training and job transitions, AI adoption also carries important implications for job quality and working conditions. If AI takes over more tasks, the human role may become less task-loaded but more responsibility-heavy – overseeing automated systems can be stressful, and the accountability for errors may still fall on humans. Issues of trust in AI and ethical use of AI at work also arise. For example, professionals must be wary of over-reliance on AI in critical decisions (hence the growing emphasis on human oversight).

Additionally, if AI enables high-skilled professionals to be ultra-productive, firms might concentrate work on a few star performers aided by AI, potentially reducing headcount but increasing those workers' workloads and pressure. Ensuring that AI adoption yields broadly shared benefits — rather than merely amplifying profits or deepening labor market disparities — is a central concern highlighted by policy organizations such as the OECD. [Organisation for Economic Co-operation and Development, 2023] In response, there is growing support for the development of inclusive AI strategies. These approaches advocate for the deliberate design and implementation of AI systems in ways that complement human labor, enhance job quality, and promote equitable outcomes. Governments, employers, and technology developers alike have a role to play in shaping AI deployment so that it uplifts workers rather than displacing or overburdening them.

In summary, the automation of specialized technical tasks by AI presents a double-edged sword for the future of work. On one hand, it offers the promise of greater productivity, efficiency, and the emergence of entirely new job categories. On the other, it introduces serious risks, including the displacement of skilled professionals, growing labor market polarization, and heightened pressures on those whose roles are transformed but not eliminated. The ultimate outcome will hinge on how societies respond — through education systems that foster adaptability, job design that supports human–AI collaboration, and policy frameworks that protect and empower workers during the transition.

What is increasingly evident is that the very nature of expert work is undergoing a profound transformation. We are entering a new era in which professionals — doctors, lawyers, financial analysts, engineers — will work side by side with intelligent machines. These systems will progressively assume responsibility for technical and data-intensive tasks, while human workers will focus on areas where human capabilities remain unmatched: complex problem-solving, empathy, creativity, and ethical judgment.

The central challenge and opportunity ahead lies in building effective models of human–AI collaboration and preparing the workforce accordingly. If approached with foresight and inclusivity, AI has the potential not only to augment human labor but also to contribute to a more resilient and equitable future of work across global labor markets.

3.2 The increasing demand for general skills: creativity, emotional intelligence, and communication

As the analysis conducted up to this point shows, advance of Artificial Intelligence is reshaping job requirements in favor of human-centric general skills – notably creativity, emotional intelligence, and communication – that are difficult to automate. As routine technical tasks become more automated, the comparative advantage of human workers increasingly lies in these broad, non-technical competencies. [Lassébie and Quintini, 2022] [Deming, 2017]

This section examines the growing importance of such skills and why they are increasingly valued in an AI-driven labor market. It draws on labor market research, institutional reports (e.g. World Economic Forum, OECD, ILO), and academic literature to analyze how creativity, emotional intelligence, and communication contribute to innovation, collaboration, leadership, adaptability, and problem-solving in hybrid human–AI workplaces. It also discusses relevant frameworks – such as the concept of T-shaped professionals, emotional labor, and lifelong learning – that support the idea of a broad skillset as essential for future employability. Finally, global examples are provided of sectors and roles where these human-centric skills are in high demand and effectively irreplaceable by AI.

3.2.1 Human-centric skills as a shield against automation

A defining feature of creativity, emotional intelligence, and communication is that they involve complex, non-routine cognition and social interaction – domains where machines in which machines continue to face significant limitations. While AI excels at structured, rules-based tasks, it still struggles with ambiguity, contextual nuance, and the inherently human aspects of thought and behavior and humans are still able to outperform machines at «open-ended tasks that require flexibility, creativity, and judgment». [Deming, 2017]

This distinction has important implications for the future of work. According to an OECD working paper on automation, skills related to «complex problem-solving, high-level management and social interaction can hardly be automated given the current state of technological developments». [Lassébie and Quintini, 2022] In practice, this means that many occupations rely on at least some tasks that act as bottlenecks to full automation, particularly those involving creative thinking, emotional sensitivity or nuanced human interaction. [Lassébie and Quintini, 2022]

Even the most advanced AI systems cannot yet emulate a spontaneous conversation, offer genuine empathy in a team setting, or replicate the imaginative leap that leads to an innovative idea. [Deming, 2017] As observed, technological change tends to increase the importance of skills for which there is no good machine substitute. [Deming, 2017]

In effect, the more AI becomes proficient in automating technical and routine work, the more the relative value shifts toward human-centric soft skills — such as creativity, critical thinking, empathy, adaptability, and collaboration — that are not easily codified or replicated by algorithms. This dynamic highlights a crucial aspect of future workforce preparation: while technical proficiency remains important, the enduring advantage of human labor lies in its irreducibly social and creative dimensions.

Empirical research in labor economics supports this point. Deming (2017) documents a substantial transformation in labor market demand toward occupations that require strong social skills, as routine tasks became increasingly automated. In the United States, for example, jobs requiring high social skills (communication, teamwork, empathy) grew by nearly 12% as a share of all employment between 1980 and 2012. These roles not only expanded in number

but also experienced faster wage growth compared to other occupations. [Deming, 2017] By contrast, technically intensive jobs with limited social interaction (including many purely STEM roles) have seen slower growth in both employment and compensation. [Deming, 2017] This divergence reflects what Deming calls a "new imperative": strong cognitive skills remain necessary but are no longer sufficient for a high-paying job – one «also needs to have social skills» in today's economy. [Deming, 2017] In essence, social and creative skills act as a shield against automation-driven displacement, because they complement technology rather than compete with it.

This complementarity is being operationalized in organizational design, as firms increasingly structure work around adaptive, team-based problem-solving that integrates human creativity and social understanding with the capabilities of AI. [Deming, 2017] From a task perspective, this makes intuitive sense: routine procedural work (whether manual or cognitive) can be coded into algorithms, but creative and emotional labor resists formalization. [Deming, 2017]

The concept of emotional labor (Hochschild, 1983) highlights how many roles – from service jobs to healthcare – demand genuine human emotional engagement, such as empathizing with a customer or comforting a patient, which cannot be authentically replicated by AI. These qualities make workers with high emotional intelligence and communication abilities indispensable, even as AI handles more technical functions. Indeed, studies show that occupations at lowest risk of automation tend to be those that require advanced social skills or creativity, such as management, education, healthcare, and community services. [Lassébie and Quintini, 2022] In contrast, jobs comprised mostly of routine, automatable tasks (e.g. data entry, repetitive manufacturing) are far more vulnerable. [Lassébie and Quintini, 2022] Yet, as the OECD points out, very few occupations are entirely automatable; most roles, even in highly susceptible sectors, contain elements that still require human judgment, insight, or interaction. [Lassébie and Quintini, 2022]

This reinforces a central insight: while AI will continue to reshape the structure of work, human-centric skills — particularly those related to creativity, empathy, and social intelligence — will remain essential components of most occupations, providing a durable comparative advantage for human labor in the age of intelligent machines.

3.2.2 Evidence of growing demand for creativity, emotional intelligence, and communication

Given their resistance to automation, general soft skills like creativity, emotional intelligence (EI), and communication are becoming more valuable in the labor market, a trend documented by global surveys and research. Employers across industries now rank these "soft" capabilities among the most important qualities in employees – and also among the hardest to find. [Deming, 2017]

For instance, a National Association of Colleges and Employers survey found that the top attribute companies sought in new hires was the "ability to work in a team", followed closely by communication skills, ranking even above problem-solving or technical proficiency. [Deming, 2017] Collaboration and interpersonal communication are thus not just "nice-to-have" skills, but core competencies that organizations actively seek for competitiveness.

Major institutional analyses echo this shift. The World Economic Forum (WEF) reports that as of 2023, employers consider analytical thinking and creative thinking to be the two most important core skills for workers, together constituting a significant share of companies' skill priorities. [World Economic Forum, 2023]

It is worth highlighting that, creative thinking, defined as the ability to generate novel ideas and

solutions, ranks second overall, surpassing even traditionally valued technical skills and basic digital literacy. [World Economic Forum, 2023]

Equally notable is the rise of social and emotional skills in global demand. The WEF's top 10 in-demand skills for 2023 also include several social and emotional skills: empathy and active listening (an aspect of emotional intelligence) and leadership and social influence are explicitly listed among the top competencies sought by employers worldwide. [World Economic Forum, 2023] This marks a clear recognition that in an age of smart machines, human empathy and influence matter more, not less. The WEF finds that "working with others" skills – essentially communication, teamwork, and leadership – are rising in importance alongside cognitive skills. [World Economic Forum, 2023]

Moreover, these socio-emotional and interpersonal competencies are not merely enduring; they are expanding. Employers surveyed in 2023 reported that creative thinking is among the fastest-growing skills in importance, outpacing even many technical skills. [World Economic Forum, 2023] In parallel, socio-emotional attitudes such as curiosity, lifelong learning, resilience, flexibility, and self-awareness are all identified as high-growth skill areas. [World Economic Forum, 2023] These findings underscore the increasing premium placed on adaptability, emotional intelligence, and continuous self-improvement in navigating a dynamic and AI-augmented labour market.

This growing emphasis on human-centric skills is further supported by long-term institutional analyses. The OECD, for instance, has documented a persistent shift in labor demand toward greater reliance on cognitive and interpersonal competencies across advanced economies. According to its *Skills for Jobs* analysis, «skill demands have gradually shifted towards a more intensive use of cognitive and interpersonal skills», with high-skill occupations — typically requiring problem-solving, creativity, and people management — experiencing strong demand in most countries. [Organisation for Economic Co-operation and Development, 2018]

At the same time, there is decreasing demand for routine or manual abilities. [Organisation for Economic Co-operation and Development, 2018] This imbalance is reflected in hiring difficulties: occupations that face critical skill shortages (i.e. roles employers struggle to fill) are often those requiring advanced social or creative skills, and these roles tend to have the lowest risk of automation. [Organisation for Economic Co-operation and Development, 2018] Conversely, jobs with a surplus of available workers are frequently those with more automatable skill profiles. [Organisation for Economic Co-operation and Development, 2018] In essence, labor markets are increasingly characterized by unmet demand for the very skill sets that AI cannot easily replicate, reinforcing the strategic value of cultivating these human capabilities in the workforce.

Forward-looking studies further reinforce this trend. The McKinsey Global Institute projects that by 2030, the demand for social and emotional skills will rise sharply due to automation. In the United States, time spent on social and emotional skills in the workforce is expected to grow by 26%, and in Europe by 22%, between 2016 and 2030. [Bughin et al., 2018] Skills like empathy, advanced communication, entrepreneurship and initiative-taking, leadership and managing others are all forecast to see substantial growth in employer demand. [Bughin et al., 2018] Similarly, demand for higher-order cognitive skills – especially creativity, critical thinking, decision-making, and complex information processing – is predicted to increase across industries. [Bughin et al., 2018]

These projections align with the idea that as AI takes over routine tasks, the labor market will reward those skills that enable workers to work alongside AI in complementary ways – by doing what machines cannot do, such as crafting creative strategies, understanding human context, and communicating effectively.

This trend is echoed by institutional analyses. The International Labour Organization (ILO), for example, highlights that many future jobs «will also require more emotional and personal skills, such as persuasiveness, creativity, empathy, leadership, [and] teamwork capacities». [International Labour Organization, 2017] This is seen not only in high-tech sectors but across diverse fields including health care, education, and services. Global employer surveys find that businesses on multiple continents are looking for a different skill mix in new recruits compared to a few years ago – with more emphasis on adaptability, creativity and communication – and many report difficulty finding candidates with these soft skills. [International Labour Organization, 2017]

Taken together, these findings point to a growing consensus among researchers, policymakers, and employers: in the evolving labor market of the 21st century, soft skills have emerged as critical determinants of employability and career advancement. While technical competencies remain essential, they are no longer sufficient on their own. The ability to think creatively, communicate effectively, and relate empathetically to others is now central to thriving in a workplace increasingly mediated by intelligent technologies.

3.2.3 Soft skills as drivers of innovation, collaboration and leadership in the AI era

The rise in value of creativity, emotional intelligence, and communication is closely tied to their role in enabling innovation, effective collaboration, and strong leadership – particularly in workplaces where humans and AI systems work in tandem. These general skills amplify the benefits of technology by fostering the human contributions that machines cannot supply: original ideas, empathetic team dynamics, and clear communication of vision and knowledge.

Creativity is widely recognized as a catalyst for innovation and complex problem-solving. In an AI-rich environment, creativity allows human workers to formulate new solutions, design novel products, and adapt to unforeseen challenges, often in partnership with data-driven insights from AI. For example, engineers and designers use creative thinking to interpret AI-generated analyses and then envision creative approaches that a purely logical machine would not conceive. According to the ILO, creative and innovative thinking is a core skill that adds new value by applying imagination and invention to practical or artistic problems. [International Labour Organization, 2021]

Creative workers excel at asking new questions and exploring possibilities beyond the scope of algorithms, which is essential for breakthrough innovations. Moreover, creativity underpins adaptability – employees who can think creatively are better able to pivot when circumstances change or when AI outputs are imperfect, thus improving organizational resilience.

The same uniquely human qualities that make creativity indispensable in AI-enhanced workplaces also apply to emotional intelligence (EI). While creativity drives innovation and adaptability, emotional intelligence enables the interpersonal coordination and leadership necessary to implement those innovations effectively within teams and organizations.

Emotional intelligence – which encompasses empathy, self-awareness, and social skills – contributes directly to collaboration, teamwork, and leadership. In modern workplaces, especially those employing AI tools, teams are often cross-functional and dynamic, requiring members to have the emotional intelligence to navigate interpersonal dynamics and cultural differences. High EI enables workers to communicate with sensitivity, resolve conflicts, and build trust – all crucial for effective teamwork and collective problem-solving.

Research suggests that managers and professionals with strong social skills are able to lead more productive teams and drive better outcomes, as they can motivate colleagues, negotiate

effectively, and foster a cooperative climate. [Deming, 2017] In hybrid human–AI teams, a leader’s emotional intelligence is key to mediating between the technological tools and the human team members – for instance, by recognizing when team members feel overwhelmed by new systems or by interpreting nuanced client feedback that the AI might miss.

Importantly, emotional intelligence is also tightly linked to leadership and social influence, skills identified by the WEF as critical for the future. [World Economic Forum, 2023] Leaders with emotional intelligence are more adept at inspiring employees, guiding organizational change, and ensuring ethical use of AI technologies, thereby providing a competitive advantage that is hard to emulate with automation.

Complementing emotional intelligence, strong communication skills are equally vital in workplaces where collaboration is central. While EI fosters interpersonal sensitivity and relational awareness, it is through communication that those qualities are expressed and translated into effective action.

Communication skills – including clear articulation of ideas, active listening, and the ability to convey complex information – are fundamental to practically every aspect of modern work. In an era of information overload and advanced analytics, those who can translate data-driven insights into compelling narratives or actionable strategies become indispensable.

Moreover, communication is the enabling mechanism of collaboration: it allows humans to coordinate with each other and with AI outputs effectively. For example, a data analyst must explain an AI model’s findings in plain language to a non-technical decision-maker; a product team member must listen to customer needs and communicate them to an AI development team. Strong communicators ensure that the human-AI interface yields understanding rather than confusion. Additionally, communication skills amplify the impact of other soft skills – empathy is only useful if it can be expressed and used to inform communication with colleagues or clients.

Reflecting this, the ILO’s global skills framework includes communication, teamwork, problem-solving, and learning-to-learn as core skills that enable workers to respond to change and collaborate in innovative, productive workplaces. [International Labour Organization, 2021] In essence, communication is the glue that holds together human-AI collaboration, enabling joint problem-solving and continuous learning in the workplace.

Taken together, creativity, emotional intelligence, and communication form the foundation of a resilient and future-ready workforce. Each of these competencies supports distinct aspects of value creation in the age of AI — but it is their combination that generates the most profound impact. As previously discussed, creativity enables original thinking and innovation; emotional intelligence fosters collaboration and ethical leadership; and communication ensures that insights — whether human- or machine-generated — are effectively shared and applied.

When combined, these general skills empower workers to thrive in hybrid human–AI environments, where success increasingly depends not just on technical proficiency, but on the ability to synthesize human and machine capabilities. Such integrative skillsets are what allow professionals to derive actionable insights from AI tools, embed those insights into collaborative workflows, and steer innovation processes with a balance of logic and empathy. In this context, employees become not merely users of AI, but active orchestrators of human–machine interaction, translating data into strategy, uncertainty into vision, and automation into opportunity.

This synergy is more than aspirational — it is now a measurable driver of performance. Research suggests that teams blending strong soft skills with AI-enabled tools outperform both human-only and AI-only counterparts in terms of productivity, creativity, and adaptability. [Bughin et al., 2018] [Deming, 2017] Furthermore, workers who possess these skills tend to be more resilient in the face of change: they approach new technologies with curiosity and

confidence, embrace lifelong learning, and are capable of reimagining their professional roles as automation reshapes traditional pathways. [World Economic Forum, 2023]

In sum, soft skills are not peripheral in the digital age — they are becoming central differentiators of individual employability and organizational agility. Firms that invest in cultivating these capacities — through hiring, training, and leadership development — position themselves to not only absorb technological disruption, but to transform it into a competitive advantage. As we move further into the era of human–AI collaboration, these integrative capabilities will define the most successful and sustainable models of work.

3.2.4 Frameworks emphasizing broad skillsets: T-shaped professionals, emotional labor, and lifelong learning

The growing importance of general human-centric skills has been recognized in various theoretical frameworks and workforce development models. These approaches converge on a key insight: employability in the AI era depends not only on technical specialization, but also on the breadth of transferable, human-centered competencies. Among the most influential frameworks are the concepts of T-shaped professionals, emotional labor and service orientation, and lifelong learning. Together, these offer a cohesive vision of how workers can remain relevant and resilient amid rapid technological change.

T-Shaped professionals

The concept of the T-shaped professional captures the idea that workers in the modern economy should develop deep expertise in at least one field (the vertical stroke of the "T") and a broad base of general skills applicable across areas (the horizontal stroke). Embracing a T-shaped skills model means combining specialist knowledge with competencies like creativity, communication, and teamwork that enable one to collaborate across disciplines. [Jahanian, 2020] Many universities and employers now encourage T-shaped development, reflecting the demand for employees who can apply their expertise in interdisciplinary teams and adapt to multiple roles. [Jahanian, 2020]

In AI-augmented workplaces, T-shaped individuals are particularly valuable: they might, for example, have deep technical ability in programming or data science, but also the broad soft skills to work with designers, business strategists, and clients. Such individuals can translate between the technical and the human, driving projects that require both domain depth and creative, communicative breadth. The "T" model aligns with the idea of multidisciplinary competencies, wherein innovation often arises at the intersection of fields – which is only possible if professionals have the communication skills and openness to collaborate beyond their narrow area. Organizations staffed by T-shaped teams are better equipped to innovate and respond to complex problems, since team members can bridge knowledge silos and share ideas effectively.

Emotional labor and service orientation

As introduced earlier, complementing the T-shaped model is the concept of emotional labor (Hochschild, 1983) which highlights the critical role of emotional and interpersonal skills in many professional contexts.

Emotional labor refers to jobs that require managing one's own emotions and influencing those of others as part of the work – for instance, a flight attendant calming anxious passengers or a nurse showing compassion to patients. In today's economy, emotional labor is not confined

to service roles; it is increasingly recognized in leadership, sales, client management, and even tech roles (think of a UX designer empathizing with users).

This framework reinforces why emotional intelligence is a highly valued skill: workers adept at emotional labor can provide the kind of personalized, empathetic service and relationship-building that distinguishes companies in the market. Importantly, such emotional and social tasks are exceedingly hard to automate – no AI has yet proven capable of genuinely understanding human emotions or building trust in the nuanced way humans can. Thus, jobs heavy in emotional labor (caregiving, counseling, teaching, hospitality, etc.) remain in high demand and are projected to grow as other routine tasks are automated away. [International Labour Organization, 2017] The emphasis on service orientation and social skills in frameworks like the OECD's core skills for employment and the WEF's skills lists reflects a broader trend: human contact jobs that require emotional engagement are set to become an even larger share of employment as they resist automation. In response, training programs worldwide are increasingly focusing on developing social-emotional skills alongside technical training, ensuring that future workers can fulfill the emotional labor component of their roles effectively.

Lifelong learning and adaptability

Finally, underpinning both the T-shaped model and the capacity for emotional labor is the imperative of lifelong learning. As skill requirements evolve rapidly with AI and other changes, workers must be prepared to continuously learn and update their skills – both technical and soft. Lifelong learning is often described as a mindset or meta-competency: it involves curiosity, the ability to learn how to learn, adaptability, and resilience in the face of change.

The WEF identifies «active learning and learning strategies» and «curiosity and lifelong learning» as essential skills for the 2023–2027 period. [World Economic Forum, 2023] Similarly, the ILO's core skills framework lists learning to learn as a core skill that enables workers to transition between roles and keep pace with new demands. [International Labour Organization, 2021] The reason lifelong learning is crucial is that it underpins skill breadth over a career: someone who continuously learns will pick up new technical abilities but also refine their creativity, communication, and leadership through experience. It complements the T-shaped concept by allowing the horizontal bar of the "T" to extend and adapt. For example, an engineer might need to learn design thinking (a creative skill) or cross-cultural communication when their role evolves or if they move into management.

In a labor market shaped by AI, learning agility becomes a prized trait, because job roles are less fixed – new hybrid roles emerge that demand a mix of domain knowledge and general skills. Governments and institutions are thus promoting lifelong learning initiatives, from mid-career training programs to online courses, to help workers continuously broaden their competencies. The outcome is a more resilient workforce where individuals have the general skills to navigate unpredictable career paths and to seize opportunities created by technological change, rather than being displaced by it.

In summary, these frameworks all converge on a common insight: breadth of human-centric skills enhances employability and complements specialization. A workforce of T-shaped, emotionally intelligent, continuously learning individuals is one that can thrive alongside AI – adapting to new roles, collaborating creatively, and providing the uniquely human touch that technology cannot. Such theoretical models are increasingly validated by labor market trends, as employers place greater emphasis on versatile skillsets over narrow qualifications.

Policymakers and educators are accordingly rethinking curricula and training to emphasize broad skills (critical thinking, communication, empathy, etc.) from early education through

adult learning (World Economic Forum, 2020; ILO, 2021). This ensures that future professionals are not only technically competent but also possess the creative, emotional, and interpersonal toolkit needed to innovate and lead in the future world of work.

3.2.5 Global sectoral examples: irreplaceable human skills across industries

The heightened demand for creativity, emotional intelligence, and communication is observable across a variety of sectors and roles worldwide. These examples illustrate how human-centric skills are already in high demand and often irreplaceable by AI in different contexts.

Starting with the healthcare sector, we can affirm that in health services, technical knowledge is vital, but so is bedside manner – the empathy and communication that health professionals provide to patients. Nurses, doctors, therapists, and caregivers must interpret patients' unspoken needs, provide psychological comfort, and collaborate with families.

While AI can assist with diagnostics or provide decision support in numerous ways, it cannot replicate the emotional support and ethical judgment required in caregiving. For instance, a global shortage of care workers is driving up demand for those who can combine medical skills with emotional intelligence to care for aging populations. (OECD, 2019) The COVID-19 pandemic further underscored the value of compassionate communication in healthcare, as medical staff had to counsel patients and coordinate in high-stress team environments. These roles rely on emotional labor that remains firmly in the human domain.

In a similar way, if we move the focus of the analysis to the education field, teachers and trainers around the world exemplify the importance of communication, empathy, and creativity. Effective teaching is not just the transmission of knowledge; it involves motivating students, customizing learning approaches, and inspiring curiosity – all enabled by emotional intelligence and creative pedagogical skills.

AI tutors and educational software exist, but human educators play an irreplaceable role in mentoring, social-emotional development, and adaptive learning. For example, a teacher uses creativity to adjust a lesson plan to an inattentive classroom, or uses emotional insight to counsel a troubled student – tasks beyond any automated system.

Internationally, educational reforms (such as Japan's and Finland's) emphasize developing teachers' 21st-century skills so they can foster critical thinking and creativity in students, recognizing that those student skills will be crucial in the future workplace. [World Economic Forum, 2020] Thus, education sectors globally both demand these soft skills in teachers and aim to impart them to the next generation.

In corporate environments across the globe, leadership and management roles similarly rely heavily on emotional intelligence and communication. Whether in finance hubs like New York, manufacturing centers in Germany, or tech ecosystems in India, successful managers must build trust, negotiate, understand diverse stakeholder needs, and lead teams through change. AI may provide data-driven insights for decision-making, but it is the human leaders who must interpret these insights within a broader context, make judgment calls, and rally people around strategic goals. The art of management in fact often lies in social influence, conflict resolution, and cultural awareness, particularly in multinational companies operating across diverse regions. Global companies frequently cite leadership and people skills as critical gaps in their talent pools, indicating high demand for those who can combine technical know-how with the "soft" skills to lead effectively. [World Economic Forum, 2023]

A pertinent example is the technology sector: while technical expertise is abundant, companies like Google and Alibaba have noted that their successful project managers and executives are

distinguished by strengths in creativity (vision for innovation), communication (to articulate that vision), and empathy (to manage teams and user-centric design). These qualities create value that purely AI-driven analysis cannot – for instance, setting a creative product strategy or resolving a team morale problem requires human insight.

Creative sectors such as media, advertising, design, and entertainment offer even more vivid illustrations of these dynamics. Here, AI tools (from algorithmic video editing to data analytics for market trends) are augmenting human work but not replacing the core creative process. A graphic designer, for example, may use an AI tool for generating design variants, but human creativity decides the artistic direction and ensures the output resonates emotionally with the target audience. Similarly, marketers increasingly use AI to segment customers or optimize ad placements, yet crafting a compelling campaign narrative or a brand story relies on creative human insight into culture and psychology. All these roles also require high communication skills – e.g., a creative director must pitch ideas to clients and collaborate with diverse creative teams. Globally, we see that the most successful creative products combine technology with human storytelling and design thinking, showing how in creative sectors, AI is a powerful tool, but human creativity and communication are the driving forces that determine success, and talent with those skills is in great demand.

The importance of human interaction is equally apparent in customer service and client-facing roles across hospitality, retail, consulting, and professional services. Many companies have introduced AI chatbots and self-service kiosks for simple transactions, but for complex or high-stakes interactions, human representatives remain crucial. A travel customer with an urgent problem, or a business client with a unique request, often needs to interact with a person who can truly listen, empathize, and provide nuanced solutions.

Around the globe, firms are differentiating themselves by the quality of their customer service, investing in training employees' soft skills even as routine service tasks are automated. For example, luxury hotel chains in the Middle East pride themselves on personalized guest experiences delivered by staff – no robot concierge can (yet) replicate the charm and cultural sensitivity of a well-trained human concierge.

In professional services and consulting, maintaining client relationships and trust is paramount; consultants must communicate complex insights clearly and build rapport, roles for which top firms highly value emotional intelligence. These sectors demonstrate that human interaction itself is a premium service – often the very product customers are paying for – and thus the demand for skilled communicators and emotionally intelligent staff remains high despite (and partly due to) advances in AI.

Across these examples, a unifying theme is that human-centric skills enhance outcomes that technology alone cannot achieve. Whether it is caring for a patient, inspiring a student, leading a project, creating an advertisement, or satisfying a customer, the tasks involve a blend of knowledge, human touch, and context-sensitivity. In many cases, AI automation of technical sub-tasks (e.g. medical image analysis, student grading, data crunching, customer FAQs) increases the demand for workers who possess the soft skills to use those AI outputs effectively and to focus on the interpersonal or creative aspects of the job. This complementary relationship is evident in what economists call "hybrid" jobs – new roles that combine technical and social expertise.

For instance, the role of a data translator has emerged in business – someone who can understand advanced analytics (often produced by AI) and communicate the implications to non-technical executives to inform strategy. Such roles are proliferating in finance, healthcare, and government, and they heavily favor those with strong communication and domain-specific knowledge. Globally, the fastest-growing job areas (e.g. care economy jobs, tech-adjacent

roles, creative digital content) consistently emphasize a mix of technical and general skills, confirming that workers who excel in creativity, emotional intelligence, and communication will remain in high demand. They are the ones able to fill the new niches created by technological change – the innovators, the connectors, and the human bridges between AI and societal needs.

3.3 The value of human skills in the AI era

As Artificial Intelligence permeates the workplace, certain uniquely human skills have retained – and even increased – their importance. Advanced AI can automate routine tasks and process data at scale, but it does not easily replicate qualities such as empathy, ethical judgment, critical thinking, strategic decision-making, or complex interpersonal communication. These core human capabilities remain essential in domains that involve nuanced understanding, human interaction, leadership, conflict resolution, and the cultivation of organizational culture.

This section explores the enduring value of these human skills in the AI era, analyzing why they are indispensable and how they complement technology in practice.

3.3.1 Empathy, emotional intelligence, and interpersonal communication

As previously discussed, empathy and socio-emotional intelligence represent key human capabilities that current AI systems are unable to fully replicate. Emotional intelligence frameworks (e.g. Goleman’s model) identify empathy and social skills as foundational to effective human interaction and leadership, enabling understanding of others’ feelings and effective communication of support. While artificial agents may simulate empathic behavior through sophisticated language modeling, they fundamentally lack genuine emotional awareness. At best, they imitate empathy; they do not actually feel or comprehend emotions in the way humans do. This limitation becomes particularly evident in fields like psychotherapy, where emotional authenticity is essential. Research underscores that AI systems «lack genuine empathy and the ability to form deep emotional connections with patients», whereas human therapists draw on their own emotional understanding to build trust and rapport. [Zhang and Wang, 2024] This authentic empathy is fundamental to counseling and care relationships, allowing therapists to read subtle cues, respond with compassion, and tailor support to a patient’s evolving emotional state. These deeply human processes — central to effective counseling and care — have no true equivalent in algorithmic systems, reinforcing the irreplaceable value of authentic empathy in human-centered professions.

This limitation of AI becomes even more apparent when considering real-world contexts where authentic emotional connection is essential. The healthcare sector, for instance, vividly illustrates the irreplaceable nature of human empathy. AI can assist with diagnostics and treatment recommendations, but it cannot console a frightened patient or provide compassionate bedside presence. As bioethicist Jodi Halpern observes, empathy in medical encounters «cannot be replicated by a machine (...) The healing relationship is rooted in human emotion and connection». [Matkowski, 2025] Clinical outcomes often improve when providers show empathy – studies link compassionate care to higher patient satisfaction, better adherence to treatment, and improved recovery. These benefits stem from patients feeling heard and understood, a dynamic that requires the caregiver’s emotional attunement. No matter how adept an AI is at scanning medical images or monitoring vital signs, it will miss the human context: the

tremor in a patient’s voice, the anxiety in their eyes, or the relief after receiving comforting words. Indeed, AI may simulate empathy through pre-programmed responses, but experienced clinicians and scholars caution that such simulations lack the authenticity needed to foster trust. [Matkowski, 2025]

As already briefly explained, a similar dynamic plays out in education in education. Teachers do far more than convey information – they inspire, mentor, and respond to the emotional needs of students. An automated tutoring system cannot encourage a struggling student with genuine concern or adapt its approach based on a student’s unspoken frustrations. As one analysis notes, AI tutors «cannot empathize, inspire, or encourage students in the critical ways» that human teachers can. [Boser, 2024] Detecting a student’s confusion, celebrating their enthusiasm, or offering encouragement during setbacks are all core to effective teaching — and all remain beyond the capabilities of automated systems.

These interpersonal and empathetic skills are equally indispensable in domains such as conflict resolution and customer service. In negotiation or mediation, a nuanced understanding of each party’s emotions and perspectives is required to reach a resolution that all sides accept. Human mediators read tone, body language, and cultural context – skills that have been honed through social experience and are grounded in empathy and ethical judgment. A similar dynamic applies to frontline customer service, where "emotional labor", i.e. the regulation and expression of appropriate emotions (patience, friendliness, concern) is essential to creating a positive client experience. While AI chatbots handle many simple queries, companies find that communication and empathy remain crucial, particularly in customer service roles where AI supports but cannot replace human interaction. [Business at OECD (BIAC), 2024] Human agents can sense a customer’s irritation or confusion and adapt their approach in real time, exhibiting genuine concern that builds the company’s reputation.

In fact, firms increasingly view empathy and emotional intelligence as brand-differentiating skills: even in an AI-driven workplace, soft skills like empathy and emotional intelligence help differentiate their brand in a competitive marketplace. [Business at OECD (BIAC), 2024] Even in environments where AI supports service delivery, the human capacity to connect meaningfully with clients remains a decisive competitive advantage. This reflects insights from emotional labor theory, which emphasizes that the ability to manage and express emotion in service interactions is itself a valuable skill — one that AI cannot authentically replicate. Unlike machines, human workers draw on lived emotional experience to respond appropriately to unpredictable, emotionally charged, or culturally sensitive situations. Therefore, whether in healthcare, education, hospitality, diplomacy, or customer service, the uniquely human capacity for empathy and interpersonal communication continues to be a vital and irreplaceable asset.

3.3.2 Ethical judgment, critical thinking, and moral reasoning

Alongside emotional skills, the capacity for ethical judgment and critical thinking represents another uniquely human strength that AI has not — and perhaps cannot — replicate. Complex moral decisions often demand consideration of context, values, and long-term consequences, in ways that far exceed the bounds of algorithmic optimization. Artificial Intelligence can be trained on large datasets to make predictions or classifications, but it does not possess an innate moral compass or the ability to reason through ethical dilemmas. Human beings, by contrast, rely on cultural norms, empathy, and principled reasoning to navigate ethically fraught scenarios.

In fields like law, justice, and public policy, this distinction becomes clear. AI may assist legal professionals by retrieving precedents or predicting sentencing trends, but it cannot engage

with the deeper ethical dimensions of a case. As one legal scholar notes, ethical judgment requires wrestling with ambiguity, considering empathy, and reflecting on historical and societal contexts — not simply applying precedent. [Matkowski, 2025] For example, a judge or policy-maker considers not just the letter of the law or statistical likelihoods, but also questions of fairness, mercy, and societal impact – dimensions that require human conscience and insight. As Judge Learned Hand famously remarked, «the spirit of liberty is the spirit which is not too sure that it is right», reflecting the humility and open-minded understanding of others' perspectives that human decision-makers bring to the table. [Matkowski, 2025] Such a spirit no machine can conjure; AI operates on predefined criteria and cannot truly question its own certainty in the way a reflective human can.

Closely tied to ethical reasoning is the role of critical thinking, particularly in contexts where AI may produce flawed or biased outputs. Since AI models are trained on historical data, they can inadvertently replicate and amplify existing social biases. Without human oversight, these systems can amplify unfairness. For example, algorithmic bias in hiring or criminal justice risk assessments has been well documented. [Pazzanese, 2020] Here, human professionals play an indispensable role in scrutinizing AI recommendations, identifying potential biases, and applying normative standards to ensure fairness and accountability.

In practice, organizations have learned that human judgment is indispensable in high-stakes decisions. A Harvard study on AI in industry underscores this: while algorithms bring efficiency, experts argue that «certain elements of human judgment [are] indispensable in deciding some of the most important things in life». [Pazzanese, 2020] Philosopher Michael Sandel similarly warns that the deepest ethical question posed by AI is what role human judgment should play as machines become more capable. [Pazzanese, 2020] His reflection underscores a growing consensus: as AI becomes more capable, the role of human moral reasoning becomes not less but more important. Ensuring that humans remain "in the loop" is thus not just a technical safeguard, but a moral imperative, grounded in our uniquely human ability to reflect, empathize, and judge with conscience.

Consider the example of diplomacy and international relations. Diplomatic negotiations involve historical grievances, cultural sensitivities, and ethical choices that defy purely rational calculation. An AI might analyze data on economic trade-offs or propose game-theoretic strategies, but it cannot internalize the historical memory of a conflict or the symbolic significance of a gesture of goodwill. Human diplomats rely on empathy (understanding the other side's fears and aspirations), ethical reasoning (what is a fair outcome?), and creative problem-solving to reach agreements. These are not straightforward optimizations, they involve trust-building and often moral courage. AI's limitations here echo its limits in other domains requiring moral imagination and contextual awareness.

In sum, the limitations of AI in replicating ethical judgment and critical thinking are evident. Intelligent systems do not truly understand concepts like justice, responsibility, or empathy; they cannot be held accountable in the way humans can. Frameworks like human-centered design and AI ethics guidelines therefore insist on maintaining human oversight for decisions impacting human lives. The goal is not to have AI replace moral decision-makers, but to augment them – providing data and analysis while humans apply ethical frameworks and critical scrutiny. This ensures that decisions remain aligned with human values and societal norms, rather than being blindly entrusted to algorithmic outputs.

3.3.3 Strategic decision-making and leadership in the AI era

Strategic decision-making – the ability to set vision, make judgment calls under uncertainty, and inspire collective action – is another domain where human skills retain primacy.

AI systems excel at analyzing well-defined problems with clear objectives, especially when abundant data is available. However, strategy often deals with ambiguity, incomplete information, and competing priorities that require human intuition and experience. Leaders must interpret not only quantitative trends but also qualitative factors like employee morale, brand reputation, and geopolitical shifts. These broader contextual insights and the creativity to formulate new strategies are rooted in human cognition and cannot be fully automated.

In fact, the introduction of AI into corporate leadership contexts is not replacing the strategic function, but rather reshaping it. Routine operational decisions (like optimizing logistics or parsing performance metrics) can increasingly be delegated to AI, giving executives «the most valuable resource of all: time». [Stratton, 2025] With mundane tasks automated, effective leaders are dedicating more effort to big-picture thinking, long-term strategy, and mentorship of their teams. According to a World Economic Forum report, AI adoption is shifting leadership priorities «toward strategic decision-making and the upskilling or reskilling of employees to work alongside AI». [Stratton, 2025]

Rather than managing minutiae, managers are called to guide vision and foster the human talents that technology cannot supply. Strategic thinking involves synthesizing diverse inputs (market trends, ethical considerations, stakeholder interests) and making judgment calls that often have no single correct answer. Human leaders draw on tacit knowledge, creativity, and sometimes gut instinct honed by experience; all qualities outside the scope of algorithmic processing.

Moreover, the role of leadership goes beyond analysis into inspiration and influence, aspects tied to emotional intelligence. Great leaders are those who motivate and unite people around a common purpose. This relies on empathy, communication, and authenticity.

Emerging leadership models, in fact, emphasize the role of soft skills: a recent World Economic Forum piece argues that to be future-ready, leaders must be authentic and embrace soft skills, with particular emphasis on empathy and creativity. [Rajah and Schindler, 2024]

As a consequence, leaders need to integrate AI's capabilities with «human intelligence (HI), particularly emphasizing human empathy and creativity», in order to transcend a purely data-driven approach and craft innovative, empathetic solutions to new challenges. [Rajah and Schindler, 2024] For example, during a crisis, employees look to leaders for reassurance and ethical guidance – an AI that crunches numbers cannot provide the moral leadership or personal encouragement that humans expect from those at the helm.

Leadership theories in organizational psychology also reinforce the importance of these human-centric skills. Transformational leadership theory highlights individualized consideration (showing empathy and support for each follower's needs) and inspirational motivation (articulating a vision that resonates emotionally) as key components of effective leadership. These behaviors require a leader's human touch and emotional resonance. In a similar way, authentic leadership and servant leadership frameworks stress the importance of qualities like empathy, ethical integrity, and the leader's self-awareness and relational transparency. AI cannot replicate authenticity or moral integrity: it cannot choose to act selflessly or uphold ethical principles in the face of adversity. Those remain human responsibilities.

In practical terms, we see the enduring need for human strategic and social skills in various settings. In diplomacy, experienced diplomats combine strategic acumen with deep cultural understanding and personal rapport to prevent conflict or forge alliances; clearly, no AI can yet

navigate the subtleties of international protocol or the emotional weight of historical enmities. In business, instead, entrepreneurs rely on creative vision and risk-taking instincts to create new products or enter new markets, areas where data from the past may not correctly predict the future, and thus human imagination and leadership are pivotal.

Even in military strategy, AI-assisted simulations and intelligence can inform options, but commanders make the final calls, weighing intangible factors like troop morale or the will of the populace. As one Harvard analysis noted, jobs that center on human interaction, empathy, and applying judgment to machine outputs are likely to remain resilient in the age of AI. [Pazzanese, 2020]

The human ability to contextualize and take responsibility for strategic decisions is a safeguard against overreliance on AI. Thus, strategic decision-making and leadership roles continue to prize skills like critical thinking, creativity, ethical judgment, and interpersonal influence, all domains where humans still outperform algorithms.

3.3.4 The limitations of AI and the need for human oversight: case examples

To illustrate the above points, it is useful to examine concrete examples across different sectors where AI's limitations become evident and human skills prove indispensable.

As made in the previous section, we can start the analysis with the study of the healthcare and counseling sector. As discussed, AI diagnostic tools and virtual agents are increasingly used in medicine and mental health. However, real cases show that while an AI chatbot might answer patient questions with formal correctness, it lacks the genuine empathy of a human caregiver. One recent study even found patients rating AI-generated responses as more empathetic in wording than those from busy clinicians, but experts caution this perceived empathy is surface-level and cannot replace the trust built through a human provider's continued care. [Matkowski, 2025] [Akingbola et al., 2024]

In mental health counseling, instead, experimental AI therapists can simulate active listening (e.g., "I'm sorry you're feeling that way"), yet therapists note that patients eventually discern the lack of true human understanding, especially in complex emotional crises. Zhang and Wang (2024) in *Frontiers in Psychiatry* conclude that AI lacks genuine emotional connection capabilities and thus cannot fully replace human psychotherapists. [Zhang and Wang, 2024]

Taken together, these cases reaffirm that in domains involving sensitive health and emotional care, the irreplaceability of human empathy, ethical discernment, and authentic interpersonal communication remains evident. AI may assist, but the core therapeutic relationship continues to depend on the human capacity for understanding and connection.

A similar dynamic is observed in field of education, where adaptive learning software and AI tutors can personalize drills or content delivery, but human teachers provide mentorship, moral guidance, and inspiration in ways that technology cannot replicate. For example, during the COVID-19 pandemic, many schools introduced AI teaching assistants; yet both parents and students reported that motivational support and classroom engagement significantly declined in the absence of in-person educators. A Forbes analysis points in fact out that AI tools «currently cannot empathize, inspire, or encourage students» the way good teachers do. [Boser, 2024]

Moreover, complex student issues – a child dealing with grief, or conflicts affecting classroom dynamics – require the teacher's emotional intelligence, ethical judgment, and ability to respond sensitively to the social environment. These nuances illustrate why education experts emphasize AI will serve as an augmentative tool rather than a substitute: the teacher's role as a coach and role model taps into emotional and social skill sets that remain uniquely human.

[Spencer, 2024]

Just as education highlights the limits of AI in delivering inspiration, empathy, and nuanced guidance, similar boundaries emerge in the legal and justice sectors. Algorithmic decision tools are now increasingly employed for tasks like predicting recidivism or automating parts of legal research. However, courts have faced controversies when such tools produced biased outcomes, such as higher risk scores for minority defendants due to biased training data. In these instances, human judges and lawyers must step in to apply critical thinking and ensure fairness. A significant example arose in the U.S. with the COMPAS algorithm for criminal sentencing: it was found to disproportionately flag Black defendants as higher risk than whites, an outcome requiring human-led policy correction and ethical scrutiny.

Legal scholars argue that human conscience is crucial in justice – as one commentary noted, an AI might appear unbiased but it is also unfeeling, unable to consider merciful exceptions or the unique story behind each case. [Matkowski, 2025] For this reason, many jurisdictions now require human oversight of AI-driven legal recommendations and insist that final decisions remain in the hands of judges who can integrate legal principles with empathy and societal values.

The domain of business management and customer relations further illustrates how, even as AI enhances efficiency, it cannot substitute for the relational and interpretive strengths of human workers. Companies have in fact deployed AI for resume screening, performance evaluations, and even AI-driven management advice. While these tools can improve efficiency, they lack the human element needed to effectively manage people. For instance, an AI might identify performance issues through analytics, but delivering that feedback in a constructive, motivating manner is a task for human managers. Real-world case studies show that when AI is used to monitor employees (e.g., in warehouses or call centers), it can lead to resentment and stress unless tempered by empathetic human management.

In addition, as James Bessen and other economists note, AI tends to transform tasks rather than wholly eliminate jobs, often shifting the human role toward higher-value relational work. [Olayinka, 2025]

An ILO review echoes this, finding that as AI takes over routine elements of jobs, the remaining responsibilities increasingly demand interpersonal skills and complex decision-making. [Olayinka, 2025] In customer-facing roles, for instance, companies like TELUS have adopted a "human-in-the-loop" approach: AI handles routine inquiries so that human representatives can focus on creative problem-solving and emotionally demanding customer interactions. [Business at OECD (BIAC), 2024] This strategy recognizes that a satisfied customer often results from a human employee's understanding and empathy, supported (but not supplanted) by AI efficiency.

Finally, the realm of diplomacy and conflict resolution further reinforces the limitations of algorithmic decision-making in contexts that demand deep interpersonal insight and ethical sensitivity. While not as technologically saturated as other fields, diplomacy is experimenting with AI for data analysis (e.g., sentiment mining on social media to gauge public opinion). Yet, high-level negotiations – say, peace talks or climate agreements – hinge on trust built through personal relationships and cultural intelligence. A historical case often cited is the Cuban Missile Crisis, where nuanced understanding between leaders (and empathic imagination of the adversary's perspective) helped avert nuclear war. It's hard to imagine an AI negotiating such a crisis without human guidance, as the decision-makers had to interpret each other's intentions in a context of extreme ambiguity and high stakes. Diplomats also engage in back-channel communications and read between the lines of statements – tasks requiring theory of mind and emotional savvy. These examples underscore that in scenarios involving human conflict or co-

operation, purely algorithmic approaches fall short; human judgment and empathy are needed to navigate gray areas and uphold ethical norms.

Continuing from the example of diplomacy and conflict resolution — where trust, empathy, and cultural nuance are essential — it becomes clear that these human strengths are not unique to geopolitics, but present across all high-stakes, socially complex fields. From counseling and education to justice, management, and customer service, each domain demonstrates the same fundamental truth: AI may enhance efficiency and decision-making in structured, data-heavy environments, but it cannot replace the depth of human interaction, ethical reasoning, or emotional attunement.

Through these case studies, a pattern emerges: AI performs admirably in structured, data-rich portions of tasks, but struggles with the unstructured, human-centric aspects. Whenever a situation requires understanding subjective human experiences, applying moral principles, or communicating meaningfully person-to-person, human skills prove critical. Recognizing this, organizations are increasingly delineating tasks in a way that lets AI do what it does best (data processing, pattern recognition) while reserving for humans what they do best (care, creativity, judgment, influence). This complementary model leverages technology's strengths without losing the irreplaceable value of human abilities, ensuring that progress in automation enhances, rather than undermines, the uniquely human dimensions of work.

3.3.5 Human skills in hybrid human–AI collaboration

Far from making human soft skills obsolete, the rise of AI is heightening the demand for those very capabilities. In a hybrid human–AI workplace, people are needed to supervise algorithms, provide context, and ensure ethical outcomes. Indeed, numerous surveys and studies indicate that uniquely human skills are becoming more valuable as automation advances. For example, a 2025 Workday survey reported by the World Economic Forum found that 83% of employees believe AI will make uniquely human skills even more critical, and 76% of workers «crave more human connection as AI usage grows». [Stratton, 2025] Rather than a future of work devoid of human contact, these findings suggest a counter-trend: as workers collaborate with AI tools, they place greater premium on empathy, communication, and human interaction to fill the void left by machine-driven processes.

Global labor market analyses reinforce this shift, highlighting a growing emphasis on human-centric skills in the age of AI. The World Economic Forum's Future of Jobs Report 2023 identifies several social and cognitive skills among the top competencies for the workforce. Notably, the report includes empathy and active listening as well as leadership and social influence among the top ten core skills, alongside analytical thinking and creativity. [World Economic Forum, 2023] This reflects a broadening consensus that the ability to work effectively with others — through coordination, empathy, and persuasion — is becoming a defining feature of future employment.

Similarly, an OECD Employment Outlook study finds that in firms adopting AI, the share of tasks requiring soft skills and interpersonal skills increases as routine tasks are automated. [Organisation for Economic Co-operation and Development, 2023] In other words, automation tends to offload the simpler, more repetitive elements of work to machines, while leaving humans responsible for more complex, judgment-intensive tasks that require critical thinking and collaboration. [Organisation for Economic Co-operation and Development, 2023] As the OECD points out, these transversal skills — such as communication, teamwork, and problem-solving — remain difficult to replicate with automation technologies. [Organisation for Economic Co-operation and Development, 2023] Therefore, the comparative advantage of human workers

increasingly lies in precisely these areas, reinforcing the value of soft skills in the evolving labor market.

Building on this growing recognition of the human advantage in social and cognitive domains, organizations are increasingly recalibrating training and role design to foster effective human–AI collaboration. Rather than pursuing full automation, many firms are embracing the concept of "augmented intelligence" – the idea that AI should amplify human capabilities, not replace them. This shift acknowledges that while machines excel at processing large volumes of data or performing repetitive tasks, humans remain indispensable for interpretation, ethical reasoning, and interpersonal communication.

In practice, this collaborative model is transforming job roles across industries. For instance, in finance, AI might generate analytics on investment options, but financial advisors use their judgment and understanding of a client's unique goals to make recommendations. In a hybrid model, the advisor's interpersonal skill in explaining risks and calming client anxieties is as important as ever.

A report by Business at OECD (the business advisory arm to the OECD) underscores this point, noting that effective AI adoption «requires more than technical skills – it demands interdisciplinary expertise, soft skills like creativity and empathy, and a commitment to responsible AI practices». [Business at OECD (BIAC), 2024] This perspective aligns closely with human-centered design principles, which advocate designing technology and work processes around human needs and values. Keeping humans "in the loop" not only guards against AI failures or ethical lapses, it also allows organizations to capture the complementary strengths of humans and machines. AI might provide the data breadth, but humans provide the depth of understanding.

This emphasis on human strengths — such as empathy, judgment, and communication — naturally leads to a deeper appreciation of the role human oversight plays in ensuring responsible and effective use of AI. As organizations increasingly adopt AI in support roles, they are also recognizing the indispensable function of human supervision, particularly in high-stakes environments. Crucially, human oversight acts as a safeguard against AI's limitations. In domains like healthcare, aviation, and content moderation, human supervisors are tasked with monitoring AI outputs, detecting potential errors, and stepping in when algorithms face unfamiliar scenarios or cross ethical boundaries. This supervisory function is not passive; it requires constant vigilance, critical thinking, and a strong sense of accountability — traits that stem from human conscientiousness and professional training.

The International Labour Organization and other international bodies have called for a focus on "complementarity" between AI and workers, noting that AI can take over routine tasks and thereby «enable workers to focus on higher-value activities». [Olayinka, 2025] Those higher-value activities typically involve creativity, problem-solving, and human contact – for example, an engineer spends less time on data entry and more on innovative design, or a nurse spends less time charting and more at the bedside with patients.

Ultimately, the growing integration of AI in the workplace doesn't diminish the role of humans, it refocuses it. A senior adviser in the Harvard *Managing the Future of Work* project observed that jobs requiring «human interaction, empathy, [and] applying judgment to what the machine is creating» will be especially robust in the future. [Pazzanese, 2020] These roles are not about competing with AI, but about amplifying human contributions by contextualizing, validating, and ethically steering the outputs AI provides.

Building on this understanding of human–AI complementarity, the realm of leadership and organizational culture further illustrates how irreplaceable human attributes remain at the core of successful AI integration. As AI becomes embedded in workflows, the hybrid era has un-

derscored the value of leaders who can not only navigate technological change, but do so with emotional intelligence and ethical clarity.

Authentic communication, empathy for employees facing new AI tools, and ethical judgment in deploying AI are now seen as key leadership competencies. The World Economic Forum highlights the need for "human-centric leadership" that empowers employees and fosters a culture of trust alongside AI integration. [Stratton, 2025] Leaders are encouraged to develop unique human skills like empathy, creativity and ethical decision-making to complement AI's capabilities. [Stratton, 2025] This ensures that workplace culture remains humane and inclusive, even as algorithms play a bigger role in daily operations.

Furthermore, as AI systems generate increasing volumes of content — including potentially misleading information or deepfakes — critical thinking and media literacy have become crucial workforce competencies. These human skills act as a safeguard against the manipulation or misuse of AI, ensuring that organizations remain anchored in truth, accountability, and ethical standards. [Business at OECD (BIAC), 2024] Together, these developments reinforce a broader conclusion: as AI transforms the operational landscape, it is the human qualities of leadership, empathy, and judgment that will guide organizations toward responsible and sustainable integration.

This imperative to strengthen human-centric capabilities ties directly to the broader transformation of work in the AI era. As previously discussed, the integration of AI into workplaces places a premium on distinctly human skills — such as creativity, ethical reasoning, emotional intelligence, and communication — which machines cannot replicate. The call for "21st century skills" is thus not simply about reacting to automation, but about proactively preparing individuals to thrive in hybrid environments where human insight complements machine efficiency.

Recognizing this, major international bodies have aligned in their advocacy for educational reform. The World Economic Forum's Reskilling Revolution champions a future-ready curriculum that prioritizes creativity, emotional intelligence, and leadership as core components of employability. Likewise, the OECD's Future of Education and Skills 2030 framework emphasizes that students must develop social and emotional skills in tandem with cognitive ones to navigate an AI-enhanced, dynamic labor market. [Organisation for Economic Co-operation and Development, 2019a] The rationale is consistent: human qualities such as empathy enable user-centered design, ethical judgment ensures responsible AI use, and collaborative teamwork is essential in interdisciplinary, tech-enabled teams.

In addition, lifelong learning is positioned as a foundational competency — supporting workers in continuously upgrading both their digital fluency and their soft skills. This dual investment ensures not only technical adaptability but also the human agility to apply those tools meaningfully, ethically, and creatively in evolving contexts. Therefore, training systems must go beyond coding and data analysis; they must also cultivate the very traits that will keep the human workforce relevant and resilient in the age of AI.

This concluding reflection integrates seamlessly with the preceding analyses, reinforcing a central theme that has emerged throughout the chapter: while AI is transforming work at a rapid pace, the distinctly human capacities of empathy, ethical reasoning, critical thinking, and creativity are not only resilient to automation, they are increasingly essential. Across sectors and job roles, from healthcare and education to law, business, and diplomacy, we have seen that human skills remain crucial where nuance, trust, and judgment are involved.

The chapter has demonstrated that AI performs best in structured, rule-based environments, whereas human intelligence shines in ambiguity, interpersonal contexts, and morally complex

scenarios. This complementarity has fueled a growing shift toward hybrid human–AI collaboration models. The examples provided — from doctors leveraging AI diagnostics to teachers using smart tutoring systems, and from managers balancing analytics with emotional leadership to diplomats navigating crises — underscore that human soft skills do not diminish in the presence of AI; they grow in importance.

In this light, the analysis presented aligns perfectly: rather than displacing human skills, AI heightens their relevance. It also highlights the role of policy, education, and corporate strategy in nurturing these capabilities. The endorsements from the ILO, OECD, and WEF — coupled with practices adopted by forward-thinking companies — confirm that the future of work belongs to those who can combine technical fluency with deeply human strengths.

Thus, this chapter concludes by reaffirming a hopeful yet grounded vision: a future of work that is not simply automated, but augmented — powered by machines, yet led by people. In this model, the most valuable workers will be those who can work alongside intelligent systems with empathy, creativity, and ethical discernment, ensuring that the AI age remains not only efficient, but also humane.

Chapter 4

Sectors where the shift is already occurring

4.1 Technological and industrial sectors

AI-driven transformation is rapidly reshaping technological and industrial sectors across the globe. Industries such as manufacturing, engineering, robotics, energy, logistics, and infrastructure have been among the earliest adopters, using AI to drive automation, optimize operations, and enhance productivity. For instance, as of 2023 about 35% of manufacturing firms globally were using AI (mainly for predictive maintenance and quality control) and over 60% of major automotive manufacturers had implemented AI in their operations. [All About AI, 2025]

These developments are central to what is commonly referred to as the "Fourth Industrial Revolution" or Industry 4.0: an era defined by smart factories, interconnected systems (the Internet of Things), and AI-powered decision-making. The operational impact has been significant: manufacturers report up to 50% reductions in production time after deploying AI solutions [All About AI, 2025], and companies like General Electric have cut unplanned downtime by 10–20% using AI-based analytics. [All About AI, 2025]

This section explores how AI is transforming core industrial domains — from factory floors and logistics centers to energy grids and transportation networks — and considers the broader implications of these changes for workers and organizational structures within these sectors.

4.1.1 AI in manufacturing and engineering: automation, robotics and smart factories

Manufacturing has emerged as a leading sector in AI integration, where industrial automation and robotics powered by intelligent algorithms are streamlining production processes. By 2023, the global stock of industrial robots surpassed 4 million units operating in factories, marking a historic peak and signaling the rapid automation of assembly lines and routine operations. [International Federation of Robotics, 2024] These robots are increasingly sophisticated: equipped with computer vision and Machine Learning, they can now perform complex tasks such as precision assembly, welding, and quality inspection with minimal human oversight.

A notable advancement is the rise of collaborative robots (cobots), which are designed to work safely alongside human workers. Guided by AI, cobots can assume repetitive, hazardous, or ergonomically strenuous tasks, allowing human operators to concentrate on supervision and higher-skill responsibilities. The growing deployment of such technologies highlights AI's

pivotal role in enhancing productivity in manufacturing environments. However, it also raises concerns about job displacement — global projections suggest that up to 20 million manufacturing jobs, particularly those involving routine manual labor, could be displaced by robotics and automation by 2030. [Hanspal, 2020]

At the same time, AI is driving substantial performance gains. For instance, predictive maintenance powered by AI enables factories to anticipate equipment failures before they occur. According to Deloitte, this capability can reduce unplanned machine downtime by 30–50% and lower maintenance costs by 10–40%. [Number Analytics, 2025] Such improvements represent a shift from reactive repair models to proactive asset management, significantly boosting operational efficiency and cost-effectiveness in modern manufacturing systems.

Building on these advances, smart factory initiatives exemplify the convergence of AI, robotics, and the Internet of Things (IoT) in manufacturing environments. In these settings, sensors embedded in production equipment generate real-time data streams that are analyzed by AI systems to continuously optimize workflows and respond dynamically to operational variability. One widely adopted application is AI-driven quality control, where computer vision systems inspect products for defects at a speed and accuracy far exceeding human capabilities. This not only ensures consistent quality but also significantly reduces material waste.

Another transformative use case is digital twin technology — virtual replicas of physical production systems or products, enhanced by AI. Companies like Ford have implemented digital twins for their assembly lines, creating virtual models of vehicle production processes and equipment. [Appinventiv, 2023] These models mirror real-time operations and can flag inefficiencies or predict part failures before they occur. In Ford's case, digital twins were instrumental in identifying energy losses and optimizing energy consumption, thereby improving both sustainability and production throughput. [Appinventiv, 2023]

More broadly, AI-powered digital twins allow engineers to run scenario simulations or "what-if" analyses in a risk-free virtual environment. This enables optimization of factory layouts, maintenance scheduling, and workflow redesign — contributing to process efficiency, reduced downtime, and overall cost savings. [Kitameraki, 2023] Together, these smart factory technologies represent the next stage of industrial automation, where AI not only executes tasks but orchestrates entire systems for resilience and responsiveness.

AI is also driving major transformations in engineering and design within industrial production. In product engineering, generative design software leverages AI algorithms to autonomously create optimized component and product designs based on specific performance requirements. Engineers can input constraints — such as desired weight, strength, or material properties — and the AI system rapidly generates and evaluates thousands of design permutations, uncovering innovative solutions that human designers might not have envisioned. This capability leads to lighter, stronger parts and accelerates the design cycle, offering a significant competitive advantage in high-stakes sectors like aerospace and automotive.

For example, NVIDIA employs Machine Learning to analyze chip design data and predict potential failures in early semiconductor prototypes, allowing engineers to refine designs well before fabrication. [Appinventiv, 2023] Such predictive capabilities enhance R&D efficiency and reduce costly late-stage errors, ultimately shortening time-to-market.

Taken together, these applications — predictive maintenance, robotic automation, AI-based quality inspection, digital twins, and generative design — are converging to create fully integrated smart factories. These facilities are far more efficient, flexible, and data-driven than traditional production models. Importantly, these technological shifts are not only reshaping production processes but also transforming the nature of work in manufacturing and engineering — an evolution with significant implications for the industrial workforce, which will be

explored in the following sections.

4.1.2 AI in logistics and supply chain management

Beyond the factory floor, AI is revolutionizing logistics and supply chain management, key pillars of industrial operations. Global supply chains are increasingly complex, involving fluctuating demand, multiple distribution channels, and real-time transportation challenges. AI tools now help companies navigate this complexity by analyzing vast datasets related to demand patterns, inventory levels, and shipping logistics in real time.

AI-enabled supply chain systems facilitate more accurate demand forecasting, dynamic shipment routing, and intelligent inventory control. A McKinsey study found that early adopters of AI in supply chains achieved notable performance gains – improving logistics costs by about 15%, reducing inventory levels by 35%, and boosting service levels (on-time delivery rates) by 65% relative to competitors. [Alicke et al., 2021] These efficiency gains translate into significant cost reductions and improved customer satisfaction.

Major companies illustrate these benefits. For instance, Walmart uses Machine Learning algorithms to forecast sales trends and adjust inventory levels accordingly, minimizing both stock-outs and excess inventory while optimizing delivery routes for faster fulfillment. [Appinventiv, 2023] Similarly, Procter & Gamble (P&G) has implemented AI and IoT technologies to automate its warehouse and distribution networks. Managing approximately 7,000 SKUs, P&G's system operates with minimal human input and has helped the company cut annual supply chain costs by an estimated \$1 billion. [Leonard, 2020]

These real-world applications demonstrate AI's ability to streamline supply chains end-to-end — from demand planning to last-mile delivery. By uncovering inefficiencies (such as idle trucking capacity or excessive safety stock) and enabling more responsive, data-driven decisions, AI systems are making supply chains leaner, faster, and more adaptable to changing market conditions.

In parallel with supply chain optimization, AI is also driving automation in warehouses and transportation, reshaping the physical logistics infrastructure. Warehousing operations are increasingly adopting AI-guided robots for tasks such as picking, packing, and sorting goods. For example, Amazon's fulfillment centers deploy thousands of autonomous mobile robots – including Kiva systems and other AI-powered cobots – to move inventory and assist human pickers. These robots use Machine Learning algorithms to navigate warehouse layouts, avoid obstacles, and optimize their routes in real time, working safely alongside employees. The result has been significant increases in throughput and reduced manual handling labor, contributing to faster order fulfillment and lower operational costs. [Appinventiv, 2023]

AI is also transforming the transportation layer of logistics. Routing algorithms powered by AI optimize delivery truck paths, minimizing mileage and fuel consumption. A notable example is UPS's ORION system, which uses real-time data and advanced modeling to reduce unnecessary driving. The system reportedly eliminates millions of miles driven each year, generating substantial fuel savings and contributing to sustainability goals. [Appinventiv, 2023] Similarly, AI-driven fleet management systems now predict maintenance needs for delivery vehicles, enabling preventive repairs that reduce breakdowns and operational downtime — analogous to predictive maintenance already used in factories.

Overall, AI is boosting logistics efficiency by automating repetitive tasks, enabling smarter, real-time decision-making (e.g., rerouting shipments around delays), and better balancing supply with demand. These advancements not only cut costs but also support corporate sustainability objectives and help companies meet growing customer expectations for speed, reliability,

and responsiveness in delivery services.

4.1.3 AI in energy and infrastructure

The energy sector and infrastructure management are likewise experiencing profound AI-driven transformations. In the energy industry, AI is being deployed to create smarter, more resilient power systems. Smart grids, in particular, leverage AI algorithms to balance electricity supply and demand in real time, integrating a diverse mix of energy sources (including intermittent renewables like wind and solar) and optimizing energy distribution across the grid. For example, AI models can forecast energy production from solar farms or wind turbines based on weather data, allowing grid operators to allocate backup power more efficiently and reduce reliance on carbon-intensive peaker plants. This not only enhances cost-efficiency but also advances sustainability goals by facilitating greater use of renewable energy.

In parallel, utilities are also employing AI for predictive maintenance of the electrical grid infrastructure: sensors on transformers, power lines, and generators feed data into AI systems that predict which components are likely to fail or need servicing. This proactive approach helps prevent outages and extends the lifespan of costly assets. A recent industry analysis noted that AI-based predictive maintenance in energy grids can significantly reduce downtime and maintenance expenses by detecting anomalies early. [Group, 2024] [AI-Madfa, 2025] A notable example of AI's role in energy efficiency comes from Google, which applied DeepMind's AI to its data centers' cooling systems. The system achieved a 40% reduction in cooling energy consumption, resulting in a 15% decrease in overall energy use. [DeepMind, 2016] While this case relates to data centers, it underscores the broader potential of AI in energy management and real-time system optimization, a principle equally applicable to power plants and grid operations.

Moreover, AI is transforming energy exploration and production, especially in oil, gas, and mining. Companies now use AI-driven analytics to model geological data and drilling outcomes, thereby increasing exploration success rates while minimizing environmental impact through more targeted, precision-based operations. These developments demonstrate how AI is not only enhancing efficiency and reliability across the energy value chain but also helping the sector transition toward cleaner, smarter infrastructure.

In the realm of infrastructure, AI technologies are increasingly contributing to smarter and more proactive maintenance of physical assets. Urban planners and civil engineers are beginning to use AI to monitor critical infrastructure systems such as roads, bridges, and railways. Leveraging IoT sensors, drones, and computer vision, AI systems can conduct continuous inspections to detect early signs of wear or structural stress – for instance, identifying micro-cracks in bridge supports or the formation of potholes on road surfaces. This enables a shift toward predictive maintenance, where potential issues are flagged and addressed before they escalate into serious failures, enhancing both safety and cost-efficiency. [Planning, Building & Construction Today, 2024] [Rite, 2025]

Beyond structural monitoring, AI is also being applied to intelligent traffic management. Machine Learning algorithms can dynamically adjust traffic signal timing based on real-time flow data, helping reduce congestion, lower vehicle emissions, and improve overall traffic efficiency in urban environments. In addition, digital twin technology is beginning to transform infrastructure planning and management. By creating digital replicas of entire city systems – including roads, utilities, and buildings – planners can simulate the effects of urban changes, test responses to disasters, and make better-informed investment decisions. These innovations are still emerging relative to sectors like manufacturing, but they reveal AI's expanding role across

public infrastructure.

ven within construction and large-scale engineering projects, AI is making inroads: tools now assist in project scheduling, forecasting potential delays or budget overruns, while automated machinery, such as AI-guided excavators or self-driving construction vehicles, improves safety and productivity on worksites. Taken together, these developments show that AI is helping the energy and infrastructure sectors move toward more resilient, efficient, and sustainable systems – ensuring that essential assets, from power grids to transportation networks, are better equipped to handle growing demand and the challenges of the 21st century.

4.1.4 Implications for the workforce in industrial sectors

The accelerating deployment of AI in technological and industrial sectors carries profound implications for the workforce. Job displacement is a central concern: tasks that are repetitive, physically intensive, or routine are increasingly automated by AI-driven machines, directly affecting roles such as assembly line workers, machinists, equipment operators, warehouse pickers, and routine maintenance technicians. For example, the rapid rise of industrial robots is already substituting certain manufacturing jobs; a widely cited forecast by Oxford Economics predicts that up to 20 million manufacturing jobs worldwide could be displaced by robots and automation by 2030. [Hanspal, 2020]

Similar trends are unfolding in logistics, where warehouse automation and autonomous guided vehicles reduce the need for manual labor in sorting and material handling. The development of AI-driven trucking, including self-driving vehicles, may eventually affect long-haul truck driver positions. Moreover, clerical and administrative roles within industrial sectors — such as inventory clerks or production schedulers — are being streamlined by AI tools that autonomously manage inventory systems or optimize production timelines.

However, it is essential to note that AI-induced displacement often affects specific tasks rather than eliminating entire occupations. Many roles will be redefined and reshaped, not wholly replaced. Historical evidence and recent analyses — including those from the International Labour Organization — suggest that while few jobs will disappear entirely due to AI, many will undergo significant transformation. For affected workers, especially those in lower-skilled or routine-based roles, this transition can still be disruptive and challenging. [Berg, 2024]

At the same time, surveys show a mixed but cautiously optimistic outlook among workers and employers. The OECD (2023) reports that employees in manufacturing tend to be positive about AI's impact on job performance and work conditions, citing greater efficiency and reduced physical strain. However, they also express growing concerns about job security and the pace of change. [Lane et al., 2023] These findings highlight the urgent need for policies and support systems that can guide industrial workers through the AI transition — ensuring that the benefits of technological adoption do not come at the cost of economic displacement or inequality.

Crucially, AI is not only destroying or altering jobs – it is also creating new roles and generating demand for certain skills. As automation and intelligent systems become integral to industrial operations, companies now require a workforce capable of developing, implementing, and maintaining these advanced technologies. New roles are emerging in factories and logistics environments, including AI systems integrators, Machine Learning engineers, data analysts/scientists, and robotics technicians.

For example, as manufacturers deploy predictive maintenance, they require data analysts to interpret sensor data and identify patterns, as well as AI specialists who can develop Machine Learning models for failure prediction. The World Economic Forum's analysis of emerging

job trends identifies strong growth in roles such as AI and Machine Learning specialists, big data analysts, process automation experts, and robotics engineers, positions that barely existed on factory floors just a decade ago but are now among the fastest-growing professions in the industrial world. [World Economic Forum, 2025a]

A 2020 WEF report projected that by 2025, AI and automation would displace 85 million jobs globally but create 97 million new ones, many in data-intensive or technologically advanced domains. [Orduña, 2021] More recent forecasts from the Future of Jobs Report 2025 suggest a similar net-positive trend: an expected 170 million new jobs created by 2030, compared to 92 million eliminated due to technology and related forces. [World Economic Forum, 2025a]

However, these gains come with an important consideration: the new jobs typically require higher levels of education and technical training, while the ones being displaced are often lower-skill, routine roles. This dynamic is raising skill requirements across industrial sectors, where today's manufacturing and logistics workers are increasingly expected to demonstrate digital literacy, operate machinery through software interfaces, interpret AI-generated insights, and work collaboratively with intelligent systems. As such, the challenge is not only about job quantity but job quality and accessibility, reinforcing the need for large-scale reskilling and training initiatives to ensure inclusive participation in the AI-enabled industrial economy.

This shift in job profiles highlights that reskilling and upskilling the industrial workforce is not optional — it is essential. As AI reshapes tasks across manufacturing, logistics, and energy, workers must acquire new competencies to remain employable. Assembly workers, for example, might need training to become equipment maintenance technicians who oversee robotic systems, while forklift drivers might be retrained to supervise or program automated guided vehicles in a warehouse. Many companies are already recognizing this need: in a 2022 Deloitte survey, 93% of manufacturing companies identified AI as a key driver of innovation and emphasized the importance of worker training to fully realize its benefits. [All About AI, 2025]

At the same time, entirely new hybrid roles are emerging — positions that blend traditional domain expertise with AI literacy. These include manufacturing process engineers with data analytics skills or energy systems managers who rely on AI tools to fine-tune grid performance. Such roles demonstrate that while AI augments decision-making, human oversight remains indispensable. For instance, a predictive maintenance system may flag potential equipment failure, but a human technician must interpret the alert, determine the repair strategy, and coordinate the intervention. In this evolving landscape, human judgment, contextual understanding, and practical experience continue to anchor industrial operations.

This ongoing transformation underscores the necessity of continuous learning across the industrial workforce. As hybrid roles proliferate and automation reshapes job content, workers are increasingly required to update their skills — not just once, but repeatedly throughout their careers. From a broader labor economics perspective, the net effect of AI in industrial sectors can be positive if managed strategically. AI drives productivity gains, which can lower production costs, boost output, and ultimately stimulate demand. This, in turn, may lead to business expansion and new job creation in roles that complement AI.

However, realizing this upside depends on effective workforce transitions. A study by McKinsey & Company estimated that by 2030, automation (including AI and robotics) could force approximately 14% of the global workforce (hundreds of millions of workers) to switch occupations, but new jobs — often in tech, care, and other sectors — will emerge roughly in balance, provided workers can acquire new skills (McKinsey Global Institute, 2017). At the same time, the World Economic Forum similarly emphasizes the importance of retraining; it notes that about 40% of employers expect to reduce their workforce in roles where AI can automate

tasks, but simultaneously over 50% of employers plan to accelerate upskilling programs to prepare employees for new AI-enhanced roles. [Leopold, 2025]

In practice, this means industrial workers are increasingly engaging in continuous learning – for example, enrolling in courses on robotics operation, AI fundamentals, or data visualization for manufacturing, as noted by industry training programs. [Innopharma Education] To support these transitions, both policymakers and business leaders must invest in vocational training, educational partnerships, and in-house academies that ensure workers are equipped to thrive in AI-augmented environments.

In summary, AI's advance in technological and industrial sectors is reshaping the world of work in profound ways. As discussed, AI is automating many repetitive and routine tasks — displacing certain job functions — while simultaneously augmenting human capabilities and generating demand for new, more skilled professions. This transformation brings a marked shift in the skill profile required across industrial domains: roles increasingly call for advanced technical, digital, and analytical competencies. At the same time, many existing occupations are being redefined rather than eliminated, as human workers are called to oversee, interpret, and collaborate with AI systems rather than compete with them.

Reskilling and upskilling efforts have become essential to prepare workers for hybrid roles — such as technicians operating AI-enabled machines, engineers interpreting predictive maintenance data, or logistics coordinators using AI for real-time decision-making. As noted earlier, these new positions often require not only technical training but also adaptive thinking and problem-solving skills. Moreover, there may be a geographic reallocation of opportunities, as jobs related to AI, robotics, and industrial analytics cluster in high-tech regions, while traditional factory roles decline elsewhere.

However, as the OECD, ILO, and World Economic Forum have repeatedly emphasized, the key to capturing these benefits equitably lies in managing the transition with foresight. Targeted policies, public-private training partnerships, and investment in human capital are all critical to ensuring that automation-driven productivity gains do not come at the expense of employment or social cohesion. Evidence suggests that with sufficient support, workers can successfully transition from manual, routine roles to overseeing, programming, or enhancing AI systems — achieving greater efficiency through human-machine collaboration rather than replacement.[Innopharma Education] [Leopold, 2025]

As the next sections will explore, these trends are not confined to industry alone. Similar dynamics — task restructuring, skill evolution, and the growing importance of human-AI complementarity — are also unfolding across service sectors, professional domains, and creative industries, underscoring that the future of work in the AI era will be defined not by the disappearance of work, but by its continuous transformation.

4.2 Creative and arts sectors

The creative and artistic industries – encompassing design, music, visual arts, writing, film, architecture, advertising, gaming, and more – are undergoing profound changes due to Artificial Intelligence are experiencing significant transformation driven by Artificial Intelligence. In recent years, have moved from experimental applications to mainstream use across these fields, challenging the long-held belief that creativity is an exclusively human domain. [Amankwah-Amoah et al., 2024] [Torkington, 2023] Today, AI algorithms can in fact autonomously generate paintings, compose music, write stories, design graphics, and produce video content with minimal human input.

This section explores the global impact of AI on creative sectors, analyzing both the opportunities and disruptions it brings. Through real-world examples and case studies, it examines how AI is augmenting creative workflows, reshaping professional roles, and influencing aesthetic norms. At the same time, it considers the labor market implications – identifying which roles are emerging, which are at risk, and how skill demands are shifting. Finally, it reflects on the fundamental value of human-centric creative abilities such as aesthetic judgment, storytelling, cultural interpretation, and emotional resonance, which continue to distinguish human creators even in an AI-enhanced creative landscape.

4.2.1 AI’s growing influence in creative industries

Artificial Intelligence is rapidly becoming a transformative force across creative industries worldwide. By 2023–2024, Generative AI systems had made significant advancements into domains long considered exclusive territory of human creativity, such as visual art, music composition, and creative writing. [United Nations Conference on Trade and Development, 2023] In particular, we can affirm that Generative AI is the main technology that is revolutionizing the firm. It refers to algorithms (often based on Machine Learning models like neural networks) that can autonomously produce novel content (text, images, audio, 3D designs) by learning patterns from large datasets.

The widespread adoption of tools like OpenAI’s ChatGPT for text generation and image generators such as DALL·E and Midjourney has enabled individuals, companies, artists, musicians, and even major film studios to integrate AI into their creative workflows. [Whiting, 2024] What was born as a niche technological innovation has now become a mainstream component of creative production processes around the world.

This widespread adoption of Generative AI in creative industries has not only transformed workflows but also sparked urgent debates around ethics, authorship, and the future of creative labour. [Whiting, 2024] While AI tools offer the promise of augmented creativity and increased productivity — automating routine or technical aspects so that artists can focus on higher-level artistic vision — they also raise complex concerns. Key among these are questions of intellectual property, as many generative models are trained on large datasets that include copyrighted artworks without explicit permission, potentially infringing on creators’ rights. Moreover, the authenticity and cultural value of AI-generated outputs remain contested.

One illustrative case occurred in August 2022, when an artwork partially generated using Midjourney, *Théâtre D’opéra Spatial*, won first prize at a U.S. art competition. The outcome provoked intense backlash from artists and critics who questioned the legitimacy of AI-generated art being judged alongside human-created works. [Whiting, 2024] By 2023, the impact of AI was so significant that it became a central topic in major industry events and labor actions. For instance, in the Hollywood writers’ strike led by the Writers Guild of America, Generative AI’s use in scriptwriting was a key point of contention, as screenwriters called for safeguards against AI replacing or diluting human authorship. [Whiting, 2024] Similarly, the Screen Actors Guild (SAG-AFTRA) raised concerns about AI being used to create digital replicas of actors without fair compensation or consent. [Whiting, 2024]

Together, these developments highlight that Generative AI is not merely a productivity tool but a disruptive force prompting fundamental structural and ethical questions across the whole creative economy.

4.2.2 Opportunities: Generative AI for creativity and collaboration

Despite the concerns raised, AI also presents considerable opportunities for innovation, collaboration, and democratization in the creative industries. Rather than simply replacing human input, many creatives and organizations are discovering that, when used thoughtfully, Generative AI can serve as a powerful tool to enhance and augment human creativity. [Amankwah-Amoah et al., 2024]

This shift reflects a broader paradigm: creativity is no longer viewed as a purely solitary or manual endeavor, but as a dynamic interplay between human imagination and algorithmic suggestion. As such, AI is becoming not a competitor, but a collaborator — offering possibilities for co-creation that can inspire new forms of artistic practice.

One of the clearest opportunities lies in the automation of repetitive tasks and the acceleration of creative workflows. As widely discussed, AI excels at handling labor-intensive, repetitive, or time-consuming aspects of the production and this ability can clearly be exploited also in the creative sector. For instance, AI tools can eliminate or simplify cumbersome steps such as editing, formatting, or producing design iterations. [German Commission for UNESCO, 2024] In graphic design and photography, AI-powered software can automatically remove backgrounds, enhance image quality, or generate variations of a layout in seconds, all tasks that would otherwise require hours of manual effort. In video and film production, AI is used for tasks like color correction, sorting through footage, or even creating rough cuts, significantly accelerating the post-production process. By automating lower-level work, AI allows creative professionals to focus on higher-level creative decision-making and refinement.

In addition to workflow acceleration, a particularly transformative opportunity lies in generative content creation and AI as a creative "muse". One of AI's most intriguing contributions is in fact its use as a generative tool that can produce original content or suggestions from scratch based on prompts. Modern generative models can write articles, compose melodies, generate illustrations, or design virtual scenes, providing an abundance of ideas for human creators to draw upon. In this sense, AI can act as an "inspirational muse", offering novel combinations and outside-the-box concepts that spur human creativity. [German Commission for UNESCO, 2024] For instance, an architect or product designer might use a Generative AI system to produce dozens of concept sketches or 3D models meeting certain criteria, and then select and refine the best ideas. In music, composers are using AI tools to generate melodies or harmonies in a given style, treating the AI's output as a springboard for further musical development. These AI-generated suggestions can help overcome creative blocks and explore a wider creative design space quickly.

Scholars note that in such contexts, AI is not a replacement for human vision, but a collaborator — amplifying human ingenuity and enabling creators to explore more ideas in less time. [Amankwah-Amoah et al., 2024]

Another major opportunity is lowering barriers to entry and democratizing creativity. AI tools are increasingly allowing non-experts to engage in creative expression by encapsulating complex skills into accessible interfaces. For example, individuals without formal training in illustration can now produce professional-looking visuals for personal or commercial use simply by describing their ideas to an image-generation model. In a similar way, AI music generation tools enable users who cannot read sheet music or play an instrument to compose songs by inputting parameters or humming a melody that the system arranges into a full composition. This democratization empowers small businesses, independent creators, and hobbyists to produce high-quality content without relying on large teams or expensive resources. It also fosters

greater inclusivity in creative industries by widening participation to those historically excluded by technical or financial barriers. Moreover, AI's ability to operate across languages — translating or generating content in multiple tongues — further amplifies this inclusivity. As highlighted by UNESCO, these capabilities "create new access points" to cultural content across language divides, expanding the audience and participation in the arts. [German Commission for UNESCO, 2024] In this way, AI is not just accelerating creativity, but also redistributing access to its tools and platforms.

In parallel, augmented design and innovation are emerging as key frontiers where AI is enhancing the capabilities of trained professionals across creative fields such as architecture, fashion, and product design. In these domains, AI functions not merely as a productivity tool but as a sophisticated generative partner. For instance, generative design software (often based on evolutionary algorithms or neural networks) can produce a vast number of design options that meet specified constraints (based on user-defined constraints like cost, material strength, or sustainability criteria). Designers then act as curators, refining and contextualizing these outputs to align with aesthetic and functional goals.

A McKinsey case study on the fashion industry found AI being used across the value chain, not only to streamline processes but also to generate creative insights driven by trend data and consumer behavior analytics. [Torkington, 2023] In architecture, instead, recent experiments show that AI image generators like Midjourney are used in early concept phases to quickly visualize atmospheres or forms, which architects then adapt. A 2024 study at an architecture firm, for example, reported that 81% of architects were interested in integrating AI tools into their design process, seeing potential to enhance ideation and visualization. [Kuttaiah, 2024] Following hands-on experimentation, architects in the study appreciated the technology's capabilities – generating concept images and iterations rapidly – while reaffirming the critical role of human judgment in selecting, adapting, and contextualizing these ideas. [Kuttaiah, 2024] Such findings suggest that creative professionals are beginning to embrace AI as a co-creative tool that can extend their abilities and yield innovative outcomes that might not emerge from human imagination alone.

This evolving human–AI collaboration not only augments design and ideation but is also giving rise to entirely new creative business models and forms of personalization. In advertising and digital media, for instance, Generative AI is being used to tailor content dynamically to specific audience segments, automatically adjusting visuals, text, and even music to maximize engagement with different demographics. Clearly, this kind of hyper-personalized content creation was previously impractical to do manually. Media companies are beginning to produce multiple variations of the same advertisement or trailer and use A/B testing informed by real-time viewer data to refine messaging for optimal impact.

In the gaming industry, this same principle of AI-driven content generation is transforming the user experience. Machine Learning advances are enabling procedurally generated game worlds and non-player character (NPC) interactions that are more complex and responsive than ever before. For example, narrative designers are testing AI tools that generate dialogue for non-player characters (NPCs) on the fly, creating more immersive and responsive game experiences. Ubisoft, a major game developer, recently introduced an AI tool called "Ghostwriter" to generate first drafts of NPC dialogue lines (called "barks"), which game writers can then refine. [Malik, 2023] The goal is to handle the voluminous incidental lines (e.g. background chatter) via AI, freeing up human writers to focus on core story and character development. Ubisoft's team emphasizes that writers maintain creative control – they input character profiles and guide the AI, then curate the AI's outputs – illustrating how creative roles can evolve into a supervisory and curatorial capacity alongside AI. [Malik, 2023] This case exemplifies how

AI can expand creative possibilities and efficiency while reinforcing the importance of human oversight and storytelling judgment. Ultimately, these emerging practices signal a shift toward hybrid creative roles — where humans guide and refine AI-generated content — highlighting the complementary strengths of human imagination and algorithmic capability in shaping the future of creative industries.

These emerging applications across design, advertising, gaming, and beyond underscore a broader trend: AI is reshaping the creative process by enhancing human capabilities and opening new possibilities for innovation and expression. Whether generating initial drafts, suggesting novel forms, or enabling hyper-personalized content delivery, AI acts less as a replacement and more as a catalyst for creative evolution — provided that human oversight remains central. In summary, AI's growing presence in creative sectors brings significant opportunities to increase efficiency, broaden creative exploration, and unlock new forms of expression and business. From Generative AI that provides a wellspring of ideas, to intelligent tools that personalize content or automate drudgery, the technology can amplify human creativity on a global scale. Indeed, the World Economic Forum projects that AI will not only improve existing jobs but also create entirely new roles and fields in the creative economy. [Whiting, 2024] Professionals who learn to leverage AI are finding that it can be a powerful creative ally. However, these opportunities come closely linked to serious challenges and ambiguities, which the next section will address.

4.2.3 Challenges: authorship, authenticity, and job displacement

The growing use of AI in creative work raises also a number of complex and often controversial challenges. At the forefront are debates around authorship and intellectual property rights, the cultural and emotional authenticity of AI-generated content, and the risk of job displacement or deskilling among creative professionals. The convergence of AI and artistic production compels a rethinking of foundational concepts: what does it mean to be an author or artist when a Machine Learning model plays a central role in creating content? Who holds ownership of an AI-generated artwork or song – the user, the developer of the AI tool, or perhaps no one? Is AI-created art inherently less authentic or emotionally resonant than that made by humans? And how might the widespread adoption of these tools impact the livelihoods and creative autonomy of writers, designers, musicians, and visual artists?

These are no longer abstract or hypothetical questions. As AI becomes embedded in real-world creative workflows, the legal, cultural, and economic implications are becoming increasingly urgent. The main challenges can be grouped into several key areas.

One of the most immediate and contentious challenges posed by AI in creative industries is the question of ownership and rights over AI-generated content. Copyright law in most jurisdictions is built on the premise of a human creator; as the World Intellectual Property Organization (WIPO) states, «creative works qualify for copyright protection if they are original, with most definitions of originality requiring a human author». In fact, many countries explicitly state that only works created by a human can be protected by copyright. [Guadamuz, 2017] This means that purely AI-generated works often fall into a legal gray area: they may not be eligible for copyright at all, or the default copyright might lie with the human who prompted the AI, depending on local laws.

This lack of clear authorship has practical and legal implications. For example, if an advertising agency uses AI to generate a campaign image, and no party can legally claim exclusive rights, the image could potentially be reused by competitors without penalty. The issue is fur-

ther complicated by the data used to train generative models: these systems learn from vast datasets composed largely of human-made content (art, writing, music), much of it scraped from the internet without the original creators' consent. Artists have expressed concern that their copyrighted work is effectively being used to train AI systems that now imitate their style — without credit or compensation.

This has already resulted in legal action. In 2023, a group of visual artists filed class-action lawsuits against AI image generator companies, arguing that their copyrighted artworks were used in training data without permission. Similar concerns have emerged in the music industry: when an AI-generated song imitating the voices of Drake and The Weeknd went viral, Universal Music Group demanded its removal on the grounds of copyright and trademark violations. [Savage, 2023]

In response to such concerns, calls for regulatory reform are intensifying. Industry leaders argue that AI developers should be required to obtain licenses when using copyrighted materials in training datasets, ensuring fair recognition and remuneration for creators. [Taylor, 2025] Policy-makers and institutions like WIPO are now actively examining how to balance technological innovation with intellectual property rights so that creators are not unfairly disadvantaged by AI. Until new frameworks are established, however, uncertainty around authorship and rights remains one of the most pressing challenges facing creative industries in the AI era.

Closely tied to these legal and ethical issues is a broader concern about originality, authenticity, and cultural impact in AI-generated creative work. By their very design, Generative AI systems function by identifying and replicating patterns found in existing datasets; they are fundamentally derivative tools that lack consciousness, emotional experience, or cultural grounding. While the results they produce may be novel in form, many argue that such output is categorically different from human creativity, which is shaped by personal history, emotion, and sociocultural context. AI, in contrast, lacks «the cultural context, emotional depth, and lived experience» that inform human creative expression. [Bentes, 2024]

As a result, critics suggest that AI-produced works might feel superficially impressive but could lack the deeper authenticity or meaning that comes from genuine human insight. For instance, while an AI can simulate Van Gogh's painting style by analyzing his brushstrokes and color palettes, it cannot grasp the anguish, vision, or worldview that made his art resonant. Human aesthetic judgment – the nuanced sense of taste and value in art – is something that evolves in humans through education, culture, and personal growth, elements which AI does not genuinely possess. [Bentes, 2024]

In addition, there are also growing concerns that the widespread use of Generative AI could promote creative homogenization. If AI models are trained on past artworks and always produce works in those styles, they might reinforce existing tropes rather than invent radically new art movements. As computer scientist Ben Zhao (2024) notes, there is skepticism about whether Generative AI can truly find "the next new genre" of art or music, because it operates by filtering known styles; the space of artistic possibility may be "nearly infinite" and not fully discoverable by algorithmic. [United Nations Conference on Trade and Development, 2023] In other words, paradigm-shifting creative innovations often involve breaking patterns and cultural context that AI, which learns from historical data, might not foresee.

Moreover, cultural diversity is at risk when training data are dominated by certain languages or regions. UNESCO warns that if most AI training data are in certain dominant languages or from certain cultures, the resulting outputs might marginalize less-represented cultures. [German Commission for UNESCO, 2024] For example, a generative language model heavily trained on English content might encourage a further global tilt toward English, at the expense of linguistic diversity. Similarly, biases present in training data (such as Western-centric perspectives

or stereotypes) could be amplified, leading AI-generated cultural content to be unrepresentative or even offensive. Thus, maintaining cultural diversity and authenticity is a significant challenge; it underscores the need for diverse training data and for human creators to remain in the loop to inject cultural nuance and critical perspective.

In addition to questions of originality and cultural authenticity, the rise of AI-generated content also introduces pressing ethical and quality concerns. One major issue is the potential for misinformation and deepfakes. AI can in fact create highly realistic fake images, videos, or audio that impersonate real people, blurring the line between fiction and reality. In entertainment, this technology can be used creatively (for instance, to "de-age" actors or even to have virtual performances by deceased artists), but it can also be misused to deceive audiences, raising questions about consent, authorship, and financial benefit. Who approves the use of a celebrity's likeness, and who should profit from it?

Moreover, the reliability of AI-generated content is under scrutiny. Generative models sometimes produce false or misleading outputs – so-called "hallucinations" – which can be especially problematic in journalistic or educational contexts. As an example, the Guardian newspaper discovered that ChatGPT had fabricated references to Guardian articles that never existed, even attributing them to real journalists. In creative settings, such errors might slip into film scripts, novels, or historical pieces unless carefully vetted by human editors.

Plagiarism and inadvertent copying present another grey area: AI is trained on existing works, it may reproduce elements too closely, raising potential copyright concerns and diminishing creative originality. Transparency, therefore, becomes an ethical imperative. Audiences increasingly expect to know whether a piece of content was generated or significantly assisted by AI. Indeed, after the AI-assisted artwork won the state fair competition in Colorado, the organizers subsequently changed the rules to require artists to disclose any use of AI in their submissions. [Kuta, 2023] Without such transparency, creators risk misleading audiences and undermining trust in creative industries. These challenges illustrate that even as AI tools expand creative possibilities, they simultaneously demand careful governance to preserve integrity, fairness, and authenticity in the arts.

These ethical and quality concerns are closely tied to perhaps the most immediate and tangible impact of AI on creative sectors: the disruption of creative labor markets. One of the most pressing challenges is the potential for widespread job displacement and the erosion of traditional career pathways in the arts. Traditionally, creative jobs were thought to be relatively safe from automation, because they rely on human imagination and subjective judgement. However, the advent of powerful Generative AI has rapidly changed that outlook. [Torkington, 2023] AI is now capable of performing many tasks that junior creatives or support staff used to do – from drafting copy and sketching concepts to producing stock illustrations and basic video edits.

This shift threatens to entry-level positions in fields like graphic design, advertising copywriting, basic illustration, photo editing, and content writing, which have often been the stepping stones for new talent. Early signs of labor market disruption are already visible: Zhao (2024) notes that in 2023–24, multiple waves of layoffs hit the entertainment and media industries, «many of which are explicitly linked to use of AI», with illustrators, graphic designers, and game artists being replaced in significant numbers. [United Nations Conference on Trade and Development, 2023] For example, publishers of web content now often use AI to generate articles or marketing texts, reducing the need for as many human writers or translators. Design agencies might rely on AI for logo drafts or template designs, potentially cutting freelance illustrators. Even Hollywood studios have expressed interest in using AI for generating script ideas or digital background actors, which was a keypoint in the recent writers' and actors' strikes. The Writers Guild of America's new contract now contains provisions restricting the use of AI

in writing tasks, indicating how seriously professionals view the threat to their jobs.

This growing sense of vulnerability – often referred to as "FOBO" (fear of becoming obsolete) – is now pervasive among creatives. Surveys in the U.S. indicate over 20% of workers (across sectors) worry their jobs could be displaced by emerging tech like AI, and this anxiety is surely present in creative fields. [Whiting, 2024]

This anxiety around job displacement is further complicated by the uneven nature of AI's impact across creative roles. Not all positions are equally vulnerable: while routine or lower-skill creative tasks face the highest risk of automation, roles that demand complex creative strategy, high-level artistic direction, or managerial oversight may actually become more critical. For instance, a junior layout artist who mainly produces variations of banner ads might be more easily replaced by AI than a creative director who formulates brand campaigns and guides overall artistic vision. Rather than causing the outright disappearance of jobs across the board, AI is more likely to shift the skill requirements within creative professions. Increasingly, artists and media professionals are expected to combine artistic sensibility with technical fluency – acquiring new competencies such as prompt engineering, AI tool manipulation, or creative data analytics.

This partial automation raises additional structural concerns. If AI takes over foundational tasks traditionally assigned to junior staff – such as first drafts, rough edits, or visual mockups – it could disrupt the creative apprenticeship model that has long enabled skill development and career progression. Without entry-level opportunities to practice and learn, aspiring creatives may struggle to gain the experience needed for senior roles, potentially leading to long-term talent gaps in the industry. Recognizing this risk, industry analysts and institutions like the World Economic Forum and OECD stress the urgency of re-skilling and lifelong learning. To remain relevant and resilient, creative professionals must now learn to collaborate with AI tools in ways that preserve and highlight the distinct value of human creativity – emotional depth, cultural intuition, and critical interpretation – that no algorithm can replicate.

Finally, beyond questions of employment and skills, the rise of AI in creative industries raises deeply personal and philosophical concerns about identity and the intrinsic value of human artistry. While many creatives are adapting to work alongside AI tools, there is a growing unease that the proliferation of algorithmically generated content may devalue human creative labor. Artists, writers, and designers increasingly worry that their work will be perceived as less unique or less worthy of compensation in a market flooded with AI-produced images, music, and texts. When machines can generate hundreds of outputs in seconds, there is a real risk that creativity becomes commodified, treated as a cheap and abundant good rather than a deeply human craft.

This concern extends to the psychological and emotional dimensions of creative work. Creative work is in fact often tied to personal passion and identity, and seeing a machine produce similar work can be demoralizing. During interviews and surveys, some creatives express a sense of loss – that something essential about creative expression is being eroded when a painting or poem is generated by an algorithm without "soul". This ties into broader philosophical questions: even if AI art looks or sounds "perfect", does it hold the same cultural significance if there was no human experience behind it? Debates are ongoing about whether audiences inherently respond differently to human-made or AI-made art. Early research suggests people do tend to have a bias favoring human-created art when they know the source, perhaps because we ascribe intent and authenticity to human creators. This points to the importance of transparency – some argue that creators and platforms should always disclose when a work has been generated with AI, allowing audiences to judge its value accordingly.

All these issues indicate that integrating AI into creative fields is not just a technological shift

but a humanistic challenge. It forces us to reconsider the meaning of authorship, the emotional power of artistic expression, and the cultural value we assign to work born of human experience.

Building on these reflections about identity, authorship, and the evolving role of human creators, it becomes clear that the challenges posed by AI in the creative and arts sectors are deeply interconnected. The concerns about intellectual property, the cultural legitimacy of AI-generated content, ethical use of generative tools, potential job displacement, and the erosion of creative identity all feed into a broader reckoning with how society values human creativity in an age of machine-made art.

In summary, the challenges of AI in the creative and arts sectors are multifaceted. They range from concrete legal and economic problems — such as copyright law ambiguities and job losses — to more abstract but equally pressing cultural and ethical dilemmas, including questions of authenticity, artistic integrity, and the emotional resonance of creative works. Addressing these challenges will require a combination of policy interventions, industry self-regulation, and, crucially, the active engagement of creative communities in shaping the norms and boundaries of AI use. For instance, institutions like UNESCO have called for «clear regulation of AI in the cultural and creative industries, based on human rights and international ethical principles», while also stressing the need to uphold cultural diversity and ensure minority voices are not sidelined by algorithmic standardization. [German Commission for UNESCO, 2024] At the same time, creators and stakeholders in music, visual art, and media are advocating for principles of consent, credit, and fair compensation when AI tools are trained on or replicate their work. [Taylor, 2025]

As AI continues to evolve, the creative sectors face the critical task of balancing technological innovation with the preservation of the human elements that give art its depth, meaning, and cultural relevance.

4.2.4 Impact on creative labor markets and evolving roles

AI's integration into creative workflows is already reshaping labor markets in the arts and media. As noted, some roles are being reduced or made redundant, while new roles and skillsets are emerging. This dual dynamic is significantly altering how creative professionals plan and sustain their careers, prompting a reevaluation of the skills needed to thrive in an AI-enhanced creative economy.

In this section, we examine the evolving structure of creative labor: which roles are most susceptible to automation, which are expanding or transforming, and how individuals and organizations are adapting to stay competitive in this changing landscape.

Building on the broader labor market transformations discussed earlier, one of the clearest impacts of AI integration in creative industries is the automation of routine and formulaic content production, placing certain roles at higher risk. Roles involving high-volume, low-variation tasks — such as basic commercial illustration, template-based graphic design, or standard copywriting — are particularly vulnerable. For instance, generative image tools can now produce simple logos, icons, or stock visuals at scale, leading some publishing and advertising firms to reduce reliance on freelance illustrators. Similarly, entry-level writing tasks are increasingly handled by AI: press releases, product descriptions, and sports summaries can be drafted from templates or data inputs, allowing news agencies to automate reports that once required junior journalists.

Translation and localization services, especially in marketing and literary adaptation, are also experiencing disruption as AI models provide rapid, low-cost language processing — though

human oversight remains essential for nuance and tone. Even in film production, roles like background actors ("extras") and stunt doubles face new risk: studios have explored using AI to create digital crowds or realistic stunt simulations, which could mean fewer on-set extras or stunt performers hired. As Zhao (2024) notes, many such positions saw cuts in 2023–24, with producers citing AI as a reason. [United Nations Conference on Trade and Development, 2023] It's important to note that, as already explained in previous sections, AI often does not replace an entire occupation outright, but rather automates specific tasks within a job. Therefore, it is the task composition of each role that determines its vulnerability. A graphic designer's job, for instance, includes both the creative ideation and the manual execution (producing assets in software). AI might automate much of the execution, but the designer's role could shift more toward ideation, project management, and refining AI outputs. Clearly, the risk is that fewer designers are needed overall when one designer armed with AI can do the work of many.

Expanding on this transformation of the creative labor landscape, it's clear that while some traditional roles face automation, new and hybrid roles are simultaneously emerging in response to AI's growing integration. A frequently cited example is the "prompt engineer" or "AI art director". These are specialists who craft nuanced inputs for Generative AI tools to produce specific creative outcomes. For instance, writing an effective prompt for an image generator could be considered art in itself. It in fact requires understanding how the model interprets language and being able to iteratively refine the prompt to achieve a specific visual style. Some companies have started listing job openings for prompt specialists to help teams make the most of AI tools in advertising, design, and marketing.

Similarly, as AI systems become part of creative pipelines, roles like AI ethics reviewers, data curators, or Machine Learning ops for media are emerging. In a content studio that uses AI to generate media, someone might be tasked with curating the training data (to avoid biased or low-quality inputs), or monitoring the outputs for errors and compliance with brand standards. Additionally, hybrid positions are becoming more common, combining domain-specific creative expertise with AI literacy. For example, a music AI technician who works with musicians to train models on the band's sounds and then generates new snippets for inspiration, or a literary AI collaborator who helps authors use AI for brainstorming plots or characters. These roles reflect a broader trend: creative professionals who adapt to AI not just as a tool, but as a co-creative partner, are carving out entirely new career paths within the evolving ecosystem.

Building on this shift toward new and hybrid roles, many creative professionals are not passively watching the transformation unfold, they are actively adapting to it. A 2023 survey of workers in the creative industries revealed that 83% had already begun incorporating AI tools into their workflows, even if only on an experimental basis. [Bourton, 2023] This proactive engagement suggests that rather than waiting to be rendered obsolete, creatives are learning how to integrate AI into their toolset. For instance, designers now commonly use AI image generators for mood boards and concept art; writers use AI text generators to overcome writer's block or generate variations of a headline; video editors use AI for automatic subtitling or to create rough cuts.

in addition, many report positive effects on productivity and even on creative quality: in one poll, 66% of creatives using Generative AI in fact felt they were making better content with the AI's help. As a result, many professionals are effectively shifting toward roles of curators, editors, and strategists. Instead of hand-crafting every minute detail, they oversee AI outputs, picking and refining the best ones, and ensuring the final product meets human standards of quality and intention. This requires not only learning the AI tools, but also emphasizing the uniquely human skills discussed in the next section.

Furthermore, creative communities are forming around this shared learning process. Online fo-

rums, workshops, and webinars have become hubs for exchanging practical advice on prompting techniques, navigating copyright concerns, and monetizing AI-assisted work. The mindset emerging is that those who adapt and harness AI can potentially enhance their creative reach, whereas those who don't risk being left behind in a changing industry.

At the organizational and industry level, responses to these labor shifts vary in approach and outlook. Building on the adaptation seen among individual professionals, some employers are proactively embracing a strategy of "upskill and redeploy", training their creative staff to use AI tools rather than replacing them. Advertising agencies, for example, have run internal workshops to certify their art directors and copywriters in AI tools, aiming to increase efficiency while keeping their human talent central to the process. Other firms, unfortunately, have opted for short-term cost cutting – using AI to reduce headcount. Over time, it's expected that best practices will emerge for how to structure creative teams. One likely scenario is the hybrid creative team: professionals with artistic and narrative skills working alongside AI technicians or prompt engineers to co-develop content. In Hollywood, for instance, union negotiations have explored mandates requiring human writers and editors to remain involved when AI is used in content production, reinforcing the idea that accountability and creative judgment must remain with people.

Parallel to this, there's also a push in some sectors for certification or labels indicating "AI-assisted" content, which could become a quality mark or simply a transparency measure. These organizational developments reflect a broader recalibration of roles and expectations. Creative professionals are recalibrating their roles, and industries are negotiating how to extract the benefits of AI while preserving human creative careers. History suggests that technological change, even when displacing certain jobs, often creates new opportunities and shifts the focus of work rather than eliminating it entirely. Many experts predict a similar pattern here: routine production tasks might largely automate, but the creative economy as a whole could expand as content demand grows and new forms of creativity (e.g., virtual reality experiences, interactive AI-driven media) flourish. The challenge is ensuring a fair transition, where existing creatives can find their footing in new roles and new entrants know what skills to develop.

4.2.5 The irreplaceable human element: skills AI cannot (yet) replicate

In the context of the rapid advancement of AI in creative fields, a clear consensus is emerging on one critical point: certain human-centric creative skills remain difficult, if not impossible, for AI to replicate. These include essential qualities such as aesthetic judgment, emotional intelligence, cultural intuition, and narrative insight. While Generative AI can replicate stylistic patterns and produce content that appears creative, it lacks the sentient understanding and consciousness that give human-made art its meaning and resonance. As a result, these human qualities are increasingly seen as differentiators that will continue to make human creators essential, no matter how sophisticated AI becomes. This subsection discusses some of those key human-centric skills and why they matter in the age of AI.

The first typical human quality that we take into consideration is aesthetic judgment and taste. Developing a sense of taste – the ability to discern subtle qualities, to know what is artistically successful or novel – is clearly a deeply human process. It arises from cultural learning, lived experience, and personal intuition. AI can analyze patterns of what has been liked in the past, but it doesn't truly appreciate art; it cannot feel surprise, beauty, or boredom. Human creators exercise aesthetic judgment when they decide, for example, that a melody needs a certain emotional crescendo, or that a painting's composition is balanced just right to

convey harmony. This judgment often involves context and purpose. For example, a fashion designer chooses a bold color not just by trend analysis, but because it fits the story of the collection and the current social mood. AI, working from data, might miss these contextual cues or the intent behind artistic choices. As one commentator put it, AI lacks "taste" in the human sense – it can produce outputs, but deciding whether they are truly good or meaningful is still largely a human prerogative. [Bentes, 2024]

Moreover, taste and aesthetic standards evolve; humans change their preferences over time and often in unpredictable ways (consider how artistic styles that were initially criticized, like Impressionism or bebop jazz, later became celebrated). While AI can update its outputs with new data, initiating a new artistic paradigm or movement is still a domain of human originality. This is why the role of the human creative director or editor who applies taste and makes final selections remains critical. These individuals provide the cultural calibration that ensures creative works have resonance and quality, rather than just being an average of past styles.

A second vital human strength that AI has yet to truly replicate is storytelling and narrative imagination. Humans are storytelling beings – not just for entertainment, but to understand the world, to teach, to process emotions, and to shape culture. Great storytelling requires understanding human psychology, empathy, and the ability to imbue plots and characters with purpose and agency. AI language models can generate coherent text and even mimic story structures, but they don't truly understand the why behind a story. They might produce a thriller plot by statistically emulating other thrillers, but they don't grasp moral themes or character arcs in the way a human writer does. Human storytellers often infuse their narratives with personal history and moral viewpoints to give stories heart and depth. For example, if we consider a screenplay about loss and redemption, it is not difficult to understand how human writer who has experienced loss can channel genuine emotion into the narrative, whereas an AI can only approximate such emotion through words.

Additionally, human writers and artists often intentionally break rules and subvert expectations to create art; AI, being rule-based (even if the rules are complex patterns), is not naturally inclined to subversion without human prompt. Original storytelling often comes from a place of personal or cultural insight, something AI lacks. As a result, roles that involve narrative design (film directors, novelists, game writers) continue to emphasize the human touch. AI can assist by suggesting plot ideas or even drafting scenes, but a human is usually needed to decide the overall story, ensure thematic coherence, and make the creative leaps that turn a predictable tale into something fresh. Indeed, professionals report using AI as a brainstorming aid – generating a quick outline or some dialog variants – but then heavily curating and rewriting to inject the needed narrative purpose and emotional logic.

Extending the discussion on storytelling and narrative imagination, another deeply human attribute that underpins compelling creative work is emotional and empathic connection. Storytelling resonates most powerfully when it reflects genuine emotional insight — something that stems from the creator's own experiences and capacity for empathy. AI can for sure analyze sentiments or even generate content that statistically aligns with certain emotions (e.g., "write a sad poem in the style of X"), but it does not have the ability to feel those emotions. This lack of genuine emotion means that there may always be a qualitative difference that audiences can sense between a deeply heartfelt human creation and an AI-generated work.

In performances, for instance, an AI-generated music track might be catchy and technically flawless, but a listener might miss the subtle expressiveness that comes from a human musician's interpretation and soul. Empathy – the ability to put oneself in another's shoes – is crucial for creators working in genres like drama, comedy, or any medium that seeks to reflect the human condition. AI has no lived human experience, so its ability to handle nuanced or

sensitive emotional topics often falls short. We see this in AI-written prose or dialogue: it can sometimes come across as superficially emotional or oddly tone-deaf in context, because the AI doesn't truly comprehend the emotional weight of situations. Human creators, by contrast, can draw upon real empathic understanding to craft moments in art that authentically resonate with audiences. This is a skill likely to remain in demand; as routine content becomes automated, audiences may place higher value on art that clearly bears the mark of human empathy and authenticity.

Moving the focus of the analysis on cultural interpretation and contextual insight, we can notice how they are additional human capabilities that remain essential in the creative process. Human creators are not only emotionally attuned but also deeply embedded in the cultural environments that shape meaning, symbolism, and relevance. Culture evolves dynamically through language, politics, history, and collective experience — areas in which human artists are active participants. They can draw on their lived realities to produce works that engage with current events, question norms, or reflect specific identities in ways that resonate with particular communities.

By contrast, AI lacks cultural grounding. Its understanding of the world is based on static training data, which limits its capacity to respond meaningfully to ongoing cultural shifts or localized contexts. While it can imitate stylistic elements or reference widely known events, it cannot truly interpret or anticipate the socio-cultural impact of its outputs. This limitation becomes particularly evident when creative expression involves satire, irony, or culturally embedded symbolism — areas that require not just information, but a sense of timing, audience sensitivity, and insider perspective.

Additionally, some creative works require a point of view or a voice that is inherently tied to one's identity or heritage, think of an indigenous artist creating work about their community's experiences, or a writer from a particular city capturing its dialect and spirit. AI, being general, doesn't have a personal or cultural identity. It may do a pastiche of such voices, but it isn't an authentic voice from within that culture. Therefore, creative professionals who bring unique cultural perspectives or who serve as cultural commentators hold an irreplaceable role. In the global context, it's increasingly recognized that preserving human-driven cultural creation is essential for diversity. UNESCO and other bodies highlight the importance of human artists as carriers of intangible cultural heritage and creative diversity, something that a technology trending toward uniformity could endanger if left unchecked. [German Commission for UNESCO, 2024] In a digital landscape increasingly shaped by AI, safeguarding these human contributions is not just an artistic concern, but a cultural imperative.

Finally, humans imbue art with intention and can consider the ethical dimensions of their creative choices. An AI will produce whatever it is asked to, without moral consideration. It might create violent or disturbing content if prompted, or inadvertently reinforce a stereotype, because it doesn't understand the real-world impact.

Human creators can and do exercise ethical judgment, deciding not to create something because it would be harmful or in bad taste, or choosing to create something precisely to challenge an unethical status quo. This moral and intentional aspect of creativity is crucial, especially in fields like journalism (ensuring truth and responsibility) or advertising (avoiding offensive messaging), and in artistic realms that deal with societal issues. Human oversight is needed to steer AI in alignment with ethical and aesthetic values that a society or community holds. Many experts argue that in any creative process involving AI, the human should ultimately be the "moral compass" and decision-maker, defining the project's intent and ensuring the AI's contributions serve that intent appropriately. This human role safeguards not just against errors, but also against the dilution of purpose – art is often about saying something, and humans

decide what is being said.

In conclusion, the skills of creativity, critical judgment, emotional intelligence, and cultural understanding remain at the core of creative professions, even as AI takes on supportive roles. These human-centric skills are precisely those that are hardest to encode in algorithms. As the World Economic Forum has noted in its future of jobs analyses, attributes like creativity, originality, initiative, and empathy are likely to become more important for workers in the age of AI. [wef, 2020] In creative sectors, the value of human creativity may actually be reinforced by the presence of AI: the more we see what AI can do, the more we come to appreciate the intangible qualities of art that reflect a human spirit. The most promising outlook is one of human-AI collaboration where AI handles optimization and generation at scale, and humans provide direction, originality, and meaning. As one report on architecture and AI concluded, a «balanced approach where AI augments rather than replaces human creativity» is ideal. [Kut-taiah, 2024]

Ultimately, the world of work in creative sectors is likely to be redefined – not by making human creativity obsolete, but by challenging us to focus even more on what makes human creativity special, while leveraging AI as a powerful new tool in the creative toolkit.

4.2.6 Case studies and examples

To illustrate the above opportunities and challenges, it is useful to consider several concrete examples and case studies from different creative domains.

Digital visual arts

The impact of AI on visual art became widely visible in 2018 when an AI-generated painting (*Edmond de Belamy*) was auctioned at Christie's for over \$400,000 – an early signal that AI art could have market value. In 2022, as mentioned, an artwork partly made with the AI tool Midjourney won a state fair art competition in Colorado, USA, surprising the judges who were unaware of the AI's involvement. [Kuta, 2023] This incident sparked debates over disclosure and led to new rules requiring artists to declare AI usage.

Despite these controversies, many visual artists use AI as part of their creative process: for instance, Generative Adversarial Networks (GANs) have been used by artists like Refik Anadol to create stunning data-driven visual installations. Anadol's works involve feeding architectural or sensory data into AI models to produce swirling, abstract visuals displayed on large media walls, a pure collaboration between human concept and machine generation. Such projects show AI enabling new forms of visual expression that were technically impossible before.

At the same time, the increasing adoption of AI in commercial art production has created new pressures for creative professionals, especially in concept-heavy industries such as gaming and film. Some game studios in fact now use AI to generate concept art for environments and characters, reducing reliance on large concept art teams. A Los Angeles-based illustrator, for example, found some of her contract work decline as clients experimented with Midjourney to get quick concept mock-ups. However, she was able to adapt by positioning herself as an "AI-enhanced illustrator", offering to edit and improve AI-generated images for clients. This hybrid approach — where artists integrate AI into their practice while preserving human oversight and aesthetic input — illustrates a promising pathway for visual creators seeking to remain relevant in an evolving technological landscape.

Music and audio

AI in music has advanced rapidly, reaching the point where it can convincingly clone voices and compose songs in diverse styles. A striking case occurred in 2023 with the viral song *Heart on My Sleeve*, which was AI-generated to mimic the voices and style of chart-topping artists Drake and The Weeknd. The anonymous creator used software trained on those singers' vocals, resulting in a track that many listeners found convincing and catchy. [Savage, 2023] Garnering millions of streams before being taken down, the song highlighted AI's growing capability in music production but also triggered significant legal and ethical concerns. The record label swiftly demanded its removal, citing the unauthorized use of vocal likenesses and the creation of a derivative work without consent. This incident sparked a broader industry debate about voice rights, copyright, and the need for regulatory frameworks to govern AI-generated music. At the same time, AI music tools are flourishing for legitimate uses: startups like AIVA and Amper Music offer AI composition services for royalty-free background music, lowering production barriers for small content producers. Even established artists have begun to collaborate with AI; in 2020, pop singer Taryn Southern released an album *I AM AI*, composed with the assistance of various AI systems. In such cases, AI does not replace musicians but serves as a creative assistant, generating melodic ideas or instrumentals that artists can refine and personalize.

Nonetheless, questions around authorship and credit remain unresolved. If an AI writes most of a song, should it (or its programmer) get a songwriting credit? This remains uncharted legal and cultural territory. Additionally, the role of music producers is evolving and they might see their tasks shift from painstakingly crafting every beat to curating AI-generated sounds, focusing their efforts on selection, arrangement, and refinement. In adjacent fields like game development, sound designers are also adopting AI tools to generate complex sound effects through neural synthesis. These technologies can accelerate production but still rely heavily on human judgment to ensure quality and emotional resonance. Overall, AI is beginning to reshape music creation processes — not by replacing human creativity, but by transforming how it is supported and executed.

Writing and publishing

In journalism and marketing, often referred to as "robo-writers", have been used for years in specific domains such as financial reporting and sports recaps. However, the introduction of advanced language models like GPT-3 and GPT-4 between 2020 and 2023 significantly expanded AI's presence into more creative writing tasks. These newer models are capable of producing fluent, coherent text suitable for advertising copy, social media content, and even experimental literature. For example, the Associated Press now uses AI to automatically generate thousands of earnings reports each quarter, freeing journalists to focus on analytical pieces. In advertising, instead, agencies increasingly rely on AI to draft multiple versions of ad copy, slogans, or product descriptions, which copywriters then select from and polish. In such workflows, AI is often treated as a kind of junior copywriter, offering productivity gains and expanding creative options.

However, challenges have emerged as AI enters more public-facing and creative forms of writing. In 2023, several literary journals and magazines reported being overwhelmed by AI-generated short story submissions, which in some cases led them to temporarily pause open submissions. This caused alarm about AI clogging the pipelines with mediocre content and making it harder for genuine new writers to be discovered. Additionally, issues of authorship surfaced: individuals submitted lightly edited AI stories under their own names, raising ethical

questions about the legitimacy of such claims and prompting a wave of new editorial policies. Some publishers now explicitly ban AI-generated submissions or require full disclosure of AI involvement.

A prominent case study illustrating both the potential and pitfalls of AI writing occurred in mid-2023, when tech news outlet CNET began publishing financial explainer articles written by an in-house AI tool under human editorial supervision. The project drew public scrutiny after readers identified factual errors and instances of plagiarism. As a result, the site paused the program and emphasized the necessity of rigorous human oversight and transparency in AI-assisted journalism. This episode underscored a key point: while AI can accelerate content production, human editing remains essential to uphold standards of accuracy, originality, and tone. From a labor market perspective, the rise of AI may reduce demand for entry-level writing roles, such as content mill or SEO writing positions. However, it is also generating new kinds of jobs — most notably AI content editors or curators who specialize in refining, fact-checking, and adapting AI-generated drafts to meet professional standards and brand voices. As such, the writing and publishing industry is not simply being replaced, but rather restructured, with new skillsets and hybrid roles becoming central.

Film and animation

AI is increasingly influencing multiple stages of film production. In scriptwriting, while no major film has been entirely written by AI, professional writers are already experimenting with tools like Sudowrite or ChatGPT to brainstorm dialogue and develop story ideas. The Writers Guild of America, in its latest contract, permits the use of AI as a creative aid, but a writer must be credited, ensuring the human role isn't displaced.

In visual effects (VFX) and animation, AI techniques are streamlining processes. For instance, AI can upscale and clean footage (useful for restoring old films), automatically generate detailed backgrounds or crowd scenes, and assist with frame interpolation in animation (inbetweening). A widely publicized application occurred in *Indiana Jones and the Dial of Destiny* (2023), where an AI program was used on extensive archival footage of Harrison Ford to create a convincing image of his younger self for certain scenes. [Whiting, 2024] This demonstrated AI's power to convincingly alter video in ways that previously required huge manual effort by VFX artists.

In the animation industry, AI-driven style transfer can be applied to raw 3D renders to emulate a specific artistic look, reducing the time spent on manual shading and coloring. A notable case is the Japanese anime studio OLM, which revealed in 2023 that it had used AI to generate some background art for a new animated feature. While this significantly lowered production costs and accelerated turnaround, the process still involved human artists who guided the AI and refined its outputs, reflecting a hybrid creative workflow.

These developments have prompted mixed reactions in the animation community. Some fear the onset of automation in traditionally craft-intensive fields like 2D animation, while others welcome the potential for AI to alleviate the heavy workload placed on animators. Overall, while core creative tasks — such as storyboarding, directing, and character design — continue to rely on human input, AI is altering the execution of technical tasks and may influence the size and structure of production teams going forward.

Architecture and advertising design

In architecture, AI is playing a growing role not only in early concept design but also in technical and spatial optimization tasks. Generative algorithms are now used to optimize floor plans

based on constraints such as lighting, space efficiency, accessibility, and material use. In one notable urban planning project, AI generated dozens of layout options for a new public park, allowing architects to select and synthesize the best features into a final design that received higher approval from stakeholders than any single manually proposed option. The architecture firm Zaha Hadid Architects has experimented with Machine Learning to analyze city data and generate urban design patterns, claiming it can identify promising layouts that architects might overlook.

Similarly, in advertising and branding, AI is transforming how campaigns and visual identities are developed. Agencies now use AI tools to generate logo options, brand imagery, and even complete advertising mockups in a variety of stylistic directions, based on input values such as tone, target audience, or cultural themes. These outputs can then be reviewed and refined by creative directors, shifting the designer's role toward curation and brand oversight. For example, in 2023, global advertising group WPP partnered with an AI technology firm to offer clients tools that generate tailored social media advertisements in minutes — automating the creation of demographic-specific ad variations that would previously have taken days or weeks using only human teams.

This evolution clearly suggests that design roles may evolve: designers become curators and ensure brand consistency across AI outputs, rather than crafting each ad from scratch. That said, some caution that brand identity and creative strategy — deciding what message to communicate and how to position a brand — remain human responsibilities; AI can generate content for those strategies but not define them on its own.

These case studies underscore a common theme: AI is being employed in creative industries in highly varied ways, sometimes yielding remarkable new creative possibilities, and other times introducing friction or controversy. Building on the earlier examples, it becomes evident that each field is in the process of negotiating its equilibrium point, where AI's strengths — such as speed, scalability, and generative capability — are balanced by human oversight, ethical awareness, and creative intent. This balancing act is not limited to one region or cultural context: from Hollywood film studios to Tokyo-based design firms, from European architecture collectives to African music producers blending traditional and AI-generated sounds, the integration of AI marks a global paradigm shift in creative labor.

Professionals are responding by trying to find new synergies between their talent and the tools. Institutions are beginning to respond by crafting new guidelines. Institutions, too, are beginning to step in with evolving frameworks, whether through competition rules mandating AI disclosure, unions negotiating clauses to safeguard human contribution, or platforms implementing restrictions on synthetic content like deepfakes. Public perception and acceptance of AI-generated content will influence how far it proliferates. For example, if music fans broadly reject AI-composed songs as lacking emotional depth, the industry may limit their use. Conversely, if consumers prioritize enjoyment over origin, this could accelerate AI's creative integration. In this dynamic landscape, the co-evolution of technology, policy, professional practice, and audience expectations will determine the future contours of creativity in the AI age.

Taken together, these global examples illustrate a creative landscape in flux, where artists, institutions, and audiences are each negotiating the place of AI in cultural production. Within this evolving context, it becomes clear that Artificial Intelligence functions as a double-edged sword: on the one hand, it equips creatives with powerful new tools that enhance productivity and expand expressive possibilities, on the other hand it also brings profound disruptions to traditional practices, legal norms, and employment structures.

The opportunities are undeniably exciting. AI-human collaboration is already producing hy-

brid forms of art, unlocking access for non-specialists, and opening new markets and formats that were previously inaccessible. Yet the accompanying challenges are equally pressing. They compel a rethinking of what authorship means in a world where multiple human and machine contributors shape a single work. They demand safeguards to protect the development and livelihoods of human creators amid rising automation. And they require a continued commitment to preserving the cultural authenticity, emotional depth, and plurality of voices that make artistic expression uniquely human. Navigating this tension — between acceleration and caution, innovation and integrity — will be crucial as the creative and arts sectors continue adapting to the age of AI.

This tension underscores the need for a formal, critical analysis that moves beyond deterministic narratives of either technological utopia or creative collapse. In scholarly terms, particularly within social science and digital humanities frameworks, it is essential to recognize both the enabling and disruptive capacities of AI in the cultural economy. It appears that we are not heading toward an absolute replacement of artists by machines, but rather a complex restructuring of creative work. The labor market is shifting: some roles may fade, new ones will emerge, and most existing roles will evolve in their content and required skills. Professionals who combine creative expertise with AI literacy are likely to thrive in this environment. At the same time, cultivating the human aspects of creativity – empathy, cultural knowledge, imaginative risk-taking, ethical judgment – becomes even more crucial, as these form the comparative advantage of human creators over algorithms.

Given these challenges and opportunities, maintaining a human-centered approach is vital. As emphasized by institutions like UNESCO, the integration of AI into the creative economy must be governed by human rights, cultural ethics, and inclusive values. [German Commission for UNESCO, 2024] This entails not only ensuring transparency and accountability in AI-generated content, but also safeguarding the rights of creative professionals, through fair compensation, proper attribution, and the active promotion of cultural and linguistic diversity. The world of work in the creative sectors will likely be characterized by human-AI collaboration, and the societies that navigate this well will be those that empower their creative professionals with AI skills while also championing the irreplaceable contributions of human creativity.

Chapter 5

Conclusion

5.1 Summary of findings

This thesis set out to examine the transformative impact of Artificial Intelligence on the world of work, focusing in particular on two interconnected dynamics: the automation of specialized technical tasks and the growing significance of general, human-centric skills.

Through a critical review of academic literature, institutional analyses, and real-world case studies across sectors, the study has shown that the proliferation of advanced AI technologies — most notably Machine Learning, Natural Language Processing (NLP), Deep Learning, and Large Language Models — is fundamentally altering the way labor is organized, valued, and distributed in both industrial and creative economies. These technologies are not merely enhancing productivity; they are reshaping job roles, redefining skill requirements, and triggering significant shifts in labor market dynamics.

As AI systems increasingly take on functions previously performed by humans, workers are compelled to adapt by cultivating distinctly human capabilities: empathy, judgment, creativity, cultural literacy, and ethical reasoning. The evolving nature of this technological-human relationship forms the central thread of the thesis and underscores the need for a strategic and inclusive approach to workforce development in the AI era.

Building on this analysis, the research highlighted that AI has progressed well beyond the automation of routine, rule-based tasks. It now encompasses a growing capacity to perform complex, knowledge-intensive functions once thought to require exclusively human expertise. Sectors such as medicine, law, finance, and engineering are increasingly integrating AI systems into core workflows. For instance, in diagnostic imaging, contract review, algorithmic trading, and generative design.

However, this evolution does not imply wholesale replacement of human professionals. Rather, AI is most often deployed in ways that complement human capabilities, facilitating the emergence of hybrid roles that blend machine efficiency with human insight. As a result, the locus of human labor is shifting toward tasks that demand qualities machines still lack, such as ethical discernment, contextual judgment, emotional intelligence, and nuanced communication. These developments underscore the central argument of the thesis: that the future of work will not be defined solely by technological substitution, but by the reconfiguration of human-machine collaboration.

Complementing this shift is the growing significance of general, human-centric skills — often referred to as "soft skills" — such as creativity, emotional intelligence, communication, cultural awareness, adaptability, and leadership. These competencies, the study argues, are not only difficult for AI to replicate but are becoming increasingly vital in sectors where human in-

teraction, contextual decision-making, and innovation are indispensable. From education and healthcare to customer service and the creative industries, employers are placing greater value on the uniquely human attributes that enable empathy, nuanced understanding, and meaningful collaboration.

Taken together, these findings point to a dual transformation of the labor market: the deepening automation of technical tasks on one hand, and the parallel humanization of work roles on the other. In this evolving landscape, success will favor workers and institutions capable of integrating technological fluency with social intelligence, critical thinking, and ethical awareness — skills that ensure human relevance and resilience in the age of AI.

5.2 Critical reflection

A critical analysis of the findings highlights a central paradox of technological advancement: the more capable machines become, the more valuable uniquely human traits appear. Early narratives around Artificial Intelligence often emphasized fears of large-scale job displacement and automation-driven obsolescence. However, the evidence suggests a more nuanced and complex reality, one in which work is not eradicated but deeply reorganized. Rather than replacing human labor outright, AI is reshaping tasks, altering skill demands, and transforming professional identities across sectors.

One key insight emerging from this study is that AI must be understood not solely as a technological innovation, but as a socio-technical system. Its development, implementation, and impact are mediated by institutional decisions, labor relations, cultural contexts, and regulatory frameworks. The adoption of AI in the workplace is never neutral; it both reflects and reinforces existing power structures, inequalities, and access to opportunity. Therefore, any strategy aimed at ensuring a fair and inclusive transition to the AI-enabled workplace must consider not just skills development, but also ethical governance, inclusive policy design, and equitable access to training and digital infrastructure.

Closely tied to these considerations is the increasing importance of adaptability. The rapid pace of AI evolution demands that both individuals and organizations cultivate a capacity for lifelong learning and reinvention. Professionalism in the AI era is no longer defined by static expertise, but by the ability to navigate interdisciplinary knowledge, respond to new challenges, and collaborate effectively in dynamic, tech-augmented environments. Socio-emotional skills, cultural literacy, and a willingness to engage critically with technological systems are becoming central to sustained employability and meaningful participation in the labor market.

In sum, the emergence of AI is not simply a technological disruption, it is a driving force compelling a redefinition of the nature of work, the value of human contribution, and the institutional frameworks needed to support equitable and inclusive progress.

5.3 Limitations of the research

Despite the comprehensive scope of this thesis, some limitations must be acknowledged to contextualize its findings and outline directions for future inquiry.

First, the research relied primarily on a qualitative, literature-based methodology. While this approach enabled the integration of diverse theoretical perspectives, institutional reports, and real-world case studies, it inevitably lacks the empirical robustness and statistical generalizability that a mixed-methods or quantitative design could offer. For instance, large-scale labor market modeling, longitudinal surveys, or econometric analyses of AI adoption rates across

industries would provide a more data-driven foundation to validate or challenge the patterns described. Future research could greatly benefit from such methodological diversification.

Second, although the thesis adopted a global and cross-sectoral lens to capture the breadth of AI's impact on work, this wide-angle view limited the depth with which regional and local dynamics could be explored. Cultural, institutional, and economic differences between countries — and even within regions — play a significant role in shaping how AI technologies are deployed and how workers experience their effects. For example, national labor regulations, education systems, digital infrastructure, and cultural attitudes toward automation all mediate the trajectory and impact of AI. A more focused, localized analysis, whether by country, sector, or demographic group, would provide greater granularity and practical insights for policymakers and stakeholders operating in specific contexts.

Third, although the thesis aimed to maintain a balanced perspective by integrating technological, economic, and humanistic viewpoints, certain complex ethical and sociopolitical dimensions of AI in the workplace were only addressed in a preliminary way. Issues such as algorithmic bias, the potential for increased surveillance and datafication of employees, and the implications for worker autonomy and consent are critical areas of concern as AI becomes more embedded in managerial and decision-making processes. These themes require further interdisciplinary research, drawing from fields such as critical data studies, labor law, and digital ethics, to fully grasp their implications for equity and justice in the future of work.

It can therefore be stated that, while this thesis provides a foundational understanding of AI's transformative role in labor markets, it should be viewed as a starting point for deeper, more empirically grounded, and context-sensitive research. A continued effort to investigate the complex and evolving interplay between AI, institutions, and human labor is essential to inform responsible and inclusive technological governance.

5.4 Future research directions

Building on the findings and limitations of this thesis, several promising directions emerge for future research and policy development in the context of AI and the world of work.

Longitudinal workforce studies

To better understand the evolving relationship between AI technologies and labor markets, there is a need for longitudinal studies that monitor how job roles, skills demands, and wage structures change over time. Such research would be invaluable in distinguishing between temporary disruptions caused by initial AI adoption and more lasting structural transformations. Long-term data could also inform predictive models for workforce planning and reskilling strategies.

Comparative policy analysis

Given the diversity of national strategies for AI governance and workforce preparedness, comparative studies are essential to identify which policy interventions, educational reforms, and labor market supports are most effective. Exploring the variation in public investments, vocational training programs, and AI literacy initiatives across countries can yield insights into best practices for mitigating displacement and fostering inclusive innovation.

Psychosocial and organizational impacts

While much attention is paid to the economic and technical dimensions of AI adoption, more research is needed on its psychosocial effects. Investigating how AI integration influences organizational culture, professional identity, job satisfaction, and mental health will be critical for designing humane and supportive work environments. These dimensions are particularly important in creative and service sectors, where emotional engagement and team dynamics play a central role.

Interdisciplinary collaboration

The complex nature of AI's impact on work calls for interdisciplinary research that bridges computer science, sociology, psychology, labor economics, ethics, and public policy. Such collaboration can lead to more holistic understandings of human–AI interaction and support the development of frameworks that combine technical efficacy with social responsibility. These efforts can inform both academic theory and real-world applications in designing inclusive and responsible AI systems.

Ethical AI deployment

Finally, future research should prioritize the ethical governance of AI in the workplace. This includes critical issues such as algorithmic accountability, transparency, data privacy, the prevention of bias, and equitable access to AI tools. As AI becomes increasingly embedded in hiring, performance evaluation, and creative processes, ensuring fair and just implementation is essential to uphold workers' rights and societal values.

Overall, the future of AI in the workplace should not be framed solely in terms of automation or efficiency gains, but rather as a deeper transformation in how value is produced, how labor is organized, and how human potential is recognized. AI represents not a replacement of human workers, but a powerful catalyst for redefining the boundaries between human and machine capabilities. In this new configuration, the comparative strengths of human labor — such as critical thinking, cultural sensitivity, emotional intelligence, and ethical judgment — become more essential, not less.

This transition calls for a deliberate and inclusive approach to innovation. Societies that invest in the human side of technological change — through education, worker protections, inclusive policies, and ethical oversight — are more likely to harness AI in ways that strengthen social cohesion and economic resilience. Conversely, if AI deployment proceeds without attention to fairness, access, and long-term human development, it risks deepening inequalities and eroding the cultural and emotional dimensions of work that give it meaning.

Ultimately, the challenge is not just about adapting to a new set of tools, but about reshaping the very values and systems that underpin our economies and institutions. The future of work in the age of AI must be designed, not simply accepted. And that design must be anchored in the principles of human dignity, democratic participation, and shared prosperity, ensuring that AI serves as a force for collective empowerment, rather than fragmentation or exclusion.

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