

Economic Impacts and Global Successes through the Internet of Everything (IoE) in the World Countries

Seyed Omid Azarkasb ^{1*}, Seyed Hossein Khasteh ¹

¹. K.N. Toosi University of Technology, Tehran Iran

Received: 26 Sep 2023/ Revised: 20 Sep 2024/ Accepted: 10 Oct 2024

Abstract

The rapid evolution of information and communication technology (ICT) in recent decades has triggered profound transformations across the global economic landscape. A key driver of this transformation is the Internet of Everything (IoE), which integrates objects, data, people, and processes to create interconnected ecosystems that generate unprecedented value. The rise of IoE has not only revolutionized technological innovation but has also played a critical role in reshaping global economies by fostering competitiveness and unlocking new economic opportunities. This article examines the economic impacts and technological breakthroughs driven by IoE in six selected countries—spanning developed, developing, and neighboring economies. By analyzing their experiences, we highlight how these nations have utilized IoE to achieve sustainable growth, strengthen market positions, and accelerate their technological advancement. Countries venturing into the realm of IoE benefit from two key aspects. Firstly, they gain new value from technological innovation, and secondly, they secure competitive advantages and market shares against nations that have yet to invest and adapt to the IoE market. Studying pioneering and trailblazing countries in the realm of this technology, unveiling their patterns, visions, and key achievements, not only provides clear insights, identifies needs, and fosters advancements, but also critically examines and analyzes the subject matter. The findings offer essential insights for policymakers, business leaders, and innovators, providing a roadmap for leveraging IoE to maximize economic benefits and drive digital transformation on a global scale.

Keywords: Internet of Everything (IoE); Digital Economy; Economic Growth; Technological Innovation; Competitive Advantage; Global Success; Digital Transformation; Sustainable Development.

1- Introduction

Today, the world is facing a multitude of changes and challenges, with these transformations manifesting in various social, economic, and technological dimensions [1]. In this era of widespread advancements in communication technologies, humans have become acquainted with novel devices, reshaping our world into a complex ecosystem of objects and data. This interconnection and data exchange among devices are referred to as the Internet of Things (IoT), enabling devices to share data and communicate with each other [2]. However, there emerges a more novel and intriguing concept: the Internet of Everything (IoE). This concept offers a more intricate and comprehensive interpretation of the evolution and expansion of the IoT. In this model, communications extend beyond objects, encompassing interactions among people, devices, data, and even processes. Consequently, the IoE becomes a tool that integrates all aspects of our daily lives, giving rise to

profound social, economic, and technological impacts. Countries are actively seeking methods to extract greater business benefits from their investments in information technology, and the demand for IT capabilities (ITC) is on the rise [3]. Hence, they allocate a substantial budget annually to information and communication technology (ICT) without certainty about the expected outcomes [4]! In this article, we will explore how countries entering the realm of the IoE benefit in two main ways. First, it will capture the new value generated through technological innovation, and second, by gaining a competitive advantage and market share against those who cannot adapt and invest in the IoE market. Therefore, in this article, we aim to better comprehend and extensively explore the experiences of prominent countries in the realm of the transition toward the IoE. The United Arab Emirates and Turkey serve as neighboring countries, while China and South Korea represent leading and developed nations. Additionally, India and Malaysia are examples of countries in the process of development. These analyses permit us to carefully examine the challenges and advancements of these nations

✉ Seyed Omid Azarkasb
Seyedomid.azarkasb@email.kntu.ac.ir

in achieving the goals of the IoE. Figure 1 provides an overarching glimpse into the key themes and objectives explored in this article.



Fig. 1 Conceptual Visualization of the Internet of Everything (IoE) and Its Global Impact

The figure illustrates the comprehensive framework of the Internet of Everything (IoE), emphasizing the interconnection of people, processes, data, and objects. It visually represents how IoE integrates these elements into a seamless global network, fostering technological advancement and economic growth. The selected countries—China, South Korea, Malaysia, India, Turkey, and the United Arab Emirates—are depicted as part of this interconnected system, reflecting their roles as pioneers in adopting IoE technologies. The soft, flowing lines and interconnected nodes symbolize the dynamic nature of IoE, driving innovation, digital transformation, and competitiveness across borders. This visualization encapsulates the essence of our paper, which explores how these countries leverage IoE for strategic economic gains and technological leadership in the global arena.

This article is structured as follows: In the second section, an introduction to the IoE and its research prospects is presented. The third section focuses on elucidating the results of efforts, experiences, successes, opportunities, and challenges faced by selected countries in their journey towards IoE, based on conducted studies. Subsequently, in the fourth section, a comprehensive and concise analysis of key achievements in this transformation is provided, country by country. The article concludes in the fifth section

2- Research Background

The concept of the IoE is introduced by Cisco to represent the broader and evolved form of the Internet of Things, and several prominent technology companies, including Gartner and Qualcomm, have also adopted this term almost simultaneously with Cisco. Figure 2 effectively illustrates the distinctions between the Internet of Everything and the Internet of Things [5].

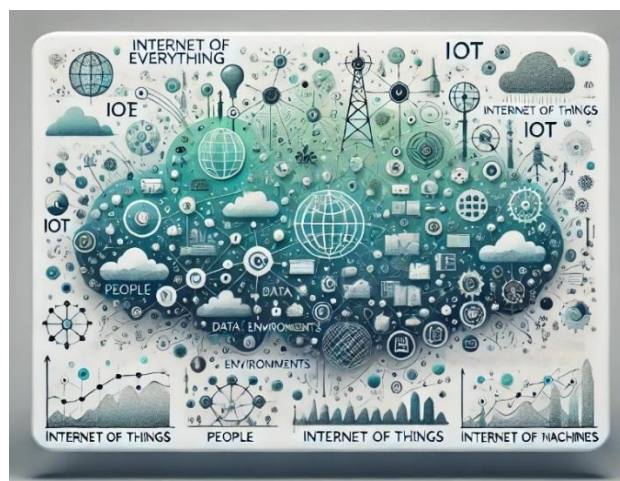


Fig. 2 The position of the Internet of Things (IoT) in front of Internet of Everything (IoE)

The distinction between the IoE and IoT can have a significant impact on the current research. These distinctions can assist us in studying issues more comprehensively and yield more valuable results. Some of the effects that these distinctions may have include:

Wider Scope: By focusing on the connectivity and interaction between objects, data, people, environments, services, and machinery, we can examine the impacts of IoE in a broader context. This enables better and more comprehensive research on the communications and mutual effects between objects and other factors.

Increased Complexity: With a higher number of interconnected factors, the complexity of communications and interactions among these factors grows. This approach helps researchers identify weaknesses and challenges related to this complexity and propose better solutions for managing and optimizing communications.

Long-term Perspective: By considering all possible connections and communications between objects and other factors, we can effectively construct a long-term vision for the development of technologies and communication systems. This process aids in designing and implementing innovative and sustainable solutions for IoE-related issues.

Machine Learning: Access to a vast amount of data generated by objects and various components of the IoE allows for the use of machine learning and artificial

intelligence techniques to extract patterns, predictions, and valuable analyses. This contributes to a deeper understanding of the relationships and trends within the Internet of Everything.

Focusing on these distinctions, this article can contribute to the development and enhancement of technologies and solutions related to the Internet of Everything, providing a better understanding of its impacts on various communities and industries. According to Cisco's report, the IoE has generated a market value of \$14.4 trillion for companies and industries globally by the year 2022, as depicted in Figure 3 [6]. Out of this amount, the potential highest stock value of 66%, equivalent to \$9.5 trillion, has been generated through industry-specific transformations such as smart networks and intelligent buildings [7]. The remaining 34%, or \$4.9 trillion, comes from cross-industry applications like remote work and travel prevention such as smart healthcare [8].

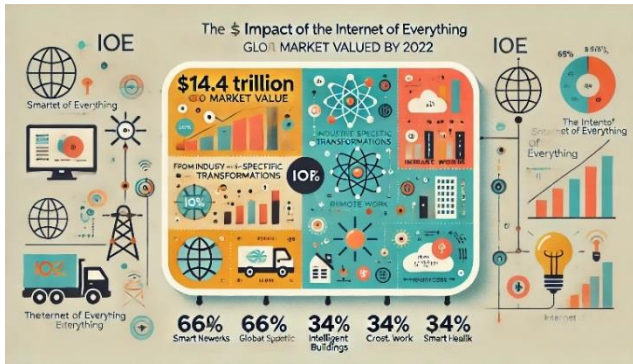


Fig. 3 Cisco's report on the global revenue of the Internet of Everything (IoE) by 2022

According to the GSMA Intelligence report, as shown in Figure 4, a 21% growth in stock value signifies a favorable opportunity for global companies to increase profits through the adoption of IoE technology. It is predicted that this figure will reach 30% by the year 2025 [9].

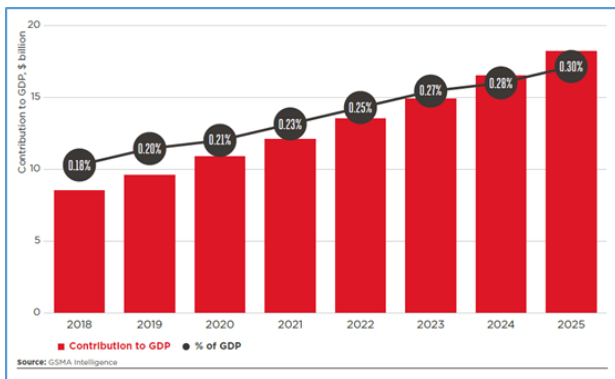


Fig. 4 Incremental Growth in Share Value through the Utilization of the Internet of Everything (IoE) [9]

The Internet of Everything encompasses four key elements consisting of all conceivable connections: People, Things, Processes, and Data [10]. In the Internet of Everything business model, people are considered end nodes connected via the Internet for sharing information and activities, as depicted in Figure 5.



Fig. 5 the Internet of Everything (IoE) Ecosystem

People, as end nodes connected through the internet, contribute to sharing information and activities. Examples include social networks, health and fitness sensors, and other human-related connections. Things encompass physical sensors, devices, actuators, stimulators, and more that generate data or receive data from other sources. Examples include smart thermostats and gadgets. Data refers to raw data that undergo processing and analysis, transforming into useful information. Processes involve using connections between data, things, and people to generate value. Examples include utilizing fitness equipment and social networks to promote health-related offers to customers. The IoE constitutes an end-to-end ecosystem of connections involving various technologies, processes, and concepts. Other categories such as the Internet of Humans, Digital Internet, IoT, communication technologies, and even the traditional Internet are subsets of the IoE.

3- Selected Countries

The advent of the Internet of Everything has created numerous opportunities and challenges for various countries. In the following section of the article, we will discuss the key achievements of the United Arab Emirates,

Turkey, China, South Korea, India, and Malaysia in this field. It will elaborate on each country, based on its characteristics, resources, and objectives, has developed unique strategies and approaches to realize the goals and visions of the Internet of Everything.

3-1- United Arab Emirates

Dubai, one of the seven emirates comprising the United Arab Emirates, has skillfully integrated key elements on the path to the Internet of Everything, resulting in remarkable achievements [12]. By deploying smart palm trees, utilizing the unified DubaiNow application to deliver city and government services, and establishing a smart city, Dubai stands out as the sole emirate that has successfully reached the implementation phase of the Internet of Everything principles. This progress signifies Dubai's transformation into a global economic hub, with a focus on service industries such as information technology and investments. Based on the insights gleaned from references [12-17], the following conclusions can be drawn:

- 1- Developing high-speed fiber-optic internet infrastructure,
- 2- Achieving the top rank for the fastest mobile internet speeds in the world with a speed of 238.28 megabits per second and the fourth rank in the list of fastest fixed internet speeds in the world with a speed of 205.77 megabits per second, according to the Speedtest Global Index report in July 2023,
- 3- Emphasizing and investing high costs in various aspects of the IoE,
- 4- Widespread use of all-purpose applications like "Dubai Now",
- 5- Launching and developing specialized applications such as "Dubai Taxi" for airport transfers and "Cafu" for mobile fuel delivery services,
- 6- Establishing the Dubai Internet City,
- 7- Creating a media city in Dubai with the aim of enhancing the media position of the United Arab Emirates,
- 8- Encouraging and attracting large, small, and medium-sized companies worldwide to engage in various IoT sectors, including software development, business services, e-commerce, consulting, sales, and marketing,
- 9- Launching a smart city project by implementing smart solutions in 17 areas, including smart parking, public transportation, smart street lighting, disaster response, smart payments, connected education, smart tolls, water management, waste management, chronic disease monitoring, employee productivity, smart buildings, surveillance, smart grid, preventive care, drug authenticity, and compliance,
- 10- Establishing a collection of smart buildings with features such as 24-hour support services, affordable internet connectivity for offices and homes, abundant local and wide area networks, international standard-based multimedia networks, integrated internet telephony with identification systems, digital services

network, and wireless communication capabilities, providing regional information services, and a secure network television system,

- 11- Installing and setting up public free Wi-Fi stations,
- 12- Beautifying the city using smart palm trees,
- 13- Creating public access to various mobile applications and websites through embedded stations throughout the city,
- 14- Providing security and managing emergency situations through city stations, each equipped with a 360-degree infrared CCTV camera and an emergency conditions notification button,
- 15- Involving young people in projects and programs.

Figure 6 provides an overview of Dubai's strategies in the realm of the Internet of Everything (IoE).



Fig. 6. Overview of Dubai's strategies in the realm of the Internet of Everything (IoE).

3-2- Turkey

While the Internet of Everything technology is not yet widely prevalent in Turkey, the foundations, technologies, and key concepts in this domain have made significant progress within the country. This technology, with its unique capabilities, has brought about significant advancements in various fields in Turkey, ranging from advancements in smart agriculture and livestock breeding to urban traffic management, smart airports, and asset surveillance. Financial results also indicate that this technology has led to increased revenues and reduced operational costs. Leveraging successful experiences and the remarkable benefits of IoT technology, Turkey is on a path towards achieving the vision of the Internet of Everything and enhancing productivity across various sectors of its economy. It is expected that this progress and growth will continue in the future. In other words, based on the findings from the referenced sources [18-21], the following conclusions can be drawn:

- 1- Achieving a 98.4% mobile phone penetration rate,
- 2- Advancements in smart agriculture and livestock breeding,

- 23- Smart medical care using medical and IoE technologies to enhance healthcare services,
- 24- Defining the structure of the IoE system for optimal utilization of smart coal mines and oil fields' technologies,
- 25- Initiating and implementing IoE projects based on space technology to advance spatial and geographical technologies,
- 26- Government policies granting tax exemptions to IoE sector producers to encourage investment,
- 27- Encouraging public institutions to invest in IoE projects with government support and facilities,
- 28- Hiring artificial intelligence experts in the field of autonomous transportation and other IoE applications,
- 29- Introducing the Internet Plus strategy by the government to maintain and strengthen the country's position in global IoE competition,
- 30- Utilizing narrowband Internet to increase the speed and efficiency of production and delivery processes for industrial units, smartifying production, mass customization of products, and collaborative innovations in smart product development tools.
- 31- Establishing a national IoE center for knowledge exchange and experience sharing in various Internet technology fields,
- 32- Government focus on developing the IoE in vital economic and productive sectors such as industrial control, financial services, and healthcare to increase productivity and quality in these sectors,
- 33- Utilizing IoE programs to address important urban issues such as air pollution and urban resource management through the implementation of smart city projects at a strategic level and allocating necessary financial resources to municipalities and economic development zones,
- 34- Emphasizing the creation of fast and cost-effective communications for small and medium-sized companies using the IoE and encouraging these companies to equip their business systems on cloud infrastructures to create extensive entrepreneurship and innovation opportunities,
- 35- Putting a major focus on enhancing cyber security using a national network to reduce security risks associated with IoE devices and industrial systems connected to the Internet,
- 36- Prioritizing global leadership in accelerating artificial intelligence progress to transform the country into a major artificial intelligence innovation hub by 2030 with the goal of global leadership in this field,
- 37- Deciding on the rapid integration of information and communication technology with industrial Internet development sectors to enhance coordination and the development of advanced technologies,
- 38- Providing cloud infrastructure and open computing platforms for the Internet of Things to integrate with local government public service platforms for modernization and transforming traditional businesses into integrated industrial IoE platforms.

Figure 8 provides an overview of China's strategies in the realm of the Internet of Everything (IoE).

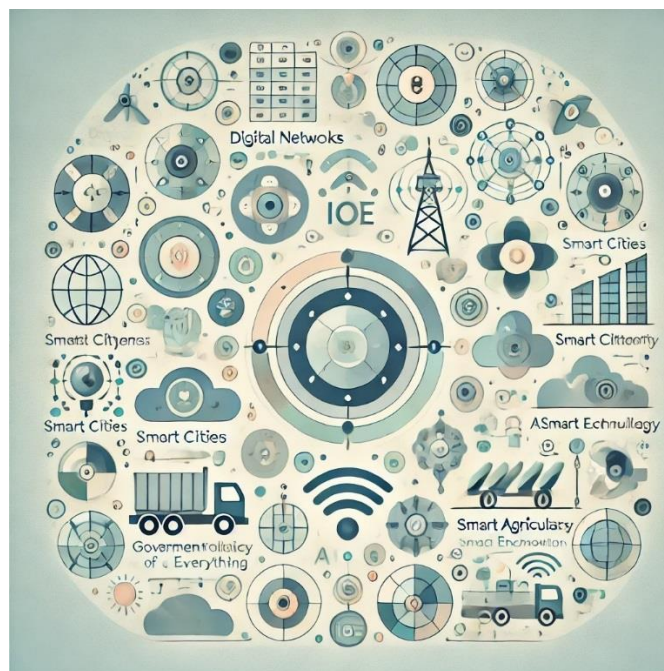


Fig. 8 Overview of China's strategies in the realm of the Internet of Everything (IoE)

3-4- South Korea

South Korea has outlined ambitious visions for the Internet of Everything. As a leader in both economy and the advancement of information and communication technology in the Asian region, South Korea has solidified its position. In 2020, South Korea claimed the top spot in average internet speed when compared to the top 10 high-speed internet countries worldwide. This accomplishment underscores the nation's substantial potential in the field of intelligent transformation and achieving the comprehensive goals of the Internet of Everything. Notably, South Korea's adeptness in establishing smart cities played a crucial role in its success in managing the COVID-19 pandemic. By leveraging secure and dynamic infrastructures, South Korea has managed to develop IoT services and enhance them, resulting in a noteworthy average growth rate of 22.6% within the IoE domain. The results of a survey conducted within South Korea's IoE industry, published by the Ministry of Science and ICT, highlight the most prominent activities among various businesses within the country. These activities primarily include innovations and the export of IoE equipment and services, driving significant growth in the export sector. Following an examination of references [31-38], the following conclusions can be drawn from this study:

- 1- Developing an open platform through collaboration with platform companies, including large and global businesses, communication service providers, as well as

- cooperation in creating a testing infrastructure and standardization,
- 2- Enhancing public management by addressing existing issues in society, including civil services, improving industry efficiency, effectiveness, and value addition, as well as enhancing aspects related to individuals such as safety, comfort, and quality of life,
 - 3- Establishing a laboratory for innovative equipment to conduct research in specific equipment ecosystems and support creative ideas in the stages of development, production, commercialization, and entry into the global market,
 - 4- Establishing a user-participatory organization called the "Cloud-Connect Society" discussing and exchanging views on various social issues such as regulatory settings, privacy, and the development of quality of life indicators for users,
 - 5- Expanding the platform and services to all industries and countries through pilot services provided by each ministry, local government, or user businesses. This expansion is also carried out through innovation and creative economy centers,
 - 6- Enhancing security technologies in the Internet of Things, including embedded security systems in IoE products and the development and enhancement of information security measures,
 - 7- Expanding access to open laboratories (managed by IoT innovation centers and creative economy centers) and developing and offering new products and services through pilot projects in which users can actively participate and gain hands-on experience,
 - 8- Developing wired and wireless infrastructures to support the Internet of Things and enhancing communication and data transfer capabilities,
 - 9- Strengthening collaboration between the private sector and the government,
 - 10- Establishing research and development programs in the medium and long term for the IoE,
 - 11- Fostering a competitive and open industrial environment for developers and businesses,
 - 12- Opening the platform for small and medium-sized enterprises and universities to develop their own services and products,
 - 13- Utilizing IoE technologies in high-potential production products by small and medium-sized enterprises through localization projects and upgrading products to smarter and better levels,
 - 14- Improving support for the commercialization process in the IoE domain,
 - 15- Enhancing information security infrastructure,
 - 16- Enhancing interaction between software, equipment, or user-related businesses and large, small, and medium-sized companies,
 - 17- Training and developing a skilled and competent workforce in the field of the Internet of Things,
 - 18- Increasing the development and expansion of services tailored to the global market,
 - 19- Creating a platform for testing security capabilities and specifications at an IoE innovation center,
 - 20- Facilitating the secure deployment of additional frequencies of one gigahertz or more,
 - 21- Providing smartphones with free internet to foreign tourists and aggregating and analyzing the data transmitted by these phones,
 - 22- Establishing research and development programs in medium and long terms to turn ideas into products and businesses,
 - 23- Creating an ecosystem to transform ideas into products and services, including open-source hardware or software and full implementation of the process by developers themselves,
 - 24- Developing IoE-based services based on demand from the government, private sector, and citizens in areas such as health, smart homes, smart cities, transportation and logistics, energy, and safety,
 - 25- Enhancing innovative services that combine public and private sector information with data collected from IoT devices in a synchronized manner,
 - 26- Developing creative services with a focus on user experience,
 - 27- Encouraging internal strategy development for large, small, and medium-sized businesses and startups,
 - 28- Developing critical infrastructures such as fiber networks and implementing IPv6 protocol to facilitate and enhance the efficiency of the IoE,
 - 29- Advancing privacy-preserving technologies in the field of IoT,
 - 30- Developing key technologies for the development and commercialization of smart sensors and establishing a connection between research and development in the smart sensor field with demonstration and pilot projects,
 - 31- Strengthening key technologies and creating suitable infrastructure for the development of skilled human resources,
 - 32- Developing products and services through government collaboration with international businesses,
 - 33- Creating and developing an open platform and testing framework to reduce market entry costs and time, and facilitate collaboration between companies,
 - 34- Preparing a comprehensive roadmap for information security in the IoT field and establishing a framework for international cooperation for managing rapid responses and information exchange based on effective sharing,
 - 35- Promoting support for coexistence of traditional industries and new software innovations,
 - 36- Establishing integrated support for all stages of product lifecycle, as well as building and developing model smart cities like Songdo,
 - 37- Developing data hubs for optimal health control in smart city-related projects,
 - 38- Promoting the process of processing and issuing temporary licenses for new products and services,
 - 39- Promoting the development of low-consumption, long-range coverage, and unrestricted bandwidth

communication technologies for connecting objects in remote areas,

- 40- Promoting the development of new generation technologies for smart devices and components, including wearable devices, health equipment, and very small devices with low energy consumption,
- 41- Promoting the creation of a smart device industry and developing innovative approaches,
- 42- Promoting open innovations in the field of IoT,
- 43- Encouraging collaboration and sharing of research and development between the private sector and military forces to advance military capabilities and excellence in international standards,
- 44- Strengthening unity and collaboration to ensure the competitiveness of platforms and forming open partnerships based on mutual growth, including collaboration between large, small, and medium-sized companies,
- 45- Empowering entry into the equipment market with lower costs through the development of open hardware and launching joint growth by companies' collaboration in the production of equipment and components in the process of IoT service development.

Figure 9 provides an overview of South Korea's strategies in the realm of the Internet of Everything (IoE).



Fig. 9 Overview of South Korea's strategies in the realm of the Internet of Everything (IoE)

3-5- India

With its immensely high potential in the realm of information technology and communications, India has set forth on a trajectory of developing and adopting Internet of Everything technology. Based on predictions, in the not-so-distant future, this country will become the most populous nation in the world. Through an exploration of the programs, projects, and strategies implemented in this field, it is evident that India is reaping the benefits of IoT technology across various economic, social, and security domains. Collaborations with international partners and effective policies play a pivotal role in its successful adoption. Emphasizing the establishment of knowledge hubs in other countries and attracting investments in service provision,

India strives to advance higher education and facilitate knowledge exchange with other nations. The advancement of information technology, enhancement of higher education systems, globalization, and alignment with the global job market serve as key determinants of India's developmental trajectory. India's experience underscores that, with a suitable approach, IoE technology can guide societal and economic transformations towards sustainable development. Upon reviewing references [39-49], the following conclusions can be inferred:

- 1- Clarifying the concept of Digital India through the establishment of a network of 100 smart cities,
- 2- Creating a government data portal for transparency and access to information,
- 3- Progressing towards smart parking using modern technology,
- 4- Designing and implementing an intelligent transportation system to enhance coherence and efficiency,
- 5- Establishing smart networks to enhance communication and information sharing,
- 6- Optimizing urban lighting in an intelligent manner for energy efficiency,
- 7- Enhancing intelligent waste management through the utilization of new technologies,
- 8- Improving intelligent water resource management with a modern and efficient approach,
- 9- Focusing on harnessing the potential of the market for smart electronic devices to increase sales,
- 10- Utilizing IoT technology to enhance border services and transportation centers,
- 11- Establishing university campuses in other countries and attracting investments in providing scientific services,
- 12- Utilizing the potential of the Internet of Things technology to ensure the security of critical sectors, including industries, banks, offices, nuclear power plants, and other facilities,
- 13- Implementing intelligent image management systems for recording and detecting unusual events, identifying individuals, locations, and recognizing colors using precise and informational methods,
- 14- With advancements in the field of tracking applications for patients, important information, including job details, geographic coordinates, contact information, ecological aspects, travel history, and biological data such as fingerprint information, can be gathered, considering the new conditions created by the emergence of the coronavirus,
- 15- Develop an Internet of Things roadmap with five vertical columns, including centers for testing and executing projects, growth and incubation centers, innovation and research and development areas, support and motivation, as well as human resources and support development; and a horizontal column encompassing standards and governmental structure,
- 16- Proposing an intelligent tsunami alert service,

green cities, Copenhagen and Kiev, has a compelling story to tell in terms of its green initiatives.

China, a developed nation with a robust human development index, the progress and development of the Internet of Everything has gained, with its leaders defining it as a new engine for economic growth and industry. Viewing transformation as an opportunity rather than a threat, the new circumstances brought about by the COVID-19 pandemic have not only failed to slow down China's advancement in Internet technology but have also contributed to a continuous increase in the country's income. The designation of national programs like the 863 Program, the 973 Research Framework, and the development of fundamental and key national projects under the guidance of the Chinese Ministry of Science and Technology, along with the collaboration of the three major Chinese operators (e.g., telecommunications companies), has been pivotal in the development of the Internet of Everything in China.

South Korea, another developed nation, which ranks among the top Asian countries in terms of economic and information technology development, boasts the highest average internet speed among the world's top 10 fastest countries, showcasing its immense potential in various smartization domains and realizing the Internet of Everything vision. This accomplishment has played a role in South Korea's success in controlling the COVID-19 pandemic, as evidenced by its smart city initiatives. South Korea has harnessed secure and dynamic infrastructure for the development of Internet of Everything services, underpinned by a comprehensive strategic plan and necessary actions. The country achieved an impressive 22.6% growth in the Internet of Everything sector from 2015 to 2018. The results of surveys conducted on the Internet of Everything industry in South Korea from 2015 to 2019, overseen by the Ministry of Science and ICT, indicate that in 2019, the highest exports were in terms of business in the equipment sector, and the highest exports in terms of application were in the manufacturing and retail sectors.

India, a developing nation, envisions becoming the world's most populous country in the near future. The Digital India program aims to transform India into a powerful digital society and knowledge-based economy. This initiative has inspired India to allocate a substantial budget of around \$7.4 billion for expanding the Internet of Everything, fostering partnerships with leading universities globally, and planning the development of smart cities. Some of the key components of the smart city agenda that have received attention in India include the government open data portal, smart parking systems, intelligent transportation systems, healthcare and patient tracking, smart grids, smart street lighting, waste management, digital signage, border security, and water management. Consequently, India witnessed an increase in sales revenue for smart electronic devices from 2019 to 2020, while other top countries in this sector experienced a declining trend due to the conditions

arising from the COVID-19 pandemic. Overall, India's information technology sector has seen consistent annual growth of over 30% since 1993, and its market value has grown from \$150 million to \$150 billion, marking a thousand-fold increase. The technology industry in India indeed holds immense potential for growth and development. India's proposed roadmap for the IoT is a multi-pronged approach, consisting of five vertical columns: Testing and project implementation centers, growth centers and incubators, innovation and research and development, support and motivation, and human resource development and support, with two horizontal columns of standards and governmental structure.

Lastly, Malaysia, another developing country, has created a roadmap for IoE readiness. Among the rich documents in studying comprehensive plans in countries, the roadmap for the IoT in Malaysia plays a significant role. In this roadmap, Malaysia's current status in terms of readiness and opportunities for the Internet of Things, as well as the challenges ahead in areas such as infrastructure, data and information, security, and privacy, talent, and the ecosystem have been assessed. Gap analysis was conducted subsequently. Indicators of information and communication technology (ICT) readiness, such as mobile and internet penetration rates and other metrics in Malaysia, indicate a conducive environment for the development of IoT services, given domestic demand. This readiness has created unique opportunities to unlock Malaysia's economic innovation potential, particularly in transformational programs across the economy, government, and digital lifestyles. However, this opportunity is highly valuable for research institutions aiming to commercialize research and development results, which require an appropriate platform for implementing solutions.

In summation, exploration of these diverse countries' IoE journeys provides valuable insights into IoE's multifaceted implementation and its potential impact on various sectors. These case studies serve as reference points for other nations looking to navigate the evolving landscape of the Internet of Everything and capitalize on its myriad benefits.

5- Conclusion

In conclusion, this article offers a comprehensive summary of key achievements and strategies in the pursuit of the Internet of Everything in select nations. The diverse case studies furnish valuable insights and impetus for government officials, researchers, managers, and entrepreneurs venturing into the realms of digital transformation and emerging technologies. The transition toward the IoE has created abundant opportunities and challenges for various countries. In the case studies of China, South Korea, Malaysia, India, Turkey, and the United Arab Emirates, it has been observed that each

country, based on its characteristics, resources, and objectives, has pursued unique strategies and approaches to achieve the goals of the Internet of Everything. These experiences can serve as models and sources of inspiration for other countries in their endeavors to realize the IoE and harness the interactions among devices and objects. For instance, Dubai has rapidly become a global leader in mobile internet and fixed internet speed, showcasing innovative IoE implementation. In contrast, Turkey has established a robust foundation for IoE, focusing on low-bandwidth IoT ecosystems and implementing smart initiatives across various sectors. China's dedication to the IoE, as seen in its national programs, has driven economic and industrial growth. South Korea's swift internet speeds have laid the groundwork for successful IoE initiatives, especially in smart city development. India, with its Digital India program, is actively investing in IoE expansion, aiming to develop 100 smart cities. Malaysia, too, has outlined a strategic IoE roadmap, emphasizing infrastructure, data, security, privacy, talent, and ecosystems. These case studies offer valuable insights for policymakers, researchers, managers, and entrepreneurs venturing into digital transformation and emerging technologies.

References

- [1] A. Khamseh, M.A. Mirfallah Lialestani, R. Radfar, "Digital Transformation Model, Based on Grounded Theory", *Journal of Information Systems and Telecommunication (JIST)*, Vol. 9, No. 36, 2021, pp. 275-284.
- [2] M. Khazaei, "Dynamic Tree-Based Routing: Applied in Wireless Sensor Network and IoT", *Journal of Information Systems and Telecommunication (JIST)*, Vol. 10, No. 39, 2022, pp. 191-200.
- [3] M. Ranjbarfard, S.R. Mirsalari, "IT Capability Evaluation through the IT Capability Map", *Journal of Information Systems and Telecommunication (JIST)*, Vol. 8, No. 32, 2021, pp. 207-218.
- [4] K. Bamary, M.R. Behboudi, T. Abbasnjad, "An ICT Performance Evaluation Model based on Meta-Synthesis Approach", *Journal of Information Systems and Telecommunication (JIST)*, Vol. 10, No. 39, 2022, pp. 229-240.
- [5] FREEDOM and SAFETY, "This is The Internet of Everything", <https://freedomandsafety.com/en/file/ioepng>, Site Visited: 2024.
- [6] James Macaulay, Lauren Buckalew, Gina Chung, "Internet of Everything in Logistics", a collaborative report by DHL and Cisco on implications and use cases for the logistics industry, 2015.
- [7] P.N. Huu, L.H. Bao, "Proposing Real-time Parking System for Smart Cities using Two Cameras", *Journal of Information Systems and Telecommunication (JIST)*, Vol. 9, No. 36, 2021, pp. 252-262.
- [8] N.P. Singh, A. Kanakamalla, S.A. Shahzad, G.D. Asi, S. Suman, "Remote Monitoring System of Heart Conditions for Elderly Persons with ECG Machine using IoT Platform", *Journal of Information Systems and Telecommunication (JIST)*, Vol. 10, No. 37, 2022, pp. 11-19.
- [9] M. Little, S. Kechiche, Y. Zhong, A. Gharibian, "Realising the Potential of IoT in MENA", GSMA Intelligence report, 2019.
- [10] Radwa Ahmed Osman, "Empowering Internet-of-Everything (IoE) Networks through Synergizing Lagrange Optimization and Deep Learning for Enhanced Performance", *EISEVIER, Physical Communication*, Vol. 63, 2024, Article ID 102309 .
- [11] D. J. Langleya, J. Van Doorn, I. C.L. Ng, S. Stieglitz, A. Lazovik, A. Boonstra, "The Internet of Everything: Smart Things and Their Impact on Business Models", *EISEVIER, Journal of Business Research*, Vol. 122, 2021, pp. 853-863.
- [12] Y. Koucheryavy, A. Aziz, "Internet of Things, Smart Spaces, and Next Generation Networks and Systems", Springer Link, 23rd International Conference, NEW2AN, and 16th Conference, ruSMART, 2023, Part II Dubai, United Arab Emirates, Proceedings.
- [13] OpenSignal, "Benchmarking the Global 5G Experience", 2021.
- [14] Cisco, "Dubai Harnesses IoE to Make Roads Safer and to Increase Usage of Public Transportation", Cisco Jurisdiction Profile, 2014.
- [15] C. Reberger, F. Atallah, M. Zeidan, S. Ei, "AED 17.9 bn Opportunity for Dubai: 2014-2019", 2020.
- [16] S. Eid, "Dubai Smart City: IoE Value at Stake in the Public Sector", Cisco Consulting Services Lead for Middle East Africa Russia CIS, 2020.
- [17] Speedtest, "United Arab Emirates Median Country Speeds July 2023", <https://www.speedtest.net/global-index/unit-ed-arab-emirates>, 2023.
- [18] M. Little, S. Kechiche, Y. Zhong, A. Gharibian, "Realising the potential of IoT in MENA", GSMA Intelligence report, 2019.
- [19] OPENSIGNAL, "TURKEY Mobile Network Experience Report", <https://www.opensignal.com/reports/2020/12/turkey/mobile-network-experience>, 2021.
- [20] H.H. Çelikyay, "The Studies through Smart Cities Model: The Case of Istanbul", *International Journal of Research in Business and Social Science*, Vol.6, No.1, 2017, pp.149-163.
- [21] G. Bodur, S. Gumus, N. GulGursoy, "Perceptions of Turkish Health Professional Students Toward the Effects of the Internet of Things (IOT) Technology in the Future", *EISEVIER, Nurse Education Today*, Vol. 79, 2019, pp. 98-104.
- [22] W. Wu, L. Shen, Z. Zhao, A. Rachana Harish, R.Y. Zhong, G.Q. Huang, "Internet of Everything and Digital Twin Enabled Service Platform for Cold Chain Logistics", *EISEVIER, Journal of Industrial Information Integration*, Vol. 33, 2023, Article ID 100443.
- [23] A. Bouverot, "How China is Scaling the Internet of Things", An insight report from the GSMA Connected Living Programme, 2015.
- [24] J. Chen, and et al, "China's Internet of Things", Research Report Prepared on Behalf of the U.S.-China Economic and Security Review Commission, 2018.
- [25] Jing Dai, Wen Che, Jia Jia Lim, Yongyi Shou, "Service Innovation of Cold Chain Logistics Service Providers: A Multiple-Case Study in China", *EISEVIER, Industrial Marketing Management*, Vol. 89, 2020, pp. 143-156.

- [26] S. Chen, H. Xu, D. Liu, Hu, H. Wang, "A Vision of IoT: Applications, Challenges, and Opportunities with China Perspective", *IEEE Internet of Things Journal*, Vol. 1, No. 4, 2014, pp. 349-359.
- [27] Statista, "COVID-19 Barometer 2020", <https://www.statista.com/study/72001/covid-19-barometer>, 2020.
- [28] Ant Group, KrASIA, <https://kr-asia.com/ant-group-searches-for-direction-in-a-new-era-of-chinese-fintec>, Site Visited: 2024.
- [29] M. Granryd, "How Greater China is Set to Lead the Global industrial IoT", A GSMA Internet of Things report, 2018.
- [30] M. Farhan, T.N. Reza, F.R. Badal, M.R. Islam, S.M. Mueyen, Z. Tasneem, M.M. Hasan, M.F. Ali, M.H. Ahamed, S.H. Abhi, M.M. Islam, S.K. Sarker, S.K. Das, P. Das, "Towards Next Generation Internet of Energy System: Framework and trends", *ELSEVIER, Energy and AI*, Vol. 14, 2023, Article ID 100306.
- [31] M. Waszkiewicz, "Internet of Things South Korea", Market Intelligence Report, Department for International Trade Report, prepared by Intralink Limited, 2018.
- [32] M. Lee, "An Empirical Study of Home IoT Services in South Korea: The Moderating Effect of the Usage Experience", *International Journal of Human-Computer Interaction*, Vol. 35, Issue. 3, 2018, pp. 1-13.
- [33] R. Triggs, "Which Country Has the Fastest Mobile Network?", <https://www.androidauthority.com/worlds-fastest-networks-709140/>, 2017.
- [34] S. Muralidharan, A. Roy, N. Saxena, "An Exhaustive Review on Internet of Things from Korea's Perspective", Springer Link, *Wireless Personal Communications*, Vol. 90, 2016, pp. 1463-1486.
- [35] IoT Business News, "The Countries with the Most IoT Devices, Ranked", <https://iotbusinessnews.com/2016/03/31/97541-countries-iot-devices-ranked>, 2016.
- [36] Ministry of Science, ICT and Future Planning, "Master Plan for Building the Internet of Things (IoT), That Leads the Hyper-Connected, Digital Revolution", Software Policy Bureau, New Internet Industry Division, 2014.
- [37] Internet World Stats, "Internet 2021 Usage in Asia, the World's Fifth Largest Market", Usage and Population Statistics, <https://www.internetworldstats.com>, 2021.
- [38] Business Korea, Korea's Premium Business News Portal, "S. Korea's IoT Sales Reach 8.6 Tril. Won in 2018", <http://www.businesskorea.co.kr>, 2019.
- [39] Statista, "Total Number of Internet of Things (IoT) Patent Applications Worldwide as of 2019, by Country", <https://www.statista.com/statistics/992140/worldwide-internet-of-things-patent-applications-country>, 2019.
- [40] Statista Global Consumer Survey, <https://www.statista.com/global-consumer-survey>, site visited: 2024.
- [41] S. Chatterjee, A.K. Kar, "Regulation and Governance of the Internet of Things in India", *Digital Policy, Regulation and Governance*, 2018, Vol. 20 No. 5, pp. 399-412.
- [42] Statista Consumer Market Outlook, <https://www.statista.com/outlook/consumer-markets>, Site Visited: 2024.
- [43] S. Chatterjee, A.K. Kar, Y.K. Dwivedi, "Intention to Use IoT by Aged Indian Consumers", *Journal of Computer Information Systems*, 2022, Vol. 62, No. 4, pp. 655-666.
- [44] Statista Global Consumer Survey, <https://www.statista.com/global-consumer-survey>, Site Visited: 2024.
- [45] S., A.K. Kar, M.P. Gupta, "Success of IoT in Smart Cities of India: An empirical Analysis", *ELSEVIER, Government Information Quarterly*, 2018, Vol. 35, Issue. 3, pp. 349-361.
- [46] India Open Government Data (OGD), <https://data.gov.in>, Site Visited: 2024.
- [47] Ministry of Electronics & Information Technology, Government of India, "IoT Policy Document", Department of Electronics & Information Technology (DeitY), <https://www.meity.gov.in>, 2016.
- [48] S. Chatterjee, A.K. Kar, S.Z. Mustafa, "Securing IoT Devices in Smart Cities of India: from Ethical and Enterprise Information System Management Perspective", *Enterprise Information Systems*, Vol. 15, No. 4, 2021, pp. 585-615.
- [49] Statista Technology Market Outlook, <https://de.statista.com/outlook/technology-outlook>, Site Visited: 2024.
- [50] S.O. Azarkasb, S.H. Khasteh, "Strategies and Ecosystem Transformations in the Internet of Everything in Malaysia", *Journal of Industry & University, ISC*, Vol. 55-56, 2024, pp. 187-204.
- [51] RICOH, "5 Pillars of Malaysia Cyber Security Strategy 2020-2024", <https://www.ricoh.com.my>, 2023.
- [52] TELECOM Review, "Malaysia's Digital Transformation Powered by New Technologies", <https://www.telecomreviewasia.com/news/featured-articles/4001-malaysia-s-digital-tranformation-powered-by-new-technologies/>, 2024.
- [53] B-K Chery, B-K Ng, C-Y Wong, "Governing the Progress of Internet-of-Things: Ambivalence in the Quest of Technology Exploitation and User Rights Protection", *ELSEVIER, Technology in Society*, Vol. 64, 2021, Article ID 101463.
- [54] Y. Yuan, T. C. Cheah, "A Study of Internet of Things Enable Hsalthcare Acceptance in Malaysia", *Journal of critical reviews, Journal of Critical Reviewe*, Vol. 7, No. 3, 2020.
- [55] A.H. Abdul Halim, and et all, "National Internet of Things (IoT) Strategic Roadmap", MIMOS BERHAD, Technology Park Malaysia, 2015.
- [56] M. A. Musarat, W.S. Alalou, A.M. Khan, S. Ayub, b. Na. Jousseau, "A Survey-Based Approach of Framework Development for Improving the Application of Internet of Things in the Construction Industry of Malaysia", *ELSEVIER, Results in Engineering*, Vol. 21, 2024, Article ID 101823.
- [57] MIMOS BERHAD, Technology Park Malaysia, "National Internet of Things (IoT) Strategic Roadmap: A Summary", 2015.