MINISTRY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF HIGH TECHNOLOGY

THE ANALYTICAL REPORT

TOWARDS

A NATIONAL STRATEGY OF ARTIFICIAL INTELLIGENCE UNTIL THE YEAR 2030

2021

MINISTRY OF SCIENCE AND TECHNOLOGY

D E P A R T M E N T O F H I G H T E C H N O L O G Y

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ACRONYMS

No	Acronyms	Description
1	AI	ARTITIFICAL INTELLIGENCE
2	ICT	INFORMATION AND COMMUNICATION TECHNOLOGY
3	4IR	THE 4TH INDUSTRIAL REVOLUTION
4	S&T	SCIENCE AND TECHNOLOGY
5	DS	DATA SCIENCE
6	R&D	RESEARCH AND DEVELOPMENT
7	GPU	GRAPHICAL PROCESSING UNIT
8	Gdp	GROSS DOMESTIC PRODUCT

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PREFACE

Artificial intelligence (AI) is a field of science and technology, aiming to develop computers and computing devices that have human-like intellectual capabilities and abilities that can be demonstrated (*feeling, comparing, measuring, evaluating*). The research and development process of AI undergoes many ups and downs: from early eagernes, optimism, enthusiasm in AI, to disappointment, laterly revival, and then to spectacular growths and breakthroughs. The early years of the 21st century have witnessed the strong development of intelligent applications, based on the achievements of modern AI technology in association with machine learning, deep learning, multi-layered learning as well as with the AI data-driven trend. On a global scale, AI plays a key role in shaping the models of connecting the cyber-physical world automatically and intelligently in most areas: manufacturing (*industrial manufacturing and agricultural production*), economics, business, services (*banking, education, tourism, health, healthcare, urban management, ...*) to improve the quality of life and quality of service to society and people; creating a new economic sector that is forecasted to require upto 1 million AI workers (by 2018, there were about 22,000 people worldwide [F5]). With the perception of AI as a disruptive technology bringing a competitive advantage to the country, contributing to increasing labor productivity, making a great contribution to GDP, major powers and many other countries have systematized, and built a development roadmap of AI in parallel with digital transformation, hence accordingly forming *the National Artificial Intelligence Strategy*.

Over the past years, a number of scientific and technological achievements in AI have been deployed and applied in Vietnam, especially in the fields of ICT, industry, agriculture and services. , ... However, due to many reasons, the scope and effectiveness of AI research and application in our country are still limited, not commensurate with the requirements of current socio-economic development as well as the future of the country.

In order to promote research and application of AI, to step by step bring AI to practically and effectively serve the cause of industrialization - modernization and sustainable socio-economic development of the country, the Party and The State has had many strategic directions for AI development. In the "*Strategy for the development of science and technology for the period*

2011-2020" according to Decision No. 418 / QD TTg dated April 11, 2012, the Prime Minister directed and identified AI as an important content in pripotized technologies. This technology orientation is also emphasized in the "*National program for high technology development to 2020*" under Decision No. 2457 / QD-TTg dated December 31, 2010. In the Politburo's Resolution No. 52-NQ / TW dated September 27, 2019, "*On a number of guidelines and policies to actively participate in the Fourth Industrial Revolution*", AI also is identified as the focal factor during the development policy of prioritized industries and technologies. On December 26, 2019, the Prime Minister assigned the Ministry of Science and Technology to assume the prime responsibility for, and coordinate with relevant ministries and branches in formulating a "*National AI Strategy to the year 2030*", in order to determine the point of target strategies, tasks, content and solutions, implement and assign responsibilities for implementation among ministries, branches and localities in order to develop research and application of AI to 2030 for production and development of economy and society in our country.

1. CURRENT AI DEVELOPMENT AROUND THE WORLD

1.1. General provision

The world underwent three industrial revolutions: mechanization, electrification and computerization - automation. Although taking place in a short time compared to the entire history of human development, industrial revolutions have brought about remarkable developments around the world. The 4th Industrial Revolution (4IR) is currently based on digital transformation, intelligent physical-cyber systems and the application of AI achievements, promising to create miracles.

The three previous industrial revolutions were based on inventions of steam engines; motors and electrical equipment; automation lines, ICT equipments in order to free up human labor, and at the same time allow increasing labor productivity. In 4IR, AI is considered as an important foundation, allowing productivity to increase to a completely different level, fundamentally altering the relationships of human-machine, human-equipment, machine-machine, person- person at different levels: *interface, interaction, integration* and *intellectual*. AI is considered as a new type of energy, playing an important role similar to electric energy in the industrial revolutions of electrification and computerization - automation. Today, AI is contributing to profound changes in many aspects of life, gradually becoming an important factor in all production, economic and service activities; and in society, life, as well as culture of humanity. Many thoughts of the bright future brought to humans by AI have been depicted.

As prediction starting in 2020, the fourth wave of digital technologies is with AI products and intelligent robotics (AI robot) both in terms of intelligence and interface. They are expected to create the success and their results are considered as the outcome of 4IR with a great influence on production and society. AI leads economic growth and AI becomes an opportunity to promote production, trade and service quality improvement in a rapidly changing global economy, with a forecasted contribution up to US $ 15,700 billion by 2030[1]. According to experts, AI also plays an important role in enhancing economic security and non-traditional security, improving the quality of life and

[1] https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

promoting national security; especially in the context of the current global COVID19 pandemic, along with digital transformation, AI has contributed greatly to the prevention of epidemics. An international race in AI has just started. Russian President Putin himself said: if any country leads in AI, it will become the dominant power in the world[2].

However, AI is also a very complex field of activities. There may also be risks and downsides, which are the source of fears, related to the ethical aspects of research, development and use of AI. This requires identification of negative and undesirable effects of AI products and services in production, economy, life and society. Appropriate awareness about AI, the future of AI and issues related to AI (especially the ethical and safety aspects) is an important content in the national strategy for the development of AI for countries around the world.

The year 2017 marks the great attention of many countries in the strategy of AI development. As of March 2019, 35 countries have developed plans and strategies for AI, including not only the world's leading powers in economics, science and technology such as the US, China, and Japan, Germany, France, UK, Russia, ... but also other countries with different socio-economic conditions such as Korea (2018), Singapore (2019), Malta (3/2019), Qatar (2 / 2019). Most recently, in February 2020, the European Union issued a White Paper on Artificial Intelligence, paying special attention to the ethical and legal regulations for the development of AI in Europe.

Each country’s strategy focuses on a number of different aspects, but the nine common points of the strategies are: data infrastructure and digital infrastructure; scientific research; talent development; human resource training; AI in the digital government; investment and industrialization of AI technology; ethical and legal issues; social welfare issue; and policies. To assist countries in the proposing process, the World Economic Forum (WEF) has developed a guide, notably the process of building a strategy with four goals for capability development, capacity, investment, adoption and regulation and 5 groups of strategies: regulation of the legal system, research, and training of skills, adoption and international collaboration [J1].

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[2] https://www.brookings.edu/blog/future-development/2020/01/17/whoever-leads-in-artificial-intelligence-in-2030-will-rule-the-world-until-2100/?fbclid=IwAR0OYAihcuvUueMPa_h7Xr9iUfxnOdS5YlRt8ZxP9CTTkseh8R9x0bIWIyI

1.2. Current status of AI research, development and deployment

In the simplest way, AI is understood as the ability of a computer (or a computer-controlled system) to perform tasks that require human intelligence such as speech recognition, visualization, and experience-based learning, prediction, and decision making. AI began to be studied in the 50s of the last century. However, only in the last 10 years AI has been widely used. AI systems are generally classified into two main categories:

• *Narrow AI, weak AI, or specialized AI*: is a concept that refers to AI systems designed for a specific problem or limited in scope such as automatic translation, voice identification, or human face recognition in video. Most of the current AI applications fall into this category.

• *General AI or strong AI:* is a concept that refers to the AI system capable of being similar to or better than human when solving a wide class of intelligence-demanding problems. Building a system with strong AI is a difficult and not feasible in the near future.

a) Scientific publication

According to WIPO statistics [F11], in the period from 1960 to the middle of 2018, the total number of articles related to AI around the world reached 1,636,649. According to another statistics [F6], in the last 20 years from 1998 to 2018, the total number of AI articles was 630,000, particularly in 2017 there were 65,100 articles in the Web of science category. Below are some data figures on research and development in the AI field:

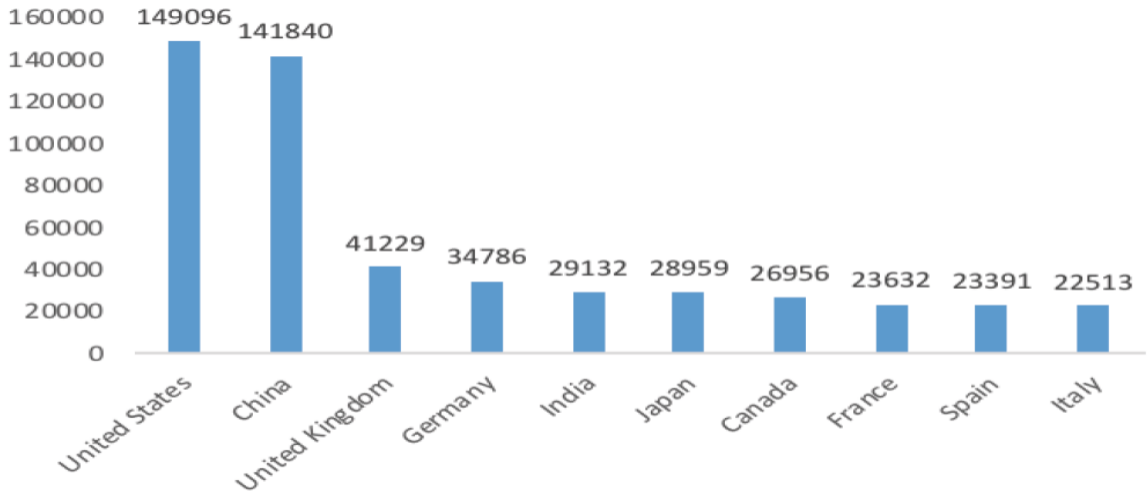

Figure 1: Top 10 countries with the number of AI articles between 1998-2018 [F6]

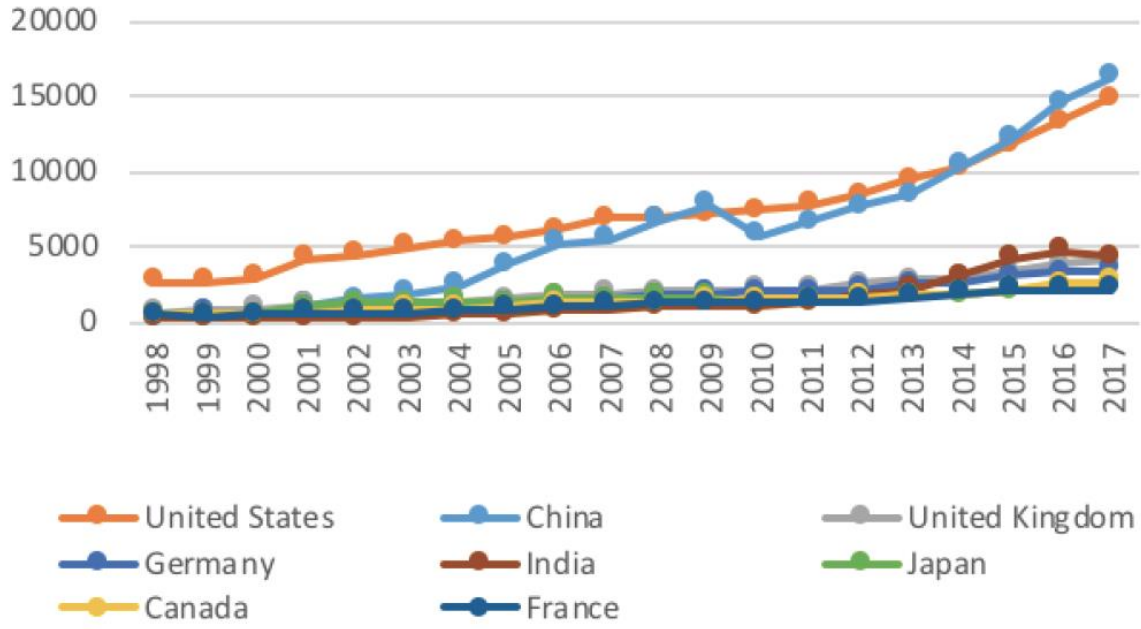

Figure 2: The number of articles by year for selected countries [F6]

b) Patents

Another important indicator of research and development related to AI is the number of patents in this field. Figure 4 shows the number of patents registered in the US under the AI technologies and application fields. The data shows that the number of inventions related to AI technologies such as machine learning, computer vision, natural language processing, prediction in all fields is high.

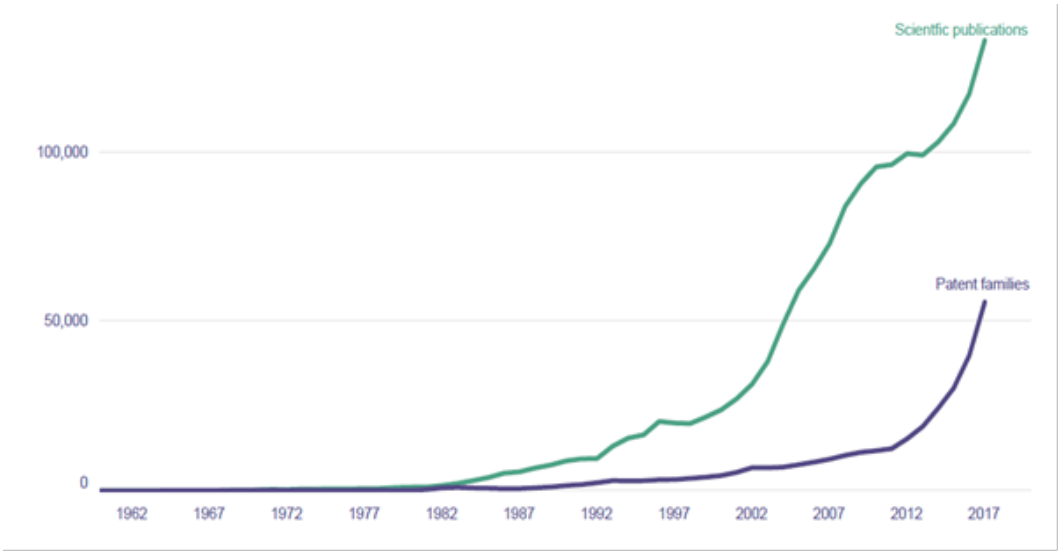

Figure 3: The number of articles and patents in the world over years [F11].

	Machine learning	Computer vision	Natural language processing	Speech processing	Control methods	Planning and scheduling	Robotics	Knowledge representation and reasoning	Predictive analytics	Distributed AI
Telecommunications	16,201	22,871	7,553	12,549	3,496	2,601	2,476	1,292	1,533	516
Transportation	13,741	21,744	2,330	3,997	14,030	3,614	5,080	761	866	533
Personal devices, computing and HCI	11,585	17,164	7,920	6,678	1,625	1,663	1,416	1,838	1,069	223
Life and medical sciences	18,772	17,098	3,818	2,504	1,494	1,617	1,988	1,698	1,694	428
Security	8,813	17,235	3,033	3,075	1,162	1,401	793	795	594	243
ocument management and publishing	6,841	11,530	9,526	3,291	163	517	221	880	431	83
Business	9,709	7,968	5,850	2,422	271	1,381	350	1,820	2,585	189
Industry and manufacturing	9,569	5,573	3,031	798	1,262	2,404	1,073	1,213	1,086	382
Physical sciences and engineering	8,330	5,397	1,284	1,183	1,540	721	679	444	720	171
Networks	5,296	3,659	2,350	1,498	343	789	380	630	570	183
Arts and humanities	2,489	4,852	2,669	2,615	237	273	371	203	277	44
Education	3,914	3,767	1,642	1,951	284	365	372	532	247	56
Cartography	3,276	3,334	1,610	759	697	697	257	365	425	98
Energy management	3,766	1,056	397	309	734	944	336	187	299	335
Entertainment	1,822	2,890	737	1,087	309	199	528	189	133	41
Computing in government	2,583	2,587	938	444	149	380	135	243	213	71
Banking and finance	2,368	2,047	1,055	493	87	435	99	394	449	81
Agriculture	1,430	1,196	291	126	778	282	415	82	138	48
Military	1,300	1,343	370	269	443	241	255	110	111	73
Law, social and behavioral sciences	780	404	550	121	25	153	37	123	65	23

Figure 4: The worldwide patent volume by sectors [F11]

c) AI Capacity

AI is widely used mainly because the ability of this technology to solve specific problems has been significantly improved. Possibly its performance is equal to and even surpass the human ability in many cases. Figure 5 shows the AI system's ability to solve a number of important problems, compared with the human ability.

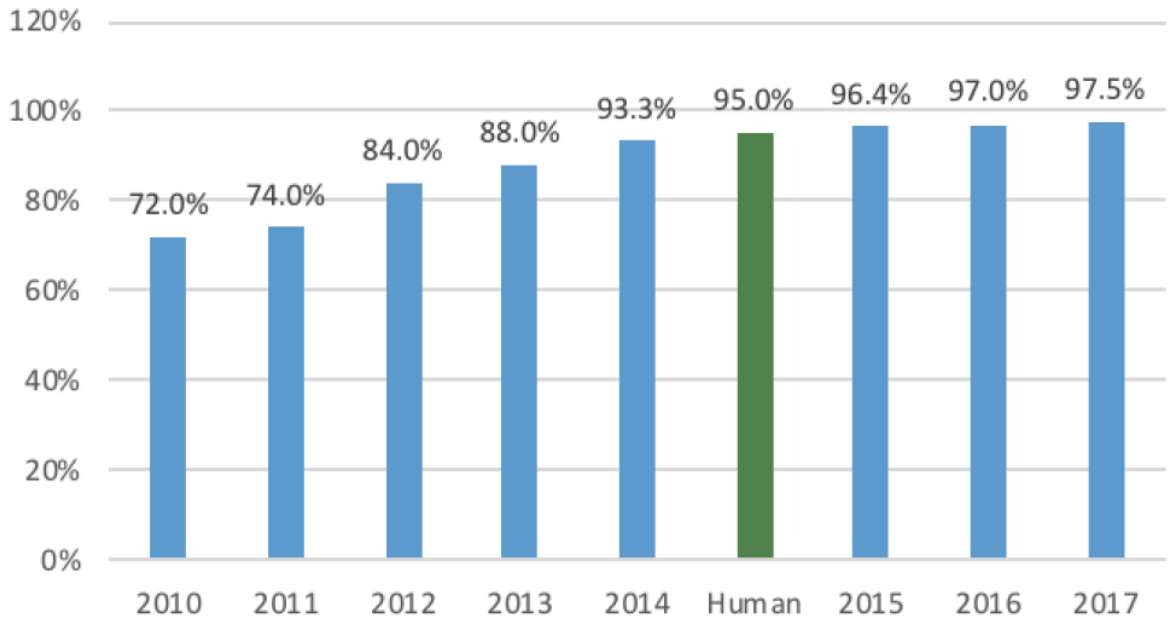

Figure 5: Results of AI object recognition compared to humans [F6]

d) AI Adoption

In nearly two decades since the beginning of the 21st century, based on newly proposed computing approaches, deep learning research results and effective technological foundations, AI (specifically *machine learning*) has developed rapidly and have groundbreaking applications on large sample databases. AI has greatly contributed to human support, in particular: (i) improving human problem-solving capabilities in decision-making assistance and production line control (via smart robots in industrial production lines), big data analysis (medical, biological data analysis); (ii) improving people's living and working conditions (automation simplifies workers' work, intelligent entertainment technologies, ...); (iii) building capacity for new human abilities (forecasting situations, supporting decision making) [F10].

Therefore, machine learning and data-driven AI has a strong impact on all applications in fields of production, economy, services, as well as in social and cultural life, which are changing every day with the digitization, computerization and digital transformation process. In McKinsey's 2018 survey [F17], the finance, telecommunications and high-tech sectors are the areas, where AI application is the most; marketing and sales is the most in using AI applications for retail services; in industrial production, the most application of AI in the automotive industry.

Thanks to machine learning achievements based on convolutional neural network, deep learning neural network, regression neural network, computer's image recognition and speech recognition capabilities have surpassed human capabilities (with accuracy over 95%):

i) Human face image recognition products have been widely deployed around the world with security authentication applications on smart phones, at the doors of buildings, and the arrival/departutre stations, in crime tracking applications in the US, China, and UK.

ii) Speech recognition products are widely used in many practical applications such as automatic input, human-machine interface (Google search engine), chatbot, intelligent virtual assistant (Siri, Cortana, Alexa , Google Now). The operating systems iOS, Android, watchOS, MacOS, tvOS use voice and answer questions and natural language user interface to respond to user requests, make recommendations, shows required fiduciary tasks for services on the Internet. With the recent advances in machine learning, speech synthesis has the ability to express, mimic the voice of any speaker if there is a sufficient amount of that person's spoken voice data.

iii) Natural language processing and understanding products: Web services that search and query information online, extracting information, summarizing documents are areas directly related to processing and understanding natural language. Semantic Web technologies and knowledge-based information retrieval techniques have better enhanced output quality in response to user requirements.

The intelligent question and answer systems approaches human ability as is the case of the IBM Watson system, USA. The translation method, based on multi-layer deep neural networks on large corpus, has resulted in better and better quality translation. Google translation system allows multilingual translation with improved quality.

iv) Military application: Due to its unique nature, the military is always an area with urgent requirements for product application of new technology. The militaries have the need to strengthen their military technological advantage over potential opponents. AI could be said to have a great influence on this particular area. There have been many experimental studies being carried out, especially in weapon intelligentization, specifically: (i) *smart weapons:* making weapons intelligent is a big trend nowadays. Currently, weapons and military equipment are adjusted to attach smart modules, in which cruise missiles are a

prime example. The rockets are no longer merely flying in a predetermined trajectory but guided through a computational mechanism with many rapid-computation devices mounted directly on the missile and the control station. (ii) *Autonomous unmanned equipment:* Breakthroughs in computing technology, AI, robotics and IoT have opened a new chapter in military weapon development, without the need for direct personnel control. Hence, it contributes to reducing casualties for soldiers in combat and increasing accuracy in operations. In recent years, the world has seen the emergence and participation of unmanned military weapons. The American Predator drone has become a strategic assassin. Predator's paths are computer-based calculated on the basis of satellite information connections, ground images are captured, processed, identified by AI algorithms and communicated to the headquarters. Underwater environment is also an area where unmanned equipment is strongly developed, notably Israel's Seagulls project, the US Navy's SeaHunter unmanned ship project, which is currently being tested and has been included, coming into operation in 2018. (iii) *Multi-format information integration, analysis and processing systems:* for the command & control at all levels, decision-making support systems for commanders advising the application of AI, surveillance systems, radar warning systems, intelligent cameras for security and national defense.

1.3. Current situation of the AI market, investment around the world

a) Revenue from AI

The revenue of the AI market in 2018 reached about 20 billion USD, of which the US accounted for nearly 10 billion, China was about 5 billion. It is forecasted to increase to more than 200 billion by 2025[3]. PwC estimates (this figure is also widely acknowledged) that the profits from the world's AI industry in 2030 will be about 15,700 billion USD (6,900 billion USD from contribution to increase productivity and 9,100 USD billion due to additional impacts). This contributes 14% to global gross domestic product (nominal) GDP [F2] (*see Figure 6*).

[3]https://www.fortunebusinessinsights.com/industry-reports/artificial-intelligence-market-100114

Figure 7 presents a table of estimates[4] of the demand and size of the AI market for industries around the world for the next five years [F3]. According to estimates, global startup equity is approximately tens of billions of US dollars, of which for the public and social sectors alone, this figure is over one billion US dollars. This estimate shows an optimistic assessment of technology and venture capitals on AI. This is a reasonable and meaningful estimate. Recognizing the need to apply AI in the public sector and society is really of great concern to state management agencies.

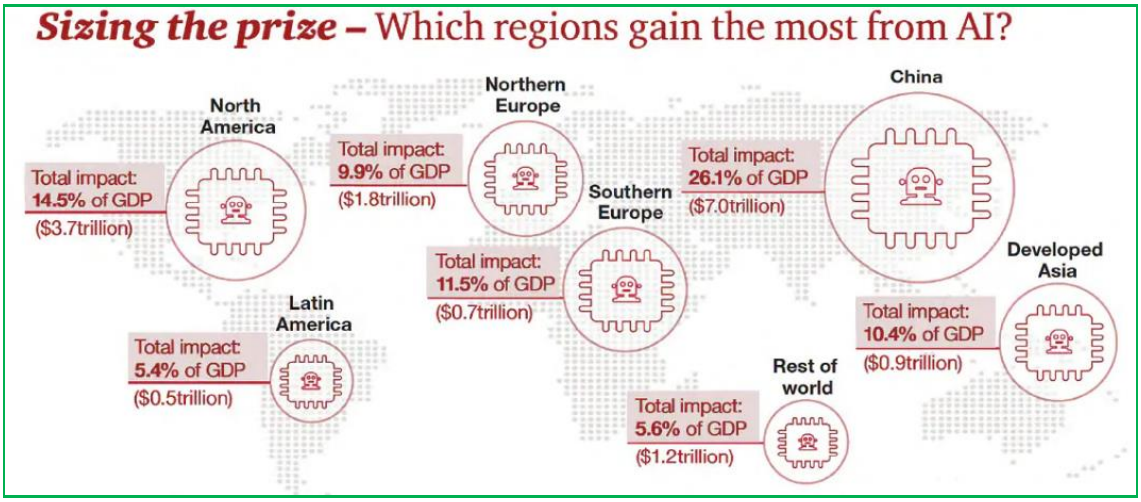

Figure 6. Estimates of AI revenue in 2030 by regions in the world [F2]

[4] https://www.mckinsey.com/industries/advanced-electronics/our-insights/artificial-intelligence-the-time-to-act-is-now

	Market size	Pain points		Willingness to pay
	Global industry size, $ trillion	Artificial intelligence (AI) use cases, #	Start-up equity raised,[1] $ billion	Average AI economic impact,[2] %
Public & social sector	25+	50+	1.0+	5–10
Retail	10–15	50+	0.5–1.0	5–10
Healthcare	5–10	50+	1.0+	15–20
Banking	15–25	50+	1.0+	<5
Industrials	5–10	50+	0.5–1.0	10–15
Basic materials	5–10	10–30	<0.5	15–20
Consumer packaged goods	15–25	10–30	0.5–1.0	5–10
Automotive & assembly	5–10	10–30	0.5–1.0	10–15
Telecom	<5	30–50	<0.5	20+
Oil & gas	5–10	30–50	<0.5	<5
Chemicals & agriculture	5–10	10–30	<0.5	5–10
Pharmaceuticals & medical products	<5	10–30	<0.5	20+
Transport & logistics	5–10	30–50	<0.5	5–10
Insurance	<5	30–50	<0.5	15–20
Media & entertainment	<5	10–30	<0.5	15–20
Travel	<5	10–30	<0.5	5–10
Technology	<5	10–30	<0.5	10–15

Figure 7. Estimate of AI market demand and size over the next five years for industries by market size, actual pain points and perceptions, willingness to spend pay. Note: (1) Start-up equity is assumed by industry size, (2) willingness to pay is the ratio of the total value of AI use cases divided by the market size of the industry. [F3]

b) AI Investment

The world has received a rather strong wave of investment in AI market in recent years, of which, in 2017, it reached 39.5 billion USD, of which China accounted for 70% of the total investment [F6]; the investment sector focuses on intelligent robot products, big data and machine vision (Figure 8). In addition, the investment trend of leading companies in the world in AI through startups is becoming more exciting than ever [F5]. Investment in the AI startup in 2018 of the top 7 companies: Google, Amazon, Uber, Intel, Microsoft,

Apple, and Twitter reached $ 8.3 billion, of which Google reached nearly $ 4 billion. Google has about 1,400 people working on AI, the largest in the world. The US and China are the two AI centers, with the largest number of AI startups in the top 6 countries in the world (USA 1393, China 383, Israel 350, UK 245, Canada 131, Japan 110).

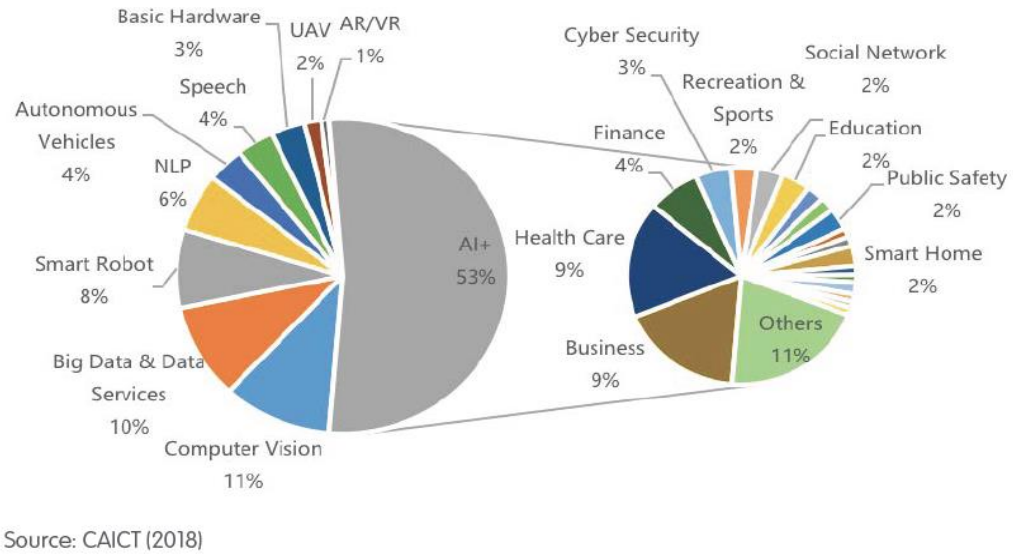

Figure 8: Allocation of investment for AI market in the period 2013-2018 [F6]

2. AI DEVELOPMENT IN VIETNAM

2.1. The political, economic and social context of Vietnam

Vietnam is a country with a high proportion of young and dynamic population and a creative economy. According to a report by the World Economic Forum WEF, Vietnam's global innovation index in 2019 ranked 42nd out of 129 countries and ranked 3rd in ASEAN [E3]. Statistics in 2019 show that the Vietnamese economy has a scale of 6,037.2 trillion VND (~ 260 billion USD), a total population of about 96.48 million, of which the labor force is about 54.7 million (~ 56.7 %), the average income is about 4.2 million VND / month, GDP increased by 7.02% compared to 2018, especially the industry in 2019 maintained a high growth rate with 8.86%, total budget revenue 1,414.3 trillion VND (revenue from non-state enterprises 218.6 trillion VND, accounting for 15.5%), total budget expenditure 1,316.4 trillion VND.

As reported in the Topdev 2019 report [G3], statistics from the Ministry of Information and Communications show that there are nearly 50,000 enterprises operating in the ICT sector, the ICT industry growing by about 10%, the total

revenue in the ICT industry in 2019 is estimated at 112,350 billion USD, of which ICT export accounts for 81.5%, software industry revenue is 5 billion USD, an increase of 500 million USD compared to 2018. The total amount paid to the State budget from the ICT industry in 2019 is 54,000 billion VND, an increase of 2,000 billion VND compared to 2018.

This is a good sign that Vietnam's economy is oriented to the digital economy, which has positive effects of digital technologies and AI. The independent statistics in 2019 from the e-Conomy SEA program of Google and Tamazek [G4] also show that Vietnam is one of the two countries with the fastest growth rates of the digital economy in ASEAN (~ 38% since 2015) and reaches about 5% of GDP. Vietnam's global e-government index (developed by the United Nations) of Vietnam is progressing positively, ranking 88 (out of 193 countries) [E3], and for the first time in 2019, Vietnam was recorded and received the AI ranking 70 out of 194 countries (in 2017, Vietnam was not ranked).

Weaknesses: *Our country's socio-economic development level is not high (According to the World Bank report in 2018* [E12, E13]*, Vietnam has a large population in the ASEAN region, nearly 96 million; Vietnam ranks 6th in ASEAN in the rankings with 8 indicators measuring the health of the economy; investment in research and development of Vietnam in 2018 only reached about 0.4% of GDP; public investment in Vietnam's higher education is about 0.33% of GDP, e-goverment index (e-goverment) ranks 88th, these indicators are still far from Thailand, Malaysia, Singapore)*.

2.2. Current situation of AI adoption in Vietnam

a) Adoption in State agencies

AI has been applied and deployed in a number of ministries, branches and localities in supporting automation at some stages, contributing to initially improving the efficiency of state management, for examples:

- AI is used in immigration. Facial recognition, fingerprints, iris, passport scanning devices are being applied at international border gates such as Noi Bai and Tan Son Nhat;

- Vehicle number plate identification, vehicle type identification, vehicle counting, applied in urban management;

- Speech recognition, document recognition help reduce costs and labor in digitizing voice data, documents, ...

- AI is used in automatic data collection, monitoring, warning, forecasting in the fields of hydrometeorology, water resources ...

- Da Nang City has digitized a number of operations including electronic one-stop service management, document management and administration and specialized operations of agencies and units. A number of AI applications have been deployed such as chatbot to support corporate as well as citizens to use city public services, traffic monitoring systems with cameras, machine learning modules with crayon applications on the management system, ... In the coming time, the city will continue to deploy identification applications (registration plates, faces) for urban management, parking spot management systems, ...

In general, the application of AI in state management agencies is in a preliminary form. However, the potential to apply AI in state management in Vietnam has a high potential, contributing to building an effective government by:

- The projects of National Digital Transformation and e-Government will create opportunities for promoting the application of AI in state management agencies;

- Smart-city projects promote the need to develop and apply AI in urban management and social management in localities, especially in big cities such as Hanoi, Ho Chi Minh City, Da Nang and Can Tho.

- Improvements in investment policies and state management in higher education, science and technology, human resource development and talent fostering will contribute to promoting the application of AI in gorvenment agencies.

b) Adoption in socio-economic fields

Although the AI market as well as the adoption of AI in the economy and society has only been boosted for about 5 to 7 years, there are also positive signs. Many sectors of production and services have shown the influence of AI such as e-commerce, banking, transportation, logistics, real estate, finance, agriculture, education ... Electronic commerce (e-commerce) is the field with the highest impact of AI ~ 29% [F5]. The event of COVID-19 epidemic showed how quickly and effectively AI was implemented when chatbots and virtual assistants appeared continuously on health information pages to gather information as well as respond and automatic consultation. According to survey

results of the Ministry of Science and Technology, ministries and localities all indicated the need for AI applications.

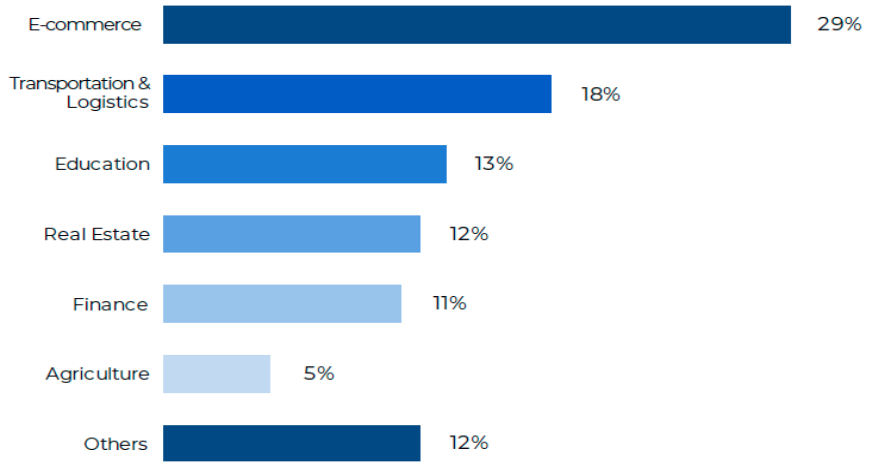

Figure 9: Distribution of AI applications in socio-economic sectors of Vietnam [F5]

Some of notable applications in the areas can be listed here such as:

- Banking and Finance: This is one of the areas with the earliest application of AI such as Chatbot, fraud detection and money laundering, and support for credit decisions. In Vietnam, Tienphong Bank and Viet A Bank can be considered as places with earliest chatbot applications and virtual assistants; these apps have been popularized by far. According to the State Bank's report, at present, BigData technology and data analytics are being researched and will be put into service operations at centers such as IT centers, credit centers. In addition, at present, the State Bank has digitized 30 types of transactions and concentrated in the data center, which is a good preparation for digital transformation as well as AI application.

- Commerce: E-commerce has emerged as an important factor in the digital economy, many electronic trading floors have been developed in Vietnam such as Sendo, Tiki, Lazada,... These markets are now using chatbots to help customers, and reccomender applications to help customers for the product selection. Product code identification applications have been widely applied such as barcode recognition. In electronic payments, many biometric applications have been deployed to enhance customer security. Some

companies such as FPT, Vietel have mastered the technology and have products widely deployed.

- Transport and logistics: This is the field that ensures the circulation of the economy; our transportation forms are very diverse and are gradually becoming the strength of the economy. Currently, there are many methods to apply high technologies in general and AI in particular to improve the quality of transportation services, such as non-stop toll stations, traffic monitoring and control centers, smart logistics systems (recently a series of logistics technology startups applying AI as Abivin), taxi systems applying AI technology such as GoViet, Grab ...

- Health: The application of AI in medicine is an irreversible trend. The COVID19 event further affirms the advantage of AI applications in the medical environment, where intelligent automated tools are needed to minimize the presence of medical staff, especially a variety of robotic products in supporting medical staff at the hospital (Vibot of the Military Technical Academy in Bac Thang Long Hospital, NaRoVid of the Institute of Technology Application at the Central Tropical Hospital…). Vinmec Medicals, Central Lung Hospital and VinBrain have signed a memorandum of understanding for cooperation and application of "AI Assistant to Doctors in Diagnostic Imaging". The government recently launches the remote health care system, starting at Hanoi Medical University Hospital. Five9 Joint Stock Company with the IBM Watson For Oncology system has been tested in 3 hospitals: Phu Tho Provincial General Hospital (tested from January 2018), Central K Hospital (from February to May) 2018), Oncology Hospital in Ho Chi Minh City (September 2018) [H8]. Our Health System has about 1,400 hospitals; this shows great potential in the AI application. However, some hospitals are now confused in using the diagnostic results of AI in treatment, leading to low confidence in AI.

Weakneses: *The infrastructure and information serving the AI industry development are still weak (the infrastructure for AI in our country is almost negligible). Data storage and sharing is still weak. Open data systems are limited. There are almost no open foundations for AI specific to Vietnam. The application of AI in key industries is still modest, such as agriculture and healthcare (see Figure 10). The index of e-government remains low (88/193). The global ICT index is 108/176, ranking 6th in ASEAN. Confidence in AI implementation is still low.*

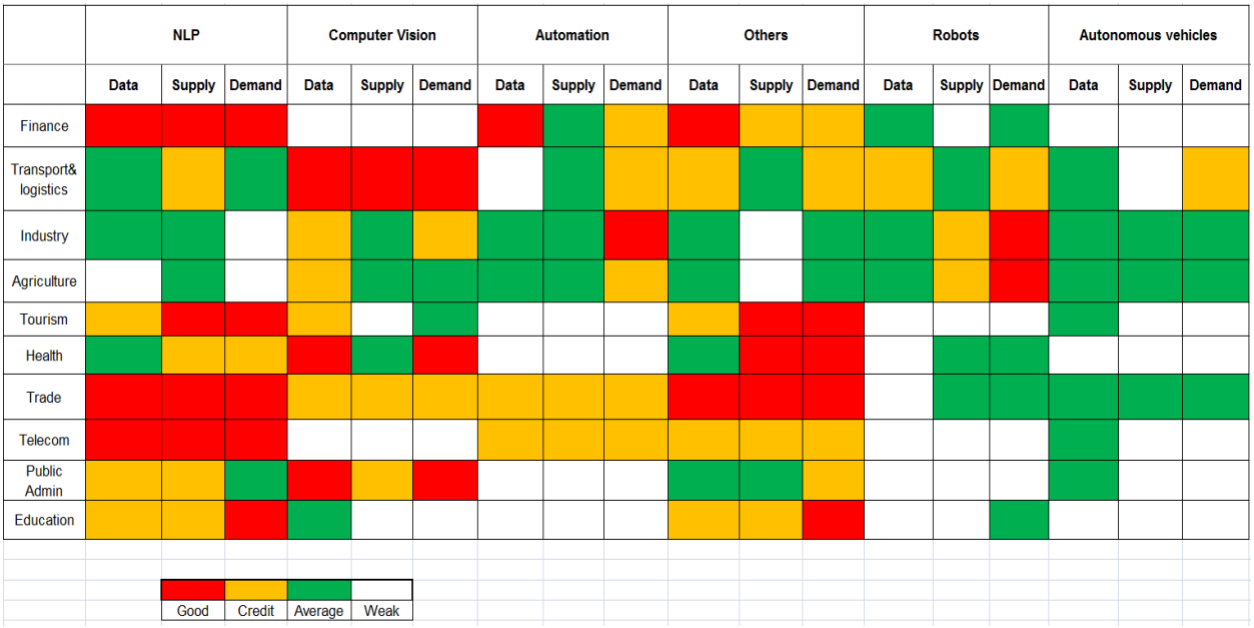

Figure 10: Status of data, supply, and demand for AI in socio-economic sectors (Note, Red: high, Yellow: fair - credit, Green: medium-average, White: almost nonexistent)

2.3. Current status of research and development of AI

Right from the 1980s of the last century, AI research groups in Vietnam had research projects oriented the application of AI on letter recognition, vehicle number plate identification, expert systems, fuzzy systems, and model- and knowledge-based decision-making. However, due to the limitations of equipment, software tools and practical environment, the application of AI is difficult and has not met the requirements of practical application. This is similar to the situation of AI in the world.

In recent years, along with the advancements in data science, machine learning, abundant practical data platforms and the maturity of young research teams, who were well-trained from developed countries, research, development and application of AI have been gradually formed, consolidated and increasingly developed. It is concentrated in leading universities, research institutes and technology companies (Institute of Information Technology under the Vietnam Academy of Science and Technology; University of Technology, University of Science. Nature belongs to Hanoi National University; Hanoi Polytechnic University; Polytechnic University, University of Natural Sciences, John von Neumann Institute under National University of Ho Chi Minh City; Military Technical Academy; Posts and Telecommunications Institute of

Technology; VinAI Institute, VinBDI, Vin Uni School; FPT Research Center, FPT Uni School; CMC Research Institute; Phenica School ...).

a) AI international publications

Regarding the published works related to AI, Vietnam has seen an increase in recent times, especially in prestigious international journals. In the period 1996-2018, among 10 ASEAN countries, Vietnam ranked 5th in the number of scientific publications on the Web of Science database, ranked 5th in the number of scientific publications on Scopus data on AI and ranked first on the AI published rate in the total number of Scopus scientific publications ~ 5.3% (topics include core AI techniques - 1,643 and computer vision - 1,096). While Vietnam's nominal GDP is significantly lower than in the top five economic countries in Southeast Asia, this shows the efforts of the Vietnamese AI[5].

Table 1a. Data on Scopus scientific publication of 10 ASEAN countries (1996-2018 period)

	SIN	MAL	THA	IND	VIE	PHI	BRU	CAM	LAO	MYA
Sum	292.560	286.411	178.133	110.610	51.748	32.326	4.169	4.007	2.965	2.672
IT	62.914	52.103	21.773	19.309	9.759	3.075	480	58	93	439
AI	14.519	9.759	5.229	5.114	**2.739**	747	87	10	7	115
Population (mil.)	5,6	31,5	69,4	267,7	95,5	106,7	0,4	16,2	7,1	53,7
GDP (bil. USD)	364,2	358,6	505,0	1.042,2	245,2	330,9	13,6	24,5	18,0	71,2

Table 1b. Data extracted from Vietnam's Scopus scientific publication on AI from 2010 to 2018

Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Amount	134	172	141	311	191	273	202	532	525

[5]Các số liệu công bố Scopus http://www.scimagojr.com/countryrank.php?region=Asiatic%20Region (toàn bộ), http://www.scimagojr.com/countryrank.php?region=Asiatic%20Region&area=1700 (CNTT), http://www.scimagojr.com/countryrank.php?area=1700&region=Asiatic%20Region&category=1702 (TTNT); Dân số quốc gia năm 2018http://wdi.worldbank.org/table/WV.1; GDP danh nghĩa https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

b) Pattents related to AI

Regarding AI-related patents, we have also had certain results. According to WIPO's statistics [F11], as of 2018, 06 countries in the ASEAN region have patents on AI, including Singapore, Thailand, Malaysia, Indonesia, Philippines and Vietnam, of which Vietnam ranked second with 372 applications being related to AI and sent in many offices around the world (the office in Vietnam has 17 applications). This is a positive sign while we are only 5th in terms of the total number of patents (see Table 2 for details).

Table 2. Patent data for 10 ASEAN countries (without Laos) for all sectors

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Singapore	1849	2040	2275	2250	2472	2739	3091	3112	3337
Malaysia	517	593	660	720	856	913	940	949	985
Indonesia	15	19	19	37	27	46	339	43	552
Thailand	391	231	144	182	199	219	225	249	348
Viet Nam	33	53	56	70	60	88	118	159	248
Philippines	59	48	63	82	94	146	141	138	141
Brunei Darussalam	22	18	19	3	2	9	10	11	1
Cambodia							1		1
Myanmar	1				1				1

State investment in AI research has also been implemented in national S&T programs related to AI, such as *KC01, KC-4.0, NAFOSTED*…. During the 15-year period from 2006 to 2020, more than 117 state-level proposals related to AI have been reviewed and approved, of which 3 major science and technology programs have been granted about 169, 215 billion VND, Specifically:

- Program KC.01 has sponsored 15 projects for AI with a total budget of about 46,405 billion VND,

- Program KC-4.0/19-25 has sponsored 10 projects on AI with a budget of 62,460 billion VND,

- The National NAFOSTED Fund sponsored 71 AI projects with funding of about 60,350 billion VND.

The projects are mainly focused on the areas of: Intelligent systems, Image processing, Natural language processing, Robotics interaction, Bioinformatics. Researches on natural language processing and machine learning provide solutions for automatic translation in two-way English-Vietnamese, Vietnamese-English; build Vietnamese corpus or community trend analysis solutions based on social networks and apply in a number of fields such as tourism, technology product trading. There are some studies on designing assistance robots, helping the sick, the elderly and the disabled, some studies of speech recognition and embedded on devices or robots, image processing, gesture / image recognition for real-time robot interactions, supporting agricultural tasks (classification cashew nut), medical (abnormal detection on X-ray image), security safety (detecting and warning of fire, fingerprint identification for police). Some topics focus on solutions to detect and monitor problems in service access, monitor network safety, monitor the safety of websites, protect and leak data in e-government. Some results of the topic have been put into practice.

AI forums and conferences have been established to exchange and connect research, application and implementation of AI. Many high-quality and in-depth international conferences and seminars with a high proportion of research papers and applications of AI have also been successfully organized by the domestic professional community in collaboration with foreign experts, such as: RIVF, KSE, SoICT, NICS, FDSE, VLSP. In addition, AI4Life-2018 which was first held at the University of Technology, Zalo AI Summit 2017 and 2018, VietAI Summit 2018 ... The first National Workshop on AI (AI4VN) held in

2018 and the second time, the AI Day (AI4VN 2019) has contributed to gathering, connecting and converging the development of the ecosystem. research and application of AI in Vietnam and for Vietnam. The Advanced Research Institute in Mathematics has established the Data Science Lab and has established connections with research groups from universities. Many seminar activities, information sharing about AI research have been organized. In addition, a number of courses and seminars related to AI are also held at some training institutions. Conferences and forums have initially contributed to the development of the field of ICT research and application, along with other researches and practical applications of IT. Through the conferences, it also clarifies the need to further promote the connection between academic research and application development in the AI field, and between researchers and information technology corporations and enterprises.

Weaknesses: Currently, Vietnam does not have the top research training institutions in the region and in the world (in the ASEAN region, the top 10 research and training institutions of ASEAN countries do not have any Vietnamese ones). Vietnam's public investment in S&T remains small (about 0.4% of GDP). Although there have been initatives recently, for many years, domestic enterprises are not aware of AI technology, so they have not made efforts to participate in research and development (R&D) of technology and application of AI. Capacity for research and development of technology and application of AI in both academic and industrial communities remains weak.

c) Demand for human resources and the situation of AI training

Human resources for ICT in general and AI human resources have been developing rapidly in recent times. According to the IT White Paper of the Ministry of Information and Communications in 2019, the total number of ICT human resources (including electronics and telecommunications) has reached over 970,000 people, of which the number of people working in the IT field (software and digital content) has nearly 180,000 people, while it is forecasted that the demand for IT human resources is huge, about 400,000 people by 2020 and the supply source is only guaranteed about 50,000 people / year [E2]. The digital transformation project to 2030 of the Ministry of Information and Communications sets the target of 1 million IT human resources. According to many statistical sources (google scholars, AI4VN seminars, ...), there are currently over 1600 researchers (domestic and overseas) working in the fields related to AI, of which there are about 700 people. working in Vietnam (the

number of experts is about 300 people). In addition, many companies have formed teams for the implementation and application of AI (Table 3). Although this number is not much compared to the need (CMC Group alone has a demand for nearly 1000 engineers and bachelor in AI), it also reflects the development of our AI human resources.

Table 3: Human resources of AI in large corporations in IT in Vietnam

	Actual			**Curent demand**			**Demand in the next 5 years**		
	PhD	MSc	Eng	PhD	MSc	Eng	PhD	MSc	Eng
FPT	10	20	200	5	10	100	20	100	500
CMC	6		136	50	200	1000	100	1000	6000
Viettel	10	15	100	20	60	150	60	100	300
VNPT	0	14	104			177			400
	26	**49**	**615**	**75**	**270**	**1427**	**180**	**1200**	**7200**

In addition, the largest job information site in Vietnam currently - Vietnamworks has released the IT Market Report 2019, clearly reflecting software developer jobs related to AI. is highly selective, though it accounts for a small percentage of about 2.5% (Figure 11) and all have top 10 salaries, of which the AI major is 1,844 USD / month, Machine vision is 1,514 USD / month, BigData 1,510 USD / month [G1]. This shows that the demand for human resources for AI is quite large and similar to the assessment of Topdev - a job information service company in Vietnam [G3], and also reflects the global picture (forecasted 1 million people, actuall: 22,000 until 2018; and the average salary of 140,000 USD [F5]).

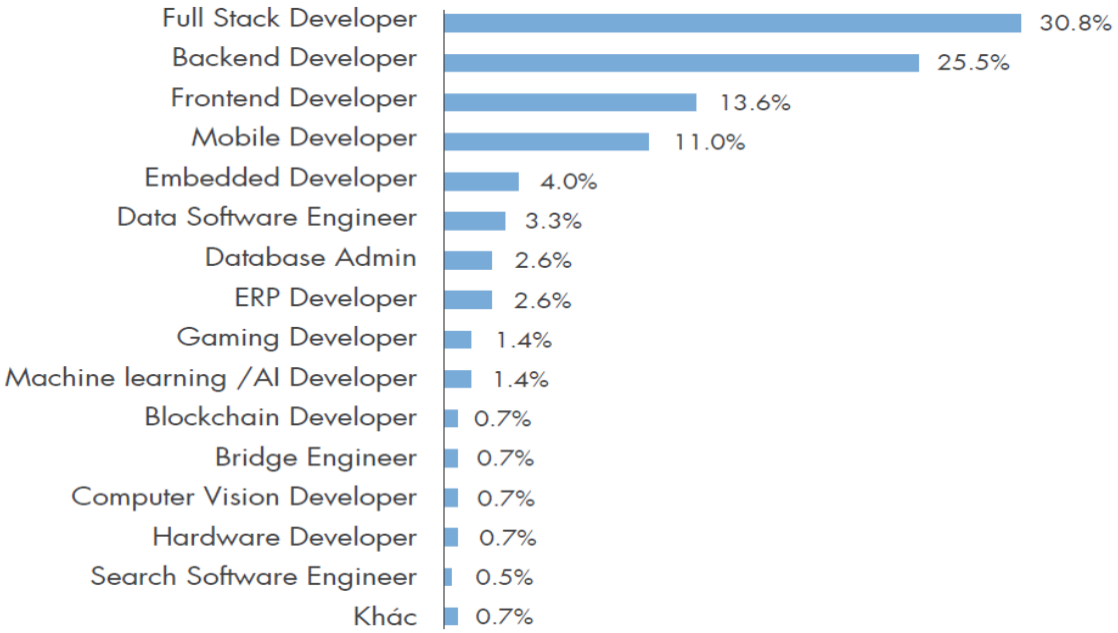

Figure 11: Professional percentage of jobs in software development related to AI, including: Machine learning / AI developer, Computer Vision and Search Software [G3]

AI training activities in recent years have been formed and developed along with IT training in Vietnam. Up to now, Vietnam's leading and traditional IT universities have implemented training programs in Computer Science with specialization in AI and data science (DS): University of Engineering and Technology, University of Natural Sciences of Hanoi National University; Hanoi University of Science and Technology; Polytechnic University, University of Natural Sciences of Ho Chi Minh City National University; Military Technical Academy; Post and Telecommunications Institute of Technology; Cantho University; Danang University…. Recently, with a new trend in BigData, many universities have started to open data science programs at different training levels. The University of Natural Sciences (HN VNU) has put into place a master's program in data science and a high-quality bachelor's program, oriented towards AI. Starting in 2016, Hanoi University of Science and Technology (HUST) has deployed training in Computer Science, specialized in AI and DS. In 2019, HUST opens its own program of Data Science and Artificial Intelligence for both undergraduate and master's training, and opens Digital Transformation program for master's as well as other short courses. According to statistics, at present, there are over 50 universities with training related to AI. Particularly in 2020, according to information from the

Ministry of Education and Training, there will be many universities planning to enroll students in AI.

In addition to training activities on AI in major universities as mentioned above, many training institutions also offer short-term training courses to supplement knowledge for students and staff to meet social demand. HCM City University of Technology has an AI training center in conjunction with businesses with short training courses on deep learning, big data analysis. AI Academy is the organizer of training courses for businesses and individuals on machine learning, natural language processing (NLP), and analysis of business activities. Starting in 2015, the University of Engineering and Technology of Hanoi National University has organized summer schools for data mining and data science in the form of short-term training programs. Since 2016, every year, HUST cooperates with Nagoya University to organize a summer school for AI. Summer school provides basic knowledge, exercises about AI for students. These are courses directly related to the hot issues and topics of the ICT in recent years, for IT bachelors, engineers and final year IT students wishing to learn more deeply and to pre-define for the future. Following that, there were public courses in data science from the Institute for Advanced Study in Mathematics and other top universities.

In order to raise awareness and capacity of AI and 4IR for government agencies and state management agencies in the provinces, the Ministry of Information and Communications is working to develop a training as well as competency assessment programs for digital industry in general and AI in particular. This will be a basic preparation step for the management and executive staff in localities ready for challgences from the 4th Industrial Revolution. The Ministry of Education and Training also has a program to cooperate with APTECH for training and retraining, to foster knowledge of AI for university lecturers to prepare teaching staff. In the global trend, domestic universities and research institutes not only confined their research and development activities, but also began to have specialized and multidisciplinary cooperation with foreign partners to build research team. The State Bank of Vietnam cooperates with German partners to organize an update course on knowledge about digital transformation.

2.4. Current status of mechanisms, policies and juridical systems for research, development and application of AI

Resolution No. 23-NQ/TW dated March 22, 2018 of the Politburo on the

orientation to formulate a national industrial development policy until 2030, with a vision to 2045: In Section III.2 (*Development Policy*) for developing prioritized industries, the Politburo also mentioned giving priority to developing fundamental technologies to create digital technology for industries (one of those technologies is AI), specifically: *"Selecting a number of industries to prioritize development in the direction of meeting the following principles: being based on the results of an objective analysis of the country's advantages; being an industry capable of deeply participating in the global production network and value chain; having fundamental significance, having a high spillover effect on other economic sectors; .... The identification of priority for industries must have the necessary dynamism and flexibility, periodically evaluate its performance according to the criteria for appropriate adjustment. From now to 2030, to prioritize the development of a number of industries such as: Information technology and telecommunications, electronics industry at the advanced level of the world, to meet the requirements of 4IR to create a digital platform for other industries; ...* "

Resolution 52-NQ/TW dated September 27, 2019 of the Politburo on a number of guidelines and policies to actively participate in 4IR: mentioning that AI is a priority focus in Section III.6 on the development policies for priority industries and technologies, specifically: "*Focus on developing priority industries with high availability such as: Information technology, electronics - telecommunications industry; network safety and security; intelligent manufacturing industry; finance - banking; ecommerce; digital agriculture; digital travel; digital culture industry; medical; education and training. Prioritize resources for implementing a number of national key research programs on priority technologies, focusing on: Information and communication technology, mechatronics, new technologies in the field of energy, artificial intelligence, biotechnology, biomedical electronics ...* "

Resolution No. 01 / NQ-CP dated 01/01/2019 of the Government on the main tasks and solutions to implement the socio-economic development plan and the State budget estimate in 2019 stated: "*Deploying solutions to absorb and master the core technologies of 4IR; applying high technology in industries, fields .. ". (One of the core technologies of 4IR is AI)*.

Resolution No. 02 / NQ-CP dated January 1, 2019 of the Government on continuing to perform key tasks and solutions to improve business environment,

enhance national competitiveness in 2019 and orientation by 2021: In Section 1.2, it is stated: "*Deploying solutions to absorb and master core technologies of 4IR; applying high technology in industries and fields* "

Resolution No. 17 / NQ-CP dated March 7, 2019 of the Government on a number of key tasks and solutions for e-Government development in the 2019-2020 period, with a vision to 2025: "*Continuing to implement programs for scientific research, technology development, integrated solutions, applications, information technology products for building e-government towards digital economy, digital society based on open data, applying new technologies such as artificial intelligence (AI), blockchain (Blokchain), Internet connecting things (IoT), big data (Big Data), open application programming interface (Open API) ... .. in the period of 2020, with a vision to 2025.* "

Resolution No. 50 / NQ-CP dated July 15, 2019 of the Government, Resolution of regular online Government meetings with localities in June 2019: "*The Ministry of Science and Technology focuses on accelerating the implementation of the Directive. 16 / CT-TTg of the TTgCP on strengthening capacity to access the Fourth Industrial Revolution; to restructure national science and technology programs; implementing solutions to improve production and business environment, improve competitiveness and global innovation index".*

Directive No. 16 / CT-TTg dated May 4, 2017 of the Prime Minister on strengthening access capacity to 4IR states: *The 4th Industrial Revolution, with development trend based on high-level integration of the digital - physical - biological connection system with the breakthrough of the Internet of Things and Artificial Intelligence, is fundamentally changing the production of the world ...*

To proactively seize opportunities, come up with practical solutions to make the most of the advantages, and at the same time minimize the negative impacts of the 4th Industrial Revolution on Vietnam, the Prime Minister assigns the Ministry of Science and Technology a number of tasks including the following tasks: *Concentrating on building and promoting application activities, research and development, and transfer of key technologies of the the 4th Industrial Revolution.* " (one of the key technologies is AI).

Decision No. 418 / QD-TTg dated April 11, 2012 of the Prime Minister

approving the Vietnam Strategy for Science and Technology Development for the period of 2011-2020 mentions AI as a priority orientation at Clause c, Section III.3, Article 1 regarding the orientation of priority technologies:

"*Information and communication technology: Continue to promote the development of information and communication technology to reach international standards and qualifications in a number of fields where Vietnam has advantages, ... Promote research and development, master and technology transfer in the field of information technology, manufacturing Vietnamese brand products such as: Software technology and digital content; technology for designing and manufacturing integrated circuits, high-capacity memory; multimedia technology; multi-access technology; artificial intelligence; network safety and security technology; developing a high-performance computing central system .....* "

Decision 66/2014 / QD-TTg dated November 25, 2014 of the Prime Minister approving the List of high-tech prioritized for investment and development and the List of high-tech products encouraged for development: *Artificial intelligence technology is one of the high technologies prioritized for investment and development by the Government and has been included in Section 6, Appendix 1 of the Decision.*

Decision No. 2813 / QD-BKHCN dated September 27, 2018 of the Minister of Science and Technology approving the Industry 4.0 technology research and development support program with the aim: *Research, application, development and transfer of some key technologies of Industry 4.0 that Vietnam has advantages to create products for socio-economic development, defense and security assurance; ... and the program's products are : There are at least 30 technology solutions formed from key technologies such as: Artificial Intelligence (Blockchain), Big data analytic (Big data analytic), Internet connecting thousands (Internet of Things), 5th Generation mobile network, robotics, cloud computing (I-cloud) ... widely applied in the fields of production - business and service such as: health, tourism, finance - banking, agriculture, processing and manufacturing industries, education - training and vocational training, transportation, construction, information - communication, resources - environment school, country room, security ...*

Decision 2910 / QD-BKHCN dated October 3, 2018 of the Minister of Science and Technology, promulgating "Plan to deploy research and development of artificial intelligence until 2025", with the overall goal:

Research to master science and technology on AI in the development, application and commercialization of high quality Vietnamese branded products; Building and developing shared digital data systems for AI research and application in the health sector, agriculture, banking, transportation, logistics, industry, national defense and security, and tourism. e-commerce, online services, information - communication; Build high-quality human resources, develop excellent research groups and centers with strong research capacity in AI.

Decision No. 18 / QD-BKHCN dated January 18, 2020 of the Ministry of Science and Technology promulgating the Action Program of the Ministry of Science and Technology to implement Resolution No. 01 /NQ-CP and Resolution No. 02 / NQ-CP dated 01/01 / In 2020, the Government, in Section II.3.7, mentioned: *Enhancing S&T potentials, focusing on implementing research and development directions for new technologies, especially key technologies of the Industrial Revolution. forth; building a National Artificial Intelligence Strategy; building a portfolio of key technologies of the Fourth Industrial Revolution. Create favorable conditions and have breakthrough policy mechanisms to attract high-tech projects. Continue to vigorously and comprehensively implement the project "Developing digitalized Vietnamese knowledge systems", in which at task No. 27 of Appendix Decision 18 / QD-BKHCN, the Ministry of Science and Technology assigns the Department of high-tech to lead the construction "National Artificial Intelligence Strategy"*.

Decree No. 47/2020 / ND-CP dated April 9, 2020 of the Government regulating the activities of managing, connecting and sharing digital data of state agencies, including: *data management and administration figures; connecting and sharing digital data; using and exploiting digital data of state agencies; provide open data of state agencies to organizations and individuals; rights and responsibilities in connecting and sharing digital data of state agencies*.

Decision No. 749 / QD-TTg dated 3/6/2020 of the Government regulating *digital government* development, improving efficiency and effectiveness of operation; develop the digital economy, improve the competitiveness of the economy; developing digital infrastructure, narrowing the digital gap with 8 priority areas for digital transformation, including: health, education, finance-banking, agriculture, transportation and logistics, energy, finance raw materials and the environment, industrial production.

In summary: Policies on AI have been interested and directed by the top leaders in recent times. However, the awareness of all levels and sectors in recent years on the role of AI is still insufficient. State investment in AI is limited, lack of concentration, and the efficiency is not high. Vietnam does not have a national data development strategy, a national policy and a roadmap for the development of AI. Currently, Vietnam does not have a separate legal framework for AI, there is no standing agency to manage, no taskforce of consulting and coordinating activities in the development and implementation of AI at the central and local levels, and there is a lack of national policy and legal framework for the development, application and international cooperation in the AI sector.

2.5. Current status of market and investment in AI

In recent years, although the Vietnamese ICT market is small, large corporations as well as medium and small IT startups have made efforts for investment in product development of intelligent systems relying on the AI platform. According to Rubik's 2018 report [F5]: the number of AI businesses is still limited with about 10 major IT corporations (such as *FPT, Viettel, CMC, VNG, VNPT, VinGroup* and some foreign companies like *Google, Amazon, NVIDIA, IBM*); nearly 10 venture capital funds in AI. As for AI startups, according to a survey from a number of information sources, Vietnam currently has about 65 AI startups. Some good examples are as follows:

Viettel Group is approaching the research and development of AI in a comprehensive way (fullstack-AI) on all 3 layers: core technology layer, foundation layer and application layer. Regarding core technology, Viettel has established research and development units for AI, organizing specialized resources for the following areas: (i) synthesizing, recognizing speech and processing Vietnamese natural language, (ii) computer vision (facial recognition, object recognition and behavior in urban traffic, optical character recognition in digitizing content of administrative documents, invoices ...), (iii) classification data analysis, (iv) AI accelerated hardware design.

In terms of foundation products, Viettel has officially announced and implemented the Viettel AI Platform from June 2019, providing AI services through the API application interface, helping other organizations to inherit the results in product development and applications of AI. The core technologies integrated on this platform are among the top quality in the current Vietnamese

market for speech processing, natural language processing, and computer vision.

In terms of application, after having had experience in applying AI to the Group's internal problems in customer care and sales staff support, Viettel had products targeting the outside market: the platform for background building automatic switchboard for Vietnamese enterprises, called *Cyber Callbot* (winning TOP10 in Sao Khue award 2020); *"audio newspaper"* product allosws reading newspapers and transfering into audio, which is suitable for electronic information portals and many major newspapers, *"voice meeting note"* product automatically saves meeting content into text, *"reputation monitoring"* product on cyberspace.

FPT Corporation is with the orientation of becoming the leading digital transformation service provider, in which the AI Platform is identified as the key technology. Its AI development strategy aims to apply at all three layers: *integrating* into FPT ecosystem, *packing* into products and services to provide the market and *building* a community for AI development. FPT Corporation has developed AI applications in a number of areas of life such as the smart transportation system applied in Ho Chi Minh City, bringing many benefits for people such as reducing congestion, saving traveling time on the road. Or the development of autonomous vehicle technology at level 3 out of 5 levels of autonomous vehicles and was officially experienced in October 2019.

In addition, FPT Corporation also provides FPT.AI comprehensive artificial intelligence platform with "senses" for machine understanding and human interaction through four components: computer vision, synthesis and speech recognition, natural language processing. On that basis, FPT.AI has been applied to business operations, helping to largely increase operational efficiency and enhance customer experience; specifically, predicting network departure warning, customer care virtual assistant or machine translation, multi-channel customer care virtual assistant, online customer identification. It is currently being used in more than 70 businesses in Vietnam and around world, including nearly 40 enterprises in the Top VNR100. In addition, FPT Corporation also continuously cooperates with leading scientists in the domestic industry and the world's leading partner in the field of AI such as Mila AI Research Institute (Canada) with the aim of improving the AI capacity for FPT, and exchanging practical knowledge in order to build community for AI development in Vietnam.

CMC Group is currently implementing a project for Hanoi to build a shared database and intelligent data analysis to improve the quality of management and administration activities of the city government. Some products have been deployed such as *Mobile Robot, C.BOT Robotics*, capable of recognizing the client's face and speaking Vietnamese, tour guiding for visitors; *C-BOT Enterprise Video* internal television system acts as a miniature television station with a mini-video studio, network broadcast video system, and integrated two-way HD video conferencing system, having facial recognition technology and remote interaction system by computer vision technology with 3D Camera.

VNG Group builds AI Chatbot and Face Check-in systems. *Five9 Company* implements a smart medical solution, acquires, masters and customize the IBM Watson system in cancer diagnosis and treatment, in accordance with the actual conditions in Vietnam. The company also invests itself, cooperates with research groups in universities to develop social data analysis solutions serving the community.

Not to be out of the way, large foreign corporations in AI such as Google, Amazon, NVIDIA, IBM, going through many ways from directly to through domestic organizations, are initially investing in building technical infrastructure, technology and expertise for companies and for research institutions in order to dominate the market for AI products and applications in Vietnam.

The form of an AI startup is also seen as a new wave in Vietnam's AI industry. Some Vietnamese startups: GotIt, VCCorp (AI Admicro application advertising platform), Infore (semantic analysis for social networks), Beeketing and NextSmarty (recommendation system for eCommerce), Vsmarty (system access control system SmartGate). In addition, a number of foreign startups working in AI have opened branches in Vietnam to take advantage of high-quality domestic AI human resources to build AI products, such as Al + Inc. (Japan), Cinnamon (Japan), Saltlux (Korea), Emotiv (USA).

In the framework of *the Digitalized Vietnamese Knowledge Systems* project, from 2017 to now, many results and products have been launched such as Vietnam digital map VNMAP, digital education, medical data platform, Vietnamese language, Vietnam relief, tourism, archiving ... In these products, many algorithms, machine learning / deep learning models are studied to solve problems arising in practice such as road drawing algorithms, routing, new

machine learning models, integrated deep learning, speech recognition, location suggestion, automatic inquiry, ... Digital map of Vietnam, under the development of Hanoi National University together VNPost in the deployment of map information collection, has officially posted the domain name *map.itrithuc.vn* or *vmap.vn* with more than 22 million addresses (accounting for about 87% of the total addresses to collect in the country). Vietnam Digital Map VNMAP has been successfully integrated on mobile applications such as Vadi - itrithuc, FastGo ... Vietnam Digital Education on *giaoduc.itrithuc.vn* currently has more than 27 thousand multiple choice questions, about 7 thousands of dissertations / dissertations and many lectures and materials from teachers across the country. Other platforms and projects have also gathered a lot of information on medical drugs, tourism, relief ... from existing or newly collected sources, and from the support of the youth union's movements.

3. SWOT ANALYSIS FOR AI STRATEGY OF VIETNAM

3.1. Strengths

Legal status: Government decree on activities of state agencies related to digital data management, connection and sharing; Government decision on national digital transformation program for digital government and digital economy development based on digital infrastructure;

Policy: Resolutions of the Politburo and the Government on proactively participating in 4IR, directing the Government to develop national AI strategy;

Management: Stable socio-economic environment; high global innovation index (42/129 2019); with the advantages of an open economy, Vietnam's digital economy ranks second in the ASEAN region in terms of growth rate;

Investment: Investment in AI startups is a strong trend (65 startups are invested, by 2019); policies to facilitate and to attract foreign investment and multinational corporations; investing heavily in 4IR technologies (digital transformation, 5G network ...);

Market: Forming AI industry and domestic AI market; creating good conditions for the development of AI in the future;

AI applications: out of total AI applications, finance and e-commerce accounts for 40%, transportation/logistics 18%; the fields of tourism, agriculture, and medicine have huge potential for AI applications;

Enterprises: A number of large enterprises have paid attention to research and development (R&D) of AI industry;

Digitalization platform: Developed some of "*make in Vietnam*" AI platforms;

Ecosystem: the AI forum spreaded nationwide; formed a coalition of AI communities;

Thee-way (Institute-university–enterprise) cooperation: Large enterprises invest and offer research grants; Institutes and universities actively cooperate in training and research on AI

Manpower: A large labor force (~ 50 million); a high proportion of young population (70% under the age of 35); forming a balance of AI workforce between R&D (institutes, universities) and application deployment (companies); the export capacity of some ICT sectors, which are close to AI, is good; being capable of receiving and developing on AI open platforms; the research achievements are well-recognized (ranked No. 1 in ASEAN in the publishing rate of scientific works on AI among SCOPUS publications, there are some patents for AI);

Training capacity: general education (in natural science) with good achievements (i.e *PISA index*); forming the STEM education model and centers for STEM education; training capacity in some closely related research fields with AI such as mathematics, agriculture and biology is quite good; the number of training institutions related to AI is quite large; there are attentions about AI skill training for human resources;

People: High rate of smartphone usage; high rate of internet and social network usage.

3.2. Weaknesses

Management: E-Government development is weak (E-Government Index 88/193); ICT application remains low (global ICT index 108/176); awareness of all levels and sectors over the years about the role of ICT in general and AI in particular is still incomplete; there are no regulations on state management related to AI; statistics and evaluation of AI development are still limited; the relationship of the parties (state management - enterprise – academies) has not been established yet for serving the development of AI industry in Vietnam;

Investment: Total social investment in S&T and in AI is low; AI is usually not an investment item of an enterprise; data resources are not abundant;

Market: Vietnam's AI market is very small; lack of national AI brands; being at a high level of dependence on foreign technologies;

AI Application: Application of AI in key industries (industrial production, agriculture, health,...) is quite modest; the digital transformation process of agencies and businesses is slow, causing difficulties and slow delay in the AI application; there are still thoughts of self-satisfaction, self-proclaiming success too early in perception and action or self-esteem, shyness, unwillingness or lack of determination - perseverance for international competition for AI industrial sectors in which Vietnam has potential advantages; domestic enterprises are not aware of the role of the AI industry, have not participated in the research and development of the AI technology;

Digitalization platforms: The computational infrastructure is weak and somewhat lacking; data infrastructure is still weak and asynchronous; data of sectors in Vietnam has not been digitized synchronously and disconected; data storage and sharing is still weak; there is no national data development strategy; the open data system is limited; there is no AI platform with Vietnamese characteristics.

Thee-way (Institute-university–enterprise) cooperation: Enterprises have not consciously offered institutes and universities for research and development; training and research os universities and institutes is not usually linked to the needs of enterprises; policies to promote human resource exchange between institutes, universities and enterprises have not been favorable; public-private cooperation policies on research, development and application have usually lost of touch with real life; there is a lack of intermediaries connecting supply and demand of AI.

Human resources: labor with low skills, and is easy to be replaced by automation (Global Human Capacity Index at 92/125, only ranked 7th in ASEAN); the human workforce of AI is too small and scattered; there are no senior experts on the AI industry.

Research and development capacity: Research capacity on AI and AI industry in both academic and industrial communities are modest.

Training capacity: STEM education in high schools is limited; tertiary education has not yet integrated, has not meet the requirements of AI development; total social investment in tertiary education remains low.

3.3. Oppotunities

Legal status: Having formed a legal framework to promote the development and application of AI; having adjusted economic policies to promote the development of AI;

Management: International organizations, international forums have impact on countries in promoting research, development and application of technologies in Industry 4.0 and AI;

Investment: Large FDI inflows; an influx of foreign investment in training AI manpower in Vietnam; investment in ICT production from abroad into Vietnam has increased with many large corporations in the world; with the situation that large corporations are out of China; there are many forms of investment in research and development of AI;

Market: The world market for AI is large;

AI Application: e-government creates opportunities to promote the application of AI in state management agencies, promote an environment of international cooperation, and attract businesses from Europe, the United States, Australia, East Asia and ASEAN for investment in research and development of AI in Vietnam;

Digitalization platforms: AI libraries and open source platforms are widely shared;

Ecosystem: The world 's AI research and development community on AI is thriving; open approach becomes the trend of scientific activities, sharing of data and results;

Research and development capacity: S&T has been a focus in Vietnam; Europe, the United States, Australia, East Asia and ASEAN focus on cooperation with Vietnam on research, development and innovation; the number of joint projects increased; many cooperation initiatives within ASEAN and between ASEAN and major countries are introduced;

Training capacity: Improving investment policies; effective state management of higher education are on the rise.

3.4. Threats

Management: State management system and administrative procedures might somewhat affect the formulation and adjustment of favorable policies for AI development;

AI Application: Low economic level leads to difficult attitudes and behaviors to accept, absorb initiatives, and hence hinder the development of the AI industry; foreign AI models, methods and systems are difficult to apply immediately to the Vietnamese context and conditions; increasing crime on cyberspace using AI applications; low confidence of users in AI; the COVID19 epidemic affects socio-economic development and also shows challenges in the application of AI in health; climate change, non-traditional security,… have strong impacts on sustainable socio-economic development;

Digitalization platform: Application requirements and AI platforms in the world develop with a faster pace than that in the required digital infrastructure in Vietnam;

Human resources: AI increases automation, leading to the possibility of job loss and unemployment for low-skilled workers; Developed countries, technology and industry groups attract highly qualified AI workforce, leading to the risk of brain drain in Vietnam.

4. AN ANALYSIS OF VISION, OBJECTIVES OF DEVELOPING AI

4.1 Vision

Option 1: Develop AI into a key and vital digital technology to build an innovative society, an efficient government and a sustainable economy; to bring Vietnam into a center for innovation and development of AI solutions and applications in the region and the world by 2030.

Option 2: By 2030, Vietnam will become one of the centers for innovation, development of AI solutions and applications in Asia, contributing to improving labor productivity and socio-economic development, ensuring national defense, security and environmental protection.

Option 3: By 2030, Vietnam is among the leading in talent training and fostering talent in researching, manufacturing products and implementing AI applications in the group of middle-income countries.

Option 4: By 2030, Vietnam will basically develop and apply AI in all areas of life, contributing to improving labor productivity, socio-economic development, ensuring national defense, security, environmental protection.

The National AI Strategy should be built with a vision orientation under Option 1. This is an option with high expectations, based on strengths, taking advantage of technology opportunities in the world, and the research workforce to develop AI and the application market, which is dynamic and thriving in Vietnam.

4.2 Objectives

The National AI Strategy focuses on research, development and application of *specialized AI* systems based on data (data-driven). The national digital transformation policy focuses on developing digital data infrastructure. Therefore, AI must be a key and important digital technology of digital transformation, serving the digital government, improving efficiency and efficiency, promoting the digital economy, enhancing the competitiveness of the economy and narrowing the digital gap. Based on the analysis of the current status of research, development and application of AI in Vietnam, in order to concretize the vision, the project gives out general and specific objectives as follows:

Overal objectives

a) Promote research, development and application of AI, making AI become a key and important digital technology in national digital transformation;

b) Vietnam becomes a center for innovation, development of AI solutions and applications in the top of the region and correspondingly positioned in the world;

c) Widely apply AI, contributing to building an innovative society, effective government and promoting the development of a sustainable economy.

Detailed objectives:

a) Bringing AI into key digital technology

- OBJ1. By 2030, Vietnam is in the group of four leading countries in the ASEAN region and the group of 50 leading countries in the world in the development and application of AI;

- OBJ2. Develop a number of large data storage as well as high-performance computing centers; connecting 30% of domestic data and high-performance centers to create a network of sharing storage and computing capacity for AI;

- OBJ3. 100% of state management agencies have professional databases connected, shared and open;

- OBJ4. Form 50 groups of shared and open databases in economic sectors, socio-economic fields serving research, development and application of AI.

b) Bringing Vietnam into a center of innovation, development and application of AI

- OBJ5. Build a team of high-quality human resources working on AI with 500 AI specialists, 5,000 engineers to deploy and apply AI by 2025; 800 AI specialists, 8,000 engineers in the implementation and application of AI by 2030;

- OBJ6. The number of scientific publication and patents on AI in Vietnam increases by 20% each year;

- OBJ7. Establish 03 national innovation centers for AI in three regions of the country; the number of startups in AI each year increases by 10%, the total investment capital in the AI field in Vietnam increases by 10% each year;

- OBJ8. Build 20 prestigious brands of AI at the world-class level;

- OBJ9. Upgrade as well as newly form 10 key research and training institutions on AI; Striving to 2030, to have at least 01 representative in the ranking of the top 20 AI research and training institutions in the ASEAN region.

c) The application of AI contributes to building a creative society, effective government and a sustainable economy

Innovative society

- OBJ10. Universalize basic skills in AI application for workers, serving to promote innovation, reduce costs, and improve labor productivity and quality of life;

- OBJ11. Application of AI in at least 5 scientific fields contributes to 20% increase in research outcomes in those fields.

Effective government

- OBJ12. Application of AI in online public services reduces waiting time by 10% and costs of people by 10%;

- OBJ13. Application of AI in public administration helps reducing 20% of processing time, 10% of human resources and 20% of public administrative costs;

- OBJ14. Application of AI contributes to improving efficiency in serving people, social management and urban management, especially in major cities such as Hanoi, Ho Chi Minh City and Da Nang.

Sustainable economy

- OBJ15. Along with digital transformation, the application of AI contributes to promoting growth in a number of economic sectors.

5. STRATEGIC SOLUTIONS ANALYSIS

5.1 Strength-oriented solutions to take advantage of opportunities (Strength-Opportunities)

5.1.1 Establishing shared and open databases to develop AI applications in Vietnam, for Vietnam, in Vietnam.

- Implementation of objectives: OBJ4.

Strengths: There are regulations on data sharing by State agencies; Resolution of the Politburo and the Government on proactively participating in 4IR, directing the Government to develop a national AI strategy; there are already AI forums nationwide; formed a coalition of AI communities; ability to build large-scale movements to mobilize experts and people to participate.

Opportunities: E-government creates opportunities to promote the application of AI in state management agencies;

- Solution:

+ Developing a national data strategy;

+ The State focuses on investment in forming shared and open administrative databases during the implementation of e-Government;

+ Integrating shared and open data of ministries, branches and localities onto the National Data Portal;

+ Expanding projects to build community data in the form of *the digitalized Vietnamese Knowledge systems* project;

+ Connecting AI communities, open scientific communities in Vietnam to share, review, and build open data groups, open applications of AI in Vietnam;

+ Gathering, standardizing and sharing open datasets in the country in the fields of *health, agriculture and industry*. These datasets are used as input to existing applications, serving the large demand for AI applications in the fields.

5.1.2 Implement universalization of basic skills in the application of AI to promote innovation for young people

- Implementation of objectives: OBJ10.

Strengths: Large workforce (~ 50 million), favorable population structure with a high proportion of young population (70% under the age of 35).

Opportunities: The world community for AI research and development is thriving, tending to operate in the form of open science and sharing data and results.

- Solution:

+ Deploying STEM, STEAM training programs for young people;

+ Large-scale implementation of training programs on popularizing skills of data building as well as applying AI for young people;

5.1.3 To attract domestic and foreign capital resources to build centers for AI training, development and application

- Implement objectives: OBJ5, OBJ6, OBJ9.

Strengths: Large enterprises invest in and offer research grants; institutes and universtiess actively cooperate in training and research on AI.

Opportunities: Europe, the United States, Australia, East Asia and ASEAN focus on cooperation with Vietnam on research, development, and innovation; the number of joint projects increased; there are many cooperation initiatives within ASEAN, between ASEAN and major countries; there is an influx of foreign investment in AI human resource training in Vietnam; there are various forms of investment in research and development of AI.

- Solution:

+ Implementing the strong form of public-private cooperation, co-finance the centers for AI training, development and application;

+ Deploying cooperation with foreign organizations and enterprises to build high quality centers and training programs for AI human resources to serve the global market;

+ Encouraging and promoting domestic technology corporations to invest in building high-quality research institutes and training institutions on AI;

5.1.4 The State invests in building a number of key centers for research and training for talents and high-quality human resources in AI at a number of top universities and research institutes.

- Implement objectives: OBJ5, OBJ6, OBJ9

Strengths: High school education in natural sciences has significant achievements (PISA index); The number of training institutions related to AI is quite considerable; There has been interests in training AI skills for the human resources.

Opportunities: Improving investment policies and effective state management of higher education; S&T is a national focus.

- Solution:

+ Investing in a number of universities to deploy AI training;

+ Investing in a number of key research groups on AI at a number of top public universities and institutes;

+ Investing in facilities for a number of key AI laboratories at the top public universities and institutes;

5.1.5 Focusing on investment in research and development of a number of essential and important AI platforms and products serving the domestic market, as well as targeting the global market.

- Implementation of objectives: OBJ6, OBJ15

- *Strengths*: forming a balance of AI workforce between R&D (institutes, universities) and application deployment (companies); the export capacity of some ICT sectors, which are close to AI, is good; being capable of receiving and developing on AI open platforms; the research achievements are well-

recognized (ranked No. 1 in ASEAN in the publishing rate of scientific works on AI among SCOPUS publications, there are some patents for AI).

Opportunities: The world market for AI is large.

- Solution:

+ Organizing tasks of fundamental research on AI: understanding technology, mastering technology, catching up with AI advances and initially contributing to the development of new AI methods in several research organizations related to mathematics and information technology;

+ Focusing on investment in R&D of several products based on data sources and specific knowledge of Vietnam;

+ Implementing the national key research program on AI linking with the training of post-graduate students;

+ Implementing R&D of some important AI platforms and products, such as natural language processing, computer vision, automated processes, other data-driven AI technologies, robots and autonomous vehicles, in some fields that are ready for data and technology and have domestic application demands, eventually targeting the global market;

5.1.6 Applying AI to improve the efficiency of R&D outputs in other fields

- Implementation of objectives: OBJ11

Strengths: proven training capacity in some research fields closely related to AI such as mathematics, agriculture and biology; there has been interests in training AI skills for the workforce.

Opportunities: The world community for AI research and development is thriving, tending to operate in the form of open science, sharing data and results.

- Solution:

+ Fostering the formation of open scientific groups in certain fields to share resources, shorten the time to complete research works;

+ Implementing interdisciplinary and transdisciplinary cooperation between research and teaching institutions on AI and other sciences to speed up the creation of outputs;

+ Promoting the use of shared and open data; applying AI in the multi-disciplinary, interdisciplinary and transdisciplinary direction to increase the efficiency of R&D activities in other fields.

5.1.7 Developing a number of typical AI products in Vietnam, step by step forming the AI industry in Vietnam

- Implement goals: OBJ8, OBJ14, OBJ15

Strengths: 40% applied in the fields of finance and e-commerce, 18% in transport / logistics applications out of total AI applications; The fields of tourism, agriculture, medicine) have problem domains and great potential for application of AI.

Opportunities: Foreign investment flows in training AI human resources in Vietnam; Investment in ICT production from abroad to Vietnam has increased with many large corporations in the world; Movement of big corporations out of China is increasing; There are many forms of investment in R&D of AI.

Solution:

+ Encouraging Vietnam's technology corporations and enterprises to focus on researching and mastering technologies and developing Vietnam's specific AI products;

+ Encouraging enterprises to offer grants to institutes and universities to research and develop Vietnam's specific AI products.

5.2 Strength-oriented solutions to reduce risk (StrengthS-Threats)

5.2.1 Promoting data sharing for AI applications

- Implementation of objectives: OBJ3

Strengths: Resolution of the Politburo and the Government on proactively participating in Industry 4, directing the Government to develop national AI strategy.

Threats: State management structure, administrative procedures affect the formulation and adjustment of favorable policies for the development of AI.

Solution:

+ Elaborating regulations and lists of professional databases that ministries, branches and localities must share and open;

+ Promoting a culture of building and sharing data among science communities, businesses, and people;

5.2.2 Raising awareness of officials, public servants, businesses, and people about AI data and application

- Implement goals: OBJ12, OBJ13, OBJ14, OBJ15

Strengths: Resolution of the Politburo and the Government on proactively participating in 4IR, directing the Government to develop national AI strategy.

Threats: Low economic level leads to difficult attitudes and behaviors to accept, absorb initiatives, hinder the development of AI industry; low confidence of users in AI.

Solution:

+ Implementing promotion programs to raise awareness of officials, public servants, businesses and people about AI data and application;

+ Organizing series of events, categories, television games, contests on AI; supporting domestic individuals and organizations to participate in international conferences, exhibitions and contests on AI.

5.3 Opportunity-oriented solutions to overcome weaknesses (WeaknessES- Opportunities)

5.3.1 Developing and adjusting legal policies, creating an open legal system to meet the requirements of the development of AI, and to promote the development and application of AI in life.

- Implementation of objectives: OBJ15

Weaknesses: Awareness of all levels and sectors over the past years about the role of ICT in general and AI in particular is still insufficient; There are no regulations on state management related to AI.

Opportunities: International organizations and international forums have an impact on countries to promote research, development and application of 4IR (AI particularlly) technologies.

Solution:

+ Developing and amending legal documents on electronic transactions such as: amending the Law on E-transactions; digital signature strategy and

electronic authentication for the period 2020-2025; decree on electronic identification and authentication;

+ Developing and amending legal documents on data establishment and sharing such as: management, connection, and sharing of digital data; national strategy for data; managing and using the shared data list in the local ministries and branches;

+ Developing and amending legal documents guiding trial institutional frameworks (sandbox) in the field of AI application implementation, creating a favorable testing space with its own legal policy framework (*which is out of sope or beyond the current legal framework*) to conduct AI testing in potential areas;

+ Developing and amending legal documents on privacy and human rights protection such as the decree on personal data protection;

+ Developing and amending legal documents on ensuring network security and safety such as the decree details a number of articles of the Law on Cyber Security;

+ Developing and amending legal documents on legal responsibilities of AI-related subjects: develop effective methods for human-AI collaboration, address ethical constraints , the legal and social aspects of AI, development of methods for designing the AI system suitable for the ethical, legal and social purposes;

+ Developing and amending legal documents on intellectual property rights related to AI such as: Amending the Intellectual Property Law in 2019;

+ Developing standards and formats on AI technologies and products such as developing criteria, guiding the evaluation of AI products; researching and selecting AI products that Vietnam needs to master in the period of 2021-2025; developing national technical regulations on data structure and format for data connection, integration and sharing of state administrative agencies;

5.3.2 Promoting the implementation of vocational training, short and medium-term certificate training on AI for graduates, workers wishing to change careers

- Implementation of objectives: OBJ5

Weakness: Low labor skills, easy to be replaced by automation (Global Human Capacity Index at 92/125, only ranked 7th in ASEAN); The human force for AI is too small and scattered.

Opportunities: The world market for AI is large

Solution:

+ Encouraging the formation of organizations to develop short-term training for researchers, engineers and managers to meet the requirements of R&D of AI products in corporations, companies and other research units;

+ Encouraging and promoting the import of a number of vocational training programs, short-term and medium-term certificate training courses in AI;

+ Promoting formal training programs on AI, data science; Promoting the inclusion of subjects on data analysis, AI application in training programs of different disciplines in universities and colleges;

+ Implementing training consultancy on AI for employees wishing to change careers;

+ Implementing short-term training programs on integrating AI technology into third-party devices;

+ Developing mechanisms to encourage overseas Vietnamese to participate in research and training activities on AI in the country;

+ Regularly organizing activities to connect the academic community, the community of engineers for research, development and application of AI at home and abroad.

5.3.3 Deploying solutions to mobilize investment capital for the development of businesses and brands of AI in Vietnam

- Implementation of objectives: OBJ7, OBJ8

Weaknesses: Total social investment in S&T and AI is rather low; AI is usually not an investment item of the business.

Opportunities: Large FDI inflows; There is an influx of foreign investment in AI human resource training in Vietnam; Movement of large corporations out of China is increasing; There are many forms of investment in research and development of AI.

Solutions:

+ Promoting the construction of several AI innovation centers in order to incubate, attract investment, and form many AI startups in Vietnam, thereby forming a number of Vietnamese AI brands on the world stage;

+ Developing a specific mechanism for innovation centers to attract venture capital funds to innovative AI startups in Vietnam;

+ Adjusting policies to attract foreign direct investment (FDI), multinational high-tech corporations build centers for AI research, development and application in Vietnam.

5.3.4 Promoting the deployment of available software platforms and open applications on AI

- Implementation of objectives: OBJ14, OBJ15

Weaknesses: The application of AI in key industries (industrial production, agriculture, health, ...) is quite modest; the slow digital transformation of agencies and businesses causes difficulties and delays in the application of AI.

Opportunities: AI libraries and open source platforms are widely shared.

Solutions:

+ Widely training about open platforms on AI data and application; Promoting open source communities and forums on AI;

+ Developing policies and programs to encourage IT corporations and businesses to develop open platforms for data and software for building AI applications;

5.3.5 Promoting ministries, branches and localities to use AI applications and services to improve the quality of state management, social management, and urban management.

- Implementation of objectives: OBJ12, OBJ13, OBJ14

Weaknesses: The application of AI in key industries (industrial production, agriculture, health, ...) is quite modest; The slow digital transformation process of agencies and enterprises causes difficulties and delays in the application of AI.

Opportunities: E-government creates opportunities to promote the application of AI in state management agencies.

Solutions: Accelerating the application of AI in urban management, social management and public administration in order to:

+ Use automated inquiry and identification systems to support information and to optimize the public service process;

+ Personalize public services, which are provided to the people;

+ Automate a number of stages in the process of public administrative procedures, and in the internal administration;

+ Automatically detect problems and incidents in urban management;

+ Assist managent process and assist smart city operation

5.4 Solutions towards reducing the vulnerability of weaknesses against threats (WeaknessES & Threats)

5.4.1 Strengthening national capacities for high-performance computing, cloud computing, and fog computing

- Implementation of objectives: OBJ2

Weakness: The computing infrastructure is weak and lacking.

Threats: Application requirements and AI platforms in the world develop with a faster pace than that in the required digital infrastructure in the country.

Solutions:

+ Supporting research tasks to master technology, to build domestic platforms for high-performance computing, cloud computing, fog computing;

+ Implementing public-private partnership, co-finance the construction of high-performance computing platforms and systems, cloud computing, fog computing;

+ Developing mechanisms to support, encourage, and promote the use of domestic platforms for high-performance computing, cloud computing, and fog computing;

+ Developing programs, mechanisms to link and share high-performance computing systems in institutes, universities and businesses;

5.4.2 Developing businesses to implement digital transformation, develop and apply AI to meet domestic demand in areas where data, technology and investment are already available.

- Implementation of objectives: OBJ12, OBJ13, OBJ14, OBJ15

Weaknesses: The application of AI in key industries (industrial production, agriculture, health, ...) is quite modest; The slow digital transformation process of agencies and enterprises causes difficulties and delays in the application of AI.

Threats: It is difficult for foreign models, methods, and AI systems to apply immediately to the Vietnamese context and conditions.

Solutions:

+ Forming businesses, which provide digital transformation solutions based on natural language processing, Vietnamese language and AI technology;

+ Developing incentive mechanisms, promoting the implementation of digital transformation based on AI technology;

+ Building and providing technical infrastructure, provide digital transformation services, AI services and applications to support domestic enterprises to deeply participate in the supply chain of global markets, to meet the needs of logistics, e-commerce and digital economy markets;

+ Promoting the development and deployment of AI applications in the fields of finance and banking to: analyze and predict loan needs, borrowers, analyze and detect banking and finance fraud records. tax…; personalize financial recommendations, provide instant assistance with virtual assistants and chatbots;

+ Promoting the development and deployment of AI applications in the field of transport, transport, logistics to: detect the identity of vehicles, determine speed and automate the process at centers for road traffic control and monitoring; improving the road traffic monitoring and toll collection process associated with vehicle detection and identification; optimization of logistics systems; enhancing the performance of border gate and customs clearance control systems; automatically find the way and consult customers in technology transport models;

+ Promoting the development and deployment of AI applications in the tourism sector to: automate the process of building a digital database of Vietnamese cultural heritages and destinations, combined with user-oriented services of smart travel advising; forecasting trends and personalizing tourism types based on analyzing information on social networks, contributing to improving the quality of planning and quality of smart travel services;

+ Promoting the development and deployment of AI applications in e-commerce to: forecast demand trends, maximize and automate negotiation and negotiation with suppliers; factory automation and store operations; sales optimization, product classification; price optimization, promotion personalization and real-time website rendering; personalize recommendations, provide instant assistance with virtual assistants and chatbots, automate in-store billing and provide last-mile distribution with drones;

+ Promoting the development and deployment of AI applications in the telecommunications field to: predicting demand for telecommunications services; analyzing and personalizing customer recommendations, promotional packages; automatically selecting suppliers, providing detailed information about consumption; automating customer service with virtual assistants and using tailor-made consumer options, improving the quality of multimedia communications;

+ Promoting the development and deployment of AI applications in the education sector to: predicting the job demand of the market; identifying student assessment criteria, assisting students in determining their employment strengths upon graduation; automating the professional process of teachers; identifying the criteria for optimal formation of a student group in order to achieve learning goals; personalizing learning, improving learning efficiency with the help of virtual teachers and tutors; supporting students' awareness.

CONCLUSION

Promugating and implementating a National Strategy for AI Development up to 2030 is necessary and urgent, in order to (1) promote the development of AI industry and economy, overall (2) contribute to the development and protection of our country; and step by step (3) build a sustainable AI ecosystem, given the context of 4IR as well as rising digital transformation trends.

Vietnam's national AI strategy requires synchronous research and development activities to serve the production, business and service goals of each enterprise in the overall strategic and national development goals. These include state investment in fundamental research, talent training and AI infrastructure construction[6]. Vietnam's national AI strategy emphasizes policies to promote Vietnamese businesses' joint investment in a sustainable digital economy and market for AI. This is also an opportunity to improve the global integration capacity of Vietnamese businesses, especially small and medium enterprises (SME).

The AI talent is the core factor to ensure the success of AI development and the digital economy in Vietnam. Investment in developing Vietnamese AI talent with expertise and good ethics not only knows how to create AI products but also ensures its use to benefit humans, imbued with the philosophy of "*AI together with humans, AI for humanity"*[7] is an important content in the Strategy.

Appropriate awareness of the opportunities of AI, the AI industry, the highly productive digital economy, the innovative and civilized digital society, effective digital government and smart manufacturing and services; appropriate understanding and promoting strengths in specific conditions of the country and international context are the core and prerequisites for the formulation and successful implementation of the strategy for the development of AI and the digital economy in Vietnam in the next 10 years.

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