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Title of research article

Artificial Intelligence as a Strategic Catalyst for Advancing Egypt's Digital Economy: Opportunities, Challenges, and Policy Directions

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Abstract

This study examines the strategic role of artificial intelligence (AI) as a transformative mechanism for enhancing the digital economy in Egypt. In the past decade, AI has rapidly evolved into a core driver of economic modernization worldwide, enabling countries to strengthen productivity, enhance innovation, and improve public and private sector performance. Egypt has shown significant commitment to this technological shift through the development of a comprehensive National AI Strategy and various digital transformation initiatives aimed at promoting economic competitiveness, efficient service delivery, and improved governance. The findings reveal that Egypt has made notable progress in adopting AI across sectors such as finance, manufacturing, education, transportation, health, and e-government. However, structural obstacles—limited human capital, inadequate R&D investment, uneven digital infrastructure, cybersecurity challenges, and gaps in legislative frameworks—continue to restrict AI's full economic impact. The study concludes that AI can serve as a powerful catalyst for Egypt's digital transformation, provided that strategic reforms strengthen human capacity, incentivize innovation, reinforce legal structures, and enhance collaboration between universities, government institutions, and private sector actors.

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Introduction:

Introduction: Artificial intelligence is the focus of attention of the majority of the world's countries, due to their realization that the current era is the era of artificial intelligence and that the latter will change the features of the future, although its risks are still being explored.

Artificial intelligence has also taken over most of the studies, research, discussions and scientific events in recent years, where participants agreed that artificial intelligence plays a pivotal role in enhancing productivity and competitiveness, especially in light of the increasing adoption of technology and digital solutions in various sectors. The importance of the digital economy is reflected in its ability to stimulate economic growth, create jobs, promote innovation, facilitate trade, provide faster and more efficient government services, and contribute to reducing the digital gap between countries and enhancing economic integration.

The digital economy is also one of the main engines of growth in the world, in light of this accelerated development, artificial intelligence has formed a fundamental pillar that plays a vital role in enhancing investment, production and employment capabilities, in addition to enhancing the economic standing of countries at the regional and international levels.

With rapid technological progress, keeping the economy abreast of modern technologies in artificial intelligence has become a key factor in creating continuous streams of economic benefits. These benefits enhance the economic activities associated with the digital economy, contributing to tangible gains that include improving productivity, directing resources efficiently, and increasing competitiveness at the global level. Egypt, like other countries in the world, has taken good practical steps in this regard and has made great efforts, but on the other hand, it may face many challenges that hinder its ability to keep up with the rapid development in the field of artificial intelligence and use it to enhance its digital economy.

The problem of studying:

Based on what has been presented, this study came to answer the following main question:

How does artificial intelligence contribute to enhancing the Egyptian digital economy ?

To answer the problem of the study, the sub-questions have been formulated as follows:

- What is artificial intelligence And what are its types?

- What is the digital economy And what are its pillars?

- What is the reality of artificial intelligence and the digital economy in Egypt?

- What is the impact of artificial intelligence on the Egyptian digital economy?

Study objectives:

In accordance with the problem of the study and its sub-questions, the objectives of the study have been formulated as follows:

- Identify the theoretical concepts related to artificial intelligence and the digital economy;

- Identify the reality of artificial intelligence and the digital economy in Egypt;

- Identify the pros and cons of the impact of artificial intelligence on the Egyptian digital economy;

- Presenting a set of proposals that will contribute to valuing the positives and reducing the negatives resulting from the impact of artificial intelligence on the digital economy in Egypt.

Curriculum of study:

The descriptive approach was used to clarify what artificial intelligence and the digital economy are, in addition to using the analytical approach to clarify the effects of artificial intelligence on the Egyptian digital economy.

1-basics about artificial intelligence

1.1. definition of artificial intelligence:

The concept of artificial intelligence has many definitions given by researchers specializing in the field of artificial intelligence, other writers and those interested in this relatively modern science, the most important of which are the following:

Artificial intelligence is a scientific and technical method that includes methods, theories and techniques aimed at creating machines capable of simulating human intelligence (shahbi et al., 2018, P. 2), and it is often defined as a cognitive science and not as a technical science, due to its history as it began with research work in neural network science and mathematical logic before copying it as a computer science (Osmania, 2019, P. 12).

It refers to the ability of a computer or any other machine to carry out those activities that usually require intelligence, it is concerned with the development of machines and the representation of knowledge for use in making inferences, artificial intelligence can also be viewed as an attempt to model aspects of human thinking on computers (Nevin, 2012, p.481).

It is the science capable of building machines that perform tasks that require a certain amount of human intelligence when performed by humans (Saleh, 2009, p.33).

A specialization in Computer Science aimed at developing machines and systems that can perform tasks perceived as requiring human intelligence, whether with limited human intervention or without human intervention (World Intellectual Property Organization, 2020, P.4).

It is the ability of the machine to simulate the human mind and the way it works, such as its ability to think, discover and benefit from previous experiences. since the development of the computer in the mid-twentieth century, it has been discovered that the computer can perform more complex tasks than we thought, as it can, despite its many advantages of processing speed and high storage capacity, but now there is no program that can match the flexibility of the human mind, especially with regard to performing tasks that require automatic daily conclusions of what is being exposed (Suleiman, 2020, P. 81).

Based on the previous definitions, it can be said that artificial intelligence is a science that employs advanced computer software to perform intelligent activities that mimic those activities performed by humans, but better, in order to achieve different purposes.

1.2. Types of artificial intelligence:

There are three main types of artificial intelligence ranging from simple reaction to perception and self-interaction, as follows (shady, 2018, page 2):

1-2-1-narrow (weak) artificial intelligence: it is the simplest form of artificial intelligence, and it is programmed to perform certain functions within a specific environment, and its behavior is expressed as a reaction to a certain situation, and it can only work in the conditions of its environment. One example is IBM's "deep blue" robot, which defeated World Chess Champion Garry Kasparov in 1996.

1-2-2-general artificial intelligence (strong): it is characterized by the ability to collect and analyze information and accumulate experience from the situations it acquires, which qualifies it to make independent and autonomous decisions, examples of which are self-driving cars, instant chat bots, and personal assistance programs.

1-2-3-super artificial intelligence: these are models that are still under experiment, and seek to simulate humans, and here it is possible to distinguish between two basic patterns, the first: it tries to understand human thoughts, emotions that affect human behavior, and has a limited ability to social interaction. As for the second: it is a model of the theory of mind, where these models can express their internal state, predict other people's feelings and attitudes, and interact with them, they are the next generation of super-intelligent machines.

1.3. artificial intelligence opportunities:

Artificial intelligence systems offer many future solutions and opportunities that support economies and advance societies. In a study of the European Union, published in June 2020, on the topic of the opportunities that artificial intelligence can offer, its authors mentioned a number of areas in which its technologies will improve the future of the Union, the most important of which are the following (Eager & al, 2020, p. 77)

1.3.1-environment: artificial intelligence can contribute to reducing global greenhouse gas emissions by 1.5% to 4% by 2030.

1-3-2-health: the use of artificial intelligence can speed up the process of identifying and developing new drugs, as well as reuse existing ones for other purposes. It can also increase and improve: diagnosis and treatment, improve fetal health, predict and monitor epidemics and chronic diseases, improve primary health care services, promote medical research and drug discovery.

1.3.3-productivity and work: artificial intelligence systems are expected to bring significant benefits in terms of productivity. For example, one estimate predicts an increase in labor productivity of 11% to 37% by 2035 . Moreover, artificial intelligence is expected to support positive contributions to the UN Sustainable Development Goals.

2 - What is the digital economy

2.1-the concept of digital economy

The economy has gone through several stages, including the transition from the agricultural economy to the industrial economy as a result of the Industrial Revolution, up to the digital economy due to the development of information and communication technology and the shift from machines to information and knowledge, where information has become a source of wealth and a final product with a very high added value contributing to the development of the economy.

The term digital economy first appeared in 1995 by the Canadian writer "Don tap Scott don tap Scott" in his book published in English entitled: The Digital Economy Promise and Periling the age of Network Intelligence, the digital economy: hopes and risks in the era of the smart network (Mr., 2019, page 2).

The economy based on digital technology is based on several components, including technological infrastructure, hardware, software and networks, in addition to digital mechanisms that are carried out through business and Economic, including e-commerce and electronic transactions that are carried out entirely on the internet, and this reflects the importance and role of the internet in the scientific economy, also known as the internet economy or web economy (Mustafawi and Khalidi, 2022, P.618).

The digital economy is an economy that is based on digital computing technologies and mainly covers all commercial, economic, social, cultural, etc. activities supported by the web and other digital communication technologies, and it can also be defined as: the share of total economic output derived from a number of broad digital inputs, these digital inputs include hardware, software, communication equipment, intermediate digital goods and services used in production, and these broad measures reflect the foundations of the digital economy (Al-Qadi, 2021, P. 43).

He also defined the digital economy as: that type of economy based on the use of information and communication technologies that facilitate the flow of information, goods, services and the movement of capital from any point in the world and at any specific time (stoning, 2018, P. 44)

The digital economy also refers to the interaction, integration and continuous coordination between information and communication technologies on the one hand, and the national, sectoral and international economy on the other hand, in order to achieve transparency, immediacy and productivity of all economic indicators supporting all economic, commercial and financial decisions in the country during some stage (al-Khodari, 2023, P.661).

The information economy, the knowledge economy, the internet economy, the digital economy, the electronic economy, there are many names, but the meaning is the same, it is known as the economy based mainly on technological and Information Development, which increases the opportunities for growth and development of products and services, especially tradable digitally through information networks.

2.2. characteristics of the digital economy

The digital economy is characterized by:

- Increasing the importance of the influence, power, and spread of information and knowledge on the economy, becoming a source of wealth and transforming societies into a knowledge society;

- The interactive relationship between the economy and information and communication technologies;

- Increasing electronic transactions that depend on the internet, and the transition from reality to digital space;

- The increasing importance of controlling information to become the controller in the market;

- The digital age is characterized by intelligence, we find smart organizations, smart services....Etc., which significantly changed the features of the economy;

- Profit maximization and the spread of knowledge-based organizations that provide modern and innovative knowledge products and services, where information is the basis of the production process in addition to previously known factors of production (Land, workers, Capital, Management);

- It is a global economy due to the impact of globalization on it, up to digital globalization, and the resulting abolition of borders and barriers when conducting various trade exchanges;

digitization and flexibility in the face of accelerated developments.

It also helps the digital economy (Salah and El Sayed, 2020, Page 6):

- Increasing the integration of the country's economy into the world economy;

- Increase global trade opportunities and access to global markets;

- The digital economy improves relations between suppliers, exporters, competitors, dealers, investors, banks, insurance networks, manufacturers, producers, government agencies, customs, taxes, diesel enterprises and others.

2-3-justifications and pillars of the digital economy

The justifications for the orientation towards the digital economy can be presented in the following points:

- Changes occurring in the environment of organizations with its components: (economic, political, legal, environmental, technological);

- Coping with the intensity of the flow of information and knowledge by controlling it and helping to solve problems and make decisions in a flexible way;

- The Fourth Industrial Revolution and the resulting modern digital technologies and tools of the digital age have changed the features of the economy, such as big data, cloud computing, three-dimensional printing....Etc.

Among the factors contributing to the transition towards a digital economy are (Mustafawi and Khalidi, 2022, P. 618):

- Information and Communication Technology;

- Educational level of society (technological culture of society);

- Information society.

The digital economy is also based on a set of pillars that can be summarized in the following points (Fawzi, 2017, p. 168):

- Technical infrastructure and equipment;

- Providing a regulated legal environment to ensure fair competition;

- The ability of the financial sector to provide and develop investments and venture capital in order to support and support new ideas;

- The real capital represented by the human resources concerned with the education and training sector;

- Protection of intellectual property from patents, trademarks and copyrights to ensure the protection of rights;

- Research and development, which requires entering the new economy, raising the proportion of spending on research and development projects, and increasing spending on everything that increases the knowledge balance;

- The phenomenon of the explosion and speed of the flow of information and its consequences, which must be controlled within the framework of Information Management and information management.

2.4. Components of the digital economy

Include the following (Abdullah, 2021, pages 44-46):

- Basic innovations (semiconductors and processors), basic technologies (computers and telecommunications devices) and enabling infrastructures (internet networks);

- Digital and IT sectors that produce key products or services based on basic digital Technologie;

- A wide range of digitization sectors in which digital products and services are increasingly being used such as e-commerce and many digitally transformed economic sectors in which new activities or business models have emerged that are changing as a result of digital technologies, such as finance, media, tourism and transport;

- Blockchain technology: it is an advanced database mechanism that allows information to be shared transparently within a common Business Network and this data is not subject to change, and data recording is time-consistent, so the chain cannot be deleted or modified without the consent of authorized network members.

3-the impact of artificial intelligence on the Egyptian digital economy

3.1-artificial intelligence and digital economy in Egypt

3.1.1. Egypt's efforts in the field of artificial intelligence

The artificial intelligence strategy was launched in Egypt in 2018, and its implementation is expected in three to five years. The aim is to develop businesses related to artificial intelligence and digital transformation projects, which represent a great opportunity for the country. The Egyptian strategy consists of four pillars, as follows (National Council for artificial intelligence, 2021, page 6):

- **Artificial intelligence for government:** the rapid adoption of artificial intelligence technologies through the mechanization of government processes and the integration of artificial intelligence into the decision-making cycle to raise efficiency and increase transparency.

- **Artificial intelligence for development**: the application of artificial intelligence in various economic sectors gradually, with the aim of raising efficiency and achieving higher economic growth, and better competitiveness.

- **Capacity building:** preparing the Egyptian people for the era of artificial intelligence, at all levels, from public awareness to school, university and equivalent, to professional training for technical and non-technical specialties.

- **International activities**: strengthening Egypt's position at the regional and international levels by supporting relevant initiatives and representing African and Arab positions.

Last January, Egypt launched a comprehensive economic strategy consisting of 8 axes for the period 2024-2030, the document of which addresses several aspects related to the economy and quality of life.

This strategy aims to create one million jobs in the fields of Science, Technology, Engineering and mathematics, including electronics design, software, and semiconductors, increase electronics exports by at least 20%, and raise the number of trainees in the field of communications and information technology to one million trainees, according to Al-Ahram Online Platform.

Specific efforts in 2024-2030 include a focus on communications and IT infrastructure, for example, the government aims to expand broadband coverage nationwide, replace copper networks with fiber-optic cables, and increase the number of mobile phone towers to 50 thousand by 2030.

The ICT sector in Egypt is expected to contribute 8% to the country's GDP by 2030, an increase from the current 5.8% recorded in the fiscal year 2023/2024, and digital exports are also expected to reach 9 billion dollars by 2026, according to Misr Al Youm newspaper.

3.1.2-the pillars of the digital economy in Egypt The digital Egypt

Project aims to accelerate the digital transformation process in the light of a comprehensive vision and an integrated plan, so that this plan is based on three main axes as follows (Zaki, 2021, page 7):

- **The first axis (digital transformation):** it aims to improve government performance, coordinate with all institutions in order to develop government performance, to convert many government services to the digital field, such as (Ministry of Justice Services, Ministry of Supply Services, Ministry of electricity services, Ministry of Agriculture Services, Ministry of Defense Internal Services, Ministry of Housing Services, Investors Services, Ministry of Environment Services...Etc.).

- **The second axis (digital skills and jobs):** it aims to train users from service providers as well as citizens to deal with the challenges imposed by digital transformation and artificial intelligence, provided that all social groups and segments are trained.

- **The third axis (digital creativity**): this axis aims to stimulate creativity and encourage entrepreneurship, and transform digital Egypt as a platform for innovation, depending on concerted efforts, and this vision resulted in the establishment of the National Council for artificial intelligence in 2019.

As for Egypt's ranking in the Arab Monetary Fund's index of the digital economy in 2021, Egypt's ranking advanced five places in the comprehensive Internet Index 2021 to become the 73rd place among 120 countries compared to the 78th place the year before, and it also ranked fourth at the level of African countries included in the index to reach 64.5 points compared to 61.8 points in 2020, according to the report issued by The Economist Research Unit and published by the information and Decision Support Center of the Council of ministers.

Since 2019, artificial intelligence has been supporting a number of digital transformation initiatives in Egypt through the availability of timely vital information for new models of operation and cash transfer.

Within the framework of encouraging innovation and the use of technology to meet the diverse needs of customers, especially young people, the financial technology strategy was launched during the events of the Arab-African Youth Forum held in Aswan in March 2019, where the Central Bank of Egypt seeks through the application of this strategy to promote youth orientation, support entrepreneurship, maintain a balance between financial stability and freedom of innovation, and meet the many and diverse needs of the Egyptian market, the financial technology strategy is a key component of the integrated plan to transform Egypt into a Regional Center for the financial technology industry in the Arab and African region, and this The financial strategy is in line with the vision of sustainable development, Egypt 2020.

Measuring the economic contribution of the digital economy is one of the most important challenges facing the countries of the world due to the difficulty of accounting and measuring the various economic dimensions of the Digital Economy, usually calculated based on the contribution of the ICT sector to GDP.

3.2. the relationship of the digital economy to economic growth

The internal growth theory explains that long-term economic growth stems from economic activities that create new technological knowledge, (internal growth is a long-term economic growth at a rate determined by internal forces in the economic system, especially those forces that govern the creation of opportunities and incentives to increase technological knowledge), and the digital economy has a strong relationship with various macroeconomic variables, especially economic growth, and this relationship is embodied in the fact that information and communications technology, which is a fundamental pillar of the digital economy, is also a basic base for activating national economies so that in the last decade it has become ranked first in terms of contributing to International trade exchanges and foreign money transfers (Rajai, 2024, P.126).

3.3-the main pros and cons of developing the hoped-for potential of artificial intelligence and the digital economy in Egypt

Despite the great Egyptian efforts and the efforts of existing private companies to develop artificial intelligence, they face problems related to material costs, legal procedures, intellectual property rights and other administrative problems and security approvals, especially startups, and some companies do not realize the full potential of machine learning and other artificial intelligence functions, and in an American study estimated the losses of infringement of intellectual property rights in artificial intelligence at about 226 billion dollars globally.

Data scientists in Egypt may face challenges in obtaining the resources and data they need to create machine learning models, and they may have trouble coordinating and collaborating with their colleagues in various ministries and authorities in the country.

The digital economy powered by artificial intelligence in Egypt is facing many challenges as a result of regional and international competition to acquire industries and services based on it, including electronic global trade, the provision of raw materials and supply chains, multiple trade wars and international competition in a number of theaters around the world, especially the Indo-Pacific region, where the dominant countries in the electronic chip industry in the world are located.

During the last decade, the growing phenomenon of cyber threats and hacks has emerged, and currently it has become one of the most challenges facing the expansion of the use of artificial intelligence applications due to the growth of deep falsification applications, as well as writing electronic software codes for machine learning through interactive chat applications powered by artificial intelligence, especially the Chat GPT application of Open AI.

In this regard, it should be noted the lack and low efficiency of human capabilities related to the field of artificial intelligence, as Egypt has not achieved a rate comparable to the average recorded at the level of OECD countries according to the education and science quality index.

The growth of the digital economy powered by artificial intelligence may promote many new economic opportunities, across several dimensions (e.g. productivity, GDP, value added, employment, income, trade) for various actors (e.g. self-employment, SMEs, service digital platforms and government).

By tracking the negative effects on the digital economy supported by artificial intelligence technologies, it highlights the need to be exposed to what is known as digital currency, which is a digital representation of a value that can be stored, transferred or traded electronically, not issued by the central bank or a public authority, not linked to a credit currency, deriving people's acceptance of it as a means of payment. We point out the seriousness of this concept on transparency, security and the digital economy and leads to an increase in money laundering crimes, the financing of terrorist networks and the growth of the informal economy.

The violation of human personal rights is one of the most prominent negatives, which is already happening by monitoring our movements, purchases and behaviors, especially that the supercomputer engines and search engines used in Egypt are not a national industry We point out that in an attempt to study the impact of the Fourth Industrial Revolution and its aftermath on the labor market, McKinsey Global Institute conducted an opinion poll to monitor these changes in labor markets, the so-called (temporary labor economy/ self-employment economy) or partnership economy appeared, this refers to informal labor relations to perform specific work for a certain wage without adhering to traditional labor contracts or being at specific hours at the workplace, digital platforms are used in the implementation and performance of these tasks, as well as the rapid growth of independent work.

Artificial intelligence systems can provide analysis of historical data and current statistics, accurate reports on all electronic systems and investment tools that in turn show patterns and trends of indices, stocks and trades, which supports the decision-making process and provides financial brokers with information and data for a better understanding of the market.

The future of manufacturing depends on smart machines that enable humans, processes, products and infrastructure to coordinate and interact seamlessly with each other in order to support the economy, smart machines have the ability to develop the manufacture of goods at the lowest time, cost and highest quality, and provide the opportunity for continuous improvement to reflect positively on the digital economy, perhaps the leading experience of:

- **Intelligent maintenance**: where downtime is reduced, maintenance costs are reduced and productivity is increased;

- Product quality inspection, automatically track and document product quality issues;

- **Demand planning:** automated forecasting is used to find out changes in consumer demand, thereby making the necessary changes to the production schedule.

The importance of smart applications for tax governance on e-commerce has emerged in order to enhance the digital economy, which is one of the most important financial resources for the general budget of the state. e-commerce has imposed itself on the domestic and international trade arenas.

The process of taxing e-commerce faces several difficulties, related to its cross-border nature and the acceleration of artificial intelligence technologies, which makes it difficult to hide some businesses or fraud and manipulation to collect taxes due on them.

The impact of artificial intelligence on income distribution is also highlighted. The debate about the nature of the relationship between technological growth and income distribution dates back to the early nineteenth century. two opinions have emerged in economic writings about the relationship between technology, growth and income distribution.

The first (optimistic) opinion indicates that technological progress leads to increased productivity, and therefore higher per capita output.

The second (pessimistic) opinion believes that technological progress, despite its increase in productivity, represents a threat to the income of a large category of workers due to the lack of need for Labor.

It is expected that artificial intelligence technologies will lead to an increase in the gap and disparity in the distribution of roles among private sector companies dealing with the state in the field of technology and digital transformation, due to the high level of investments required to develop and adopt these technologies, and low levels of incentive to adopt artificial intelligence technologies (Rajai, 2024, pp. 126-128).

Conclusion:

Results of the study and recommendations through the theoretical analysis of the study variables, the study came to a set of important results:

- That there is a high readiness of the Egyptian economy to benefit from artificial intelligence technologies based on many factors, the most important of which is the existence of a clear, comprehensive and implementable national strategy to encourage artificial intelligence;

- That the digital economy is considered a fundamental pillar of economic development and economic growth, as there is a direct relationship between the mechanisms of the digital economy and economic growth in Egypt;

- The digital economy contributes to the integration of the international economy into a unified economy, so that it increases the percentage of trade openness and financial regulation of those emerging economies;

- Egypt needs more trained human resources and support the infrastructure necessary for the digital economy;

- Egypt attaches great importance to the development of digital financial services, especially taxes, because of their various positive effects on the national economy and the banking sector.

Based on the results, the following are the most prominent recommendations to enhance the field of digital economy using artificial intelligence in the Egyptian state in an effort to reach high scores in the world rankings, paving the way for attracting local and foreign investments, which are as follows:

- Focus on the ethics of artificial intelligence and intellectual property rights in the research and programs that it implements to prevent falling into problems that lead to international arbitration and the inevitability of paying compensation;

- Reducing obstacles and restrictions on investments, especially in the field of high-tech, while supporting the manufacture of some high-tech vocabulary in preparation for export;

- Setting clear parameters for Egyptian startups and foreign investors at the Investment Commission with clear advertising on digital and virtual platforms;

- Continue to develop the infrastructure and infrastructure supporting the use of artificial intelligence to enhance the digital economy in the Egyptian state in a manner commensurate with the global trend for this;

- Reviewing and facilitating tax laws for small and medium-sized companies working in the field of artificial intelligence, especially those working through presidential and government initiatives;

- Continuous assessment of the Egyptian labor market while working to prepare the necessary skills required in all areas of artificial intelligence and the digital economy, in order to avoid facing high unemployment rates in light of the automation crisis of many jobs;

- Developing human capabilities, whether students, graduates or actually working in the field of artificial intelligence through specialized missions and courses inside Egypt or abroad;

- Work on the introduction of artificial intelligence applications in the informal economy, and work on integrating it into the official economy of the Egyptian state;

- Reviewing and revising the necessary laws and legislations regarding e-commerce and taxes; using artificial intelligence technologies in preserving the environment and expanding clean energy that uses green and blue hydrogen with artificial intelligence technologies;

- Expanding the use of artificial intelligence in all economic sectors.

Ethical Considerations

This study adheres to internationally recognized ethical research standards. All information used was obtained from publicly accessible and academically verified sources. No personal, confidential, or sensitive data were collected. The study involves no experiments on humans or animals and does not violate any ethical, legal, or privacy-related norms.

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Conflict of Interest

The authors declare no conflict of interest regarding the publication of this research.

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