

Examining the Generative Artificial Intelligence Landscape: Current Status and Policy Strategies*

Hyoung-Goo Kang^a, Ahram Moon^b, Seongmin Jeon^{c,**}

^a Professor, Department of Finance, Hanyang University, Korea

^b Research Fellow, Korea Information Society Development Institute, Korea

^c Associate Professor, College of Business, Gachon University, Korea

ABSTRACT

This article proposes a framework to elucidate the structural dynamics of the generative AI ecosystem. It also outlines the practical application of this proposed framework through illustrative policies, with a specific emphasis on the development of the Korean generative AI ecosystem and its implications of platform strategies at AI platform-squared. We propose a comprehensive classification scheme within generative AI ecosystems, including app builders, technology partners, app stores, foundational AI models operating as operating systems, cloud services, and chip manufacturers. The market competitiveness for both app builders and technology partners will be highly contingent on their ability to effectively navigate the customer decision journey (CDJ) while offering localized services that fill the gaps left by foundational models. The strategically important platform of platforms in the generative AI ecosystem (i.e., AI platform-squared) is constituted by app stores, foundational AIs as operating systems, and cloud services. A few companies, primarily in the U.S. and China, are projected to dominate this AI platform squared, and consequently, they are likely to become the primary targets of non-market strategies by diverse governments and communities. Korea still has chances in AI platform-squared, but the window of opportunities is narrowing. A cautious approach is necessary when considering potential regulations for domestic large AI models and platforms. Hastily importing foreign regulatory frameworks and non-market strategies, such as those from Europe, could overlook the essential hierarchical structure that our framework underscores. Our study suggests a clear strategic pathway for Korea to emerge as a generative AI powerhouse. As one of the few countries boasting significant companies within the foundational AI models (which need to collaborate with each other) and chip manufacturing sectors, it is vital for Korea to leverage its unique position and strategically penetrate the platform-squared segment-app stores, operating systems, and cloud services. Given the potential network effects and winner-takes-all dynamics in AI platform-squared, this endeavor is of immediate urgency. To facilitate this transition, it is recommended that the government implement promotional policies that strategically nurture these AI platform-squared, rather than restrict them through regulations and stakeholder pressures.

Keywords: Generative Artificial Intelligence, Platform Strategy, Ecosystem, Applications, Operating System, Cloud, AI Platform of Platforms

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**Corresponding Author. E-mail: smjeon@gachon.ac.kr

I . Introduction

In the rapidly evolving realm of artificial intelligence (AI), one sector that has garnered significant attention is generative AI. This technology, capable of creating new data instances based on the patterns it identifies in the data it is trained on, has profound implications across industries and sectors (Makhzani et al., 2015). The impact of artificial intelligence (AI) is evident in many sectors, with a few particularly notable examples as follows:

In the realm of healthcare, AI plays an instrumental role in predicting disease outbreaks and personalizing patient treatment plans. By analyzing vast amounts of data from various sources, it can identify patterns and predict potential health crises before they become widespread. Moreover, it personalizes treatment plans by understanding a patient's unique genetic makeup and lifestyle, offering bespoke healthcare solutions. AI also streamlines administrative tasks, freeing healthcare professionals to focus more on patient care.

In the manufacturing industry, the transformative power of AI technology, particularly predictive analytics and machine learning, is quite evident. These tools enable manufacturers to increase efficiency, reduce waste, and improve quality control. They can predict equipment failures before they occur, schedule timely maintenance, and optimize production schedules, resulting in significantly enhanced operations.

The financial services sector is another area that's being reshaped by AI. It provides tools that are critical for fraud detection, risk management, customer service, and algorithmic trading. For instance, AI can analyze patterns to detect suspicious transactions that may indicate fraud. It can also assess market data to manage investment risks and execute trades at

optimal times. Additionally, AI-powered chatbots are revolutionizing customer service in the sector by providing instant responses to customer inquiries.

Lastly, in the field of agriculture, the pattern recognition abilities of AI are making a considerable impact. AI technology can predict yield and track crop health, allowing farmers to adjust their practices accordingly. These capabilities lead to more efficient farming practices and improved food security. AI-powered drones and sensors can monitor crop health and environmental conditions in real time, enabling quick responses to any issues, thus optimizing crop yields and minimizing losses.

In all, these examples underscore the profound and broad-reaching implications of AI technology across various industries.

This article explores the current state of the generative AI ecosystem, detailing the principal actors, emerging trends, power structure, and significant challenges from the perspectives of Korea. Moreover, we will delve into a discussion on policy measures, aimed at guiding an evolution of this transformative technology ecosystem.

Indeed, the Ministry of Science and ICT unveiled the "Plan to Strengthen Competitiveness of Super-large AI", earmarking an investment of 390.1 billion won this year to promote super-large AI (SL-AI) as a strategic industry for the future. The plan's vision is to construct a SL-AI platform to target the global market, aim for global leadership in the AI application services, expand the core infrastructure for SL-AI technology and industry, establish an innovation ecosystem, and cultivate a national AI innovation system and culture.¹⁾ See <Figure 1>.²⁾

1) <https://www.etnews.com/20230414000131>

2) Translation of the Figure: Vision: Smart Artificial Intelligence. We aim to accelerate the digital economy alongside our citizens.



<Figure 1> Korean Government's AI Vision.

In response to these pivotal considerations, this study seeks to furnish a discerning assessment of the present state of the generative AI ecosystem, alongside formulating policy suggestions aimed at cementing Korea's standing as a formidable force within the generative AI landscape. We present an innovative framework designed to shed light on the structural dynamics of the generative AI ecosystem. We elaborate on the practical application of the proposed framework through indicative policy suggestions, focusing primarily on the desired evolution

of the Korean generative AI ecosystem and the implications of platform strategies at the "AI platform-squared".

Our methodology hinges on the exploration of interconnections within AI ecosystems, placing particular emphasis on hierarchical structures and power dynamics. We offer a detailed classification scheme within generative AI ecosystems that comprises app builders, technology partners, app stores, foundational AI models serving as operating systems, cloud services, and chip manufacturers.

Our analysis suggests that the market competitiveness for both app builders and technology partners will largely depend on their proficiency in navigating the Customer Decision Journey (CDJ) while providing localized services that address the deficiencies of foundational models. The strategically significant "platform of platforms" in the generative AI ecosystem (i.e., AI platform-squared) will be constituted by app stores, foundational AIs as operating systems, and cloud services. A few companies, predominantly

Objective: Our main objective is to develop a mega-scale AI platform that aspires to be the world's number one Korean language platform, with a focus on non-English-speaking regions, targeting the global market. Furthermore, we are challenging ourselves to become the global leader in specialized areas by establishing a mega-scale AI application platform that fosters collaboration between enterprises.

Implementation Strategy: Our strategic approach includes: (a) Enhancing the core in frastructure of the technology and industry for mega-scale AI. (b) Establishing an innovative ecosystem for mega-scale AI. (c) Institutionalizing a nationwide AI innovation system and embedding its culture.

from the U.S. and China, are projected to command this AI platform-squared, thereby likely becoming the main targets of non-market strategies by various governments and communities. Korea still retains opportunities within this strategically significant AI platform-squared, albeit the window is gradually narrowing. To cultivate market and non-market strategies for Korean stakeholders in the AI platform-squared, we employ the resource-based perspective and dynamic capabilities.

We caution against hastily adopting potential regulations for domestic large AI models and platforms. Importing foreign regulatory frameworks and non-market strategies, such as those from Europe, without careful consideration could potentially neglect the vital hierarchical structure that our framework emphasizes. Our study delineates a clear strategic pathway for Korea to rise as a formidable player in the generative AI sector. Korea, as one of the select countries with substantial companies in the foundational AI models³⁾ and chip manufacturing sectors, needs to utilize its unique position and strategically infiltrate the platform-squared segment-app stores, operating systems, and cloud services. Considering the potential network effects and winner-takes-all dynamics in the AI platform-squared, this endeavor is of immediate importance. We suggest the government put into action promotional policies that strategically foster these AI platform-squared, instead of restricting them through regulatory and stakeholder pressures.

In the subsequent sections, we will explain the AI landscape in Korea, delve into the specifics of the generative AI landscape, followed by a detailed analysis of the current challenges and potential countermeasures. We will then outline the necessary

policy measures and integrated strategies (Baron, 1995, 1997). Our exploration will culminate in a set of recommendations designed to fortify national competitiveness in the generative AI domain.

II. The AI Landscape in Korea and Objectives of Korean AI Companies

The Korean AI landscape is a dynamic and rapidly developing one, underpinned by robust technological infrastructure and strong government support. Korea's AI industry is home to a diverse range of players, including well-established tech conglomerates (e.g., Samsung, Naver, Kakao), innovative startups (e.g., Riid, Moloco, Rebellions), and research institutions. Moreover, with its highly digital and connected population, the country serves as a fertile ground for AI development and implementation. For example, the World Economic Forum (WEF) has reported that for the third year in a row, Korea maintains its global leadership position in the proliferation of information and communication technologies (ICT), ranking first worldwide, as of September 2022.

In terms of AI application, Korean companies span across multiple sectors such as healthcare, manufacturing, finance, and consumer electronics, to name a few. For instance, in 2021, Naver made significant strides in AI technology by introducing its large-scale language model, HyperClova. This development followed closely on the heels of OpenAI's GPT-3 and Huawei's PanGu- α . The uniqueness of HyperClova lies in its extensive learning foundation; it was trained using fifty years worth of Naver news articles. According to Naver, the Korean language-based dataset that HyperClova learned from is a staggering 6,500 times larger than that of GPT 3. That same

3) <https://www.tortoisemedia.com/intelligence/global-ai/>

year, Kakao Brain, the research subsidiary of Kakao, unveiled two large-scale AI systems. These systems, named KoGPT and minDALL-E, were built upon the foundation of Open-AI's GPT-3 and Dall-E.

SK Telecom, a major player in the Korean AI landscape, has launched a virtual assistant app named A., powered by GPT-3. The company is also collaborating with SK hynix and Sapeon to innovate in the realm of AI chips. Meanwhile, KT, another telecommunications giant, is in the process of developing its own large-scale language model, Mi:Deum. The company plans to debut Mi:Deum in the market during the first half of the year, in partnership with Rebellion, a domestic chip designer.

On the other hand, Naver has chosen to invest in the AI chip company, Furiosa AI. In December 2022, Naver further established a task force in collaboration with Samsung Electronics. This joint endeavor aims to develop a chip capable of powering Naver's large-scale language model, HyperClova.

The rapid advancements and collaborations of these large corporations have opened up a wealth of opportunities for local start-ups, enabling them to create innovative services built on computing models developed by these tech behemoths.

For instance, Wrtn Technologies has developed Wrtn Training, a writing assistant tool, using Naver's HyperClova. Similarly, Scatter Lab, renowned for its Lee Lu-da chatbot, is leveraging GPT-2 to develop a sophisticated conversational chatbot. These developments serve to highlight the burgeoning AI ecosystem in Korea, fueled by both large tech companies and vibrant start-ups.

However, it's worth noting that the Korean AI landscape is not devoid of challenges. Predominantly, Korean AI companies are grappling with the market dominance of international AI giants. The foremost challenge lies in the lack of data.⁴⁾ Artificial

Intelligence models necessitate extensive amounts of data for effective training. In Korea, there is a conspicuous shortage of high-quality, extensive datasets that can be harnessed to train AI models. This deficit can be attributed to a number of factors, one of which is privacy concerns that often limit the availability and sharing of data. Additionally, the absence of a unified platform for datasharing further compounds this problem, stymieing the efficient use and exchange of valuable data.

The Ministry of Science and ICT has identified the aforementioned challenges and is contemplating adaptations to the data labeling project to better align with the era of generative AI. The data labeling project, part of the Digital New Deal initiative, exemplifies this shift. Notably, this initiative is a key component of the Korean New Deal, a comprehensive plan introduced by Jae-in Moon's administration.

In tandem with the issue of data shortage, the Korean AI industry also faces a dearth of skilled AI talent.⁵⁾ AI is a relatively nascent field in Korea with insufficient academic programs dedicated to it. Consequently, there aren't many graduates equipped with the necessary skills to navigate this evolving field. This talent crunch places a considerable strain on companies as they struggle to recruit qualified AI professionals for their operations.

Furthermore, stringent regulatory frameworks governing AI use in Korea present another layer of complexity. Companies intending to adopt AI technologies are required to navigate a maze of regulations to ensure compliance.⁶⁾ These often rigorous regulatory hurdles may act as a deterrent to the swift adoption and integration of AI technologies into

4) <https://www.etnews.com/20230413000175>

5) <https://zdnet.co.kr/view/?no=20210605223536>

6) <https://news.kbs.co.kr/news/pc/view/view.do?ncd=7696241>

businesses. Korean companies are wary that excessive regulation may impede the growth of the domestic AI sector. While it's critical to have regulations in place to guide the ethical and safe use of AI, overly stringent premature regulation could potentially stifle innovation and slow down progress.

If regulations are tightened before the AI technology has had a chance to mature and develop, it could lead to missed market opportunities. Not only would this affect the individual companies, but it could also impact the overall competitiveness of the Korean AI industry.

This emphasizes the need for a balanced regulatory approach. Policymakers must carefully consider the timing and extent of AI regulations to ensure that they protect consumers and society, without curtailing innovation or hindering the growth of the industry. An open dialogue between regulators, industry stakeholders, and the broader public could be a viable way to achieve this delicate balance.

In addition, public acceptance of AI is not without its challenges. Certain segments of the public harbor concerns about the potential adverse impacts of AI.⁷⁾ Fear of job losses due to automation and worries over AI being used for malicious purposes fuel resistance to the widespread adoption of AI technologies. Such apprehensions underscore the need for more robust public communication and education about AI, its benefits, and its ethical use to foster greater public acceptance.

Finally, the Korean AI sector, though progressive and innovative, is grappling with significant challenges posed by global big tech companies. These multinational behemoths- Google, Amazon, Microsoft, to name a few- have solidified their foot-

hold in the global AI domain, amassing substantial resources, broad and varied data sets, and ground-breaking technologies.

One of the primary concerns arises from the market dominance of these tech giants. With their vast resources and well-established global networks, these companies can effortlessly commandeer the market, making it arduous for local Korean companies to compete. Such market dominance can curb innovation and impede the growth of the homegrown AI sector, a scenario that Korean stakeholders are keen to avoid.

Moreover, the control of data by these global giants further amplifies the challenge. AI, in its essence, is heavily reliant on data for development and operation. The massive and diverse datasets these global tech giants have at their disposal provide them with an advantage in training more sophisticated and robust AI models. Consequently, local Korean firms might struggle to match the quality and efficiency of AI applications that these giants can offer.

For instance, the recent launch of new plugin features by ChatGPT has sparked increased interest among local startups. They are now increasingly engaged in the development of GPT application programming interfaces (APIs) in a bid to fortify their competitive stance in the AI industry. This surge in activity, however, is exacerbating the government's concerns.

If GPT usage becomes widespread, there is a risk that the vast collections of Korean labeled data may lose their value. Moreover, there's a potential concern that data generated within South Korea could be assimilated by entities like OpenAI, creating implications for data sovereignty and control. The issue of technological superiority further compounds this challenge. Big tech companies often spearhead technological innovations, possessing the most advanced

7) <https://m.hankookilbo.com/News/Read/A2023060412050003523>

AI technologies and drawing in top AI talent from around the globe. While Korean companies are known for their innovative approaches, they might find it hard to keep up with the rapid advancements being made by these tech giants.

In addition to the above, regulatory challenges also loom large. Owing to their significant clout, global tech giants have the capacity to sway policy and regulatory frameworks (Kang and Jeon, 2023). The rules and standards established by these companies often become the de facto norms, potentially introducing regulatory hurdles for Korean companies.

Finally, the threat of talent drain is a critical concern. The prestige and resources of big tech companies often lure top talent, including those from Korea, leading to a “brain drain” that hampers the local AI sector’s growth.

Taken together, these threats highlight the urgency for strategic planning, increased investment, and supportive regulatory measures in the Korean AI sector. These steps are crucial to ensure competitiveness and foster sustainable growth amidst the pressures of the global tech landscape.

Despite these challenges, the goals of Korean AI companies remain ambitious and multi-faceted. At the forefront is the desire to foster innovation and expand Korea’s AI capabilities to be competitive on a global scale. Korean AI companies are striving to develop unique, cutting-edge technologies that can stand up against those produced by international tech giants.

Furthermore, there is a strong emphasis on creating AI solutions tailored to local needs, whether that means developing AI-powered education tools to enhance remote learning or creating smart city solutions to improve urban living.

For example, Hancom has joined forces with Naver Cloud to introduce a service termed “AI Office”.

This development is anticipated to present a direct challenge to Microsoft, which recently declared its ambition to incorporate AI into all of its productivity tools. Naver Cloud has revealed that HyperClova X, the driving force behind this new service, was designed using data derived from NAVER News and blogs, with over 97% of the training data being in Korean. This emphasis on Korean data means that the AI can better comprehend and align with domestic laws, systems, and cultural contexts. As a result, it becomes more feasible to develop AI services that are specifically tailored to Korean characteristics, a feature that sets it apart from models predominantly centered around English.

However, their objectives extend beyond domestic concerns. Korean AI companies also aim to contribute to global challenges, utilizing AI to address issues ranging from climate change to healthcare access.

In conclusion, the Korean AI industry is vibrant, diverse, and ambitious, with Korean AI companies working tirelessly to innovate, compete, and make a meaningful impact both domestically and globally. Their journey, successes, and challenges provide valuable insights for the wider global AI community.

III. Theory: Framework

The progression of artificial intelligence from machine learning and deep learning to foundational models has given rise to a plethora of groundbreaking applications centered on large language models (Zhao et al., 2023). The advent of generative AI, typified by text and image generation models utilizing super-large AI, has sparked an explosive societal interest in AI technology. The rapid acquisition of users has become crucial as it provides an avenue for gathering invaluable behavioral data.

Some prominent examples of generative AI include text generation models like ChatGPT and Bard, image generation models like Dall-E, Midjourney, and Stable Diffusion, code generation model Codex, video generation models such as MS Xclip and Meta's Makea Video.

Nevertheless, the generative AI ecosystem is also fraught with concerns, primarily about the potential for existing market leaders to further solidify their dominance (Ferr'as-Hern'andez et al., 2023). This dominance is facilitated by the development of new applications via previously built, super-large AI models, which rely heavily on computing power and data.⁸⁾

Given the anticipation that a few companies with relevant technologies and models will lead the market, it is essential to foster an environment that encourages the vibrancy of the generative AI ecosystem, promoting the emergence of fast followers.

For a broader perspective, the current ecosystem configuration can be summarised into chip manufacturers, cloud service providers, foundational models and platforms, app stores, technology partners, and app developers.⁹⁾

Chip manufacturers form the bedrock of this system, supplying the essential hardware that powers generative AI computations. Cloud service providers, on the other hand, offer the necessary infrastructure to host and deploy these AI models on a scalable and accessible platform. Foundational models and platforms, being the core operating systems for AI applications, serve as the cornerstone that enables the creation and functionality of AI-driven services. App stores could potentially be the marketplace for AI-enabled applications, offering a wide variety of services to end-users. Technology partners facilitate

the deployment and operationalisation of AI models, contributing critical solutions that span across various aspects of the AI life cycle. Lastly, app developers are responsible for crafting AI applications that solve real-world problems, capitalising on the capabilities of AI to deliver value to users. This classification allows us to understand the interconnections, dependencies, and hierarchies within the generative AI ecosystem, thereby providing valuable insights into its structural dynamics. More details are as follows.

3.1. App Builders

App builders, also known as AI application developers, are entities that address customer problems through the deployment of generative artificial intelligence (AI) applications. They either leverage pre-existing foundation models and platforms, or construct their own models to generate new content across diverse domains and modalities.

The scope of AI application development is vast, encapsulating various industries ranging from healthcare and finance to entertainment and education. As an instance, in healthcare, AI applications can support diagnostic processes by generating interpretations of medical images, while in finance, they can assist in risk assessment by generating predictive analyses of market trends. Similarly, in the field of entertainment, AI applications can create content such as stories, music, and even visual arts. In education, AI applications can deliver personalized learning experiences by generating custom-tailored educational content based on individual learners' needs and progress.

The competitive landscape for AI app builders is anticipated to mirror the intense competition observed among contemporary app developers. As with

8) <https://a16z.com/who-owns-the-generative-ai-platform/>

9) One can add another private versus open axis, which future studies can address.

any emerging technology, the race to develop unique, effective, and user-friendly AI applications is likely to be fierce. The competitive advantage in this domain could be determined by various factors such as the quality and novelty of the AI-generated content, the usability of the application, the effectiveness of the underlying AI models, and the ability to successfully address user needs.

The advent of AI app stores, akin to the current app stores for mobile and desktop applications, may further intensify this competition by providing a centralized platform for the distribution and discovery of AI applications. This could potentially drive AI app builders to continually innovate, improve, and differentiate their applications in order to gain visibility and user adoption in an increasingly crowded marketplace.

Simultaneously, the rise of AI app stores could also lead to the democratization of AI, providing a wide array of AI applications to users across the globe, thereby fueling the widespread adoption and integration of AI technologies in everyday life.

However, the intensifying competition among AI app builders and the potential dominance of global AI operating systems and app store platforms may raise concerns for Korean AI ecosystems. It highlights the importance of developing policies and strategies to support local AI industries especially at AI platform-squared, ensuring they remain competitive in the global AI market. This may involve fostering innovation, investing in AI research and development, and creating conducive regulatory environments for AI adoption and growth.

In conclusion, AI app builders will play a crucial role in the AI ecosystem. They translate the advancements in AI research and technology into practical applications that address real-world problems. The competitive landscape for AI app builders is expected

to be dynamic and intense, driven by rapid technological advancements and evolving user needs and expectations.

3.2. Technology Partners

Technical partners play a pivotal role in empowering businesses to develop and deploy generative artificial intelligence models tailored for a wide array of use cases. They offer comprehensive solutions encompassing facets such as data labeling, model development, model management, model deployment, model monitoring, and model optimization. Illustrative instances of such companies include Labelbox, Databricks, Algorithmia, Seldon, and Fiddler. These companies provide a technological infrastructure that facilitates the operationalization of AI models, contributing significantly to the dynamic and evolving landscape of AI deployment.

Labelbox, for example, is an industry-leading data labeling platform that aids businesses in training high-quality AI applications. By providing an efficient and collaborative interface for data annotation, it ensures that AI models can learn from accurately labeled data, thereby improving their performance and accuracy.

Databricks, on the other hand, provides a unified analytics platform that accelerates innovation by unifying data science, engineering, and business. Its platform is designed to aid in the development of machine learning models by providing a collaborative workspace where data scientists can share and iterate on models, thereby reducing the time from idea to deployment.

Algorithmia specializes in machine learning operations (MLOps) and management, providing tools that allow businesses to deploy, manage, and scale machine learning models efficiently. They offer a

robust infrastructure that handles the complexities of deploying and managing machine learning models, freeing developers to focus on the development of AI applications.

Seldon Technologies Limited is another key player that specializes in deploying machine learning models at scale. Its focus is on helping organizations successfully implement machine learning models in production, providing tools for model deployment, scaling, monitoring, and management. Seldon’s platform ensures models are robust, reliable, and performant, thus enabling businesses to extract maximum value from their AI initiatives.

Fiddler, meanwhile, provides a platform focused on explainable AI and model monitoring. This allows organizations to understand, analyze, and improve their AI models, ensuring they are transparent, accountable, and reliable. It is a crucial part of the AI technology stack, especially given the growing emphasis on ethical AI and the need for transparency in AI decision-making processes.

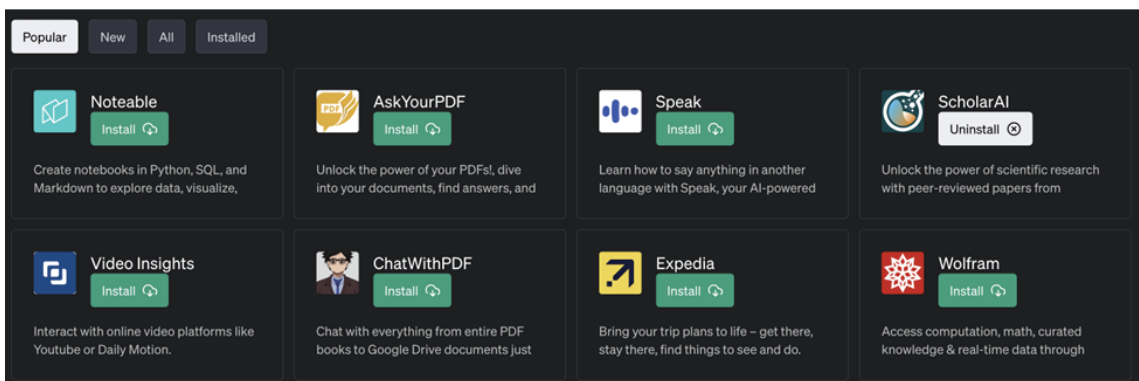
These technical partners thus form a critical part of the ecosystem enabling the development, deployment, and management of generative AI models. They provide a range of solutions that address the unique challenges posed by AI, from the need for

accurately labeled data to the management and monitoring of deployed models. By doing so, they facilitate the widespread adoption and integration of AI technologies across various sectors and applications.

3.3. App Stores

The concept of AI plugin and application marketplaces (app stores), similar to Apple’s App Store or Google’s Play Store, is a logical advancement in the swiftly changing AI ecosystem. As complex AI models like OpenAI’s GPT or Microsoft’s Bing evolve, they could potentially function as the base for a variety of specialized AI plugins. This mirrors the existing relationship between operating systems and software applications in the current computing models. <Figure 2> depicts the initial phase of an app store known as the ChatGPT plugin store. Although it possesses rudimentary interfaces and a constrained range of functionalities, it showcases the early development of the store.

An AI app store could significantly streamline the process of discovering, distributing, and monetizing these AI applications, thus creating immense value for both developers and end-users. Specifically, there are a few reasons why these app stores will



<Figure 2> ChatGPT Plugin Store

emerge on top of super-large artificial intelligences (SL-AIs):

Diverse Applications: SL-AIs can be applied in a multitude of ways, varying from natural language understanding and generation to complex decision making. The vast scope of potential applications makes a unified platform or 'app store' a logical solution for distribution and accessibility.

Ease of Access: An app store can facilitate easier access to the capabilities of SL-AIs for businesses and individuals. This lowers the entry barrier to AI technology, opening up a larger market.

Standardisation: App stores can provide a standardised interface and set of tools for developers to build upon, accelerating the development and adoption of AI applications.

Indeed, the advent of AI app stores could potentially signify a shift in the role of foundational AI models such as ChatGPT or Bing, strongly situating them akin to operating systems in the context of traditional computing.

Viewing the situation through the lens of the Korean AI ecosystem, a scenario that raises significant concerns is the potential monopolization of global AI as an operating systems and app store platforms, mirroring the dominance observed in the realm of app stores and operating systems within the current web2 platforms (Kang et al., 2022).

The dominance of a few large global entities could limit the growth and competitive potential of Korean AI initiatives, potentially stifling innovation and diversity in the Korean AI sector. It underscores the need for active strategies to foster a competitive and inclusive domestic AI ecosystem while navigating the global AI landscape. While the emergence of AI app stores is still in its infancy, we regard AI app stores as one of the AI platform of platforms (AI platform-squared) because of its strategic im-

portance, especially network economy.

3.4. Foundation Models and Platforms

Foundation model and platform providers, including prominent entities such as OpenAI, Anthropic, Cohere, Hugging Face, Amazon, Google, Meta, and Bloomberg, construct and offer foundational models including Large Language Models (LLMs). These models have the capacity to significantly accelerate the development of generative AI and Natural Language Processing (NLP) applications. These organizations not only supply Large Language Models but also provide platforms and tools that allow access and fine-tuning capabilities, thereby leading the ecosystem surrounding these technologies.

We anticipate that certain foundational models will arise as influential de facto "operating systems" in the landscape. In the traditional computing paradigm, an operating system serves as a fundamental layer of software that oversees hardware resources and provides essential services for application software. Likewise, foundational AI models can be seen as offering the "base layer" of cognitive services, including natural language understanding, image recognition, and decision-making capabilities. These models would serve as an AI orchestration¹⁰⁾ or a foundation upon which more specialized applications could be created and implemented.

Just as operating systems act as a bridge between hardware and user-facing applications, these AI operating systems could mediate between raw data and high-level AI applications. By providing a standardized interface to a suite of general-purpose AI capabilities, these foundational models could sig-

10) Satya Nadella at Microsoft Build 2023-05-23
<https://www.youtube.com/watch?v=FaV0tlaWWEg>

nificantly lower the barrier to entry for AI application development, accelerating innovation and diversifying the ecosystem of available AI tools.

However, this analogy between foundational AI models and operating systems also brings into focus a range of pertinent considerations. For instance, the risk of monopolistic control over the foundational layer of AI infrastructure parallels concerns in the operating system market. Furthermore, just as operating systems have been targets of malicious activity due to their ubiquity and privileged access to hardware resources, foundational AI models could present attractive targets for adversarial attacks. Lastly, issues of compatibility, standardization, and interoperability — long-standing challenges in the realm of operating systems — could also assume new significance in the context of AI app stores. Given its significance, we include foundational AI models (especially, AI as an operating system) as one of the AI platform of platforms (AI platform-squared).

3.5. Cloud Service Providers

Cloud service providers, offering cloud computing services such as infrastructure, platform, software, storage, databases, networking, etc., are leading the generative AI industry. Given the importance of cloud services in super-large AIs, we regard them as one of the AI platform of platforms (AI platform-squared). The market is saturated with many cloud service providers, but in reality, a small number of them dominate as follows:

Amazon Web Services (AWS): As a leading player in cloud computing, AWS provides a variety of services, including computing, storage, databases, analytics, machine learning, networking, security, and more.

Microsoft Azure: A strong runner-up in the field

of cloud computing, Azure's strength lies in its hybrid cloud platform, integrated with Microsoft's software and services. Azure offers a range of services, including computing, storage, databases, analytics, machine learning, networking, security, and more.

Google Cloud Platform (GCP): A third in the cloud computing arena, GCP's strength lies in its cloud platform leveraging Google's expertise in big data and AI. GCP provides services including computing, storage, databases, analytics, machine learning, networking, security, and more.

Generative AI development necessitates large-scale data storage and processing, thus the influence of the top three cloud providers is likely to strengthen significantly. Indeed, they are leading the development of generative AI in various ways. The top three cloud service providers all have ties to generative AI in different ways. Here are a few examples:

Amazon Web Services (AWS): AWS offers generative AI solutions and services that aid customers in creating new content and ideas, encompassing dialogues, stories, images, videos, and music. AWS provides a variety of foundational models popularized by AI21 Labs, Anthropic, Stability AI, and Amazon itself. These models can be customized and deployed using Amazon SageMaker and other AWS tools. Additionally, AWS offers generative AI-based solutions such as Amazon CodeWhisperer, an AI coding companion that assists developers in writing code more efficiently and effectively.

Microsoft Azure: Azure provides generative AI capabilities through Azure Cognitive Services, a suite of APIs that allow customers to incorporate AI functionalities such as natural language processing, computer vision, speech recognition and synthesis, and decision-making into their applications. For instance, Azure Cognitive Services includes Text Analytics for Health, a service that employs generative models to

extract and analyze health-related information from unstructured text.¹¹⁾

Google Cloud Platform (GCP): Leveraging Google's expertise in big data and AI, GCP offers generative AI services such as Cloud Text-to-Speech, Cloud Speech-to-Text, Cloud Natural Language, Cloud Translation, and Cloud Vision. Moreover, through GCP, customers can access Google's pre-trained FMs like BERT and T5 using Vertex AI, an integrated platform for building and managing machine learning workflows.

Nvidia (GDx cloud): GDx cloud is a cloud-based service to use NVIDIA DGX AI supercomputers for generative AI and other advanced applications. With GDx cloud, one can access dedicated clusters of NVIDIA DGX systems that combine multiple GPUs, CPUs, and high-speed interconnects. One can also use NVIDIA AI software, such as Base Command Platform and NVIDIA AI Foundations, to manage AI workflows and build custom generative AI models. GDx cloud can be regarded as a hybrid strategy extending chip manufacturing capabilities toward cloud services and foundational AI models (NeMo and Picasso).

3.6. Chipmakers

The evolution of generative AI technologies is anticipated to interact with the semiconductor industry by driving demand for various chip types including CPUs, GPUs, ASICs, FPGAs, memorychips, and potentially, quantum and neuromorphic chips (Batra et al., 2019). The specific impact on each chip type is likely to vary significantly, contingent on the evolving requirements of AI applications and the overall growth of the AI market. As follows, classify the

chip manufacturers further.

Central Processing Units (CPUs): The demand for CPUs optimized for generative AI workloads is expected to rise, eventually leading to the development of CPU architectures more suited for AI-specific tasks. General-purpose chips, such as central processing units (CPUs), have the capability to handle certain basic AI tasks. However, as AI continues to progress, CPUs are gradually losing their effectiveness. This is due to their inherent design for sequential processing, limited memory bandwidth, and high power consumption, which are ill-suited for the intricate and dynamic computations demanded by AI algorithms.

Graphics Processing Units (GPUs): GPUs, already widely used for training deep learning models due to their parallel processing capabilities, could see an increase in demand for more powerful and efficient versions. This uptick, driven by growing AI applications, could spur semiconductor companies to innovate and improve their products.

Application-Specific Integrated Circuits (ASICs): As AI applications become more specialized, there will likely be an increase in demand for ASICs tailored for specific AI tasks. These customized chips can provide high performance and energy efficiency for niche AI applications, making them an attractive choice for developers and companies.

Field-Programmable Gate Arrays (FPGAs): FPGAs, which can be highly customized and reprogrammed to suit a variety of AI workloads, are a flexible option suitable for prototyping and testing AI applications, as well as for use in edge computing scenarios. As AI applications diversify, demand for FPGAs will likely increase.¹²⁾ Notable companies in this sector include the following.

11) <https://learn.microsoft.com/en-us/azure/cognitive-services/language-service/text-analytics-for-health/overview>

12) <https://www.intel.com/content/www/us/en/artificial-intelligence/programmable/fpga-gpu.html>

- Xilinx: As the inventor and industry leader of FPGAs, Xilinx offers a diverse range of FPGA products, including Virtex, Kintex, Artix, Zynq, and Versal. Additionally, Xilinx provides software tools, IP cores, and development boards for FPGA design and development. AMD acquired Xilinx on 2022/02/14.
- Intel: Intel integrated FPGA products into its portfolio through the acquisition of FPGA pioneer Altera in 2015. Intel offers a variety of FPGA products, such as Stratix, Arria, Cyclone, and Agilex. Moreover, Intel supplies software tools, IP cores, and development boards for FPGA design and development.
- Microchip: Microchip incorporated FPGA products into its portfolio by acquiring FPGA vendor Microsemi in 2018. Microchip offers an assortment of FPGA products, including PolarFire, SmartFusion2, IGLOO2, and RTG4. Furthermore, Microchip delivers software tools, IP cores, and development boards for FPGA design and development.

Memory Chips: AI models like ChatGPT require significant amounts of memory for training and inference. As AI applications continue to expand, there may be an increased need for high-capacity, high-speed memory chips.

Neuromorphic Chips: Neuromorphic chips, designed to mimic the structure and function of the human brain, offer high levels of parallel processing and low power consumption for AI tasks. Although still in the early stages of development, neuromorphic chips could become an option for future AI applications. Leaders in this field include IBM, Intel, Qualcomm, along with academic institutions like MIT and Stanford, which have made notable strides. Products like IBM's TrueNorth and Qualcomm's

Zeroth are under development and being mass-produced.

Foundries: Semiconductor foundries play a crucial role in the field of AI. The production of advanced chips by foundries is essential for enabling AI applications to run faster and more efficiently. AI indeed requires significant computing power and data processing capabilities, both of which heavily rely on the performance and innovation of semiconductors.

Foundries such as TSMC (Taiwan Semiconductor Manufacturing Company) and Samsung are indeed among the leading suppliers of chips for AI. TSMC, in particular, is a prominent player in the semiconductor industry and manufactures advanced chips using cutting-edge processes. They have been instrumental in providing high-performance chips that power a wide range of AI applications, including data centers, cloud computing, and mobile devices.

IV. Discussion

Our framework bears resemblance to Kang et al. (2022), which builds upon the seven layers described by Russell (2013) (<Table 1>). This is to be expected since the same technology companies (i.e., platform of platforms) that dominate web2 also dominate generative AIs, such as Microsoft, Google, and Amazon. Moreover, the present-day tech giants are making massive investments in AI, indicating that they should be well-positioned to adapt to any disruptions caused by generative AIs in the sector. As a result, we can generate predictions and draw implications based on the current state of the platform landscape as follows.

Our framework was developed to address certain limitations and expand on the classification provided by Kang et al. (2022). Their model was focused on

<Table 1> Platform classifications in Web2 Services and Generative AI

Kang et al. (2022)	Ours	Issues
Contents and Services	App Builders	High competition and CDJ
Meta Information	Technology Partners	Enabling
App Stores	App Stores	SDK, Plugins, etc.
Operating Systems	Foundational Models and Platforms	AI as an operating system
Clouds	Cloud service providers	Cloud as platforms
Infra	Chipmakers	Nonmarket competition

specific components like Contents and Services, Meta Information, App Stores, Operating Systems, Clouds, and Infrastructure. It provided valuable insights but primarily from a technical and platform perspective.

Our proposed framework, in contrast, takes into account the dynamic nature of the AI landscape and accommodates a wider range of factors. For instance, we replaced “Contents and Services” with “App Builders”, with an added focus on high competition and Customer Decision Journey (CDJ). Instead of “Meta Information”, we use “Technology Partners” to highlight the enabling role of these entities.

While we retained “App Stores” in our model, we extended the concept to include SDKs, plugins, etc., acknowledging the expanding functionality of app stores. We proposed “Foundational Models and Platforms” as a replacement for “Operating Systems”, emphasizing the role of AI as an operating system. Finally, we substituted “Infrastructure” with “Chipmakers”, considering the nonmarket competition in this field.

The development of our framework was based on a comprehensive review of current literature, in-depth analysis of recent trends in the global and Korean AI industry, and inputs from industry experts. We believe it offers a more nuanced understanding of the AI sector and can aid in the formulation of more effective strategies for Korean AI companies.

In order to extract implications from the per-

spectives of Korea, we apply the Resource Based View (RBV) (Barney, 2001; Mahoney and Pandian, 1992; Peteraf, 1993; Wernerfelt, 1984) and one of its variation, Dynamic Capabilities (DC) (Teece and Pisano, 2003; Teece et al., 1997; Winter, 2003). The RBV suggests that sustained competitive advantage arises from a firm’s unique and valuable resources and capabilities, which are difficult for competitors to replicate. By effectively managing and developing these resources, firms can achieve long-term success. Dynamic capabilities refer to a firm’s ability to adapt, innovate, and reconfigure its strategically unique resources and capabilities in response to changing market conditions. These capabilities enable a firm to identify new opportunities, adjust its strategies, and effectively navigate dynamic environments. In the following, we highlight the strategic importance of chipmaking, clouds, foundational AIs as operating systems, and the potential emergence of AI app stores.

4.1. App Builders

We do not anticipate a market failure in the domain of app developers. Consequently, inclusive and market-friendly policies would likely be optimal, whilst simultaneously warding off destructive conflicts between innovators and stakeholders. Therefore, when it comes to app developers, it is pivotal to dodge hasty regulations and amplify innovation amidst dis-

agreements with other stakeholders. An AI regulatory sandbox could be instrumental in this scenario.

We predict that the provision of customer-focused artificial intelligence services encompassing the consumer decision journey (CDJ) could prove to be a key determinant of success in the market for app developers.

The Consumer Decision Journey (CDJ) (Van Bommel et al., 2014) represents the process that consumers go through before, during, and after making purchases. It begins with the initial consideration of a product or service, moves onto active evaluation through comparisons and reviews, leads to the moment of purchase, and extends to the post-purchase experience and potential advocacy or rebuying.¹³⁾

In a highly digital and personalised marketplace, understanding and addressing the CDJ is crucial for success. Artificial intelligence can play a pivotal role in mapping and influencing this journey, providing personalised recommendations, insights, and interactive experiences that can guide consumers through their decision-making process.

AI-powered apps can capture and analyse vast amounts of consumer data in real-time, tracking

changes in behaviour, preferences, and needs. They can then use this data to provide highly targeted and personalized services at each stage of the CDJ, enhancing customer engagement, improving conversion rates, and building customer loyalty.

For example, AI can help identify potential consumers, target them with tailored advertising, assist them in comparing and choosing products, streamline the purchasing process, and provide personalised post-purchase support. In this context, AI becomes not just a tool, but a strategic ally in understanding and influencing the consumer decision journey.

Therefore, we anticipate that app builders who successfully harness the power of AI to provide customer-centric localized services throughout the CDJ will be particularly successful in this emerging market. It is a significant opportunity for innovation and growth, and one that Korean app builders are well-positioned to seize, conditional on innovation-friendly government regulations.

4.2. Technology Partners

Technology partnerships are pivotal for the growth and development of a robust AI ecosystem. These partners can offer comprehensive solutions that contribute significantly to the AI deployment landscape. Here are some strategies that Korea can pursue to enhance its position through technology partnerships:

Identify Key Partnerships: Identify and establish partnerships with leading technology firms that offer specialised AI solutions.

Nurture Local Tech Start-ups: By fostering a supportive environment for local start-ups and offering incentives for innovation, Korea could create a rich network of domestic technology partners. This could involve providing grants, tax breaks, public procure-

13) The Customer Decision Journey (CDJ) is a strategic marketing concept that delineates the stages a consumer undergoes while making a purchase. It commences with the "Awareness" stage, where a consumer acknowledges a specific need or problem. This progresses to the "Consideration" stage, where potential solutions are evaluated and compared. The journey advances to the "Decision/Purchase" stage, where the best-fit product or service is selected and purchased. Post-purchase, the consumer evaluates their satisfaction with the product in the "Post-Purchase Evaluation" stage, impacting future decisions and brand loyalty. Finally, if the consumer's experience was positive, they may become brand advocates, recommending the product or service to others, thus entering the "Advocacy" stage. The CDJ is pivotal for marketers, offering a structured approach to effectively engage with consumers throughout their buying journey.

ment, or other support mechanisms to stimulate local AI development.

Encourage Government Involvement: Government policies can play a critical role in fostering technology partnerships. This could involve the creation of favourable policy environments, access to the government's dataset, financial incentives, or matchmaking initiatives to connect Korean firms with potential partners.

By pursuing these strategies, Korea can build a robust network of technology partnerships that enhances its capabilities in the deployment of generative artificial intelligence models. In turn, this could significantly contribute to Korea's becoming a global leader in the AI space.

4.3. Application Stores and Marketplaces

The emergence of super-large AIs (SL-AIs) signifies a significant step towards advanced artificial intelligence capabilities that have the potential to revolutionize various sectors. As the underlying technology evolves, there is a parallel opportunity for an ecosystem of applications to be built upon these SL-AIs. This is where the concept of an 'AI App Store' comes into play, a marketplace where developers can publish and distribute their AI-powered applications.

Fortunately, the idea of AI plugin marketplaces is still in its early stages, providing Korea with a distinctive opportunity. Despite Microsoft's advancement with plugins, no country or organization has secured a solid leadership position in this area, giving Korea a prime opportunity to initiate this venture and solidify its status as a global AI powerhouse. Taking the helm in developing an AI plugin marketplace could present numerous advantages for Korea:

Pioneering Advantage: As no plugin marketplaces

have yet gained dominance over Superintelligent-Large Artificial Intelligences (SL-AI), Korea has the potential to establish the benchmark for such marketplaces, influencing worldwide best practices and guiding the trajectory of AI plugin development and distribution. However, given Microsoft's rapid progression in developing plugin marketplaces, this unique opportunity may soon vanish.

Leveraging Existing Capabilities: Korea's capabilities in SL-AIs, chipmaking, and its strong IT infrastructure provide a firm foundation for pioneering in this space. These strengths, combined with a robust AI strategy, could set the stage for the successful launch of an AI app store.

Global Prestige and Influence: By leading the way in AI app stores, Korea can boost its prestige and influence in the global AI community. This could help Korea attract international partnerships, investment, and talent, further strengthening its position in the global AI landscape.

Economic Opportunities: The successful development of an AI app store could create a wealth of economic opportunities, from stimulating the growth of local AI start-ups to attracting international businesses seeking to leverage the capabilities of SL-AIs.

Given these significant potential benefits and the opportunity provided by the current absence of established AI app stores, it is crucial for Korea to act swiftly and decisively to seize this moment. Implementing a strategic approach that leverages Korea's strengths while addressing potential challenges will be critical to its success in this venture.

4.4. Foundational Models: AI as an Operating System

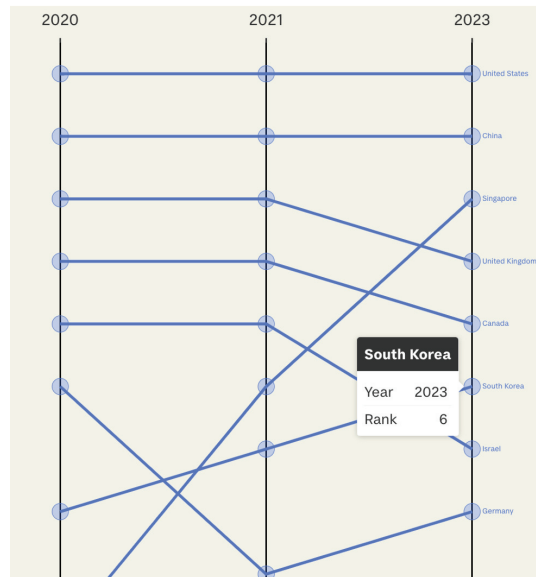
If large generative AI is viewed as an operating system, competitiveness in this domain will expand

to include app stores and app builders. Fortunately, Korea is commonly recognised as one of the four nations possessing significant super-large AIs (SL-AI).¹⁴ To enhance its unique strategic position and extend resources and capabilities in SL-AI towards app stores, app building, technology partnerships, cloud and chipmaking, Korea might consider the following approaches.

Developing an AI-Centric Ecosystem: An essential step towards Korea's competitive advantage in SL-AI is to establish a robust, AI-centric ecosystem. This initiative could include the financing and nurturing of AI startups, fostering research and development in AI at academic and corporate levels, and creating platforms that facilitate knowledge sharing and collaboration within the field. Policies aimed at attracting both domestic and international AI talents could further enhance the growth of this ecosystem. Consider <Figure 3>, showcasing Korea's position as the sixth country in the global AI index, despite its distinctive status in the realm of large language models.

Investment in Infrastructure: A sound technological infrastructure is pivotal for the success of SL-AI applications. This involves high-performance computing resources, secure data centers, and reliable cloud services. Given Korea's strength in chipmaking, the nation has a unique advantage in developing bespoke, high performance AI hardware, which could act as a cornerstone for its SL-AI infrastructure.

Advocating for AI in the Public Sphere: Propagating the utilization of AI in public amenities,



<Figure 3> The Global AI Index¹⁵

such as automated public officers, can not only create a market for AI technologies but also exhibit the capabilities of Semantic Learning AI applications. This could catalyze the expansion of the domestic AI industry while displaying to the global stage the aptitude of Korean SL-AI. Specifically, it is crucial that the public sector takes the lead in developing app stores and applications using Korean foundational models prior to those based on foreign equivalents.

Cultivating SL-AI Applications Development: To truly tap into the expansive capabilities of SL-AI as an operating system, it's vital to foster a dynamic market that incorporates SL-AI in its applications. These applications could permeate various sectors-encompassing healthcare, finance, and entertainment. Spurring developers through measures like hackathons, financial aid, and education can help in crafting a diverse array of SL-AI applications. This situation represents a marketdesign issue (Roth, 2008), hence, the influence of regulators and policymakers

14) <https://www.hankyung.com/it/article/2023020681181> and https://futureoflife.org/wp-content/uploads/2022/11/Emerging_Non-European_Monopolies_in_the_Global_AI_Market.pdf, and <https://www.ajunews.com/view/20230603021641308>

15) Source: <https://www.tortoisemedia.com/intelligence/global-ai/>

will be critical.

Forming Strategic Partnerships: Establishing strategic partnerships with leading technology companies worldwide can accelerate Korea's advancement in the SL AI field. These partnerships could be around sharing of technology, joint research initiatives, and development of common standards, all contributing towards a more integrated global SL-AI landscape.

Regulatory Innovations: Given the rapidly evolving nature of the AI field, it is crucial to have an agile and forward-thinking regulatory framework. This would mean regulations that ensure ethical use of AI, protect data privacy, and promote fair competition, while not stifling innovation.

Other countries are rapidly catching up with foundational models. For example, Saudi Arabia and the UAE are intensively investing in Nvidia's AI chips, underlining their commitment to emerging technological advancements. Their endeavors, such as Saudi's acquisition of 3,000 H100 chips for AI projects at Kaust and the UAE's development of the Falcon AI model, highlight their intent to become front-runners in the AI sphere.¹⁶⁾

4.5. Cloud Service Providers

Large generative artificial intelligences necessitate cloud computing, leading to successful cloud providers demonstrating strength in this aspect of AI. As data is considered the fuel of the fourth industrial revolution, particular standalone competencies in

cloud services are integral to national security. However, Korean companies currently lack valuable, rare, inimitable, and non-substitutable (VRIN) resources and capabilities in the field of cloud computing.

To address this deficiency and reinforce the nation's standing in the era of AI and digitisation, several integrated strategies can be proposed:

Extending Competitiveness in Chipmaking: The high-performance chips required for large generative AIs are a crucial aspect of this technological infrastructure. By amplifying their dominance in the chipmaking sector, Korean companies could secure uninterrupted access to these essential components. This strategic move also presents opportunities for cross-sector innovation, potentially sparking advancements in AI capabilities as well.¹⁷⁾ Korean players can benchmark Nvidia GDX's intriguing hybrid strategy, which extends the capability of chipmaking to cloud services and foundational AI models like NeMo and Picasso.

Promoting Cloud Computing in the Public Sector: Governmental bodies can act as early adopters, creating a demand for local cloud services and fostering a climate conducive to innovation. This, in turn, can stimulate the overall cloud computing market in Korea, encouraging growth and diversity within the sector.

Subsidising Domestic Clouds in Research and Education: Providing financial incentives for the use of homegrown cloud services in academia¹⁸⁾ could help cultivate a new generation of skilled cloud computing professionals. This not only ensures a steady supply of talent but also lays the groundwork for future industry growth.

16) However, this rapid push into AI isn't without its concerns. While both nations aspire to global AI leadership, the aggressive pace and scope of their projects have raised eyebrows in the international community. There are apprehensions about how these autocratic nations might use such powerful technology, especially given the potential for misuse in surveillance and control. Source: <https://on.ft.com/45noFnc>

17) Example: <https://www.yna.co.kr/view/AKR2022120602630003>

18) Google workspace currently dominates Korean academia.

Collaboration and Partnerships: Encouraging collaborations between tech companies, universities, and research institutes could expedite advancements in cloud technology. Simultaneously, it would contribute to a thriving ecosystem conducive to technological innovation and growth.

Investing in R&D: Promoting research and development within cloud technology can lead to breakthroughs and ensure a competitive edge for Korean companies. It can also contribute to a robust, self-sustaining national cloud infrastructure.

Legislation and Policy Reforms: The government can play an instrumental role in shaping a positive regulatory environment for cloud computing. By implementing favourable policies and guidelines, it can stimulate growth in the sector and ensure secure data handling practices.

Focus on Data Centers: Building advanced, energy-efficient, and secure data centers will be crucial. It can ensure reliable and high-performance cloud services, thereby encouraging more businesses to adopt these services. Creating a Start-up Ecosystem: Encourage start-ups focusing on cloud computing and AI. Provide them with necessary financial support, mentorship, and policy assistance. They can contribute to the technology diversity and promote innovation in the sector.

Whilst we recognise the difficulty for Korean businesses to triumph in the realm of cloud services, it is imperative that the Korean government does not forsake this sector, given its pivotal role within the generative AI ecosystem. It falls to the government to execute integrated strategies that merge both market and non-market approaches in order to spur the progression of cloud services within Korea.

4.6. Chip Manufacturing

So called Chip War (Miller, 2022) makes it clear that the competitive landscape in chip manufacturing becomes the arena for integrated strategies that should take into account not only market competition, but also nonmarket strategies and competitions (Barney, 2001; Baron, 1995, 1997; Mellahi et al., 2016). Then, we can look at the Korean chipmakers through RBV, DC and integrated strategies to propose strategies.

Resources and Capabilities Discussion Based on RBV and DC:

Valuable: Korean chipmakers, like Samsung and SK Hynix, possess several key resources such as state-of-the-art manufacturing facilities,¹⁹⁾ talented workforce,²⁰⁾ strong R&D capabilities, and close relationships with suppliers and customers.²¹⁾ These companies also have vast experience and technical know-how in the semiconductor industry

Rare: The Korean semiconductor industry's advanced technology and expertise in chip manufacturing are unique and not easily replicable. The ability to manufacture chips with extreme precision and high yield rates is a distinctive competency.²²⁾

- Inimitable: The knowledge, experience, and skills developed over decades make Korean chipmakers' capabilities hard to imitate. Additionally, their proprietary technologies and patents add to their competitive edge.²³⁾
- Non-Substitutable: The chips manufactured by these firms are integral components in a wide

19) <https://koreajoongangdaily.joins.com/2023/03/22/business/industry/Korea-Chips-and-Science-Act-Samsung-Electronics/20230322182806150.html>

20) <https://en.yna.co.kr/view/AEN20220719007400315>

21) <https://www.asiatime.co.kr/article/20230608500256>

22) <https://zdnet.co.kr/view/?no=20221103163825>

23) <https://www.etoday.co.kr/news/view/2023131>

range of electronic devices. Until alternatives are developed and adopted, these chips are non-substitutable.²⁴⁾

- **Dynamic:** Korean chipmakers have shown the ability to respond to market changes, continuously innovating their products and processes.²⁵⁾ They have made significant strides in moving to smaller, more efficient semiconductor nodes, and have been at the forefront of developing memory technologies like DRAM and NAND flash (Jun et al., 2013).

The above plainly indicates that Korean chipmakers possess dynamic capabilities and resources that fulfill the VRIN criteria (valuable, rare, inimitable, non-substitutable). The logic of the RBV and DC suggests that Korea is capable of utilising these resources and capabilities to devise beneficial integrated strategies for the entire AI ecosystem as follows.

Investment in AI-Specific Chips: The AI era demands more powerful and efficient chips. Korean chipmakers should develop chips tailored for AI applications, which will also require significant advancements in software and hardware. The triple helix of chipmakers, government and universities (Etzkowitz and Zhou, 2017) should actively seek partnerships or acquisitions of firms that already have these capabilities.

Strengthen R&D: Continued investment in research and development will be crucial for maintaining competitiveness. A focus should be on future-oriented technologies like quantum computing, neuro-morphic chips, and advanced AI chip designs.

Talent Development and Acquisition: Attracting,

developing, and retaining AI talent will be vital. Governmental support in enhancing STEM education and creating a favorable environment for researchers and engineers could be beneficial.

Collaboration and Partnerships: Collaborations with other tech firms, universities, and research institutes can accelerate technology development and offer a wider range of applications for their products. This will also help in creating an ecosystem around their technologies.

Non-Market Strategies: Formulate nonmarket strategies or even lobby for favorable policies, subsidies, and trade agreements to protect and promote the domestic chip industry. Korea should also seek to reduce its dependency on certain countries for chip-making equipment and materials.

Developing Supply Chain Resilience: This can be done by diversifying sources of key inputs and stockpiling critical components. Given the vulnerabilities exposed by the COVID-19 pandemic and recent trade wars, supply chain resilience is vital.

Sustainability: Emphasize on creating sustainable and energy-efficient manufacturing processes and products. As environmental concerns become increasingly important, breaking through non-tariff barriers and being a leader in green technologies could provide a competitive edge.

The Korean chipmakers possess robust resources and dynamic capabilities, which can be leveraged into the sustainable competitive advantages in generative AI. However, the Korean triple helix requires an integrated strategy that combines market and non-market strategies to succeed in the global competition for AI. This strategy should also be flexible and adaptable to the ever-changing technological landscape.

4.7. AI Platform-Squared

24) <https://news.samsungsemiconductor.com/kr/한국-반도체-산업의-생태계가-더욱-강력해진다-삼/>

25) <https://www.mk.co.kr/news/culture/9763881>

The market competitiveness for both app developers and technology partners will largely depend on their capacity to effectively traverse the consumer decision journey (CDJ), whilst delivering localised services that bridge the voids left by foundational models. Nevertheless, our principal focus rests upon the AI platform-squared.

Given their strategic significance, the “platform of platforms” in the generative AI ecosystem (i.e., AI platform-squared) will consist of app stores, foundational AIs operating as systems, and cloud services. A select handful of companies, predominantly in the U.S. and China, are anticipated to dominate this AI platform-squared. Consequently, they are likely to become the primary targets of non-market strategies by various governments and communities.

There are several reasons why companies from the U.S. and China are projected to dominate the platform of platforms in the generative AI ecosystem (AI platform-squared).

Firstly, both the U.S. and China have a significant head start in AI development, driven by the presence of tech giants like Google, Amazon, and Microsoft in the U.S., and Alibaba, Baidu, and Tencent in China. These companies have been investing heavily in AI research and development for years, leading to an accumulation of valuable AI resources and capabilities.

Secondly, the U.S. and China boast a vast customer base, which provides a considerable amount of data for AI systems to learn from and improve upon. This rich data environment enables AI companies in these regions to train more efficient and effective machine learning models, contributing to their dominance.

Thirdly, both countries have favorable policy environments for AI. The U.S. has traditionally been a global leader in technological innovation, and its

regulatory environment tends to favor innovation and competition. Meanwhile, the Chinese government has identified AI as a strategic industry and provides strong support for AI development, including significant funding and policy support.

Finally, these companies also have strong networks of partnerships across the AI value chain, from chip-makers to cloud service providers. These relationships allow them to collaborate and innovate effectively, enhancing their competitive advantage.

Despite the projected dominance of U.S. and Chinese companies in the AI platform-squared, we should note that this field is still in its early stages. This infancy presents an opportunity for other countries, including Korea, to make their mark. Korea still stands a fighting chance. However, the window of opportunity is narrowing.

V. Regulatory Implications

The careful consideration of regulations for the expansion of domestic generative artificial intelligence (AI) models, platforms, and ecosystems is an essential process. It needs to be guided by cautious and sound reasoning. Hastily adopting foreign regulatory frameworks and non-market strategies, mainly those derived from Europe, may unintentionally overlook the essential hierarchical structure fundamental to our indigenous system. Indeed, tech giants at the forefront of generative AI competition actively employ non-market strategies, exerting control over the spread and development of generative AIs via regulations.

As stated in *The Economist*,²⁶⁾ “big tech uses regu-

26) <https://www.economist.com/business/2023/05/25/why-tech-giants-want-to-strangle-ai-with-red-tape>

lation to fortify its position at the commanding heights of generative ai”. Notably, instead of using this revolutionary technology to entirely supplant their existing products, these corporations prefer to apply it to enhance their current offerings. Their main goal is to shield their primary enterprises, such as Microsoft’s enterprise software or Google’s search functions. This strategy, however, may potentially stifle the radical transformative potential of the technology, making it less revolutionary than it could be and highlighting the extent to which these dominant incumbents orchestrate the direction of innovation. In essence, these leading big tech companies have a tendency to promote “creative accumulation” over “creative destruction”.

While stringent regulatory strategies might be most effective for Europe, which has yet to secure a significant competitive edge in generative AI, or for major tech firms seeking to safeguard their pioneering advantages, these approaches may not be fitting for Korea. Considering these circumstances, our study delineates a precise strategic route for Korea to ascend as a potent contender in the international generative AI arena.

Owing to its unique standing as one of the few nations with significant influence in foundational AI models and chip manufacturing sectors, it is essential for Korea to seize this distinctive advantage. The strategy involves a thoughtful venture into the AI platform-squared segment, incorporating aspects such as AI operating systems and cloud services. Recognizing the potential network effects and winner-takes-all dynamics in the AI platform-squared sector, the need for this strategic action is immediate.

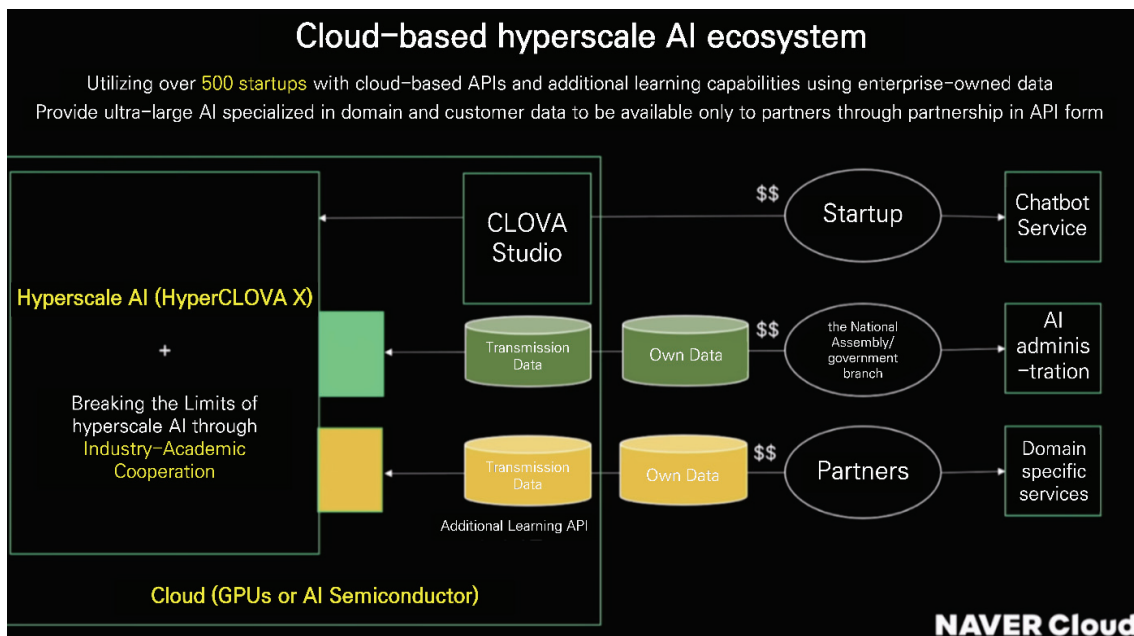
To expedite this crucial transition, we advise the Korean government to implement promotional policies that strategically nurture these AI platform-squared sectors. This approach diverges strate-

gically from restraining them with regulations and succumbing to stakeholder pressures. This strategy not only promotes growth in the AI platform-squared area but also safeguards Korea’s potential as a global AI leader from being undermined by overregulation.

In particular, the regulators need to be careful in regulating platform’s diversification. Ecosystems are crucial, particularly for SL-AI. The development and operation of SL-AI are expensive endeavors. Without an ecosystem that offers goods and services to recover those costs, there is no incentive for investment in SL-AI. However, if there is already a presence of commerce, content, and other services, SL-AI can be leveraged to generate value and directly recoup profits in those areas. This process allows for continuous improvement of AI through user feedback and enables the collection of consumer behavior data for the development of more advanced services.

Companies lacking diversification and scope in this manner would need to invest separately in creating a plug-in or app ecosystem or seek partnerships, resulting in high transaction costs due to the absence of an established market in this high-tech field. Thus, the integration of various businesses can serve as a potent competitive advantage for the platform, making the diversification strategy vital to eliminate externalities and internalize the market. Analyzing the diversification strategy of companies from a traditional perspective proves challenging. For companies with SL-AI as a core competency, diversification becomes a logical strategy, providing a conducive environment for success in SL-AI. See <Figure 4> for Naver’s diversification plan on its large language model and cloud service.

The argument for diversification in platforms aligns with existing academic literature. Prior studies have demonstrated that failures and imperfections in external capital markets have compelled firms to



<Figure 4> Naver’s Diversification Strategy on Cloud and HyperCLOVA

establish internal capital markets and business groups (Almeida and Wolfenzon, 2006; Carney et al., 2011; Gertner et al., 1994; Hoshi et al., 1991; Khanna and Yafeh, 2007; Stein, 1997). Following a similar rationale, it is believed that the inadequacies and incompleteness of the external data market are driving platform companies to create internal data markets and pursue diversification through business groups. It is anticipated that in the future, the internal data market will evolve into an internal artificial intelligence market, becoming more sophisticated in nature. Regulators can provide support for such corporate strategies that contribute to the development of the Korean AI ecosystem.

Our study gives significant attention to South Korea’s strategic emphasis on the recent partial advancement and endorsement of generative artificial intelligence (AI). The approach marks a partial shift from a primarily regulatory one, reminiscent of Europe’s model, towards one that champions

innovation. This move is seen as a mechanism to bolster South Korea’s international standing in the AI arena. Central to this innovative approach is a triad of strategic avenues:

Firstly, South Korea is heavily invested in the expansion of hyperscale AI technologies and the strengthening of its industrial infrastructure. The intent is to develop state-of-the-art, large-scale AI models that can stand tall in the global arena. This, of course, implies a concurrent need for considerable enhancements in the country’s technological and industrial infrastructure, a challenge the country is actively working on.

Secondly, the country is focused on the establishment of an innovative ecosystem. The importance of a dynamic, nurturing ecosystem that fosters innovation is undeniable for growth in any technology sector, including AI. South Korea is hence cultivating an environment conducive to the proliferation of companies, researchers, and innovators. This active

nurturing enables the genesis of cutting-edge AI applications and solutions.

Finally, South Korea understands that the scope of AI innovation extends beyond national boundaries. Consequently, the country is proactively forging collaborations with international partners. The ultimate goal is to create a seamless blend of AI innovations from across the globe, resulting in a multicultural AI system that can address a wide array of user needs.

It's important to note that South Korea's dedication to AI development is evidenced by the recent enactment of the "Promotion of AI Industry and Establishment of Trust-based Foundation" law. This legislation, passed by the "Science, ICT, Broadcasting, and Communications Committee", epitomizes the foundational principles of AI within the nation. Although South Korea's AI regulatory landscape is not entirely detached from the influences of international guidelines, such as the EU AI ACT, the nation leans more towards nurturing AI industry growth rather than heavy-handed regulation.

Recognizing this unique policy perspective necessitates a profound and nuanced analysis of South Korea's policy terrain in order to formulate effective policy recommendations. Thorough exploration is required to pinpoint current restrictions and areas needing enhancement. Based on this comprehensive analysis, a bespoke policy strategy can be crafted to efficiently address the specific requirements and ambitions of South Korea's burgeoning AI sector.

VI. Conclusion

This article proposes a new framework for classifying and analyzing the generative artificial intelligence ecosystem. The ecosystem is divided into six key

sectors: chip makers, cloud service suppliers, foundational artificial intelligence models as operating systems, the prospective emergence of app stores constructed atop these AI operating systems, technology partners, and app creators. By harnessing academic insights from literature on the resource-based view and dynamic capabilities, we underscore the pressing need and importance of crafting integrated strategies (combining market and non-market strategies), with a particular focus on proficiency in AI platform of platforms (AI platform-squared): cloud computing, super-large AIs functioning as operating systems, and the embryonic phase of app stores. In summary, our recommendations are as follows:

1. Korea should exploit its distinct position within the super-large AI (SL-AI) domain and extend its capabilities, aiming to achieve competitive supremacy in the areas of app stores, app building, technology partnerships, cloud services, and chip manufacturing. These endeavors could, in time, position Korea as a global frontrunner in the generative AI ecosystem, influencing the future of AI-driven applications and services.

2. The advent of super-large generative AIs is likely to give birth to a new type of marketplace: AI app stores. These stores will proffer applications powered by super-large AIs, ranging from customer service robots to virtual assistants and content creation tools.

In spite of the abundant potential benefits and the existing opportunity, it is imperative to acknowledge the current dearth of fully established AI plugin marketplaces, even though Microsoft appears to be at the forefront. Consequently, it is of utmost importance for Korea to respond expeditiously and definitively to capitalize on this prospect. Formulating a strategic approach that maximizes Korea's strategic resources and proficiency in foundational AI models and semiconductor manufacturing, while con-

currently addressing possible impediments, will be instrumental to its triumph in this endeavor.

3. Invest significantly in cloud computing. Large generative AIs necessitate cloud computing, and consequently, successful cloud providers are also strong in this area of AI. As data is considered the lifeblood of the fourth industrial revolution, certain standalone competencies in cloud services are integral to national security. However, at present, Korean companies lack valuable, rare, inimitable, and nonsubstitutable (VRIN) resources and capabilities in the domain of cloud computing. This necessitates entrepreneurial government support (Mazzucato, 2011; Mingardi, 2015).

4. Enhance the unique strategic position and capabilities of Korean chipmakers, such as through investment in AI-specific chips and fostering collaboration and partnerships with key triple helix players in the generative AI ecosystem.

5. Construct a strong network of technology partnerships that enhance Korea's capabilities in the deployment of generative artificial intelligence models. In turn, this could make a substantial contribution to Korea's ambition of becoming a global leader in the AI arena.

6. Regarding app builders, avoid precipitous regulations and bolster innovation during disputes with other stakeholders. An AI regulatory sandbox could prove beneficial in this context. Successful app developers will be those who merge the progress made in generative AI with the intricacies of the Consumer Decision Journey (CDJ).

7. Approach judiciously when contemplating possible regulations for domestic super-large generative AI models and platforms. Impetuously adopting foreign regulatory frameworks and non-market strategies, such as those originating from Europe or incumbent tech giants, could disregard the fundamental

hierarchical structure that our framework emphasizes. Our study proposes a lucid strategic pathway for Korea to surface as a global generative AI powerhouse. Being one of the scant countries possessing noteworthy companies within the foundational AI models and chip manufacturing sectors, it is imperative for Korea to leverage its distinctive position and strategically infiltrate the AI platform-squared segments, AI as operating systems, and cloud services. Given the potential network effects and winner-takes-all dynamics in AI platform-squared, this endeavor is of immediate urgency. To expedite this transition, we recommend the government implement promotional policies that strategically cultivate these AI platform-squared, as opposed to constricting them through regulations and stakeholder pressures.

8. Implement Korean foundational models and establish application stores and applications. Promote seamless integration between the foundational models and app stores to enhance interoperability. Launch services like AI public officials, AI teachers, medical services, and financial services, which necessitate access to sensitive or national data. Running these services on foreign foundational models should be avoided.

9. Advocate for the "internal markets for artificial intelligence", with an emphasis on Korean platforms. Apparent unrelated diversification by platforms will minimize externalities in the development of SL-AIs and eventually transform into strategic resources and capabilities for continued diversification and growth. Abandon antiquated apprehensions about business groups.

We identified several key factors that Korean AI stakeholders need to address. It's important to note, however, that while we believe our recommendations have broad applicability, we do not suggest they are

one-size-fits-all solutions. Companies vary significantly in terms of their resources, market position, and strategic objectives. Therefore, our recommendations should be viewed as a strategic guide rather than a prescriptive blueprint. We recommend that each stakeholder assess these suggestions in the context of its own circumstances and adapt them as necessary.

In closing, the opportunities and challenges in the AI era are both immense and multifaceted. The potential for Korea to transform itself into a global leader in super-large (generative) AI is vast, given its solid footing in technology and remarkable potential. Through the strategies detailed herein,

spanning from nurturing local talent to embracing global partnerships, pioneering in emerging AI app stores, supporting corporate diversification strategies, and investing in crucial areas like cloud computing and AI-specific chips, Korea can build a robust and sustainable generative AI ecosystem. Yet, the window of opportunity may not stay open forever, and swift, decisive action will be required. This paper hopes to have shed light on the strategic course that Korea can undertake to leverage its strengths and seize the opportunities that the AI era presents. By doing so, Korea can potentially shape the future of AI and play a leading role in the fourth industrial revolution.

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<Appendix A> List of Key Players or Services

1. Application Builders

The applications of large generative AI systems can be categorized as:

Content Generation

- Traditional Content: Articles, blog posts, social media posts, etc.
- Creative Writing: Stories, poems, etc.
- Marketing and Advertising: Marketing copy, slogans, ad text, etc.
- Product Descriptions: Based on product specifications.

Communication Support

- Chatbots: Customer service, support, and engagement.
- Virtual Assistants: Understanding and responding to complex queries.
- Email and Message Drafting: Based on the context and given prompts.

Language Services

- Translation: Converting text from one language to another.

Education and Learning

- Tutoring: Personalized learning experiences, answering questions, and explaining concepts.

Software Development

- Code Generation: Generating code snippets based on a given prompt.

Data Analysis and Reporting

- Data Analysis: Generate human-readable reports from large sets of data, identifying trends and important points.

Simulation and Scenario Planning

- Scenario Planning: Generate different potential scenarios based on given inputs.

Legal and Medical Services

- Medical Diagnosis: Generating possible diagnoses based on a list of symptoms or medical history.
- Legal Document Drafting: Drafting legal documents based on specific inputs and requirements.

<Appendix A> List of Key Players or Services (Cont.)

Game Development

- Narrative and Character Creation: Creating dynamic and responsive narratives and characters.

Personalization

- Personalized Content: Generating content for individual users based on their past behavior and preferences.

2. Technology Partners

- Labelbox: A data labeling platform that helps enterprises create high-quality training data for generative AI models.
- Databricks: A data and AI platform that helps enterprises build, train, and deploy generative AI models at scale.
- Algorithmia: A machine learning operations platform that helps enterprises manage, deploy, and monitor generative AI models in production.
- Seldon: A machine learning deployment platform that helps enterprises orchestrate, scale, and monitor generative AI models across hybrid and multicloud environments.
- Fiddler: A model performance management platform that helps enterprises explain, monitor, and analyze generative AI models throughout their lifecycle.
- Replit: A cloud-based development environment that helps developers build and deploy generative AI applications using tools like ChatGPT and DALL-E.
- Canva: A graphic design platform that helps users create stunning visuals using generative AI tools like DALL-E 2 and FlowGPT.
- AI Technology Partners (AITP): A consulting and implementation service provider that helps enterprises leverage generative AI technologies for various use cases.

3. Application Stores and Marketplaces

Some of the primitive app stores built on top of foundational AI models:

- Hugging Face Hub: offers a wide range of pre-trained AI models, including chatGPT, for developers to use in their own applications.
- DeepSent: offers a variety of AI-powered applications that use chatGPT, such as chatbots, question-answering systems, and text generation tools.
- Rasa: a framework for building chatbots that use chatGPT, as well as a variety of pre-trained models and tools.
- OpenAI API: This API allows developers to access chatGPT and other AI models from OpenAI.
- AI plugin and application marketplaces for buying and selling prompts:
- Chatsonic Prompt Library: for buying and selling prompts for Chatsonic.

<Appendix A> List of Key Players or Services (Cont.)

- AIPRM: for buying and selling prompts for ChatGPT, a powerful AI chat tool that can generate coherent and engaging texts from a given prompt.
- PromptBase: for DALL-E 2, an image generator that can create original images from a text prompt.
- ChatX: for Midjourney
- FlowGPT: for FlowGPT, an AI code editor that can help you write and debug code faster and easier
- PromptHero: for various AI tools, such as Chatsonic, ChatGPT, DALL-E 2, Midjourney, FlowGPT, and more

4. Foundational Models

Generative AI systems have revolutionized numerous fields with their wide-ranging applications. These systems encompass image generators like Midjourney or Stable 38 Diffusion, code generation tools such as Copilot, audio generation tools like VALLE or resemble.ai, and notably, large language models such as GPT-4, PaLM, or Claude. These models have emerged as highly active and impactful contributors to the AI landscape.

Large language models, in particular, have garnered significant attention and utilization due to their remarkable capabilities. They demonstrate the power of AI in generating diverse and realistic outputs across various domains, making significant strides in creativity and automation. <Table A1> is a list of prominent large language models.²⁷⁾

<Table A1> List of Large Language Models

Name	Release date	Developer
AlexaTM (Teacher Models)	Nov-22	Amazon
BERT	2018	Google
BLOOM	Jul-22	Large collaboration led by Hugging Face
BloombergGPT	Mar-23	BloombergL.P.
Cerebras-GPT	Mar-23	Cerebras
Chinchilla	Mar-22	DeepMind
Claude	Dec-21	Anthropic
Ernie 3.0 Titan	Dec-21	Baidu
Falcon	Mar-23	Technology Innovation Institute
Galactica	Nov-22	Meta
GLaM (Generalist Language Model)	Dec-21	Google
Goper	Dec-21	DeepMind
GPT-2	2019	OpenAI
GPT-3	2020	OpenAI

27) https://en.wikipedia.org/wiki/Large_language_model

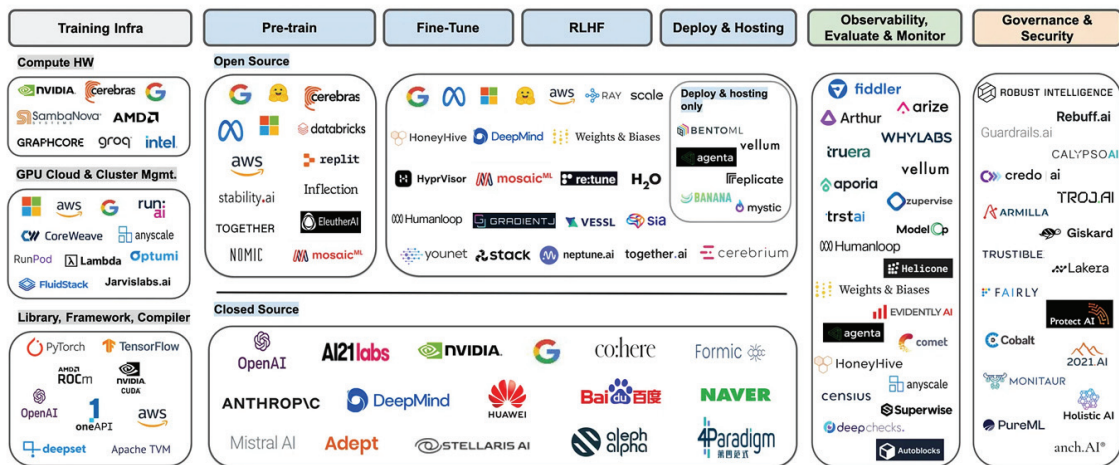
Source: <https://liu-gendary.medium.com/llm-explained-the-llm-training-landscape-82c803495caa>

<Appendix A> List of Key Players or Services (Cont.)

<Table A1> List of Large Language Models (Cont.)

Name	Release date	Developer
GPT-4	Mar-23	OpenAI
GPT-J	Jun-21	EleutherAI
GPT-Neo	Mar-21	EleutherAI
GPT-NeoX	Feb-22	EleutherAI
LaMDA (Language Models for Dialog Applications)	Jan-22	Google
LLaMA (Large Language Model Meta AI)	Feb-23	Meta
Megatron-Turing NLG	October 2021	Microsoft and Nvidia
Minerva	Jun-22	Googlr
OpenAssistant	Mar-23	LAION
OPT (Open Pretrained Transformer)	May-22	Meta
PaLM (Pathways Language Model)	Apr-22	Google
PaLM 2 (Pathways Language Model 2)	May-23	Google
PenGu-Σ	Mar-23	Huawei
XLNet	2019	Google
YaLM 100B	Jun-22	Yandex

On the other hand, smaller language models (sLLMs) would thrive as well. One famous example is Alpaca (An Instruction-following LLaMA Model), in which Stanford researchers used only \$600 to develop it. <Figure A1> illustrates salient LLM landscape.



<Figure A1> LLM Landscape

<Appendix A> List of Key Players or Services (Cont.)

5. Cloud Service Providers

- Amazon Web Services (AWS): The leader in IaaS and branching out
- Microsoft Azure: A strong No. 2, hybrid player and enterprise favorite
- Google Cloud Platform (GCP): A strong No. 3 with a \$11 billion annual revenue run rate, but building out its sales scale and industry approach
- Nvidia's GDGX: Anhybrid strategy extending chip manufacturing capabilities to cloud services and to foundational AI models (NeMo and Picasso)
- Alibaba Cloud: The primary cloud option in China
- IBM Cloud: Big Blue looks to Red Hat to juice hybrid cloud deployments and growth
- Oracle Cloud Infrastructure: A major database player moving to the cloud
- CloudLinux: A leading provider of secure and stable Linux software for web hosting

6. Chip Manufacturers

Central Processing Units (CPU):

- Intel: Intel produces a wide range of CPUs for various devices, including desktops, laptops, and servers. Intel's Core processor family includes the Core i9, Core i7, Core i5, and Core i3 processors, which are designed for high-performance computing and are used in both desktops and laptops. Intel also produces the Xeon line of processors, which are built for data centers and workstations to handle the heavy processing demands of cloud computing, big data analysis, modeling, artificial intelligence, and more.
- AMD: AMD produces a wide range of CPUs for various devices, including desktops, laptops, and servers. AMD's Ryzen processor family includes the Ryzen 9, Ryzen 7, Ryzen 5, and Ryzen 3 processors, which are designed for high-performance computing and are used in both desktops and laptops. AMD also produces the EPYC line of processors, which are built for servers and data centers to handle the heavy processing demands of cloud computing, big data analysis, modeling, artificial intelligence, and more.
- Apple: Apple designs its own series of ARM-based system-on-a-chip (SoC) processors for use in its mobile devices, such as the iPhone and iPad, as well as for its Mac computers. These chips, known as the A-series and M-series, combine a CPU, GPU, and other components into a single package¹. The most recent chips in this series are the M1 Pro and M1 Max, which were introduced in October 2021 and are used in Apple's MacBook Pro laptops. These chips deliver up to 70% faster CPU performance than the M1 chip and up to 4x faster GPU performance.
- Qualcomm: Qualcomm designs and manufactures a range of processors for various devices, including smartphones, tablets, laptops, and other mobile devices. Qualcomm's Snapdragon system-on-a-chip (SoC) processors combine a CPU, GPU, and other components into a single package.

<Appendix A> List of Key Players or Services (Cont.)

- Samsung Electronics: Samsung produces a series of ARM-based system-on-chips (SoCs) under the Exynos brand, which are used in Samsung's mobile devices, including smartphones and tablets. The Exynos processors are developed by Samsung's System LSI division and manufactured by Samsung Foundry.
- IBM: IBM produces a family of superscalar, multithreading, multi-core microprocessors based on the Power ISA.
- Nvidia: A company originally known for its graphics processing computer chips, has entered the CPU business with its data center CPU, an Arm-based processor.
- MediaTek: MediaTek designs processors for use in smartphones, tablets, smartwatches, IoT, Smart TVs and smartbooks. These processors are based on the ARM architecture and include a range of cores such as ARM11, Cortex-A5, Cortex-A7, Cortex-A53, Cortex-A55, Cortex-A57, Cortex-A72, Cortex-A75, Cortex-A76, Cortex-A77, Cortex-A78, Cortex-A510, Cortex A710, Cortex-A715, Cortex-X2 and Cortex-X3.
- HiSilicon: A Chinese fabless semiconductor company based in Shenzhen, Guangdong and wholly owned by Huawei. HiSilicon purchases licenses for CPU designs from ARM Holdings, including the ARM Cortex-A9 MPCore, ARM Cortex-M3, ARM Cortex-A7 MPCore, ARM Cortex-A15 MPCore, ARM Cortex-A53, ARM Cortex-A57 and also for their Mali graphics cores.
- Via: A Taiwanese manufacturer of integrated circuits, mainly motherboard chipsets, CPUs, and memory.

Graphics Processing Units (GPUs):

- Nvidia: Makes some of the most powerful GPUs (Graphics Processing Units) out there right now. They have a range of graphics cards under the GeForce brand.
- AMD: The Radeon brand. Their graphics cards are built on the AMD RDNA 3 architecture.
- Intel: The Intel Arc brand. Its graphics solutions are built to enable premium gaming, creating, and streaming experiences.
- Apple: Apple designs its own GPUs such as M1 and M2 chips.
- ASUS: Have several series of GPUs, including ROG- Republic of Gamers, Dual, TUF Gaming, Phoenix, and ASUS KO.
- GIGABYTE: Produce a wide range of graphics cards (GPUs) for gaming and other purposes. Have several series of GPUs, including AORUS and Gaming Series. Gigabyte GPUs are available with both NVIDIA and AMD chipsets.
- MSI: SUPRIM, GAMING, SEA HAWK, DUKE, ARMOR, VENTUS, and others. Such MSI GPUs are available with both NVIDIA and AMD chipsets.
- Sapphire Technology: PULSE and NITRO+. They are available with AMD chipsets.
- ZOTAC: GeForce RTX 40 Series, GeForce RTX 30 Series, GeForce RTX 20 Series, and GeForce GTX 16 Series. They are available with NVIDIA chipsets.

<Appendix A> List of Key Players or Services (Cont.)

Application-Specific Integrated Circuits (ASICs)²⁸):

- Infineon Technologies
- STMicroelectronics
- Texas Instruments
- Analog Device
- NXP Semiconductors
- ONSemiconductors
- Renesas Electronics
- Skyworks Solutions
- Faraday Technology
- Xilinx

Field-Programmable Gate Arrays (FPGAs):

- Xilinx
- Intel
- Microchip Technology
- Lattice Semiconductor
- Achronix
- QuickLogic
- Efinix
- GOWIN Semiconductor

Memory Chips:

- Samsung Electronics
- SK Hynix
- Micron Technology
- Kingston Technology
- Intel Corporation
- SanDisk
- Toshiba Corporation
- Western Digital
- Transcend Information
- G.Skill

28) <https://www.pcbaaa.com/top-10-asic-manufacturers-in-the-world/>

<Appendix A> List of Key Players or Services (Cont.)

Foundries:

- Taiwan Semiconductor Manufacturing Company (TSMC)
- Samsung Electronics
- GlobalFoundries
- United Microelectronics Corporation (UMC)
- Semiconductor Manufacturing International Corporation (SMIC)
- Powerchip Semiconductor Manufacturing Corporation (PSMC)
- Tower Semiconductor
- Vanguard International Semiconductor Corporation (VIS)
- Hua Hong Semiconductor
- DB HiTek

<Appendix B> Visualization

<Table B1> Visualized Generative AI Ecosystem and SWOT Analysis

SWOT	Ours	Players
S, T (regulatory)	App Builders	High competition and CDJ
S	Technology Partners	Labelbox, Databricks, etc.
Platform ² : W, O (Shrinking fast)	App Stores	Fragmented, but emerging fast
Platform ² : S, O, T	Foundational Models and Platforms	US, China, Korea
Platform ² : W, T	Cloud service providers	AWS, Azure, GCP, Nvidia
S, T	Chipmakers	GPUs, AI chips, Foundries, Memories, etc.

This table illustrates the key components of the Generative AI Ecosystem, along with a SWOT(Strengths, Weaknesses, Opportunities, Threats) analysis. The highlighted rows in sky blue represent strategically significant areas for Korea.

<Appendix C> Platform Strategies

1. Strategic Focus and Implementation Plan

One of the first strategic focus areas for the Korean government should be fostering collaboration among foundational AI models and chip manufacturers. To achieve this, joint R&D initiatives can be developed. The government can support this by establishing tax incentives and grants specifically for R&D collaborations between these two key players in the AI ecosystem. The anticipated outcome is to significantly strengthen the competitive edge of homegrown AI technologies.

Secondly, the domestic app stores should be enhanced to become the go-to marketplaces for generative AI applications. Financial incentives can be provided to domestic app stores that prioritize hosting and promoting AI-based applications developed within Korea. This would increase the visibility and distribution of locally-produced AI applications, thereby driving both innovation and consumption within the domestic market.

Thirdly, cloud services should be localized to cater to AI computing needs. These infrastructures should be optimized for AI workloads, offering the same, if not better, performance as international competitors. The government can subsidize these cloud infrastructure projects, making local services more competitive and attuned to the specific needs of AI developers and end-users.

Fourthly, penetrating the strategically important AI platform-squared segment should be prioritized. Companies in this space, which includes app stores, foundational AIs as operating systems, and cloud services, should experience reduced regulations and red tape. The government should aim to provide a level playing field for domestic companies to compete effectively against international giants, particularly those from the U.S. and China.

The implementation plan can be phased into short-term, mid-term, and long-term goals. In the short term, spanning 1-2 years, the government should formulate the aforementioned tax incentives and grants, establish an overseeing committee for AI development, and initiate pilot projects. In the mid-term, covering 2-5 years, these pilot projects should be reviewed and iterated upon, public-private partnerships should be formalized, and phased deregulation for AI platform-squared companies should be initiated. Long-term plans, extending beyond five years, should involve continuous monitoring of market dynamics, adaptation of policies for sustained competitiveness, and a thorough evaluation of the impact of these strategic initiatives on Korea's generative AI ecosystem.

2. Monitoring, Evaluation, and Risk Assessment

Success can be monitored through several key performance indicators such as the number of collaborations between foundational AI model companies and chip manufacturers, the market share of Korean AI apps and platforms, and the utilization rates of localized cloud services.

However, there are inherent risks. Over-reliance on the domestic market could limit the ecosystem's growth potential, while geopolitical factors and potential brain drain to countries offering better opportunities could also impact market dynamics adversely.

<Appendix C> Platform Strategies (Cont.)

By meticulously implementing these strategies and policies, Korea has the potential to dominate various elements of the AI platform-squared ecosystem. This would mitigate the risks posed by the monopolistic tendencies of a few global giants and allow Korea to leverage its unique strengths in foundational AI models and chip manufacturing.

3. Consumer Decision Journey (CDJ)

Addressing the nuances of the Consumer Decision Journey (CDJ) is crucial for shaping a consumer-centric AI ecosystem in Korea. The government's strategy should be multi-pronged, aimed at facilitating not just technological growth but also consumer adoption and satisfaction.

For the Awareness Stage, public awareness and education about AI can act as catalysts for market growth. The government should fund educational programs in schools and online platforms that focus on AI literacy. These initiatives will equip the public with the knowledge to interact responsibly with AI platforms, thus fostering a well-informed consumer base. Public campaigns can be rolled out to increase general awareness, and these would serve as foundational steps for deeper consumer engagement with AI technologies.

When consumers reach the Consideration Stage, the complexity and opacity of AI solutions can often be barriers to entry. To address this, the government should establish guidelines for AI companies to offer simplified and transparent information about their products. Compliance with these guidelines could be incentivized through tax benefits, leading to a scenario where consumers can make better-informed decisions. The ease of understanding the benefits and limitations of different AI platforms will likely boost local adoption rates.

The Purchase Stage is where transactional frictions could lead to loss of potential sales. To simplify the buying process, the government should encourage domestic app stores to integrate localized payment gateways. Monetary incentives can be offered to app stores that comply, making it easier and more familiar for consumers to complete their purchases. This localized approach can significantly improve the user experience and likely lead to higher conversion rates.

During the Usage Stage, personalization and localization can make a significant impact on user retention. Companies that can leverage AI to provide more personalized and localized services should be rewarded. Tax incentives could be an effective policy tool here. By offering a highly tailored user experience, companies can not only retain their existing customers but also benefit from positive word-of-mouth, further amplifying the network effects within the AI ecosystem.

Lastly, the Loyalty and Advocacy Stage can be leveraged to build long-term value. The government can support platforms that encourage user-generated content like reviews and testimonials. Incentives could be offered for users who contribute content, thereby enriching the consumer decision journey and adding a layer of peer credibility to these platforms.

<Appendix C> Platform Strategies (Cont.)

In terms of implementation, the short-term focus should be on developing public awareness campaigns and educational programs, while also establishing initial transparency guidelines. Over the mid-term, these efforts can be evaluated for effectiveness, and localized payment options can be integrated into app stores. The long-term strategy should involve continual updates to educational content and monitoring of user-generated content to ensure that the strategies remain aligned with consumer expectations and technological advancements.

In conclusion, by strategically integrating the Consumer Decision Journey into the AI policy framework, the Korean government can ensure that its domestic AI ecosystem is not just technologically advanced but also finely tuned to consumer needs. This would likely result in better market penetration, increased consumer satisfaction, and a more robust and competitive AI ecosystem.

◆ About the Authors ◆



Hyoung-Goo Kang

Hyoung-Goo Kang is a Professor of the department of finance at Hanyang University Business School and the deputy head at Hanyang Institute for Entrepreneurship in Seoul, Korea. His research focuses on machine learning, financial innovations, innovative institutions, strategic process, asset allocation and the big data approach to behavioral economics. He received his PhD and MA from the Fuqua School of Business at Duke University, his MA from the economics department at the University of Virginia and his BA from the economics department at Seoul National University.



Ahram Moon

Ahram Moon is a research fellow at the Korea Information Society Development Institute. She has been studying social issues and policies related to information communication technology. She has been engaged in government projects about ethical Artificial Intelligence and researches on the evidence-based policy of intelligent information society. She currently focuses on research about trustworthy AI, the impact of AI on labor market, and policies for users in the algorithmic society based on scientific evidence and data. She received her PhD in Economics from the University of Southern California.



Seongmin Jeon

Seongmin Jeon is an Associate Professor at Gachon University in South Korea. He has two major areas of expertise: 1) empirical analysis on electronic marketplace, and 2) the use of data science methods to extract, process, and analyze online behavioral data. His works have been published in peer-reviewed journals including *Journal of Interactive Marketing*, *Information & Management*, *Electronic Commerce Research*, and *Internet Research*.

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