Review of Artificial Intelligence Platform Policies and Strategies in South Korea, United States, China and the European Union Using National Innovation Capacity

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ABSTRACT

South Korea is at an important juncture in its history to decide whether to continue its investment to become a first-mover of artificial intelligence (A.I.) platform technology or stay as a fast follower. This paper compares South Korea's A.I. platform capacity to that of the United States, China and the European Union by reviewing publicly opened documents and reports on AI platform strategies and policies using the three elements of the national innovation capacity: common innovation infrastructure, cluster-specific conditions, and quality of linkages. This paper found three major areas the South Korean government can focus on in the A.I. platform industry. First, South Korea needs to increase its investment in the A.I. field and expand its public-private collaboration activities. Second, unlike the U.S. and the U.K., South Korea lacks data protection policies. Third, South Korea needs to build a high-performance system and environment to experiment with artificial intelligence technology and big data.

1. Introduction

The ongoing pandemic worldwide changes people's behavior and raises the demand for "untact" services. In South Korea, the government is pushing for "contactless" services and customer experience to stop the spread of COVID-19 (Hutt, 2020). This contactless or "untact" service is another name for digital platforms that can provide everyday services such as ordering food remotely and online shopping without needing a person-to-person contact (Hutt, 2020). According to the Ministry of Economy and Finance (MOEF) of South Korea (2020), the proportion of online consumption compared to retail sales has continuously increased from 2017 to 2020.

The demand for "untact" services pushes a transition from an industrial economy to a digital/platform economy (MOEF, 2020). With the high interest in the digital platform economy, the South Korean

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government announced its plans to expand its investment in the platform economy to sustain innovation growth (Yoon, 2018). MOEF (2020) reported that traditional service industries and small and medium enterprises (SMEs) with less digital capacity have been struggling, while the sales of platform businesses have hiked by more than 160 percent. In addition, a survey found around 540,000 platform economy workers in South Korea (Park, 2019a).

The South Korean government announced its plans to transition from a fast-follower to a first-mover economy by becoming a "smart country" focusing on digital transition based on data and artificial intelligence infrastructure (MOEF, 2020). Major countries like the United States are front-runners in the platform economy, but these countries are in the "incipient stage of institutionalization" (Kim, 2019).

Therefore, the objective of this paper is to review artificial intelligence (A.I.) platform-related strategies and policies in South Korea, the United States (U.S.), China and the European Union (E.U.) using the national innovation capacity (NIC) framework elements. By comparing the strategies and policies, this paper provides an overview of the innovation activity in the A.I. platform industry, shows the primary areas of A.I. platform-related strategies and policies in various countries and regions, and provides policy directions and implications for South Korea to guide its A.I. platform infrastructure and markets.

The study's main question is that with global ICT firms already moving to capture the market of A.I. platforms, should the South Korean government focus on transitioning its ICT firms to first-movers or strengthening its capabilities as a fast-follower? While the A.I. platform market is still growing (Data Bridge, 2020), South Korea's A.I. technology level lags that the United States, China, and Japan (Institution of Information & Communications Technology Planning & Evaluation (IITP), 2020).

2. Literature Review

2.1 Platform Economy and Its Definitons

While factories have focused on the industrialization era, platform owners focus on power in the digital economy since digital platforms have a powerful impact on society, markets, and firms (Kenney & Zysman, 2016). The digital platform economy changes how people work, socialize, compete for profit, and create value (Kenney & Zysman, 2016). The OECD (2019) stated that the platform economy had become important in domestic and global economies because digital platforms have disrupted the market. In addition, the application of big data, artificial intelligence, cloud computing, and machine learning algorithms is growing and driving changes in actors' organizatio nal strategies and the economic and political environment (Dolata, 2009; Kenney & Zysman, 2016).

Poutanen, et al. (2019) stated no single definition of the platform economy, but the most common definition is a platform like a digital marketplace where buyers and sellers meet. Park (2018) defined the A.I. platform as an "organic space of software, libraries, and service infrastructure that supports

data preparation, development, verification, and distribution through artificial intelligence services desired by users in various industries and areas." In this study, an A.I. platform is defined as "an ecosystem that evolves through connections and interactions between participants (suppliers and consumers) by providing new values and benefits and also exchanging information that each participant wants to obtain through fair trade" (Noh, 2014).

2.2 Fast Follower or First Mover Dilemma for South Korea's Platform Economy

With the rise of A.I., the South Korean government announced its plan to create a platform economy despite the ongoing conflicts between the "old and new businesses" (Park, 2019b). The South Korean government focuses on amending the conflicts between taxi drivers and application developing firms (Park, 2019b). According to Park (2019b), South Korea lags behind these leaders while the United States and China form digital economies. While other nations and private firms are actively investing and acquiring innovative startups, the South Korean government created the "innovation growth engine program" to target the fourth industrial revolution by investing in big data, next-generation communications, A.I., autonomous driving, smart city and more (Kim & Choi, 2019).

While South Korea dominates the semiconductor industry due to its quality of technology (Chawla, 2020), the next focus is on becoming a leader in the A.I. industry (Yoon, 2018). As shown in Table 1, South Korea's A.I. technological capabilities were behind the United States, Europe, and Japan but ahead of China from 2013 to 2016. However, with their big investment in A.I. research and fostering A.I. experts, China has overtaken South Korea regarding technological capabilities (Ministry of Science and ICT (MSIT), 2018a).

Table 1. Technological Capabilities Compared to the U.S. from 2013 to 2017

Countries	A.I. Technological Capabilities				
	2013	**2014**	**2015**	**2016**	**2017**
U.S.	100.0	100.0	100.0	100.0	100.0
E.U.	85.7	83.3	86.8	86.3	88.1
Japan	83.7	85.8	81.9	81.9	83.0
China	66.5	67.2	66.1	71.8	81.9
Korea	73.1	74.0	70.5	73.9	78.1

Source: MSIT (2018a)

However, the South Korean government is hopeful that the gap will greatly decrease by 2030. In addition, South Korea lacks digital human capital, and its technologies and products are not global standards; South Korea should focus on being a fast follower in the A.I. platform industry (Park, 2019b). Despite these drawbacks, the South Korean government released its plans for A.I. initiatives and invested in basic research grants and original discoveries to transition from a fast-follower

to the first mover of innovation (Hawkins, 2020).

Despite the high R&D investment per GDP and highly educated scientists, South Korea is not known for being a first mover of innovation but prefers to import innovations, develop them further, or be a fast follower (Nature Physics Editorial, 2015). Underwood (2012) stated that South Korea is a society that is "moving forward but stands at a critical juncture." The author highlighted that South Korea needs to change its fast-follower mindset to survive the rapidly changing and highly competitive nature. Unlike the industrialization era, South Korea needs a "new model for future prosperity, led by innovative talents" (Underwood, 2012).

2.3 Research Gap

From the literature, three gaps have been identified.

First, countries are noticing the importance of platform economy through the rise of artificial intelligence platforms and contactless services due to the outbreak of COVID-19. Furthermore, Kenney et al. (2019) believe that digital platforms and intelligent machines will remain important in social and economic activities. Furthermore, the authors stated that the impact of digital platforms has only begun. South Korea is one of the countries investing in the platform economy's growth to sustain innovation growth. The government has announced its plans to invest in A.I. technology and become a first-mover in the platform economy. However, despite the effort, South Korea lags behind other countries.

Second, little has been written on the A.I. platform-related policies. Kenney, et al. (2019) also stated that digital platform adoption and operation decisions would depend on the government's power. In addition, one critical area of importance for the next decade for the platform economy will be the formulation of a regulatory framework and how to regulate digital platforms (Kenney, et al., 2019).

3. Research Framework

National Innovation System (NIS), a conceptual framework that suggests that research systems' goal is innovation and is one part of a larger system that includes government, universities, industry, and the environment, was introduced in the late 1980s (Godin, 2009). OECD (1997) stated that the NIS stresses the flow of technology and innovation, and people, enterprises, and institutions are key factors in the innovation process. Watkins, et al. (2015) highlighted that scholars and policymake rs widely used the NIS to explain the interactions between nationally bounded institutions and the emergence/diffusion of innovation and technological change. In addition, the NIS has been used as a framework for newly industrialized countries such as South Korea and Taiwan, and more recently, it has been applied to developing countries to assist in catching up with developed countries.

NIS, however, lacks comparable approaches across countries (OECD, 1997). Furman, Porter, and Stern (2002) stated that past policy analysis studies on innovation were set for a given public policy environment, but policy analysis requires how innovation varies across different countries'

policies. Furthermore, the authors introduced a novel framework based on the national innovative capacity (NIC) framework. National innovation capacity is the "ability of a country to produce and commercialize a flow of innovative technology over the long term" (Furman, Porter, & Stern, 2002). Furman, Porter, and Stern (2002) further explained that countries' national innovation capacity varies by the overall technological sophistication of a country's economy and labor force and the government's investment and policy choices. Furthermore, the NIC incorporates a wide set of political and economic influences, explaining the variation of innovation intensity among countries (Furman, Porter, & Stern, 2002).

Porter and Stern (2001) wrote that national innovation capacity refers to the innovation level and the fundamental conditions, investments, and policy choices that can create an environment for innovation in a nation. The authors highlighted that the national innovation capacity depends on 1) common innovation infrastructure, 2) cluster-specific conditions, and 3) quality of linkages.

Common innovation infrastructure examines the investments, policies, and the country's overall human and financial resources devoted to scientific and technological activity. Porter and Stern wrote that the R&D activities of companies are strongly influenced by national policies and the presence of public institutions. Cluster-specific conditions focus on the companies. Porter and Stern highlighted that companies innovate and commercialize while the common innovation infrastructure sets the foundation of innovation. Furthermore, cluster companies can rapidly source components and other elements to implement innovations (Porter & Stern, 2001). The quality of linkages focuses on the relationship between the common innovation infrastructure (investments, resources, and policies) and innovation clusters. Porter and Stern highlighted that innovation could diffuse to other countries more quickly than diffuse within the country without a strong linkage between technology and companies.

4. Methods

This paper reviews South Korea's A.I. and digital platform capacity and compares it to that of the United States, China and the E.U. The paper did not include Japan because South Korea and Japan showed similar characteristics. Like South Korea, Japan is rapidly entering an aging society and has a significant population decline. Therefore, the need for A.I. research to solve social problems through convergence research is increasing. In addition, South Korea and Japan are far behind the United States and China in terms of A.I. policies and A.I. leading firms. Also, Japan is lagging behind its competitors in the field of artificial intelligence due to a lack of R&D investment, talent, slowing down of industrial competitiveness, and a declining number of journals published (Korea Institute of Advanced Technology (KIAT), 2019). From this information, the authors assumed that South Korea and Japan are in similar situations in A.I. platform policies and strategies, and therefore, focused on comparing South Korea, the United States, China and E.U. strategies and policies.

The study was analyzed using publicly available official documents and secondary research. The

data was assessed based on the three elements of the national innovation capacity (common innovation infrastructure, cluster-specific conditions, and quality of linkages). The currently implemented policies for the digital platform economy will be analyzed for the common innovation infrastructure. As stated above, policies play an important role in developing and deploying technologies. Furthermore, the industry collaboration environment and ICT-related firms will be analyzed for cluster-specific infrastructure. Finally, for the quality of linkages, this paper focuses on two factors: the collaboration activities of government, industries, and universities and the presence of repositories and data centers.

5. Review of Artificial Intelligence Platform Strategies and Policies

5.1 South Korea Case

5.1.1 Common Innovation Infrastructure

In 2017, the South Korean government first introduced its roadmap for A.I. development to secure the foundation of A.I. core technologies and establish an AI-led economy. However, South Korea's interest in data, A.I., and 5G networks peaked due to the outbreak of COVID-19 (Institution of Information & Communications Technology Planning & Evaluation, 2017). In 2019, the South Korean government announced its plan to invest in a data and AI-led economy (IITP, 2017; Ministry of Culture, Sports and Tourism (MCST), 2019). The action plan defined the roles of the government and private companies. The government should build an infrastructure that promotes data and A.I. convergence and demand for startups and small and medium-sized businesses. Private companies should strengthen the cooperation between large companies and SMEs and promote data and AI-focused new products and services.

Furthermore, the South Korean government announced its national strategy, "Medium and long-term comprehensive measures for the intelligent information society in response to the fourth industrial economy through the development of A.I. technologies" (IITP, 2019). Efforts are being made to establish a national A.I. strategy by focusing on institutional innovation, industrial promotion, and education/employment in the A.I. industry. The strategy further announced policy directions to create new values and build a competitive and intelligent information society, such as strengthening the A.I., data, and network technologies, supporting the medical and manufacturing sectors, and strengtheni ng the security capabilities to deter cyber threats (IITP, 2018).

Despite these strategies, South Korea lacks the policies and acts necessary for the A.I. platform to prosper. One of the issues with Korean A.I. policy is the lack of a commercialization platform. A.I. policy covers government A.I. platforms such as Exobrain and Deep View but does not cover privately owned commercial platforms (Institution of Information & Communications Technology Planning & Evaluation, 2018). Furthermore, there are difficulties in establishing information protection, privacy, and data governance regulations. While the United States is preparing for a new ICT paradigm with A.I. technologies, South Korea is lagging because of insufficient preparation and lack of human resources in the A.I. field and focusing only on developing big data and machine learning technologies.

Furthermore, unlike the U.S., South Korea has a limited AI R&D budget and has low efficiency in making investments (MSIT, 2018a). South Korea has world-leading technology in interactive A.I., but there is insufficient data to create commercialization platforms (MSIT, 2018a).

South Korea also lacks regulations to help protect information and data. MSIT is actively pursuing A.I. policies by setting up the Intelligent Information Society Promotion Group, but currently, it is necessary to protect A.I. platform-related data and regulate privacy (Choi, 2020). For the A.I. platform to reach its potential in South Korea, general legal acts such as the Personal Information Protection Act, the Act on the Protection and Use of Location Information, the Act on Promotion of Information and Communication Network Utilization and Information Protection, the Act on User Protection, and the Development of Cloud Computing need to be reorganized (Choi, 2020). In addition, it would be necessary to improve the legal system for each industry for the use of artificial intelligence in various projects such as medical care, finance, law, education, and disaster prevention. Moreover, in preparation for the era of big data and A.I., the impact of data on expanding the market dominance of digital platforms and countermeasures is necessary, and regulations on data mobility and access to third-party data are needed (Choi, 2020).

5.1.2 Cluster-specific Conditions

The South Korean government, which was focused on advancing A.I. technology and reinforcing A.I. and ML expertise, is focusing on applying A.I. technology to existing digital platforms (MSIT, 2018b). While the A.I. platform market in Korea has been centered around business-to-consumer (B2C) voice recognition platforms developed by ICT conglomerates, South Korea is advancing its A.I. platform ecosystem by developing an A.I. platform with the big three telecommunication companies and developing a cloud-based A.I. platform with SMEs such as Minds lab (MSIT, 2018a). In addition, the South Korean government has announced its plans to apply A.I. platforms in pharmaceuti cal, materials, medical, agriculture, finance, and education (MSIT, 2018b).

South Korean ICT companies participate in government support projects and conduct technology transfers to create a domestic A.I. platform ecosystem (MSIT, 2018a). Naver has acquired a US AI company, XRCE and has actively developed its own A.I. platform, Clova. Kakao, one of the most innovative companies in South Korea, is currently developing A.I. technologies such as natural language processing (NLP), text-to-speech, posture analysis, A.I. speaker, meta-learning, video/image/a udio analysis, and as their cloud-based platform. SK C&C provides a Korean version of IBM's Watson, which provides medical cancer diagnosis and various infectious disease data analyses. The South Korean government is growing the industrial-specific A.I. platform market through investment in SMEs and startups (MSIT, 2018b). Startup A.I. platforms, such as VUNO and Lunit, have award-winn ing A.I. technologies and are being promoted in the medical sector (MSIT, 2018a).

5.1.3 Quality of Linkages

One major limitation of South Korea's A.I. platform industry is the lack of A.I. collaboration clusters (Ministry of Science and ICT, 2018a). Therefore, it is necessary to establish an R&D cooperation

system based on the flagship system in which the affiliated groups form a consortium while continuing the R&D currently being promoted, centering on competitive institutions in each field of artificial intelligence (MSIT, 2018a; 2018b). For example, in the United States, IBM is a research institute, and other universities and research institutes participate in developing an ecosystem.

The "A.I. + X (other industries)" flagship project is promoting the establishment of an A.I. system/plat form in the medical, public security, and safety industries, but the convergence ecosystem policy and platform commercialization plan are required (MSIT, 2018a). Furthermore, it is necessary to link AI-related research institutes and companies with government research institutes that produce research data for various fields such as bio, chemical, and machinery (MSIT, 2018b). Therefore, the Ministry of Science and ICT (2018b) announced its plans to promote leading A.I. technologies in industries with future potential, such as medicine and the medical sector. The ministry further announced that A.I. technology could help shorten the time to develop new drugs (15 years to 7 years), shorten the development period and cost for new materials, and provide patient care bots, doctor assistants, gene analysis, and 24-hour monitoring services (MSIT, 2018a). Table 2 shows some applications for the A.I. platforms in various industries.

Table 2. Applications for AI platforms in various industries

Industry	A.I. Platform Applications
Traffic	Self-Driving Cars and Shuttles, Drones for Shipping
Smart City	Efficient City Management, Intelligent Traffic System, Safe Society Using Law Enforcement and Closed-Circuit Television (CCTV)
Medical Management	Rapid Diagnosis, Precision Medicine
Cyber Security	Detecting and Responding to Attacks such as Hacking
Finance	Credit Crisis Analysis and Voice Phishing Detection
Military	Utilizing Chatbots to Recruit New Soldiers
Judicial Service	Judgment by Big Data Analysis
Environment & Natural Disasters	IBM attempts to address the OmniEarth California Drought
Statistics	Demographic Based on Big Data Analysis

Source: MSIT (2018b)

Furthermore, with the lack of human resources in the A.I. field, the Korean government selected five universities (KAIST, Korea University, Sungkyunkwan University, Gwangju Institute of Science and Technology, and Pohang University) in 2019, and the other three universities (Yonsei University, Ulsan Institute of Science and Technology, and Hanyang University) to create a graduate program for A.I. (IITP, 2020). Furthermore, these seven universities will be funded with two billion won annually for five to ten years to cultivate quality workers who can design and develop high-level A.I. algorithms and systems (IITP, 2020).

5.2 United States Case

5.2.1 Common Innovation Infrastructure

According to Chiang (2019), only two bills contained the word A.I. in 2015-2016, but in 2017 and 2018, there were 42 and 51 bills related to A.I., respectively. Since the end of the Obama administration, long-term A.I. policy plans such as “Preparing for the Future of A.I.” have been proposed. The Trump administration announced “American A.I. Initiatives” in 2019 to solve A.I. technical, social and ethical issues from a long-term perspective (Chiang, 2019). In addition, the Trump administration emphasized that A.I. technology is the core of national security and competitivene ss and suggested that investment in A.I. will be doubled by 2022 while reducing the R&D investment in other fields (MSIT, 2018b). The U.S. Ministry of Defense (MOD) was the first federal ministry and agency to announce the “Department of Defense A.I. Strategy.” The MOD strategy appointed Joint Artificial Intelligence Center (JAIC) as an A.I. strategy center that will enhance core A.I. competencies, cooperate with private firms and academia, and foster A.I. human resources. Similarly, the Defense Advanced Research Projects Agency (DARPA) announced they would invest 2 billion dollars in new projects related to A.I. (Institute of Information & Communications Technology Planning & Evaluation, 2019).

Furthermore, the United States government focused on supporting various AI-related projects, such as providing supercomputers and datasets to I.T. companies, universities, and research institutes at low cost (Kim & Kim, 2018). One of the projects is creating the “National A.I. Research Cloud” to help collaborate between universities (Stanford University, Carnegie Mellon University, and Ohio State University) and global I.T. companies (Google, Amazon, IBM, Nvidia, and M.S.) (Kim & Kim, 2018; Lohr, 2020). Furthermore, the U.S. government proposed policies such as the “National A.I. Research Resource Taskforce Act” to promulgate A.I. and cloud platform technology to support the National A.I. Research Cloud. In addition, other acts, such as big data and machine learning algorithm-related regulations, are under consideration (Nam, Cho, Byun, & Yeo, 2019).

5.2.2 Cluster-specific Conditions

In the United States, the private sector is developing large-scale A.I.; market formation, technology development, and investment are underway with private participation. Unlike Korea, the U.S. governme nt develops A.I. technology and transfers it to the private sector, leading innovative product services and playing a role in market leadership (Lee, 2017). Leading ICT industries such as Amazon, Google, and M.S. improve platforms to efficiently introduce and utilize A.I. and machine learning and develop optimization services by adding new functions (MSIT, 2018a). Google, Facebook, and Amazon focus on A.I. platforms applicable to various B2C services, and IBM and G.E. focus on specialized A.I. platforms applicable to specific industries. IBM has unrivaled competitiveness in A.I. convergence with other industries (Lee, 2017; MSIT, 2018a). For example, IBM’s Watson is currently used in the medical field, such as at Memorial Sloan Kettering Cancer Center and MD Anderson Cancer Center, to diagnose better and analyze medical data (Lee, 2017). In addition, IBM is working with Baker & Hostetler in the legal field and the Development Bank of Singapore in finance (Lee, 2017).

5.2.3 Quality of Linkages

There is already several A.I. platform-based cooperation in the United States. The University of Rochester worked with the Southern Nevada Health District (SNHD) to develop Nevada's food poisoning prevention and testing tools (Ministry of Science and ICT, 2018a). As a result, the rate of restaurants discovering food poisoning problems has increased from 9% to 15% (Ministry of Science and ICT, 2018a). Competitions were held in Boston and New York to build A.I. services and platforms to promote public data use. Furthermore, Boston announced that it would be establishing a data analysis team to collect and analyze civil complaint information (road damage, graffiti, garbage, and parking problems) (Ministry of Science and ICT, 2018a).

Furthermore, the United States has created an ecosystem where major federal agencies and universitie s operate data centers and repositories. Repositories are central in computer storage, where data aggregates are stored and maintained (Kim & Kim, 2018). Each research institute and the university support preserving and sharing research data through a repository. Harvard's Dataverse, Stanford's Digital Repository, and the University of Wisconsin at Madison's MINDS@UW are examples of university-owned repositories. Similarly, National research institutes such as NASA, NOAA, and NIH established their own data centers to collect, manage, and disclose data from various research projects (Kim & Kim, 2018).

5.3 China Case

5.3.1 Common Innovation Infrastructure

In 2016, the Chinese government announced the "Overview of National Informatization Development Strategy" to provide guidelines for becoming an internet powerhouse, establishing ICT businesses, and improving inefficient public/private systems (Jung & Lee, 2018). In 2017, the "Next Generation A.I. Development Plan" was announced. The plan strives toward making China a leading nation in the A.I. industry by 2030 and focuses on building platform services in various industries such as medical, transportation, agriculture, finance, and education, centered around Chinese ICT firms (Jung & Lee, 2018). The plan included a roadmap that focused on developing A.I. technology, fostering the A.I. market by 2030, and its plan to invest 10 trillion yuan in AI-related industries (Jung & Lee, 2018). According to Kim, et al. (2020), China is rapidly catching up with the United States by focusing on image recognition technology. The Chinese government also recognized the importance of A.I. as a national strategic technology and fostered A.I. platforms through investment and human resource training.

The Chinese government's strategy is to strengthen private cooperation and accelerate technology development to vitalize a "National Open Platform For Next-Generation Artificial Intelligence" (Korea Institute of Science & Technology Evaluation and Planning (KISTEP), 2019). This open platform will help establish an A.I. hub and create an ecosystem in the A.I. field (KISTEP, 2019). In addition, the Chinese government hopes that the Open platform can expand the software and hardware sharing services and revitalize the startup ecosystem.

5.3.2 Cluster-specific Conditions

The Chinese government reinforced public-private partnerships to revitalize the A.I. open platform and selected fifteen companies in the A.I. field as technology development partners (Kim, et al., 2020). Furthermore, the Chinese government assigned specific industries to these companies, and therefore, Baidu is creating an autonomous vehicle platform, Tencent is focusing on a medical platform, and Alibaba is developing a smart city platform (Kim, et al., 2020). Table 3 shows China's major enterprises and their next-generation A.I. open innovation platform.

Table 3. China's major enterprises and their next-generation AI open innovation platform

Company	AI Platform
Baidu	Autonomous driving platform
Alibaba	Smart city platform
Tencent	Cloud-based medical and health platform
iFlyt	Voice recognition platform
SenseTime	Visual platform
Yitu Technology	Visual computer platform
MiningLamp	Marketing platform
Huawei	Software and hardware platform
Ping An Insurance	General finance platform
Hikvision	Video detection platform
J.D.	Smart supply chain platform
Megvii	Image detection platform
Chifu	Security platform
TAL	Smart education platform
Xiaomi	Smart home platform

Source: Kim, et al. (2020).

5.3.3 Quality of Linkages

China created institutional repositories operated by the Chinese Academy of Science (CAS), called the CAS IR Grid (Korea Institute of Science and Technology Information (KISTI), 2016). The CAS IR Grid integrates 112 repositories around China to share about 260,000 articles, patents, papers, reports, and datasets (KISTI, 2016). It also distributes data and research findings, includes copyright management, search engines, and statistics services, and provides researchers' profiles. In addition, the Chinese government has established data centers in six fields (forestry, earth science, population, health, agriculture, and meteorology) to collect, share, and manage science and technology data (KISTI, 2016).

5.4 European Union and the United Kingdom Case

5.4.1 Common Innovation Infrastructure

The E.U. announced a directive on reusing public data and public sector information, also known as the "Open Data Directive," in 2019 (Choe, 2018). The open data directive replaced the "Public Sector Information (PSI) Directive," which was first passed in 2003 and amended in 2013 (European Commission, 2021). According to the European Commission (European Commission, 2021), the Open Data Directive will 1) stimulate the publishing of datasets and adopt the use of Application Programming Interfaces (APIs), 2) limit the public institutes to change the cost to reuse their data, 3) enlarge the scope of the directive to include data available for reuse and research data that came out of public funding, and 4) strengthening the transparency requirement for public-private agreements.

In addition, the E.U. boasts one of the toughest privacy laws for personal information protection (Wolford, 2021; Jung, Seo, Shin, and Kim, 2020). The "General Data Protection Regulation (GDPR)" applies to anyone who processes data of E.U. residents or people or offers goods and services in the E.U. and fines up to tens of millions of euros for violations of security standards (Wolford, 2021). The GDPR defines personal data as "any information related to an individual who can be directly or indirectly identified" and includes location information, ethnicity, biometric data, religious beliefs, and web cookies as personal data (Wolford, 2021). The GDPR also includes clauses for A.I. algorithms, such as the "right to ask for an explanation" and the "right to limit automated decision-making," as well as protecting the rights of information providers (Wolford, 2021; Jung, et al., 2020).

Germany is one of the nations in the E.U. heavily investing in the digital platform economy's growth. The Federal Ministry of Education and Research (BMBF) released a guideline in October 2020 that derived A.I. implementation plans for a learning system platform. Furthermore, the German government launched the "Platform Lernende System" in 2020 to provide self-adjustment rights, fairness, and personal information protection measures for developers, users, stakeholders, and policyma kers to help develop the field of A.I. (Seo & Ahn, 2019). According to Jung and Lee (2018), the total R&D expenditure in Germany for A.I. technology development is about 4.8 billion euros, with an additional 3 billion euros will be invested by 2025 to push Germany into a major AI powerhouse. Despite the importance of data management, there are currently no regulations regarding data quality assurance, A.I. system traceability, and I.T. security in Germany (Seo & Ahn, 2019). Furthermore, there have been cases where false results were produced due to security issues, data errors, and forged data (Seo & Ahn, 2019). Therefore, the German government is focusing on strengthening data security.

The United Kingdom (U.K.) was also preparing for the digital platform economy and published a series of industrial strategy white papers and the "A.I. Sector Deal" policy papers in 2017 and 2018 (Shim, 2019). Furthermore, the U.K. government selected A.I. and data innovation as one of the four major projects. It will focus on developing the A.I. industry by creating a mid-to-long-term public-private innovation A.I. ecosystem through industry-government-academia collaboration (Shim,

2019). Furthermore, the U.K. announced its strategy to focus on strengthening AI R&D, cultivating talent, creating a data infrastructure, building an A.I. business environment, and building an A.I. cluster (Institution of Information & Communications Technology Planning & Evaluation, 2018). The A.I. strategy also specified the government's role and emphasized the importance of applying A.I. technologies to various public/private sectors and implementing policies to use A.I. technologies safely and ethically (Institution of Information & Communications Technology Planning & Evaluation, 2018). Therefore, the U.K. created the "Centre for Data Ethics and Innovation (CEDI)." CEDI is an independent advisory body established and mandated by the U.K. government to maximize the benefits of A.I. technologies and addresses the public on the opportunities and risks presented by data-driven technologies (Centre for Data Ethics and Innovation, 2020). CEDI examined online targeting systems results and stated that the U.K. government should strengthen regulatory oversight of companies' usage of online targeting systems and must develop a regulation to "safeguard freedom of expression and privacy online and to promote human rights-based international norms" (Centre for Data Ethics and Innovation, 2020). CEDI also emphasized that regulators must protect the privacy and commercial confidentiality, and digital platforms should operate with sufficient transparency and accountability (Centre for Data Ethics and Innovation, 2020).

5.4.2 Cluster-specific Conditions

The U.K. boasts one of the highest numbers of AI-related human resources in the E.U., which also ranks third globally below the U.S. and China (Park, 2019c). In addition, one-third of all A.I. startups in the E.U. are located in the U.K., where most of them are based in London, and various geographical clusters are formed in other regions of the U.K. (Park, 2019c). Furthermore, the United Kingdom focuses on creating an A.I. ecosystem by building A.I. clusters. The U.K. announced its goal to build and activate a medical A.I. platform through domestic and international cooperation (Autor, 2019). Sensyne Health, a U.K. clinical trial A.I. company, has agreed to build an A.I. platform with Swiss multinational medical company Roche to convert to anonymous electronic patient records and build a platform to support clinical trial plans (Autor, 2019). In addition, NHS will cooperate with the German Bayer company to build an A.I. platform using NHS patient data, and the results derived through the partnership will be used for cardiovascular disease research (Autor, 2019).

The German government announced its collaboration plan with the E.U. to build an A.I. data infrastructure platform in 2019 (Jung & Lee, 2018) and is applying A.I. technology in medical systems. In addition, Germany announced their plan to provide domestic companies that plan to develop and operate digital platforms with massive storage from domestic firms (Deutsche Telecom, SAP, and Festo) and foreign companies such as M.S. (Jung & Lee, 2018).

5.4.3 Quality of Linkages

The U.K. government created an environment where research committees and universities operate data centers and repositories in each field to comply with the government and research committees'

data-sharing policies. Natural Environment Research Council (NERC) and Economic and Social Research Council (ESRC) directly operate data centers. Furthermore, the government builds and operates an integrated platform (ResearchFish) that collects and shares research and research data through government support projects (KISTI, 2020). About 2 million research outcomes were saved in Research Fish in 2019 (KISTI, 2020). In addition, DMPOnline, provided by Data Curation Center (DCC), analyzes various research institutes and research communities' data policies and provides researchers' assistance. JISC is a non-profit company that supports education and research institutes and built its own data center in 2014 to share research data with research institutions and universities. JISC's service allows users to use their data storage and share many data (KISTI, 2020).

6. Discussion and Findings

Table 4 compares the A.I. platform strategies and policies in South Korea and other nations. South Korea has created an A.I. startup ecosystem and has slowly integrated A.I. technologies with various industries but lacks privacy and personal information protection policies. In addition, access to high-performance computing resources and big data is limited, which causes difficulty in developing A.I. technologies. However, the biggest difference between South Korea and the United States is the government and enterprises' role. In the United States, private enterprises lead the A.I. ecosystem while the government supports them. South Korea's A.I. ecosystem is government-fo cused, while private enterprises and conglomerates play a big role in expanding and strengthening the A.I. platform market.

Table 4. Comparison of A.I. Platform Policies in South Korea and Other Nations

Country	Description
South Korea	① (Personal information regulation) It is necessary to overhaul existing personal information protection and privacy infringement laws.
	② (Create an A.I. ecosystem) Create an A.I. startup ecosystem by integrating A.I. and data into major businesses
	③ (Industry-specific cooperation) Various industry-specific cooperation projects, such as the "A.I. + X" flagship project, are in progress
	④ (Difficulty in creating an ecosystem) Access to high-performance computing resources and big data are limited, and basic ecosystems related to artificial intelligence such as H.W., S.W., and development environments are not established in Korea.
	⑤ (Government focus) The trend of expanding and strengthening artificial intelligence platforms by the private sector and the government, respectively
China	① (Ecosystem construction): Establish an A.I. hub, share an A.I. open-source platform to support all companies, and expand A.I. technology (SW/HW) sharing services.
	② (Startup) Activating the AI-related startup ecosystem
	③ (Government focus) Currently, private companies do not create an A.I. ecosystem but are led by the government, and the role is divided among key conglomerates for the national next-generation A.I. open innovation platform

E.U.	All	① (Policy direction) E.U.'s integrated support by proposing laws on the use of open data and public sector information ② (Personal information protection) Through the E.U.'s GDPR policy, strong personal information protection laws help protect data, a major part of the A.I. platform.
	Germany	① (A.I. policy) Action plan to establish GAIA-X joint data platform through long-term investment ② Establish an A.I. data infrastructure platform jointly with the E.U. ③ (Importance of data security) Focus on securing high-quality data and strengthening software/personal information security to prevent false results such as security problems and data errors.
	U.K.	① Present clear policy guidelines for the role of the government and the private sector, human resource development, platform development through the A.I. sector deal ② Establishment and operation of CEDI (Centre for Data Ethics and Innovation), and through this, a professional advisory role in the field of artificial intelligence ③ (International cooperation) Establish a medical A.I. platform through cooperation with European Swiss companies and German companies, share data, and use them for medical research ④ (Private enterprises focus) Currently, private enterprises lead the A.I. ecosystem, and the government supports them
United States		① (Personal Information Protection Act) There is a "Future of Artificial Intelligence Act," but concerns about privacy and personal information protection legislation continue. ② (International cooperation) Focus on strengthening solidarity by cooperating with China and Russia ③ (Private enterprises focus) Currently, private enterprises lead the A.I. ecosystem, supporting the government. ④ Private companies introduce and utilize A.I. and machine learning to improve their platform and build optimization services. For example, Amazon and Google use the latest AutoML (automated machine learning) technology and an artificial intelligence platform based on open-source software. ⑤ (Government investment) Announcement of full-scale investment for A.I. platform and technology development such as American A.I. Initiatives and DARPA ⑥ (Expanding research data) Developing a platform that combines artificial intelligence technology with bio-research through the Big Data To-knowledge (BD2K) program and expanding the National A.I. Research Cloud ⑦ (Expanding public services utilizing artificial intelligence) Platform development in Boston and New York to promote software and app development to promote public data utilization

Furthermore, the United States focuses on strengthening solidarity by cooperating with China and Russia and strengthening their privacy and personal information policies. The U.S. government announced a full-scale investment in A.I. platforms and technology development, such as American A.I. Initiatives and DARPA. Private enterprises are also introducing and utilizing A.I. and machine learning technologies to improve their platform and build optimization services.

The E.U. focuses on developing key policies and acts as they boast one of the strictest privacy and personal information policies. Germany and the U.K. have key institutions and centers to deal with the development of A.I. platforms. Moreover, the E.U. emphasizes sharing best practices for creating AI-related conditions. Finland is highly valued for human resources and the U.K. for innovation.

On the other hand, China is actively focusing on creating an A.I. startup ecosystem by establishing A.I. hubs and creating an A.I. open-source platform to support all companies to expand A.I. technology (SW/HW) sharing services. The Chinese government has a well-defined role in developing the A.I. platform and has assigned specific industry platforms to key conglomerates. In addition, China strives to ensure that AI-related achievements can be reintroduced into the overall economy while the A.I. ecosystem has progressed considerably.

From the review of strategies and policies from various countries, this paper found three major areas that the South Korean government can focus on to make South Korea a fast follower in the A.I. platform industry. First, South Korea needs to increase its investment in the A.I. field and expand its public-private collaboration activities. South Korea's R&D investment and accumulated technology in the A.I. field are insufficient, and long-term public-private cooperation needs to be expanded. It is necessary to reinforce leading investments that look forward to the future and establish an investment strategy to secure technological capabilities early and preoccupy the market. In other nations, such as the U.S. and China, their governments and the private sector jointly develop AI-based platforms. Leading private companies are expanding the A.I. market and actively promoting the development and commercialization of A.I. platforms. Therefore, it is necessary to strengthen A.I. cooperation to develop new platforms and expand services.

Second, unlike the U.S. and the U.K., South Korea lacks data protection policies. South Korea needs to focus more on data protection policy, privacy policy, and national ethics framework to protect consumer rights and prevent unfair and discriminatory consequences. As data portability and third-party data access are expected to become more important regulatory policy issues in the future with the enforcement of the Data 3 Act in 2020, clear guidelines and policy directions for the rational use of the Data 3 Act need to be presented. Moreover, South Korea needs encryption and data management policies for artificial intelligence research. In the U.S. and the U.K., efforts are underway to protect personal information, and when building an A.I. platform through this, it is necessary to strengthen A.I. ethics laws and provide guidelines for using the platform to respond to personal information and security issues.

Third, South Korea needs to build a high-performance system and environment to experiment with artificial intelligence technology (machine learning and deep learning) and big data. There is also a need to create supply and demand based on the government's public sector data. A.I. technologies and platforms/services are recognized rapidly and widely, penetrating society and industry. South Korea is in a situation where it needs to establish and implement a national plan to respond to this quick change. Furthermore, a plan is needed to support machine learning and A.I. technology development through public data and add big data and machine learning technology to the A.I. platform. South Korea must construct a basic ecosystem related to A.I. and data such as HW/SW, development environment, and A.I. platform. Cooperation with various industries such as medical, bio, chemical, and machinery should be established, and an ecosystem for industry-academic cooperatio

n such as companies and public institutions should be created. A long-term policy to promote artificial intelligence-related technology sharing is needed. Establishing an industry-academic cooperation ecosys tem is necessary, such as providing opportunities for companies to utilize artificial intelligence technologies through technology transfer by disclosing artificial intelligence technologies in public research centers step by step (Lee & Cho, 2016).

7. Conclusion

This paper aims to overview South Korea's transition into the platform economy. The research question was whether the South Korean government should transition its ICT firms to a first-mover or strengthen its capabilities as a fast-follower. This paper examines the A.I. platform in terms of the NIC framework because it incorporates political and social influences and compares innovation capacity. This paper offers insights into South Korea's current situation in developing the A.I. platform. The results of this paper are consistent with the results presented by Tortoise Intelligence, which ranked South Korea seventh and dropped from fifth in the global A.I. index. The main reason for this drop was low rank in the number of A.I. talents and a bad operating environment. While the government's investment is high, commercial investment is low. Therefore, for South Korea to become a powerhouse in the A.I. platform, it would need to focus on implementing an operating environment in which commercial investments are booming, and the number of talents is also increasing.

Nevertheless, this paper has several limitations and requires future research. Firstly, A.I. policies are still a novice and play an important role in developing and deploying the technology. Therefore, policies should be continuously examined and analyzed. Brundage & Bryson (2016) claim that science and technology policies "operate more broadly than restrictive regulations" and accelerate and change the technology development trajectories. In addition, as A.I. is developed and innovated, the issues of ethical behavior will rise; therefore, societies need a set of ethical norms, standards, and policies to ensure that A.I. is used to benefit humanity (Anderson, et al., 2018). Secondly, the paper examined the policies mainly using document reports published by Korean government institutions. Therefore, the paper's focus and definitions were from the Korean perspective. A broader focus and various definitions of A.I. platforms would be needed to have a holistic view.

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