

The Impact of Deep Technology on Traditional Industries**أثر التكنولوجيا العميقة على الصناعات التقليدية****Reggani Lalla Fatma¹, Lensari Embarka²**¹ Tamanghasset University (Algeria), reggani.lalafatma@univ-tam.dz² Ouargla University (Algeria), lensari.bk18@gmail.com**Received:** 06/04/2025**Accepted:** 30/06/2025**Published:** 30/06/2025**Abstract:**

This paper aims to study the effects of deep technology on traditional industries comprehensively, through an analysis of the mechanisms of digital transformation and its multidimensional implications. The study focuses on examining the various changes that deep technology is bringing to traditional productive sectors, with a focus on how modern technologies such as artificial intelligence, robotics, and advanced analytics are being integrated into traditional value chains

It was concluded that deep technology has become a strategic determinant of competitive advantage across different economic sectors, going beyond being a mere complementary element, as the disparity in the levels of adoption of these technologies between different sectors reflects multidimensional challenges that include structural, cultural and financial factors, which requires the design of comprehensive strategic initiatives that take into account the distinctive features of each sector and its potential, ensuring a more effective response to specific sectoral challenges and maximizing the utilization of available technological opportunities.

Keywords: Deep Technology, Traditional Industries, Digital Transformation, Economic Sectors, Artificial Intelligence.

JEL Classification Codes: O33, L16, O14, I15, G29

ملخص:

تهدف هذه الورقة البحثية إلى دراسة تأثيرات التكنولوجيا العميقة على الصناعات التقليدية، من خلال وصف وتحليل لآليات التحول الرقمي وانعكاساته المتعددة الأبعاد، حيث تركز الدراسة على فحص مختلف التغيرات التي تحدثها التكنولوجيا العميقة في القطاعات الإنتاجية التقليدية، مع التركيز على كيفية دمج التقنيات الحديثة على غرار الذكاء الاصطناعي، الروبوتات والتحليلات المتقدمة في سلاسل القيمة التقليدية. ولقد تم التوصل إلى أن التكنولوجيا العميقة أصبحت محددًا إستراتيجيًا للميزة التنافسية عبر القطاعات الاقتصادية المختلفة، متجاوزة كونها عنصرًا تكميليًا، حيث أن التباين في مستويات تبني هذه التقنيات المختلفة يعكس تحديات متعددة الأبعاد تشمل العوامل الهيكلية، الثقافية والتمويلية، وهذا ما يتطلب تصميم مبادرات إستراتيجية شاملة تأخذ بعين الاعتبار السمات المميزة لكل قطاع وإمكاناته الكامنة، مما يضمن استجابة أكثر فاعلية للتحديات القطاعية المحددة ويعظم الاستفادة من الفرص التكنولوجية المتاحة.

كلمات مفتاحية: تكنولوجيا عميقة؛ صناعات تقليدية؛ تحول رقمي؛ قطاعات اقتصادية؛ ذكاء اصطناعي.

تصنيفات JEL: O33، L16، O14، I15، G29.

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INTRODUCTION:

In the era of the Fourth Industrial Revolution, the global economic landscape is undergoing an unprecedented transformation, as deep technology erases traditional boundaries between sectors and rewrites the basic rules of competition. These technologies - from artificial intelligence and machine learning to nanotechnologies and quantum computing - go beyond being tools for incremental improvement, and become engines of radical change that are reshaping the very fabric of traditional industries.

Unlike previous waves of technological change that often followed a linear and predictable trajectory, this one is characterized by its transformative and accelerated nature, making it a complex challenge for decision-makers to predict its trajectory and implications.

Problematic:

In this context, this study poses the following central question: How is deep technology structurally transforming traditional industries?

Hypotheses of the study

In order to answer this question, a set of hypotheses were put forward:

- Deep technology leads to radical structural shifts in traditional industries, enhancing productive efficiency and competitiveness.
- Levels of deep technology adoption vary across economic sectors as a result of structural, cultural and funding factors.
- Deep technology is creating new economic opportunities by fostering innovation and developing unprecedented markets.

Objectives of the study:

This paper seeks to achieve a number of objectives, including:

- Studying the effects of deep technology on traditional industries comprehensively.
- Analyze the mechanisms of digital transformation and its multidimensional repercussions on productive sectors.
- Examine the changes that deep technology is disrupting traditional value chains by incorporating technologies such as artificial intelligence, robotics, and advanced analytics.
- Assess the role of deep technology as a strategic determinant of competitive advantage across economic sectors.
- Explore the challenges and opportunities arising from the adoption of deep technology in various sectors.

The relevance of the study:

The significance of this study is as follows:

- Explain how deep technology has become a key driver of radical change in traditional industries, reshaping the rules of economic competition.
- Highlighting the importance of understanding the structural transformations resulting from deep technology for decision makers to face challenges and exploit opportunities.
- Highlighting the digital divide between sectors, providing a basis for designing targeted strategies to boost technology adoption.

- Provide insights on the impact of deep technology on the digital economy and labor market, which supports future economic planning.

Approach:

The descriptive-analytical approach was used to describe the characteristics of deep technology and analyze its effects on traditional industries using data and statistics from authoritative reports.

Previous studies:

This topic has been addressed in several studies, including:

- **Michael Choi & Sarah Williams (2021):** "Deep Technology: The Future of Global Innovation" - on the future of global innovation through deep technology (Source: McKinsey).
- **Angelo Romasanta et al. (2022):** "Deep Tech: Unveiling the Foundations" - The foundations of deep technology presented in a working paper from ESADE.
- **MIT Technology Review (2022):** Addresses recent advances in deep technology and its applications.
- **MIT Media Lab (2023):** "The Future of High Technology" - Focused on advanced technology and its future impact.
- **Joshua E. Siegel et al. (2020):** "Cultivating Invisible Impact with Deep Technology and Creative Destruction" - Discussed the impact of deep technology in reshaping industries via disruptive innovation.

The difference between these studies and the current study is that the current study is characterized by its precise focus on traditional industries and analyzing the effects of deep technology on them using clear quantitative data, which makes it more practical and applied compared to references that tend to generalize or focus on theoretical foundations or future visions. This difference reflects the current study's orientation towards providing applicable economic insights for decision makers in traditional sectors

1- Deep technology

1-1 Definition of Deep Technology:

Deep Tech is an advanced scientific methodology based on fundamental scientific discoveries, characterized by its ability to go beyond traditional and gradual solutions, focusing on finding radical innovations that solve complex issues, and its importance stems from its reliance on rigorous scientific research and overlapping disciplines, enabling it to provide qualitative solutions to global challenges. (MIT Technology Review, 2022)

Deep technology is defined as a technological paradigm that aims to create high economic value through radical innovations, investing heavily in research and development, creating new industries and changing traditional production systems, in order to bring about qualitative economic revolutions beyond incremental improvements in the market. (Choi, Williams, 2021)

Deep technology is an integrated technological ecosystem that combines advanced technologies such as artificial intelligence, robotics and biotechnology, and relies on the integration of different scientific disciplines, enabling it to produce innovative and unique solutions

1-2 Characteristics of Deep Technology:

Deep technology has a number of advantages, including the following:

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- **Advanced scientific innovation:** Deep technology is characterized by its ability to produce complex scientific innovations based on specialized research, as it is not limited to improving existing technologies, but seeks to create radical solutions based on advanced scientific discoveries that require a high level of expertise and knowledge.
- **Technological complexity:** They are characterized by a high degree of technical and structural complexity, as they require huge investments in research and development and require specialized and multidisciplinary teams capable of dealing with complex and interconnected technological systems.

High value-added: Aims to provide innovative solutions to complex challenges in society and has the potential to disrupt industries and create new markets, generating significant economic value beyond the traditional uses of technology (MIT Media Lab, 2023).

- **Sustainability and social impact:** Primarily focused on addressing major global challenges such as climate change, healthcare and food security.
- **Offers sustainable solutions:** Aim to improve the quality of life and make a positive impact on society and the environment.

Intellectual property and patents: It is characterized by the protection of innovations through complex patents that are difficult to imitate, so that they have a high moral and economic value that reflects the depth of innovation and the scientific effort exerted in developing them; (Romasanta et al., 2022, pp. 11-13)

- **High risks and challenges** involve a high level of risks and challenges, as they require large and long-term investments, due to the high failure rate, and therefore require great patience and determination to overcome technical and scientific challenges.
- **Multiple applications:** They can be applied in a wide variety of fields such as medicine, biotechnology, artificial intelligence, renewable energy, nanotechnology, space science, etc.
- **Technological integration** is characterized by its ability to integrate multiple technologies together and create innovative solutions through the intersection of different scientific disciplines, which makes it develop complex and integrated systems that rely on the integration of advanced science. (CB Insights, 2025,)

These characteristics make deep tech a complex but promising field, as it can lead to major innovations and transformations in the market and society.

1-3 The Goals of Deep Technology: Deep technology aims to:

- **Expanding cognitive and technological boundaries:** The main strategic objective of deep technology is to transcend traditional concepts of technology and establish new knowledge standards and thresholds. It constantly seeks to displace knowledge boundaries and open up new horizons for scientific and technological innovation, representing a continuous process of cognitive and expansion.
- **It seeks to materialize the concept of turning "science fiction" into reality:** Most deep technology initiatives emerge from highly specialized academic research, working to transform innovative laboratory discoveries into practical applications with societal impact, through a rigorous and structured research methodology.

- Tackling complex societal challenges: Deep tech is focused on developing innovative solutions to humanity's most intractable challenges, using advanced technologies and disruptive innovations to address complex issues in critical areas such as health, environment, energy and food security, with a focus on generating positive societal value (TechCrunch, 2025);
- Bringing about transformational change: This technology aims to develop core technologies that are capable of bringing about radical changes across different sectors, not just incremental improvements, but also reshaping technological, economic and social structures.
- Creating innovative business models: Through the development of advanced fields such as quantum computing and materials science, deep technology creates new platforms for innovation, creates innovative revenue opportunities and opens up new horizons for unprecedented business applications.
- Contributing to sustainable development: Deep Tech is committed to achieving the SDGs by developing environmentally friendly and sustainable technological solutions and focuses on creating positive value beyond direct economic gains to include human well-being and conservation of natural resources (Deloitte, 2025).

Deep technology is not just a technical path, but a holistic vision to reimagine the potential of science and technology in the service of humanity, a bridge between theoretical potential and practical applications that can make a real difference in people's lives.

1-4 Deep technology fields:

Artificial Intelligence (AI) and Machine Learning: This field of technology is considered a paradigm shift in understanding and analyzing complex data, as it gives computer systems the ability to learn, adapt and predict almost independently. The importance of AI and machine learning lies in their ability to transform various sectors, from healthcare to industry and education to logistics and security, (Vajirao Institute, 2025)

1-4-1 Artificial intelligence: Artificial intelligence can process huge amounts of data at record speeds, extract complex insights and patterns that are difficult for the human mind to grasp, opening new horizons for innovation and development, and contribute to solving complex issues through advanced learning models capable of continuous modification and adaptation, as they can learn from previous experiences and gradually improve their performance, and in essence this field is a key enabler of digital transformation, helping organizations and companies make more accurate and smarter decisions, achieve unprecedented operational efficiency, and go beyond its technical role to become a key driver of innovation and reshape concepts

1-4-2 Biotechnology and genomics: It is an advanced scientific system that explores, analyzes and re-engineers the genetic structure of living organisms, which represents a technological revolution in the field of life sciences. These technologies provide unprecedented possibilities for precise intervention in

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genetic material, with the aim of developing personalized treatments, improving crops, treating genetic disorders, and understanding disease mechanisms in greater depth. (Parmar, 2024, p. 18) Despite its promising potential, it raises ethical and security challenges that require a strict regulatory framework to ensure its responsible and safe use, making it one of the most important areas of deep technology that has the potential to radically change our understanding of life and our ability to intervene therapeutically. (Arya, 2025)

- 1-4-3 Advanced robotics:** They represent the pinnacle of technological development in the field of mechanical engineering and artificial intelligence, as they constitute a complex technological system capable of simulating the functions of living organisms with a high degree of accuracy and complexity. These robots are characterized by advanced capabilities to learn, adapt and interact with the surrounding environments using advanced artificial intelligence algorithms, making them capable of performing complex tasks in various fields such as medicine, industry, space and scientific research (Nwabueze et al., 2024, p. 12). (Nwabueze et al., 2024, p. 12), relying on advanced technologies in the fields of sensing, control and processing, allowing them to make autonomous decisions and perform accurate tasks with high efficiency that exceed human capabilities in many fields, advanced robots represent an integrated model of deep technology that combines mechanical, electronics and artificial intelligence sciences, which opens new horizons for innovation and development in various sectors, while continuing challenges related to ethics and social impact. (Nwabueze, 2024, p. 13)
- 1-4-4 Quantum computing:** It is an advanced technological model that represents a radical revolution in the world of informatics and computing, based on the principles of quantum mechanics for processing and encryption, this technology exceeds the limits of traditional computing through the use of quantum units (qubits) that can exist in multiple states at the same time, which provides huge computational capabilities that exceed classical computing systems by billions of times, and its applications include multiple fields such as data encryption, artificial intelligence, complex scientific modeling, and solving strategic issues in physics, chemistry, and business. Quantum computing is a promising technological technology capable of radically transforming the way complex data is processed and analyzed, opening new horizons for scientific and technological innovation; (Das & Al, 2024, p. 34)
- 1-4-5 Nanotechnologies:** It is an advanced scientific and technological system that deals with matter at the atomic and molecular level, as it allows manufacturing and processing in dimensions ranging from 1-100 nanometers, these technologies represent a scientific revolution that enables researchers to manipulate materials at the most accurate levels, which opens new horizons for innovation in multiple fields such as medicine, electronics, energy...It is characterized by its ability to create new materials and structures with unique properties, such as high resistance, advanced conductivity, and unprecedented efficiency, and its applications include the development of precision medical treatments, microelectronic devices, and high-performance composite materials, making it

one of the most important areas of deep technology that has the potential to radically change our understanding of matter and our ability to engineer it with extreme precision;("Technology Use in Traditional Industries," 2019, p. 4)

1-4-6 Advanced Renewable Energy: It is an integrated technological model that aims to develop clean and sustainable energy sources using the latest scientific innovations. These technologies go beyond the traditional concepts of renewable energy by integrating advanced technologies in the fields of solar cells, wind and bioenergy, with a focus on increasing conversion efficiency and reducing environmental costs, relying on innovative solutions such as advanced nanomaterials and smart storage systems, allowing for more sustainable and reliable energy production, and its applications include developing smart power plants, high efficiency batteries, and advanced conversion technologies that contribute to addressing global environmental and energy challenges, making it (Meissner, 2019, p. 12)

It is worth noting that the technology arena is witnessing an accelerated growth in investment rates, as companies and institutions direct their investments towards modern technological technologies, as the table below shows the volume of investments in five main technological areas: Artificial Intelligence with its various applications, the Internet of Things and its ability to connect different systems, Blockchain technology with its potential to transform transaction models, advanced robotics that reshape production sectors, and augmented reality that opens new horizons for human-machine interaction. This data reflects the evolution of the global technological landscape and provides important indicators about investment trends in these vital sectors.

Table (1): Distribution of investments by technology type (2024)

Technology	Percentage (%)	Average cost to implement (million dollars)	Expected Return (%)
Artificial intelligence	42	25.3	185
Internet of things	28	18.7	142
Blockchain	15	12.4	98
Robots	10	28.6	156
Augmented reality	5	8.9	75

Source: Prepared by the researchers based on(CB Insights, 2025)

The table provides a comprehensive analytical overview of investment trends in five advanced technology areas, with detailed data on investment ratios, average implementation costs, and expected returns for each area. These data reflect the current landscape of technology investments and provide important indicators of future trends in the sector.

Artificial Intelligence (AI) accounts for the largest share of investments at 42%, reflecting the growing confidence in the potential of this technology and its diverse applications in various sectors. Although the average cost of implementing AI projects is \$25.3 million, the high expected return of 185% justifies the investment. This explains why companies and organizations are racing to adopt AI solutions despite the high initial costs.

In second place is the Internet of Things (IoT) with 28% of the total investment, and a relatively lower average implementation cost of \$18.7 million. With an expected return of 142%, IoT is

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an attractive investment option, especially with the growing demand for connected systems and smart infrastructure in cities, factories, and homes.

Blockchain technology ranks third with 15% of investments and an average implementation cost of \$12.4 million. Although its expected return (98%) is only slightly more than double the initial investment, the technology is still attracting significant interest due to its promising applications in smart contracts, supply chains, and financial services.

Robotics makes up only 10% of the total investments, but it has the highest average implementation cost of all the technologies mentioned, at \$28.6 million. This high cost reflects the technological complexity and infrastructure required to implement robotics projects, especially in the industrial and medical sectors. However, the expected return of 156% makes it a worthwhile investment in the long run.

Finally, AR comes in last with only 5% of investments and the lowest average implementation cost of all technologies (\$8.9 million). Although the expected return of 75% is the lowest compared to other technologies, the field is growing rapidly with AR applications in education, entertainment, and marketing.

2- The impact of deep technology on traditional industries

2-1 Industry and manufacturing sector

The impact of deep tech on industry and manufacturing is demonstrated by the following:

2-1-1 Automation of industrial processes using intelligent robots: An advanced model of industrial transformation, it is an exceptional technological strategy that aims to re-engineer production processes by employing robotic systems with advanced artificial intelligence (AI) capabilities. This methodology focuses on replacing traditional manual processes with automated systems that are capable of continuously learning and adapting, ensuring high accuracy and unprecedented efficiency in industrial performance, characterized by its ability to improve production quality, reduce operational costs, enhance the competitiveness of industrial enterprises, and provide a safer and more reliable work environment. Despite the challenges associated with high cost and workforce retraining, this technology remains a key driver of industrial innovation, opening up new horizons for technological development in various global production sectors (Siegel et al. (Siegel et al., 2020, pp. 6-19)

2-1-2 Improving production efficiency through advanced data analytics: This model relies on the use of AI and machine learning tools to process massive amounts of industrial data with exceptional speed and accuracy, which allows predicting operational challenges and foreseeing productive opportunities before they occur. Its importance is evident in the ability to extract complex analytical insights, identify points of efficiency and waste, and continuously improve manufacturing processes, leading to higher productivity and lower operational costs. This advanced analytical approach is a strategic methodology that enables industrial organizations to make data-driven decisions and achieve sustainable competitive advantage in a complex and ever-changing business environment. (Jing, 2022, pp. 15-17)

2-1-3 Developing new materials using nanotechnology: Nanotechnology is a promising scientific and technological revolution in the development of

industrial materials, enabling scientists and engineers to engineer materials at the atomic and molecular level with unprecedented precision. This trend focuses on designing and manufacturing advanced materials with unique and advanced properties that go beyond the limits of traditional technology. ("Deep Tech, Big Science, and Open Innovation," 2024, p. 34)

Nanomaterials have the potential to improve functionality in various industrial sectors, such as automotive, electronics, energy, and medicine. For example, lightweight and durable nanomaterials can be developed for engineering structures, or highly efficient conductive materials for advanced electronic circuits. (Hou, 2020) Some of the most promising applications of nanomaterials include :

- Produce self-cleaning, corrosion-resistant surfaces.
- Designing biocompatible medical materials with high precision.
- Improving the efficiency of transformers and industrial equipment.
- Developing ultra-efficient insulating materials for thermal and electrical insulation.

Nanotechnologies represent a promising future for industrial innovation, offering unlimited possibilities to develop unique materials that meet the needs of advanced technology.

2-1-4 Optimizing supply chains with AI: Artificial Intelligence (AI) is completely revolutionizing industrial supply chain management, giving organizations the ability to optimize logistics processes with unprecedented efficiency. By processing and analyzing massive amounts of data, AI is transforming traditional supply chains into dynamic and intelligent systems that are able to instantly adapt to market changes. The importance of these technologies is evident in their ability to predict inventory needs, optimize shipping routes, and identify efficiency points, leading to lower operational costs and enhancing the competitiveness of industrial organizations in a rapidly changing business environment. ("Challenges and Opportunities for Deep Learning," 2022)

2-2 Agriculture:

2-2-1 Precision agriculture using sensors and artificial intelligence: Precision agriculture is a high-tech model of agricultural production that utilizes sensors and artificial intelligence (AI) to maximize the efficient use of agricultural resources. These technologies continuously collect and analyze accurate data about the soil, climate, and crops, allowing farmers to manage farmland in a scientifically informed manner. A smart farmer can determine the exact water and fertilizer needs of crops, predict potential plant diseases, and optimize irrigation and fertilization in real time. These technologies contribute to increasing agricultural productivity by up to 30%, while reducing the consumption of natural resources and promoting environmental sustainability, constituting an innovative solution to agricultural challenges under climate change and increasing population growth (Raju, 2024, p. 2).

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- 2-2-2 Developing genetically modified crops to resist climate conditions:** Genetic modification of crops represents an advanced scientific strategy to address the growing climate challenges, as scientists aim to develop plant strains capable of adapting to harsh environmental conditions. This technique focuses on genetically engineering crops to enhance their ability to withstand drought, salinity, and extreme temperatures, ensuring food security in areas prone to climate change. These crops are designed using advanced genetic modification techniques that allow the introduction of genes resistant to environmental stress, such as modifying drought resistance genes or increasing water use efficiency. As such, these GM crops are an innovative solution to the challenges of agricultural production under global climate change, while maintaining nutritional value and the potential for mass production. (Padhiary, 2024, p. 6)
- 2-2-3 Smart irrigation systems:** Smart irrigation systems represent a paradigm shift in agricultural water management, relying on advanced technology to maximize water efficiency. These systems use a sophisticated set of sensors and artificial intelligence to determine the exact water needs of crops at every stage of their growth. Smart technologies collect and analyze integrated data on soil moisture, temperature, and transpiration rates, allowing for highly accurate water management. These systems can directly adapt to changing climatic conditions, directing water in the right amount and timing, reducing water consumption by up to 40% compared to traditional irrigation systems. These technologies contribute to enhancing agricultural sustainability and protecting water resources, and constitute an innovative solution to environmental challenges in the agricultural sector. (Ramteke, 2023, p. 9)
- 2-2-4 Drone crop monitoring:** An advanced form of precision agricultural monitoring, drone crop monitoring technology provides an effective tool to continuously and comprehensively monitor crop conditions. Drones are able to fly over large agricultural areas and capture high-resolution images using advanced cameras and specialized sensors, allowing for analysis of plant health and early detection of any issues such as diseases, pests, or nutrient deficiencies. This technology provides accurate and real-time data to farmers, enabling them to make proactive decisions to protect crops and improve productivity. Drones also allow for fast and accurate cadastral surveys and minimize operational costs compared to traditional methods, making it an innovative technological solution in the field of smart agriculture. (Ramteke, 2023, p. 9)

2-3 Transportation Sector

- 2-3-1 Intelligent Transportation Systems (ITS) and transportation:** Intelligent Transportation Systems (ITS) is an advanced economic model that combines advanced technology with operational efficiency, bringing significant added value to the economy and society. These systems rely on artificial intelligence and sensors to optimize traffic management and substantially reduce operational costs (Haghighat, 2025, p. 2). (Haghighat, 2025, p. 2) In economic terms, this technology contributes to reducing losses due to traffic congestion, estimated at

billions of dollars annually, by optimizing traffic flow and reducing fuel consumption by up to 20%. These systems also create new job opportunities in high-tech fields and support the transition towards a knowledge economy, while realizing significant economic savings for the public and private sectors. They enhance operational efficiency, reduce environmental costs, and improve the quality of logistics services, making them a strategic investment for modern infrastructure (Sagar, 2024).

2-3-2 Smart freight: Smart Freight is an advanced technological ecosystem that re-engineers transportation and logistics with a transformative approach, based on high-precision digital technologies. This strategy is centered around the use of AI tools and advanced sensor networks to transform supply chain management from a traditional model to a dynamic, flexible, and highly efficient system (Hargroves, 2023, p. 5).

This methodology has the ability to provide real-time tracking of shipments and strategically deep data analysis, allowing companies to optimize transportation routes, reduce operational costs, and enhance delivery reliability. Its importance is evident in its ability to achieve economic savings of up to 35% through optimal use of resources and decision-making based on accurate and real-time information.

Smart freight represents a future model that combines technological innovation with economic efficiency, giving companies a sustainable competitive advantage in the rapidly changing world of logistics.

2-4 The financial services sector:

The rapid development of Deep Tech is having a major impact on the financial services industry, disrupting traditional business models, and the following is a comprehensive analysis of the impact of these technologies on the financial sector:

2-4-1 Artificial Intelligence and Machine Learning

Artificial Intelligence (AI) applications are one of the most influential technologies in the financial sector. It contributes to improving financial analysis by processing huge amounts of data with accuracy and speed beyond human capabilities, as financial institutions use these technologies to assess risks more accurately and make informed investment decisions, in addition to developing fraud detection systems that continuously monitor transactions and identify unusual patterns, which protects institutions and clients from financial threats. Robo-advisors can be created to provide personalized investment advice based on the client's goals and risk tolerance, making financial advice available to a broader segment of the population (Robo-advisors). (Manikandan, 2024, p. 23)

2-4-2 Blockchain and cryptocurrencies:

Blockchain technology has revolutionized financial transactions by enabling secure and transparent transactions without the need for traditional intermediaries, reducing costs and speeding up transfers, especially in cross-border payments, and developing smart

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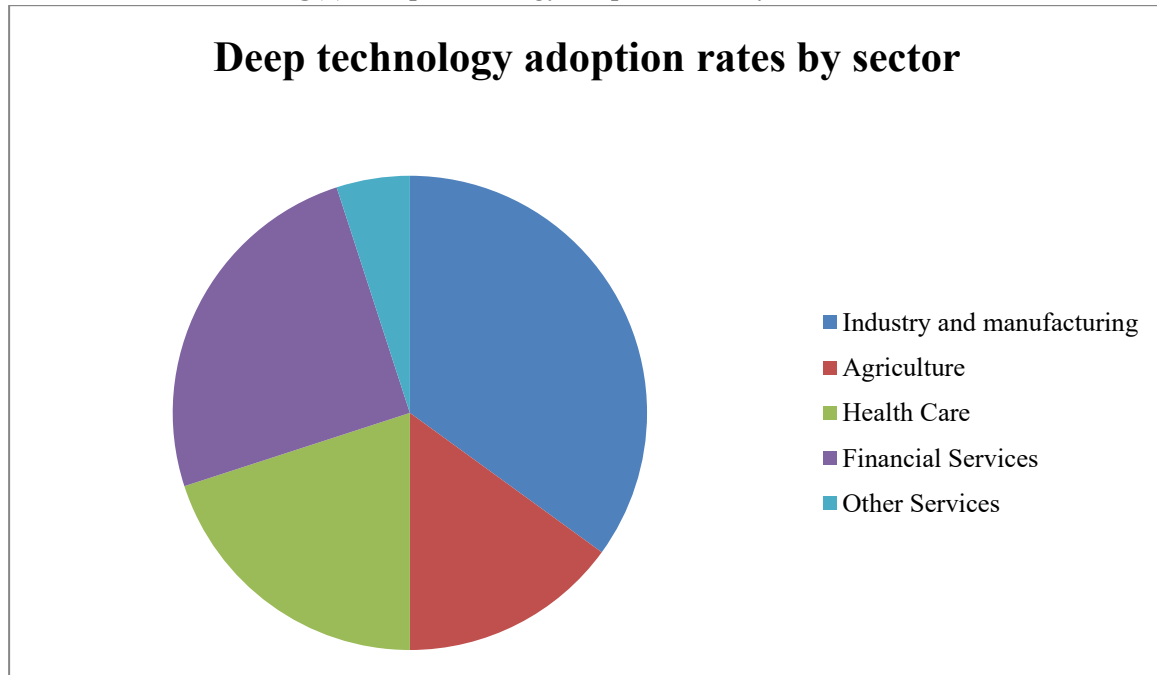
contracts that are automatically executed when specific conditions are met, simplifying complex financial processes such as securities settlement and supply chain management. (Jiahui, 2024, p. 3)

2-4-3 Cloud Computing and Financial Application Programming (APIs)

These technologies have enabled Open Banking models that allow financial institutions to share data securely, fostering innovation and the development of new services, as well as reducing the infrastructure costs of financial institutions by relying on a "pay-as-you-go" model instead of large capital investments. (Zijun, 2024, p. 8)

Deep technology is a key driver of digital transformation in today's global economy, and its effects vary depending on the sector in which it is adopted. The following figure shows the distribution of adoption rates of deep technology technologies such as artificial intelligence, machine learning, and advanced robotics across major economic sectors

Fig(1): Deep technology adoption rates by sector for 2024



Source: Prepared by the researchers based on (McKinsey Global Institute, 2025)

The figure above shows the distribution of deep technology adoption rates in various economic sectors, where the industry and manufacturing sector tops the list of sectors in adopting deep technology with 35% for several reasons, including the sector's need to improve productive efficiency and face global competition, large investments in automation, industrial robotics and the Industrial Internet of Things, as well as the need to improve product quality and reduce waste and operational costs, followed by the financial services sector with 25%, due to large investment in artificial intelligence technologies and big data analytics, the spread of blockchain applications and digital currencies, and the use of blockchain technology and cryptocurrencies.

Table (2): Deep technology adoption rate by sector (2024)

Sector	Adoption rate (%)	Annual growth rate (%)	Investment size (billion dollars)
Industry and industrialization	35	12.5	89.4
Financial services	25	15.8	67.2
Health care	20	18.3	45.6
Agriculture	15	9.7	23.8
Other services	5	7.2	12.5

Source: Prepared by researchers based on (McKinsey Global Institute, 2025)

The table above reveals important trends and investment opportunities, with industry and manufacturing leading the way with a 35% adoption rate and a USD 89.4 billion investment volume, reflecting the strategic importance of digital transformation in this sector, followed by financial services with 25% and an impressive annual growth rate of 15.8%, indicating a high efficiency in technology investment. The transportation and communication sector shows promising potential with the highest annual growth rate (18.3%), despite an average adoption rate of 20%. In contrast, the agriculture and other services sectors have lower adoption rates and investment volumes, creating significant opportunities for future development and growth. Total investments across all sectors amount to USD 238.5 billion, with a weighted average growth rate of 13.7%, exceeding global economic growth rates. These indicators confirm that deep technology has become a major driver of economic development and has a significant impact on the labor market, as shown in the following table:

Table (3): Impact of deep technology adoption on the labor market for 2024

Domain	New Jobs (%)	Jobs affected (%)	Rehabilitation Requirements (hours)
Data analysis	45	28	120
Programming robots	38	32	180
Information security	42	25	150
Digital Project Manager	35	30	90
Maintenance of smart systems	40	35	160

Source: Prepared by researchers based on (Deloitte, 2025)

The table provides valuable information on five key areas of the technology sector, and illustrates their impact on the labor market through three key indicators: Proportion of new jobs, proportion of jobs affected, and retraining requirements. This data reflects the ongoing structural shift in the labor market as a result of rapid technological advances.

The data shows that the field of data analysis tops the list of new job creation with 45%, followed by the field of information security with 42%, which reflects the growing importance of data as a strategic asset in the digital economy and the growing need to protect these assets from cyber threats, while the field of smart systems maintenance comes third with 40%, indicating the expansion of smart and automated systems in various economic sectors.

Programming robots accounts for 38% of new jobs, a high percentage that reflects the expanding use of robots in industry and services, while digital project management comes last with 35%, a percentage that remains high and indicates the growing need for specialized management skills to lead digital transformation projects.

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The data shows that the field of smart systems maintenance has the highest impact on current jobs at 35%, indicating a rapid shift in the requirements of this field due to the evolution of technology. This is followed by robotics programming at 32% and digital project management at 30%.

Data analytics has a 28% impact on current jobs, while information security has the lowest impact at 25%. These percentages reflect the degree of change in the skills and competencies required in each field, with more technology-driven fields experiencing higher rates of change. Robotics programming requires the highest number of recertification hours (180 hours), reflecting the complexity and continuous evolution of the required skills, followed by smart systems maintenance with 160 hours, and information security with 150 hours.

The field of data analytics requires 120 hours of recertification, while the field of digital project management has the lowest number of required hours with only 90 hours. This disparity reflects the difference in the nature of the skills required, with directly technical fields requiring more hours of training than administrative fields.

Conclusion:

In conclusion, it is clear that the adoption of deep technology has become a decisive factor in determining the competitiveness of different economic sectors, not just a secondary option. The study showed the disparity in deep technology adoption rates between sectors, which reflects different structural, cultural and investment challenges, which calls for the development of integrated strategies that take into account the specificity of each sector and the opportunities available to it.

The study came up with a number of findings:

- The future of the digital economy depends on the ability to accelerate the pace of digital transformation and bridge the technological gap between different sectors.
- The financial and advanced manufacturing sectors top the list of sectors that are adopting deep technology.
- Agricultural sectors suffer from a significant digital divide with adoption rates of less than 15% despite the great potential for precision agriculture applications.
- The healthcare industry is showing a marked acceleration in the adoption of deep technology after the COVID-19 pandemic, with a focus on early diagnosis and remote care applications.

Recommendations:

- The need to adopt government policies that support digital transformation in less developed sectors through incentive packages and tax exemptions for investments in deep technology.
- Establishing specialized innovation centres in each sector to facilitate the transfer of knowledge and technology and their adaptation to local needs.
- Developing educational and training programs geared towards capacity building in the field of deep technology in line with the requirements of the future labor market.
- Fostering partnerships between the public and private sectors and academic institutions to accelerate the pace of innovation and disseminate innovative solutions.

- Develop flexible regulatory frameworks that support innovation and protect data and privacy, while ensuring fair competition and minimizing the risks associated with digital transformation.

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