AI and the KNOWLEDGE ECONOMY:

Transforming APO Members

Asian Productivity Organization

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Bangladesh, Cambodia, Republic of China, Fiji, Hong Kong, India, Indonesia, Islamic Republic of Iran, Japan, Republic of Korea, Lao PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Turkiye, and Vietnam.

AI AND THE KNOWLEDGE ECONOMY

TRANSFORMING APO MEMBERS

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AI and the Knowledge Economy: Transforming APO Members

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CONTENTS

FOREWORD VII

EXECUTIVE SUMMARY 1
Methodology 1
AI and the Knowledge Economy 1
Summary of Analytical Findings 2
Policy Recommendations 2

SECTION 1: INTRODUCTION 4

SECTION 2: THE EMERGENCE OF AI AND THE TRANSITION TO A KNOWLEDGE ECONOMY 6
AI: A Major New GPT 6
Defining AI 6
The Economic Importance of AI as a GPT 7
Knowledge Economy: Major Trends and Key Issues 10
Defining the Knowledge Economy 10
Key Characteristics of a Knowledge Economy 11
Current Trends in the Knowledge Economy 12
Critical Issues in the Knowledge Economy 14
Role of AI in the Transition to a Knowledge Economy 16
AI as a Catalyst for Knowledge Creation and Innovation 16
Impact of AI on Workforce Dynamics and Knowledge Work 18
Challenges and Ethical Considerations of AI Integration 19

SECTION 3: ANALYSIS OF AI UTILIZATION IN APO ECONOMIES AND ACROSS THE GLOBE 22
Introduction 22
AI Utilization Trends: APO Members vs. World 23
AI Patent Filings at the USPTO by APO Members 23
AI Patent Filings at the EPO by APO members 29
Total AI Patent Filings at the USPTO and the EPO 34

SECTION 4: GLOBAL TRENDS IN AI POLICY 37
Introduction 37
AI Policies in APO Member Economies 38
The ROC AI Action Plan 2018–2021; AI Action Plan 2.0 in 2023 38
India's National Strategy for AI 2018; #AIforAll 39
Bangladesh National Strategy for AI 2019-2024 40
Japan's AI Strategy 2019, 2022 Revision 40
Republic of Korea's National Strategy for AI 2019 42
Singapore's National AI Strategy 2019 42
Indonesia's National Strategy for AI 2020 43

Malaysia's AI-RMAP 2021–25 43
The Philippines' National AI Strategy Roadmap 2021 44
Turkiye's National AI Strategy 2021–25 44
Sri Lanka's Digital Sri Lanka 2030 45
Thailand's National AI Strategy and Action Plan 2022–27 45
Pakistan's Draft National AI Policy 2023 46
Nepal's AI Concept Paper 2024 46
Other APO Economies 49
Key Features of APO Members' AI Policies 49
AI Policies in Non-APO Economies 51
The USA 52
European Union 54
Germany 55
The United Kingdom 57
Key Features of AI Policies in Major Economies 58
The Future of APO AI Policies 60
Sector-focused Collaboration 60
Policy Instrument-focused Collaboration 61
Conclusion 61

SECTION 5: AI AND PRODUCTIVITY 63
AI Adoption and Economic Outcomes 63
AI Take-up 63
Economic Expectations 63
Empirical Studies on AI and Productivity 65
Best Practices in AI Utilization 68
Innovations in Automotive Product Design 71
Maintenance Systems Innovations in the Automotive Industry 71
Intelligent Automotive Manufacturing Processes 71
Intelligent Management of Semiconductor Equipment Operations 72
Operational Innovation through Autonomous Control AI in the Chemical Industry 72
Innovative Applications of AI in Engineering Design 73
Innovations in Battery Design and Manufacturing 73
Innovations in Operations and Customer Service in Rail Transit 74
Innovations in Demand Forecasting and Logistics Operations in the Retail Industry 75
Innovations in AI-powered Logistics 75
Innovations in Contract Intelligence in the Financial Industry 76
Innovations in New Product Development in the Pharmaceutical Industry 76

SECTION 6: CONCLUSION 78
Main Findings and Implications 78
AI and the Knowledge Economy 78
AI Capabilities in APO Member Economies 79
AI Is Dominated by a Handful of Major Global Leaders 79
Two Emerging AI Innovation Hubs within the APO 79
Collaborative and Open Innovation Models Are Crucial to AI Development 79
Need for Robust Policy Support and Investment in Digital Infrastructure 79
There Are Many Opportunities in Regional Specialization 80

AI Policies of APO Members 80
AI and Productivity 80
Policy Suggestions 80
Policies for Leading APO Members 80
Policies for Emerging Economies in the APO 81
Suggestions for Intra-APO Cooperation 82

REFERENCES 84

LIST OF TABLES 91

LIST OF FIGURES 92

LIST OF CONTRIBUTORS 93

FOREWORD

The concept of a knowledge-based economy has evolved significantly over the past few decades, driven by globalization, advancements in information technology, and the growing importance of intellectual capital. AI, as a transformative general-purpose technology, has emerged as a key enabler of this transition, revolutionizing industries and reshaping the global economic landscape. By leveraging AI to create, share, and apply knowledge, societies can unlock unprecedented opportunities for innovation, productivity, and sustainable growth.

The transition to a knowledge-based economy presents both significant challenges and opportunities for APO member economies, making research in this area both timely and essential. With varying levels of technological capability and digital infrastructure across Asia, actionable insights and policy frameworks are urgently needed to help bridge the digital divide. Furthermore, the complexities of an AI-driven knowledge economy underscore the critical importance of ethical AI governance, inclusivity, and regional collaboration in ensuring that all nations can effectively navigate this transformation. Addressing these issues will provide valuable guidance for fostering sustainable and equitable growth in the region.

This report presents a comprehensive analysis of AI adoption and its role in the knowledge economy, providing important insights into patent activity, global policy trends, and productivity impacts. It compares the AI innovation landscape among APO members with that of global leaders and provides tailored, tiered policy recommendations for supporting different levels of AI maturity. By emphasizing actionable strategies and fostering collaboration, this report equips policymakers with the tools to leverage AI for sustainable and inclusive economic growth while enhancing productivity.

In collaboration with the Korea Institute for Industrial Economics & Trade (KIET), this study represents a valuable collective effort, combining expertise and insights to explore the critical factors influencing AI adoption and its integration into the knowledge economy. By embracing the opportunities and addressing the challenges of the knowledge economy, we hope that APO member economies can position themselves at the forefront of sustainable and inclusive growth in the digital age.

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Asian Productivity Organization
Tokyo

EXECUTIVE SUMMARY

Artificial intelligence (AI) has emerged as a transformative force, reshaping entire industries and driving economic growth. As a key general-purpose technology (GPT), AI is poised to drive wide-ranging industrial and economic transformations going forward. Despite its potential, the adoption of AI remains relatively low, and its outcomes are still uncertain. However, global competition among major countries surrounding AI technologies continues to intensify. This report investigates the implications of AI technologies for sustainable growth of Asian Productivity Organization (APO) member economies by analyzing patent data, examining in depth the role played by AI in the transition to a knowledge-based economy, and evaluating its impacts on productivity. The results of the analysis will provide valuable insights and carry significant implications for policies to help APO members navigate a rapidly changing technological and political environment.

Methodology

To achieve the primary objectives of the research, we first assess the extant literature on AI and the knowledge economy, reviewing some of the proposed pathways through which AI may impact the knowledge economy. We then perform the main analysis, a quantitative exploration of AI technological capacities of APO member economies using patent data, comparing their performance with global leaders and evaluating the technological leadership of the AI pacesetters in the APO. Next, we survey the current AI policy landscape of APO member economies, probing the policies and various initiatives of its AI leaders to identify benchmarks for future policy development. We conclude the study with a discussion of the relationship between AI utilization and productivity, supplemented by an analysis of various empirical cases demonstrating the use of emerging technologies and their outcomes. Through this comprehensive approach, the study helps lay the groundwork upon which APO members might build policy frameworks going forward. The policy recommendations presented are to guide the governments of the APO member economies as they work to facilitate the transition to the knowledge economy within their own unique national contexts and improve productivity by adopting emerging technologies.

AI and the Knowledge Economy

This study adopts the definition of the knowledge economy as an economic system where intellectual capital and information are the primary drivers of growth and competitiveness, surpassing physical resources and other traditional factors. In this context, knowledge is a key asset; and innovation, research, and technological advancement are central to value creation. AI has the potential to powerfully catalyze knowledge creation and innovation by transforming data into actionable insights, automating complex processes, facilitating global collaborations, personalizing learning experiences, and generating predictive knowledge. Through these capabilities, AI can amplify the growth potential of the knowledge economy by helping organizations and individuals thrive in an era in which intellectual capital and technological advancement are paramount. AI is also reshaping workforce dynamics and transforming the nature of work in the knowledge economy. It has enabled the automation of routine tasks, demand for new skill sets, and fostered greater human–machine collaboration.

However, AI has also raised serious ethical questions, making its impact on the workforce multidimensional and complex. Job displacement remains a real risk, and it is important that AI ethics guidelines be developed and followed. But reskilling, upskilling, and responsible AI practices have the potential to enable workers and organizations to more effectively harness the enormous potential of AI and more readily adapt to the rapidly evolving digital landscape. As AI becomes a pillar of the knowledge economy, it brings with it a set of challenges and ethical considerations that impact organizations, individuals, and societies at large. Addressing these issues is crucial to ensure that AI-driven innovations promote equitable, secure, and responsible growth.

Summary of Analytical Findings

The empirical analysis using patent data highlights significant disparities in AI capabilities among APO member economies, with Japan, the Republic of Korea (ROK), and India leading in AI innovation while others lagging behind. The dominance of the USA, Japan, PR China, and other global leaders underscores the concentration of AI advancements within a few economies, shaping international standards and technologies. The ROK and India, both emerging AI hubs, while investing heavily in R&D and global partnerships, have showcased some successful development strategies and provided lessons for other APO members. To bridge this digital divide, we recommend pursuing collaborative models, such as joint R&D, patent sharing, and technology transfer. Robust policy support, investment in digital infrastructure, and fostering AI ecosystems are critical for enhancing capabilities across APO economies. In addition, APO members should focus on their strengths when looking to apply AI, aligning strategies in ways that leverage national competitiveness to create synergies and enhance the APO's position in the global AI arena.

In our review of APO members' AI policies, we noted a tendency for governments to focus on leveraging AI for economic growth, social development, and improved public services, while emphasizing inclusivity and equity. This contrasts with the AI policies of the USA and PR China, which prioritize technological dominance and national security. Key areas of focus include AI R&D, workforce training, and ethical governance. These policies vary across countries, reflecting unique priorities, but collectively position AI as a tool for addressing societal challenges and fostering sustainable development.

In our survey of the literature on AI and productivity, we found that despite its potential, much empirical research on the effects on productivity has yielded mixed results, with adoption rates remaining low, as evidenced by data from the USA and the ROK showing firm-level AI adoption below 10%. While AI is widely seen as having the potential to fuel economic growth, its impact on productivity remains uncertain. Case studies reveal that AI adoption is concentrated among a small number of leading firms, typically those having strong foundational capabilities and access to skilled labor. This trend reveals the existence of growing digital divide in the AI space, where benefits are increasingly concentrated among advanced firms and developed economies, thereby potentially widening economic disparities across firms, industries, regions, and countries.

Policy Recommendations

The policy suggestions we outline for APO member economies are grounded in the results of the analyses described above. We find that while Japan, the ROK, and India are leaders in AI innovation, other APO members lag behind. The success of the APO's AI leaders is owing to their heavy investments in AI R&D and their tireless pursuit of global partnerships. These successes can inform

lessons for other APO members. To bridge the AI divide within the APO, we recommend pursuing collaborative models such as joint R&D, patent-sharing, and technology transfers. Robust policy support, investment in digital infrastructure, and fostering AI ecosystems are critical for enhancing capabilities across APO nations. Also, APO members should leverage their strengths to enhance their overall AI capacities.

We propose sector-specific cooperation and policy instrument collaborations to advance AI development among APO member economies. In healthcare, developing AI-based telemedicine, diagnostics, and personalized treatment solutions presents a promising opportunity. Establishing joint research centers and regional standards will improve healthcare quality and accessibility across the group. In manufacturing, leveraging the ROC's advanced technology can support the less-developed members, particularly their SMEs, in implementing AI solutions and boosting productivity and competitiveness through knowledge sharing and pilot projects. Smart city initiatives in the ROK, Japan, and the ROC have shown success in AI-driven urban management; and by standardizing these technologies, APO economies can promote sustainable urban development, thereby making cities more efficient, safe, and livable.

To foster AI growth, we propose that APO economies establish regional educational platforms and AI training centers in partnership with advanced nations. By standardizing AI curricula and scholarship programs, such initiatives will ensure a steady supply of skilled AI professionals, which is crucial for the sector's expansion. Additionally, creating collaborative networks between governments, private enterprises, and academia will foster AI research, development, and commercialization. Public–private partnerships will accelerate innovation and bring AI solutions to market more efficiently, benefiting both the sectors. A strong AI governance structure, including regional ethics committees and guidelines on data privacy and transparency, is essential to align with global standards and ensure responsible AI use.

Finally, to promote widespread AI adoption, we recommend establishing a shared AI Case Platform for APO member economies to exchange outcomes of AI applications and encourage spillover effects. Although AI technology is advancing, adoption remains low, partly due to uncertainty about its economic impact. However, early adopters with strong foundational capabilities are already seeing benefits, which is widening the gap between leading and lagging firms, regions, and countries. Therefore, governments must actively promote AI adoption by sharing successful case studies and advocating for the practical benefits of AI utilization. Such initiatives would help businesses understand the value of AI and encourage broader adoption across the APO bloc.

SECTION 1:
INTRODUCTION

AI has emerged as a transformative force capable of reshaping entire industries and fueling economic growth. Today, AI is generally defined by the capacity of a program or a set of programs for self-analysis, prediction, and judgment. These abilities are powered by machine learning and deep learning techniques based on foundational algorithmic models. Utilizing these technologies, AI is transcending traditional automation and roboticization by emulating the human intellect and is poised to drive wide-ranging industrial and economic transformations going forward (Agrawal et al., 2018).

Scholars are in broad agreement that AI is a quintessential general-purpose technology (GPT), akin to the Internet and electric power generation. As such, it is expected to exert far-ranging and profound impacts across the global industrial and economic landscape (Goldfarb et al., 2023; Trajtenberg, 2018). Its pervasive influence extends from the manufacturing and defense sectors to healthcare, and is just now beginning to penetrate every stage of doing business, from product and service development to production, sales, and administration. Moreover, recent technological advancements in AI have seen an explosion in the number of large language models (LLMs) such as OpenAI's ChatGPT available to everyday users. LLMs have vastly improved the usability and accessibility of AI, further buttressing the technology's already-substantial transformative potential.

The main purpose of this study is to investigate the implications carried by AI technologies for the sustainable growth of APO member economies, and devise policies that enable APO members to capably respond to the AI revolution. We explore the role played by AI in the ongoing transition to a knowledge-based economy, the axis of economic development in recent decades. We also examine the impact of AI on productivity.

The specific objectives of the work are as follows:

(1) Discuss the emergence of AI and the knowledge economy: The study comprehensively explores the fundamental paradigm undergirding all economic growth and the nexus of technological innovation and the transition to a knowledge-based sustainable economy.

(2) Analyze AI capabilities using patent data: It empirically assesses the contemporary state of AI development in APO member economies through an analysis of patent data.

(3) Review policy trends: It analyzes recent policy trends among APO members and global leaders in AI to identify new and emerging policy approaches.

(4) Evaluate the productivity effects of AI adoption: The study surveys the academic literature on AI and its impact on productivity in various sectors of the economy. It also reviews some key AI use case studies, identifying the implications carried by the body of scholarship on AI for sustainable economic growth.

(5) Provide tiered policy recommendations: Finally, based on the results of the above analyses, we propose a suite of strategic recommendations to guide APO economies in the transition to a knowledge-based economy. We package these recommendations into two packages: one for developed APO members, and the other for emerging economies in the APO. These recommendations are designed to promote sustainable economic growth in the AI era. Each package is further divided into policy suggestions, industrial planning recommendations, and suggestions for collaboration.

The global race for AI is on, and AI leaders such as the USA have aggressive policies in place to foster AI development and facilitate its widespread adoption.[1] Yet, despite its immense potential, global adoption rates remain low. In the ROK, for instance, only 4.5% of companies were found to actively utilize AI (Statistics Korea). Moreover, research on the impact of corporate AI use points to mixed results and ambiguous outcomes.[2] Given the varied competencies and the policy environment across the diverse range of APO members, this study offers timely policy recommendations to harness the power of AI for sustainable economic growth and keen insights into the trajectory of global AI development.

The report describing the results of this research undertaking begins with a brief discussion of AI technologies and their relationship with the knowledge economy in Section 2. Section 3 empirically analyzes the current state of AI capabilities in APO economies using patent data. Section 4 highlights recent trends in AI policy in a handful of core economies and APO member economies. In Section 5, we discuss AI utilization, focusing on its impact on economic performance through productivity effects. The final section contains concluding material that summarizes the key takeaways of the study and presents our policy recommendations.

[1] We survey major AI policies in APO member economies and across the globe in detail in Section 4.
[2] We present our findings on AI utilization and outcomes in Section 5.

SECTION 2:

THE EMERGENCE OF AI AND THE TRANSITION TO A KNOWLEDGE ECONOMY

The rapid advancement of AI is reshaping the global economy, driving the transition from traditional industrial paradigms to a knowledge-based economy. This section explores the intersection of the AI technology and the knowledge economy, beginning with foundational definitions and the economic significance of AI as a general-purpose technology (GPT). It examines the knowledge economy's defining features, prevailing trends, and critical challenges, providing a contextual backdrop for understanding its evolution. Finally, the section highlights the transformative role of AI in this transition, emphasizing its capacity to accelerate innovation, reshape workforce dynamics, and raise pressing ethical and societal concerns. Together, these discussions provide a comprehensive framework for understanding how AI is shaping the future of economic and industrial landscapes.

AI: A Major New GPT

In this subsection, we provide a definition of the AI technology (see Table 1).

Defining AI

The Organisation for Economic Co-operation and Development (OECD) in 2023 defined AI as "a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments." Defining AI as such underscores its ability to emulate human cognitive functions, including learning, reasoning, perception, and understanding of natural language (OECD, 2023).

TABLE 1

UPDATING THE DEFINITION OF AI (OECD).

2019	2023
A machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments	An AI system is a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. Different AI systems vary in their levels of autonomy and adaptiveness after deployment.

Source: Grobelnik et al. (2024), "What is AI? Can you make a clear distinction between AI and non-AI systems?" Available at: https://oecd.ai/en/wonk/definition

Viewed this way, we can see that AI transcends conventional automation and robotics, harnessing machine- and deep-learning techniques to emulate human cognitive abilities. By enabling machines

to perceive, analyze, predict, and make judgments, AI approximates some of the capabilities of human intelligence, which empowers organizations to optimize processes, reduce costs, and enhance productivity across a range of applications, from data analysis to predictive modeling. (Agrawal et al., 2018a; Agrawal et al., 2018b).

The Economic Importance of AI as a GPT

The multifaceted nature of AI as a GPT owes to its (1) broad applicability; (2) innovation potential; and (3) pan-industrial impact. This aligns it with other historical GPTs such as the steam engine, electricity, and computers, all of which transformed the world (Goldfarb et al., 2023; Bresnahan and Trajtenberg, 1995). This makes it essential that policymakers, businesses, and individuals understand the potential of AI as a GPT and develop the capacity to navigate AI's implications and fully harness its abilities. For policymakers, AI's wide-ranging impacts are widespread use-case scenarios that justify policy support, while businesses must decide how to strategically invest in and leverage AI (see Table 2).

While AI offers enormous opportunities for economic growth and social advancement, like all GPTs it also has the potential to widen existing gaps in technological capabilities and exacerbate disparities in access to AI's benefits. This makes efforts to mitigate inequalities imperative. Such efforts may take the form of capacity-building initiatives for all economic stakeholders (workers, companies, industries, and nations); measures to expand the adoption of AI; and policies that work to diffuse the benefits of the technology.

TABLE 2

AI USE CASES BY INDUSTRY AND ACTIVITY.

Category		Main issue	Applied technology	Outcome
Industry	Steel	Removal of impurities in steel	Automation of production processes with "smart factory' systems	Real-time analysis of sensor data, enabling early detection and prevention of failures
	Semiconductors	Microfabrication	Problem-solving through AI and data analysis	Increased production
	Finance (banking)	Labor shortage in in-person banking	Personalized services using AI chatbots	Reduction in the number of bank branches: 5,800 at the end of 2022, down 13.5% from 2019
	Finance (investment)	Increasing profitability	AI-driven investment platform staffed by "robo-advisors" (automated portfolio managers)	Average three-year yield of robo-advisors: –7.88%; Korean stock ETFs: –14.72% post-COVID
	Gaming	Enhanced reality in virtual game space	Character voice dubbing and natural conversation support using AI and large language models (LLMs)	Positive user feedback

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Category		Main issue	Applied technology	Outcome
Activity	Product design	Weight reduction and competitiveness	Application of generative AI for design in Autodesk CAD software, vehicle parts redesign	Successful weight reduction of over 150 kg on 14 Chevrolet models through application of lighter and stronger parts
	Predictive maintenance	Early detection and prevention of equipment issues	Smart monitoring of electricity consumption, temperature, etc., to detect signs of abnormal conditions and leakage	Prevention of major downtime, with an annual reduction of approximately 500 hours in vehicle assembly lines
	Optimization of production processes	Minimizing waiting times	Optimization of complex production processes through Zapata AI and MIT's quantum computing technology	Achieving monthly production targets compared with traditional methods, maintaining assembly line efficiency
	Demand forecasting	Need for low-margin improvement	Collecting proprietary data for forecasting and analysis, targeted advertising through Retail Media Network (RMN)	RMN sales: USD 310 million in 2022
	Engineering	Maximizing accuracy and efficiency	Generative AI applied to programming and operating systems; user-friendly programming in computer numerical control (CNC) machinery adjustment	Reduction in time and cost for machine adjustments, enhancement in product quality through AI-driven error correction

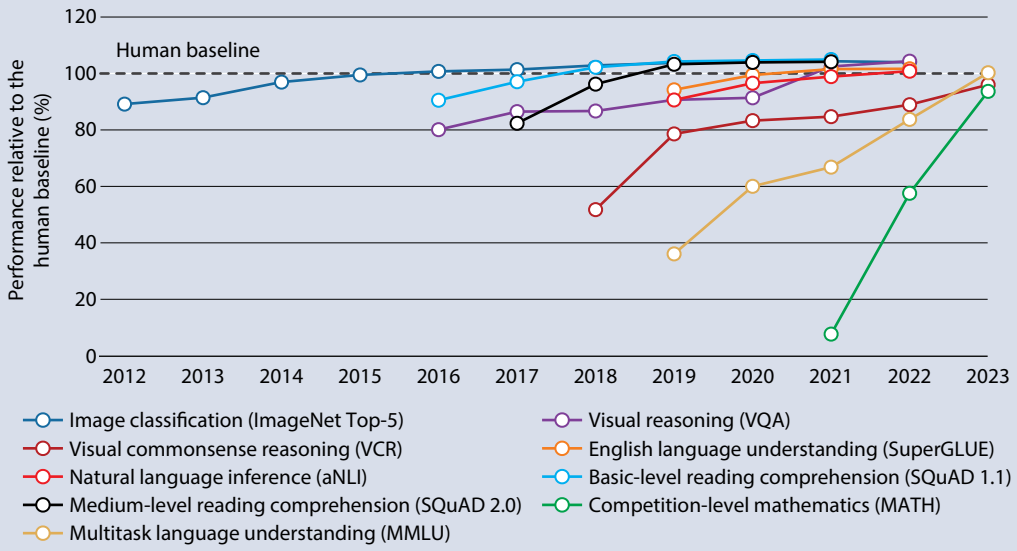
Source: "AI Utilization and Performance: Opportunities and Challenges," working paper (KIET).

Recent advancements in AI have propelled the technology to new heights, surpassing human performance in various technical domains. A 2024 report by HAI found evidence that AI can outperform humans in tasks such as image classification, visual reasoning, and natural language understanding (English) (see Figure 1). This rapid evolution, built upon the foundation laid by the field of deep learning, continues to push the boundaries of AI's potential (Intel, 2020).

The staggering pace of AI development is also evident in the exponential growth of computing resources dedicated to AI training. Since 2012, the cumulative amount of resources dedicated to training AI models has doubled approximately every 3.4 months, surpassing Moore's Law. This drastic increase in computational power is what is enabling leading firms to pursue AI innovation at breakneck speeds (see Figure 2).

FIGURE 1

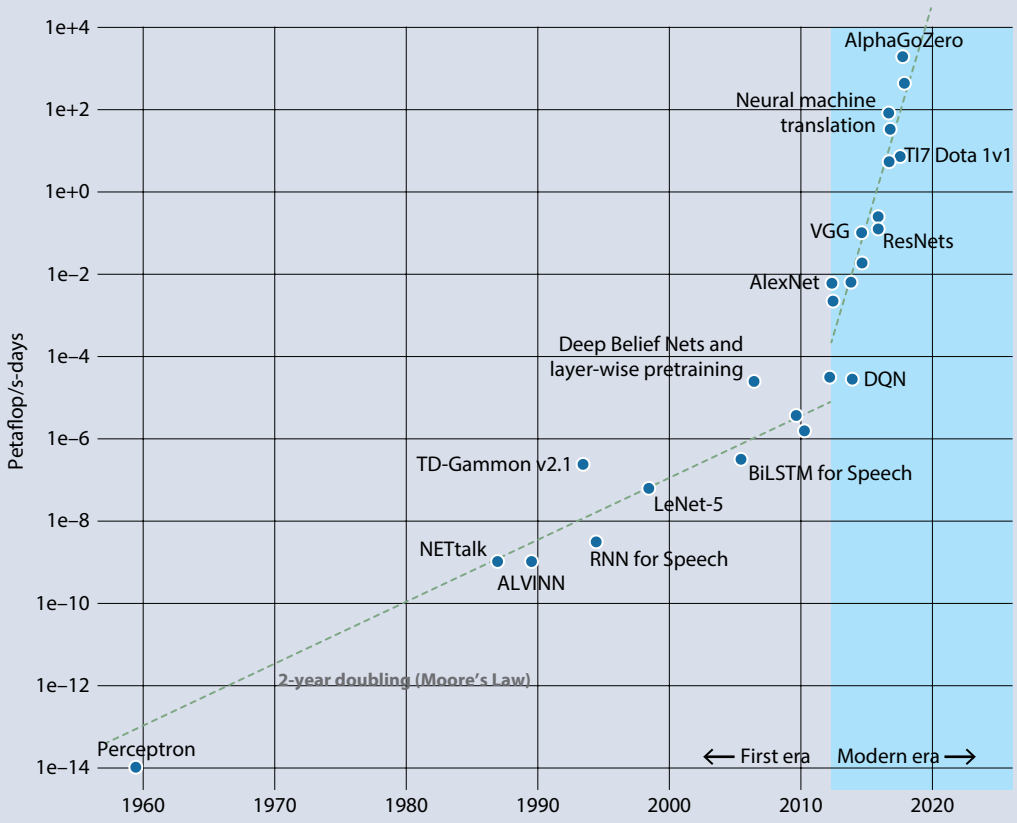
TECHNICAL PERFORMANCE COMPARISON OF AI AND HUMANS.



Source: Artificial Intelligence Index Report 2024, HAI, Stanford University; https://aiindex.stanford.edu/report/

FIGURE 2

COMPUTATIONAL POWER FOR AI TRAINING, 1960–2020.



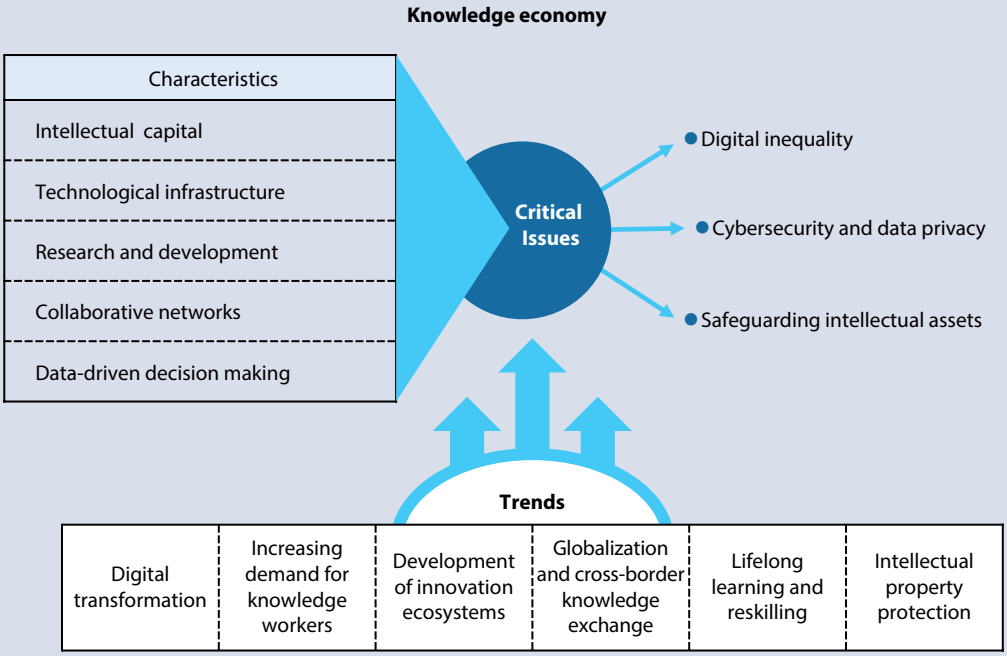
Source: https://openai.com/index/ai-and-compute/

Knowledge Economy: Major Trends and Key Issues

In this subsection, we explore the concept of the knowledge economy to seek a comprehensive definition (see Figure 3), examining recent trends and pertinent issues to provide a summary of some fundamental defining traits. We also inquire into significant changes and recent trends associated with the knowledge economy, framing major issues in the context of environmental changes.

FIGURE 3

DEFINING THE KNOWLEDGE ECONOMY.



Source: The authors.

Defining the Knowledge Economy

For this study, we define the knowledge economy as an economic system where intellectual capabilities and information are the primary drivers of economic growth and the main sources of economic competitiveness, surpassing physical inputs and natural resources (Powell and Snellman, 2004). In the knowledge economy, knowledge itself is a valuable commodity, with innovation, research, and technological advancement being the pillars of value creation. The emergence of the knowledge economy in the late 20th century was spurred by advancements in information and communication technologies (ICT), and marked a shift from the economy of yore, dominated by the production of physical goods, to one in which the production and dissemination of knowledge was at the core of socioeconomic development (Drucker, 1993; Castells, 1996).

In the knowledge economy, knowledge is both an output and an input, and as such the provision of intellectual services has come to dominate the economy. Knowledge-intensive sectors include IT, finance, education, and R&D. The OECD defines a knowledge economy as one in which the most significant investments are made in knowledge-based industries to generate advancements in science, technology, and innovation, with the end goal of boosting productivity and driving economic growth (OECD, 1996). Major knowledge-intensive sectors leverage data, algorithms,

and knowledge-based insights to optimize decision-making and raise efficiency, thus fostering sustained innovation (Brynjolfsson and McAfee, 2014).

Knowledge workers who create, manage, and apply knowledge-based products and services have become essential resources in the knowledge economy. This represents a shift from the role of the worker in a manufacturing-centered economy, as it necessitates the creation and maintenance of a highly skilled workforce capable of complex problem-solving and adapting to technological advancements (Bell, 1973; Davenport, 2005). In addition, digital infrastructure, intellectual property rights, and lifelong education and training programs are required to sustain the knowledge economy, as these ensure the accessibility and protection of valuable information, fostering knowledge production, distribution, and application. This integrated approach is what makes economic growth and social development possible in an increasingly data-driven and interconnected world (Maskus, 2000).

Key Characteristics of a Knowledge Economy

A knowledge economy is one in which knowledge is the primary driver of productivity, innovation, and economic growth. Accumulated knowledge has led to the creation of a new type of asset, the intellectual capital, which comprises human expertise and skills. Intellectual capital contributes to corporate and national competitiveness and constitutes the foundation of productivity in knowledge-based organizations (see Table 3 summarizing key characteristics of the knowledge economy).

Investments in robust technological infrastructure (digital platforms and advanced technologies) facilitate rapid exchange of information, efficient data management, automation, and increased levels of R&D, all of which are essential to driving productivity growth and fostering new business models (Brynjolfsson and McAfee, 2014). Studies have shown that R&D in particular is closely related to the production of intellectual capital, a prerequisite for growth in the knowledge-based economy (Edvinsson and Malone, 1997). R&D in particular is the primary fuel of innovation and economic growth, as evidenced by the growth seen in knowledge economies such as the USA, Japan, and Germany (Romer, 1990).

The importance of intangible assets in a knowledge-based economy underscores the strategic importance of knowledge workers, who perform the kinds of analyses and complex problem-solving tasks that characterize the modern face of work (Stewart, 1997). Consequently, developing human capital through lifelong education and training programs is critical, as such initiatives enable workers to adapt to the rapidly evolving demands of the labor market.

Knowledge-based economies thrive when collaborative networks enable the flow of ideas, skills, and information across organizations and sectors. These information flows are embodied by the triple helix model, which describes how partnerships between academia, industry, and government can foster a robust ecosystem in which knowledge is openly shared, driving innovation (Etzkowitz and Leydesdorff, 2000). These cross-sector collaborations expedite knowledge diffusion, which is essential to swift commercialization of new ideas and technologies and nurturing an environment that incubates innovative activity.

Finally, data-driven decision-making is a key attribute of the knowledge economy. The ability to gather, analyze, and interpret vast amounts of data provides organizations with critical insights that inform tactical and strategic choices, thereby enhancing their competitive edge. Knowledge management systems, as described in Nonaka, Takeuchi, and Umemoto (1996), offer structured

approaches for creating, storing, and utilizing knowledge within firms. By converting tacit knowledge into explicit knowledge, organizations can effectively manage institutional knowledge, improve institutional responsiveness to market fluctuations, and support sustainable innovation in the digital age.

TABLE 3

KEY CHARACTERISTICS OF A KNOWLEDGE ECONOMY.

Characteristic	Description
Intellectual capital	Intellectual capital, including human expertise, skills, and knowhow, is essential to competitiveness and productivity in knowledge economies. Developing human capital through education and training is critical for adapting to technological advancements.
Technological infrastructure	Advanced technologies like cloud computing, AI, and data analytics support real-time information exchange, data management, and automation. These technologies drive productivity, enable decision-making, and create new business models.
R&D	Investment in R&D by public and private sectors drives innovation, resulting in new technologies, products, and services that fuel economic growth. High R&D investments link directly to long-term economic progress in knowledge economies.
Collaborative networks	Collaborative frameworks, such as the "triple helix" model (academia, industry, and government), support knowledge sharing, innovation, and commercialization of ideas, thus creating an ecosystem conducive to continuous innovation.
Data-driven decision-making	Knowledge management systems facilitate data analysis and structured approaches for storing and utilizing information, which enables organizations to derive insights, improve responsiveness, and innovate sustainably in a rapidly changing environment.

Source: The authors.

Knowledge-based economies are inherently dynamic. However, sustaining this dynamism requires dedicated investment in education, technology, collaboration, and R&D. Only then can economies achieve sustainable growth in an era where intellectual capital is the key to value creation.

Current Trends in the Knowledge Economy

The knowledge economy is undergoing a major transition shaped by rapid technological advancements, globalization, and the supremacy of knowledge and innovation. These forces are molding economies and driving sustainable growth (see Table 4).

One major megatrend is digital transformation, characterized by the pan-sectoral integration of digital technologies into corporate business models. Digital data is now a valuable asset, as it enables organizations to make data-driven decisions and improve efficiency (Vial, 2019). Advanced analytics, machine learning, and AI have empowered businesses to forecast trends, streamline operations, and provide bespoke services to clients. As a result, data is increasingly viewed as a form of capital itself. This has prompted firms to make enormous new investments in data infrastructure to secure market competitiveness.

Another significant trend is the overwhelming demand for knowledge workers, i.e., professionals with analytical, technical, and creative thinking skills. This has resulted in less demand for workers

with more traditional sets of skills (Davenport, 2005). Only a workforce capable of adapting to technological advancements and solving complex problems can meet this demand, and so, to train these workers, educational institutions must equip digitally literate students with essential critical thinking and problem-solving skills (Davenport, 2005).

Robust innovation ecosystems, characterized by collaboration between academia, industry, and government, are a defining feature of the knowledge economy. Governments support these ecosystems through funding R&D initiatives, creating innovation hubs, and fostering public–private partnerships, recognizing innovation as a key driver of competitive advantage in a globalized market (Cooke, 2001).

The knowledge economy is increasingly globalized, with rapid cross-border exchange of information and innovation. This global trend enables organizations to access diverse knowledge pools, fostering collaboration and driving innovation. However, this interconnectedness presents challenges, such as complex intellectual property protection and heightened cybersecurity risks. Governments and companies must balance the benefits of globalization with the need to protect sensitive information and intellectual assets (Archibugi, 2001).

In addition, lifelong learning and training ("reskilling") are essential for maintaining a competitive workforce in the rapidly evolving knowledge economy. Governments and businesses are investing in reskilling initiatives to address changing job demands and skill gaps. Online education platforms and micro-credentialing offer flexible and accessible learning options, enabling individuals to adapt to the evolving needs of modern industries (Schleicher, 2018).

Finally, protecting intellectual property (IP) is crucial. Only by doing so can governments ensure that the innovations of national champions remain competitive, and so, governments worldwide are reinforcing IP laws and enforcement. Yet, the international regulatory environment remains in flux, and globally IP protection remains a major challenge for firms and governments alike (Maskus, 2000).

TABLE 4

CURRENT TRENDS IN THE KNOWLEDGE ECONOMY.

Trend	Description
Digital transformation	Integration of digital technology across industries to enhance processes, customer experiences, and business models. Data and AI drive decision-making and operational efficiency, positioning data as a valuable asset and capital.
Increasing demand for knowledge workers	Knowledge workers, valued for analytical, technical, and creative skills, are essential to knowledge-driven industries. This trend pressures educational institutions to focus on digital literacy, critical thinking, and problem-solving.
Development of innovation ecosystems	Collaboration between universities, research institutions, government, and private sectors drives innovation. Governments support these ecosystems through R&D funding, innovation hubs, and public–private partnerships.
Globalization and cross-border knowledge exchange	Rapid exchange of information and innovation across borders enhances access to specialized expertise. Digital platforms facilitate this exchange, though IP protection and cybersecurity challenges arise with global interconnectedness.

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Trend	Description
Lifelong learning and reskilling	Continuous skills updates are critical in a fast-evolving knowledge economy. Reskilling initiatives, online learning, and corporate training programs help workers adapt to changing demands and address skills gaps.
Intellectual property protection	IP protection secures innovations, especially in technology and pharmaceuticals. Strengthening IP laws is crucial, yet achieving consistent global protection remains challenging due to varying regulations.

Source: The authors.

These trends underscore the dynamic evolution of the knowledge economy, in which continuous innovation, global collaboration, and adaptive learning are all critical factors of production. The landscape of the knowledge economy is one where intellectual capital and digital capabilities take precedence over classical factors of production.

Critical Issues in the Knowledge Economy

While the knowledge economy presents significant opportunities for growth and innovation, it also poses risks that must be addressed in order to ensure equitable and secure access to knowledge and thus continued growth. Particularly, digital inequality, cybersecurity, and intellectual property protection are salient issues that must be grappled with (see Table 5).

TABLE 5

CRITICAL ISSUES IN THE KNOWLEDGE ECONOMY.

Issue	Description
Digital inequality	Digitalization disrupts traditional industries and employment, while the need for continuous reskilling, restructuring, and adaptation strains resources, widens the gap between digital leaders and traditional firms, and poses regulatory challenges. Unequal access to digital resources creates a digital divide that stretches to separate industries, firms, and countries as well. Inclusive and comprehensive policies are needed to promote equitable access to infrastructure and skills.
Cybersecurity and data privacy	Increased reliance on data exacerbates vulnerability to cyber threats. Cybersecurity investments and stricter laws (such as the European Union's General Data Protection Regulation) are essential to guard against breaches of sensitive data and protect privacy.
Safeguarding intellectual assets	Cross-border innovation flows make it more difficult to legally protect IP, even as the fragmented and complex regulatory regimes complicates enforcement efforts. Taken together, these issues raise the risk of IP theft and deter investment. Strengthened international IP laws and treaties are needed to safeguard innovation in the knowledge economy.

Source: The authors.

One especially pressing issue is digital inequality, often referred to as the digital divide, which stems from unequal access to digital resources. While the digital transformation has led to major advancements, it has also disrupted the structure of employment in traditional industries. To remain

competitive, companies are increasingly forced to constantly innovate and adapt their business models. This adaptation often takes the form of investments in emerging technologies such as AI, cloud computing, and data analytics. But these investments are a drain on corporate resources, and many traditional firms have been unable to do so, thus widening the digital divide between them and the digital firms leading the market. Moreover, constant technological disruptions also present a significant regulatory burden, as regulators must balance the need for innovation with the responsibility to protect stakeholders from the risks and fallouts of rapid technological changes (Vial, 2019).

The digital divide exists within as well as between countries. Disparities in access to high-speed internet, digital literacy, and advanced technologies often reflect class divisions. As economies become increasingly knowledge-driven, individuals and regions lacking access to digital infrastructure, tools, and education often become marginalized, limiting their participation in the economy. In this way, the digital divide worsens extant socioeconomic inequities, highlighting the need for inclusive policies that promote more widespread access to digital infrastructure, literacy, and skills development (Hargittai, 2003). Bridging this gap is essential to ensure that individuals living anywhere can benefit from and contribute to the knowledge economy.

In addition, as data has become a vital asset in the knowledge economy, the chorus of voices raising concerns regarding cybersecurity and data privacy is growing louder. Organizations rely on vast volumes of data to inform decisions, gain insights into customers and other stakeholders, and drive innovation, but this reliance also makes them vulnerable to cyberthreats.

Cyberattacks are growing in sophistication even as they become more frequent, thus posing serious risks to personal and organizational finances, privacy, and even national security. Data breaches and neglect of data security can result in the loss of intellectual property, reputational damages, and punitive fines. In response, companies are investing heavily in cybersecurity measures while governments have implemented ever-stricter data protection regimes, best exemplified by the EU's General Data Protection Regulation (GDPR). These efforts are designed to safeguard individual privacy and data integrity (Bélanger and Crossler, 2011).

Finally, the protection of intellectual property is fundamental to the proper functioning of the knowledge economy. In the knowledge economy, innovation is the primary driver of economic value, making the protection of proprietary knowledge an overriding concern for any business. However, protecting intellectual property is extremely challenging due to its transient nature. Knowledge and innovations move freely across borders, amplifying the risk of IP theft. Moreover, globalized firms and organizations are often confronted with a wildly diverse and occasionally incoherent set of IP regulations to meet, which complicates enforcement and leaves IP vulnerable in many jurisdictions. Ineffective or inconsistent IP laws can discourage innovation and reduce investments in R&D, as firms are apprehensive of poor returns on their R&D efforts. Talks to strengthen global IP protection through treaties such as the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) are underway but face significant challenges to adoption (Maskus, 2000).

It is necessary for all stakeholders to tackle these and other issues to ensure continued growth of the knowledge economy. Policymakers, businesses, and individuals must work collaboratively to bridge the digital divide, strengthen cybersecurity, and protect intellectual assets, ensuring that the benefits of the knowledge economy are accessible and secure for all.

Role of AI in the Transition to a Knowledge Economy

AI as a Catalyst for Knowledge Creation and Innovation

AI has the potential to catalyze economic activity in the knowledge economy (see Table 6), driving innovation and reshaping the way knowledge is created, shared, and applied across sectors. It has proven especially adept at processing data, automating complex tasks, and generating insights from large sets of data. This is enabling organizations to innovate more effectively while fostering economic growth and enhancing competitiveness.

TABLE 6

THE ROLE OF AI IN THE TRANSITION TO A KNOWLEDGE ECONOMY.

Role	Description
Data-driven innovation	AI algorithms process and analyze vast troves of data quickly, generating insights into consumer behaviors and market trends, and making it easier for firms to offer more personalized services to their clients and stakeholders. This data-centric approach enhances decision-making and competitiveness in a variety of sectors.
Automation of routine tasks	AI-powered tools such as robotic process automation (RPA) streamline repetitive tasks, freeing human resources to perform high-value strategic and creative work. This enhances organizational efficiency and fosters a culture of innovation.
Collaborative knowledge creation	AI facilitates real-time global collaboration through digital platforms by reducing barriers to communication. Important tools include AI-powered translation packages and predictive analytics, which allow for more seamless knowledge-sharing across borders.
Personalized learning	AI-driven learning platforms adapt to individual learning styles, making education, skill development and training (all essential in knowledge economies) more accessible and efficient.
Predictive modeling and simulation	AI enhances knowledge generation by making the construction of predictive models much simpler in a range of fields, from environmental science to finance. The insights generated by these models can be used to inform policymaking and aid in forecasting, thus expanding the scope and scale of human understanding of various phenomena.

Source: The authors.

Contemporary AI algorithms (and especially those used in deep learning and machine learning) are adept at facilitating data-driven innovation, being capable of processing and analyzing vast amounts of data with speed and accuracy. Such capabilities are critical in the knowledge economy, where data is an asset that is leveraged to improve decision-making and enhance operational efficiency. For instance, AI algorithms are used to analyze consumer behavior data, identify market trends, and develop targeted marketing strategies, which help businesses stay competitive in dynamic markets (Brynjolfsson and McAfee, 2014). In industries like healthcare, AI-driven data analytics have accelerated the development of personalized medicines through automated analyses of genetic, clinical, and lifestyle data. These analyses can be used to create treatment plans tailored to the needs of individual patients (Topol, 2019). By extracting actionable insights from large and complex datasets, AI amplifies innovation capacity across various sectors.

AI can also be used to bolster knowledge creation by automating routine tasks, freeing up human resources to perform high-value activities that require creativity, strategic thinking, and problem-

solving. Robotic process automation (RPA), for instance, enables businesses to automate repetitive, rules-based processes, data entry, document processing, and customer support inquiries. This improves efficiency and allows knowledge workers to engage in more strategic tasks, thereby fostering a culture of innovation within organizations (Davenport and Kirby, 2016). In R&D, AI-powered tools including natural language processing (NLP) and text mining programs assist researchers by greatly simplifying the analysis of academic publications, patents, and technical documents, which accelerates the discovery process and enables rapid identification of trends and uncovering of insights (Jurafsky and Martin, 2024).

Moreover, AI plays a central role in collaborative knowledge creation by facilitating real-time cross-border collaborations. Digital collaboration platforms, equipped with AI tools such as translation services, break down language barriers and enable seamless communication and knowledge exchanges between international teams (Lee, 2018). Predictive analytics and project management software powered by AI can further streamline knowledge-sharing processes, thereby allowing global teams to make data-driven decisions and adapt to new information rapidly.

AI also fuels innovation by enabling personalized learning and adaptive knowledge systems. In the education sector, for instance, AI-driven platforms offer personalized learning experiences by adapting content to individual learning styles, alternating pace, and adjusting to personal preference. Educational AI platforms can identify areas where learners struggle to provide more customized resources or exercises to address specific needs (Luckin et al., 2016). In the workplace, AI-powered learning management systems can help organizations deliver bespoke training services, ensuring that employees acquire the necessary skills and knowledge to adapt to changing industry demands. Personalized AI-driven learning systems support continuous skill development and even re-skilling, both of which are essential for workers in knowledge economies.

Furthermore, AI-based predictive modeling and simulation are powerful instruments used by scientists and researchers that greatly accelerate the production of new knowledge. In the field of environmental science, for instance, AI modeling tools can simulate climate patterns, helping scientists analyze environmental changes and project future climate scenarios, which could ultimately be used to inform policy decisions and research priorities (Rolnick et al., 2022). In the finance sector, AI algorithms can assist in forecasting economic trends and assessing market risks, thereby helping firms and policymakers make informed decisions based on predictive insights. These capabilities testify to the ability of AI to not only process information but also generate new insights that expand the boundaries of human knowledge.

However, while AI can speed up knowledge creation and innovation, it also poses serious challenges that require careful management. Privacy, algorithmic transparency, and bias are all inherent risks in AI models, and call for more responsible AI governance. As AI continues to shape the knowledge economy, governments need to develop ethical guidelines and regulatory frameworks to ensure that AI-driven innovation benefits the society equitably and sustainably (Floridi et al., 2018).

In summary, AI has the potential to powerfully catalyze knowledge creation and innovation by transforming data into actionable insights, automating complex processes, facilitating global collaborations, personalizing learning experiences, and generating predictive knowledge. Through these capabilities, AI can amplify the knowledge economy's growth potential, helping organizations and individuals thrive in an era in which intellectual capital and technological advancement are paramount.

Impact of AI on Workforce Dynamics and Knowledge Work

AI is reshaping the dynamics of the knowledge economy's labor market and transforming the nature of work (see Table 7). The adoption of AI has led to new roles, skills, and workflows to which workers and organizations must adapt, creating both opportunities and challenges. As AI automates routine tasks, shifting the focus to higher-value work, it also drives demand for more specialized skills, and it is through this mechanism that it manifests a profound impact on the workforce.

TABLE 7

IMPACT OF AI ON WORKFORCE DYNAMICS AND KNOWLEDGE WORK.

Impact	Description
Automation of routine tasks	AI can be used to automate routine tasks such as data entry and scheduling, freeing employees to focus on higher-value, creative tasks; boosting productivity; and reducing the potential for human error.
Creation of new specialized roles	AI has generated demand for new roles, including data scientists, AI ethicists, and automation specialists, as well as "hybrid" roles that combine domain expertise with AI skills. These new jobs require technical proficiency and represent a bridge between AI and traditional sectors.
Reskilling and upskilling demands	The need for AI-related skills is pressuring educational systems and companies to support lifelong learning initiatives, using flexible learning formats and leading to the creation of so-called "micro-credentials" designed to help workers gain the skills necessary to adapt to evolving job requirements.
Job transformation vs. displacement	While some roles are at risk of automation, AI more often transforms jobs rather than eliminating them outright. These transformations create opportunities in areas that complement AI and mitigate negative impacts on employment.
Human–AI collaboration	AI enhances the efficiency of knowledge work by making complex decision-making easier and allowing workers to tackle more sophisticated problems. In doing so, AI has helped redefine roles and led to a re-emphasis on creativity and critical thinking, as companies look to balance human insights and AI capabilities.

Source: The authors.

Nowhere is the impact of AI on workforce dynamics more evident than in the automation of routine and repetitive tasks. By leveraging AI and machine learning, businesses can automate tasks such as data entry, scheduling, and basic customer service interactions. RPA, for example, allows businesses to streamline previously labor-intensive but low-value processes (Davenport and Ronanki, 2018). This has enabled employees previously stuck with busywork to focus their time and energies on strategic, creative, and analytical tasks that AI cannot yet perform, thus enhancing the overall productivity and allowing workers to engage in more intellectually stimulating roles.

AI is also creating demand for new, specialized roles that did not exist before. As organizations adopt AI technologies, they are hiring workers for new positions as data scientists, AI ethicists, machine learning engineers, and automation specialists. These jobs require advanced skills in data science, algorithm development, and AI ethics, thus highlighting the growing need for technical proficiency in the workforce (Bughin, 2018). Firms are also hiring workers in new hybrid roles, which combine expertise in legacy domains with AI proficiency. This is especially pronounced in the healthcare and finance sectors. Medical professionals trained in AI-enabled diagnostic tools, and financial analysts that have studied predictive modeling, can interpret AI-generated insights within their fields, effectively bridging the gap between technical teams and traditional departments (Brynjolfsson and McAfee, 2014).

The new prominence of AI-centric roles has created a demand for reskilling and upskilling curricula that teach the requisite skills. As AI and automation transform job requirements, lifelong, continuous learning has become essential to workforce development. Many governments and companies are investing in lifelong learning initiatives and are providing opportunities for workers to acquire relevant skills in AI, data analytics, and digital literacy. Online platforms and modular courses have popularized new kinds of qualifications such as micro-credentials and nanodegrees, which are both flexible and accessible, allowing workers to reskill or upskill as per their own schedules (Bessen, 2018). These programs are particularly valuable to knowledge workers who must stay updated with rapidly evolving technologies to remain competitive in the job market.

In summary, AI is reshaping workforce dynamics and transforming the nature of work in knowledge economies. It has enabled the automation of routine tasks, demand for new skillsets, and fostered greater human–machine collaboration. However, it has also raised serious ethical questions, thereby making its impact on the workforce multidimensional and complex. Job displacement remains a real risk, and it is important that AI ethics guidelines be developed and followed. Nevertheless, reskilling, upskilling, and responsible AI practices have the potential to enable workers and organizations to more effectively harness the enormous potential of AI and more readily adapt to the rapidly evolving digital landscape.

Challenges and Ethical Considerations of AI Integration

AI is becoming a pillar of the knowledge economy, but it brings with it a set of challenges and ethical considerations that impact organizations, individuals, and societies at large (see Table 8). Addressing these issues is crucial to ensure that AI-driven innovation promotes equitable, secure, and responsible growth.

TABLE 8

CHALLENGES AND ETHICAL CONSIDERATIONS OF AI INTEGRATION.

Impact	Description
Data privacy and security	AI relies on vast troves of data, raising concerns about the collection, storage, and use of personal and sensitive information. Ensuring compliance with privacy laws such as the European Union's General Data Protection Regulation (GDPR) is essential, particularly for multinational organizations.
Algorithmic bias and fairness	AI models are built by humans and thus may inevitably contain inherent social biases. These biases may in turn generate discriminatory outputs. Mitigating bias requires AI models to be developed with equity and sensitivity in mind, and data to be carefully curated. Most important, AI models should be transparent to ensure that AI systems are equitable and reliable and their designers accountable to all stakeholders.
"Black box" transparency	Many AI models, especially deep learning algorithms, are essentially "black boxes," i.e., proprietary blocks of code indecipherable to all but their designers. This poses major risks in healthcare, finance, and other fields where decision transparency is crucial. Using Explainable AI (XAI) frameworks can enhance understanding and oversight.
Job displacement	Automation of routine tasks through AI raises concerns about workforce displacement. Proactive reskilling and upskilling are essential to help workers develop AI competencies and transition to roles where they can use their new skills.
Environmental impact	Training large AI models consumes substantial energy, increasing carbon footprints. Sustainable practices, such as developing energy-efficient algorithms and optimizing data centers, are critical to address AI's environmental impact.

Source: The authors.

One of the main challenges associated with the widespread integration of AI is data privacy, or the security of personal information. AI systems rely on reams of data to train models, make predictions, and deliver insights. However, collection, storage, and use of personal information for these models raise significant privacy concerns. Breaches in data security can lead to severe consequences, including identity theft, financial fraud, and unauthorized access to sensitive information (Bélanger and Crossler, 2011). As AI technologies continue to penetrate all sectors of the economy, maintaining rigorous data protection standards is essential. The European Union's General Data Protection Regulation (GDPR) has established a framework for data privacy, but ensuring compliance remains a challenge for multinational corporations of global reach (Tene and Polonetsky, 2012).

Another critical ethical issue is algorithmic bias and fairness. AI models, particularly those based on machine learning, are built by humans using data generated mostly by humans and thus are likely to reflect existing social prejudices. These embedded prejudices may lead to unfair or discriminatory outcomes when AI systems are utilized. For example, biased training data in hiring algorithms can result in discriminatory recruitment (O'Neil, 2016). Similarly, biases in predictive policing models have been shown to disproportionately target certain communities, raising concerns about equity and justice. Addressing algorithmic bias requires a conscientious approach to AI model development, including rigorous data curation, transparency, and testing to identify and mitigate biased outcomes. Researchers and practitioners have advocated for major AI models to adopt explainable AI (XAI) models to help ensure that these models provide understandable, valid decisions, and foster increased accountability and trust in AI systems (Doshi-Velez and Kim, 2017).

The "black box" nature of many AI models presents an additional ethical concern. Complex AI algorithms, especially those built using deep learning models, are often opaque systems where decision-making processes are difficult to interpret. This lack of transparency poses significant risks in fields where understanding the rationale behind decisions is essential, e.g., healthcare, law enforcement, and finance. In these areas, AI-driven decisions must be explainable to ensure that they are ethically sound and legally defensible (Burrell, 2016). Developing easily understandable models and fostering transparency through XAI frameworks can help address this challenge, making it possible for humans to understand, validate, and challenge AI-driven decisions as and when necessary.

In addition, concerns over worker displacement continue to grow as AI continues to automate routine tasks performed by both blue and white-collar workers. Jobs in which workers repeatedly perform predictable, repetitive tasks, such as data processing, manufacturing, and basic customer service, are especially vulnerable to automation (Frey and Osborne, 2017). While integrating AI into workflows does create new roles requiring specialized skills, it also necessitates proactive measures to support workers at risk of displacement. Reskilling and upskilling initiatives are needed to equip workers with in-demand skills and ensure that they can transition to new roles that AI is yet to impact significantly. Governments and companies must take a proactive approach to address job displacement, promoting an inclusive transition toward a future where AI augments, rather than replaces, human capabilities (Brynjolfsson and McAfee, 2014).

Finally, the environmental impact of AI has emerged as a pressing ethical concern. The computational resources needed to train large-scale AI models, particularly those based on deep learning algorithms, are voracious consumers of energy. Studies have shown that training a single deep learning model can emit as much carbon dioxide as five cars do over their entire lifespans (Strubell et al., 2020). This energy-intensive nature of AI is likely to exacerbate the carbon footprint

associated with digital technologies, raising concerns about the environmental sustainability of AI development. As AI adoption increases, developing energy-efficient algorithms and prioritizing sustainable practices in data centers will become crucial to minimizing the environmental impact of AI technologies.

In this section, we discussed the immense potential of AI to drive innovation and growth in the knowledge economy, but also showed how its integration into contemporary workflows poses significant ethical and policy challenges. Data privacy, algorithmic bias, transparency, job displacement, and environmental impact are all intractable issues that companies and regulators nonetheless need to tackle. Ensuring responsible AI integration requires a collaborative effort from policymakers, businesses, and researchers to establish standards and frameworks that promote transparency, fairness, accountability, and sustainability. Only by addressing these ethical considerations can society reap the benefits of AI while mitigating its potential risks. This is what it will take to foster a knowledge economy that is not only innovative but also ethical and sustainable.

SECTION 3:

ANALYSIS OF AI UTILIZATION IN APO ECONOMIES AND ACROSS THE GLOBE

Introduction

In this section of the report, we analyze and compare how APO member companies utilize AI technologies, drawing from a rich set of patent data. Our analysis is based on two basic research questions.

Research question 1: How big is the gap in AI innovation within APO member economies?

By examining trends in AI patents in APO member economies, we highlight the significant disparities in intra-APO AI innovation capacity. We find that, among APO members, Japan, the ROK, and India are at the forefront in terms of AI patent filings, while other members are lagging behind.

Research question 2: How do the leading APO member innovators compare with major world economies?

In this section, through a comparative analysis of Japanese and Korean AI patent filings with the filings by the USA, PR China, France, Germany, Canada, and the UK (hereafter referred to as the Big Six), we illustrate how the top APO member innovators stand in comparison to the global leaders in AI technology. Our analysis here produces quantitative evidence of the capabilities of APO members regarding new and advanced technologies.

We analyze AI trends using patent data from the OECD to provide a structured and comprehensive measure of AI innovation output. These data effectively represent the innovation capacities of entire countries, regions, and specific technological sectors. Patents are a critical metric as they directly reflect the performance and output of inventive activities across economies. As shown in Baruffaldi et al. (2020), AI patenting activity can be effectively traced using a combination of patent classification codes and specific AI-related keywords. This method effectively captures the diversity of advancements within the field. Moreover, the OECD dataset includes recent (2021) data, allowing for a more contemporary analysis, despite the usual time lag between patent filing and disclosure (OECD Data Explorer, 2024).

AI patents are typically identified through fractional counts to accurately attribute patents to each country involved. This approach is used because international collaborations often produce patents. By attributing a fraction of the patent to each contributor, the fractional count method provides a more nuanced view of any given country's input to AI innovation. This system covers AI patents filed with the United States Patent and Trademark Office (USPTO) and the European Patent Office (EPO), the world's two most prominent registries of global patent activity.

AI Utilization Trends: APO Members vs. World

We analyze AI innovation performance for 15 APO member economies, namely, the ROC, Hong Kong, India, Indonesia, IR Iran, Japan, the ROK, Malaysia, Mongolia, Pakistan, the Philippines, Singapore, Sri Lanka, Thailand, and Turkiye.[1] Our analysis shows that Japan, the ROK, and India stand out as the leading innovators within the APO group, with patenting activities that reflect significant advancements in AI technologies, particularly in robotics, machine learning, and neural networks. We then compare the performances of APO members with each other and to the aforementioned Big Six major economies (USA, PR China, Germany, France, Canada, and UK), revealing large disparities in various AI innovation capacities. Through this comparison, we find significant disparities in AI innovation both within the APO group and between the APO group and the major global economies.

First, we found a large gap in AI patent output between the members of the APO. Japan and the ROK were found to be the primary drivers of AI innovation, filing substantially more patents than other APO members. This reflects their established roles as technological leaders and highlights their capacity to develop and protect AI-related technologies across multiple domains. Conversely, most of the other APO members have produced few AI patents, which suggests that they have much room for growth and capacity-building.

And while Japan and the ROK are active players in AI innovation, they nonetheless lag the world leaders, especially PR China, which has posted a substantial increase in AI-related patents, particularly machine learning and image processing patents. This signals that PR China's strategic emphasis on AI innovation is already influencing global AI trends. In the USA, we found patenting activity to be concentrated around application-driven areas like autonomous vehicles and natural language processing. By contrast, Japanese AI patents are focused on industrial AI, especially in areas of robotics and automation.

These findings provide insights into the strengths and limitations of APO member economies and show how APO AI leaders Japan and the ROK compare with the global frontrunners. The results of our analysis also carry implications for policymaking. One obvious suggestion is to build a framework for enhanced collaboration among APO members to enhance their AI capacities. Taken together, the insights gleaned through our analysis of patent data in this section help foster a clearer understanding of both opportunities and challenges that APO economies face in the evolving AI landscape. They also highlight areas in need of strategic development, particularly in fostering the innovation ecosystems that can bridge disparities in AI patenting and investment.

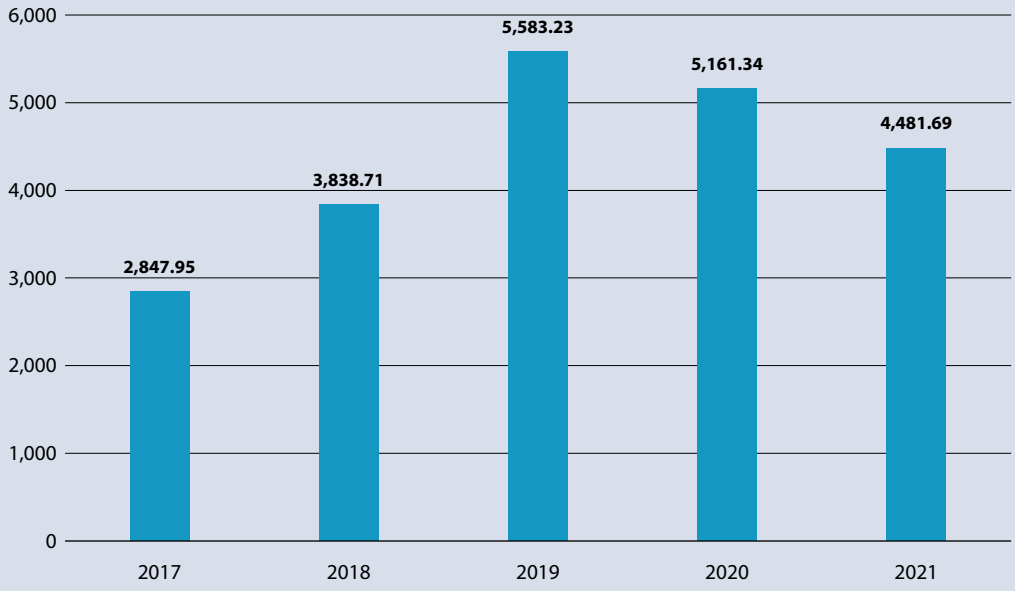
AI Patent Filings at the USPTO by APO Members

Figure 1 illustrates the trend in AI patents filed at the USPTO by APO member economies between 2017 and 2021. From 2017 to 2019, we can observe a clear upward trajectory, with the total number of AI patents jumping from 2,847.95 in 2017 to 3,838.71 in 2018 before peaking at 5,583.23 in 2019. This growth reflects a surge in innovative activity and investment in AI technologies among APO members during this period. However, after 2019, we can see a slight decline in patenting activity. This could be due to a shift in patenting strategies; the impact of global economic conditions (the COVID-19 pandemic); or other factors that could have influenced the AI innovation landscape within APO member economies post 2019.

[1] Patent data for some APO member economies (specifically Bangladesh, Cambodia, Nepal, Fiji, Vietnam, and Lao PDR) are absent in the OECD dataset. This is likely due to a lack or complete absence of AI patenting activities.

FIGURE 4

AI PATENT FILINGS AT THE USPTO BY APO MEMBERS.



Source: The authors, based on data from the OECD Data Explorer (2024).

Table 1 presents AI patent activity for every APO member economy with a relevant patent filed at the USPTO from 2017 to 2021. The table features both raw observations and the compound annual growth rates (CAGR) in patenting activity. We can see how Japan, the ROK, and India lead the APO pack. Japan peaked in 2019 with 2,308.1 patents, but this figure fell to 1,354.0 in 2021, resulting in a negative CAGR of –2.49%. The ROK maintained a strong growth throughout the period, achieving a CAGR of 21.03% and reaching 1,110.4 patents by 2021. India also demonstrated an impressive growth, with the number of patents filed increasing from 568.6 in 2017 to 1,398.0 in 2021, resulting in a robust CAGR of 25.22%. Patents from the ROC also grew notably over the same period, from 163.9 to 404.6 (CAGR of 25.34%). Overall, the table highlights the dominance of Japan, the ROK, and India among APO members in AI patent filings, suggesting that other APO member economies are at relatively early stages of AI development.

TABLE 1

AI PATENT FILINGS BY APO MEMBERS AT THE USPTO.

Member	2017	2018	2019	2020	2021	CAGR(%)
Bangladesh	0	0	0	0	0	0
Cambodia	0	0	0	0	0	0
The ROC	163.9	296.7	387.2	378.5	404.6	25.34
Fiji	0	0	0	0	0	0
Hong Kong	20.3	33.2	24.8	24.1	27.1	7.46

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Member	2017	2018	2019	2020	2021	CAGR(%)
India	568.6	809.8	1,118.0	1,203.7	1,398.0	25.22
Indonesia	0.8	0.7	0.9	1.7	1.9	26.04
IR Iran	1.2	4.5	2.3	3.3	5.7	48.45
Japan	1,497.7	1,869.2	2,308.1	2,007.1	1,354.0	–2.49
The ROK	517.4	726.8	1,617.1	1,362.7	1,110.4	21.03
Lao PDR	0	0	0	0	0	0
Malaysia	6.7	6.7	5.4	16.4	13.7	19.47
Mongolia	0.5	0.0	0.3	0.0	0.0	–100
Nepal	0	0	0	0	0	0
Pakistan	0.9	1.2	0.5	1.0	6.4	63.52
The Philippines	1.7	5.6	3.7	5.7	1.7	0.98
Singapore	51.0	66.5	99.1	141.0	139.7	28.65
Sri Lanka	2.0	0.0	0.1	1.1	1.5	–6.94
Thailand	0.0	2.8	4.4	2.4	10.2	0
Turkiye	15.3	14.9	11.4	12.8	6.8	–18.37
Vietnam	0	0	0	0	0	0

Source: The authors, based on data from the OECD Data Explorer (2024).

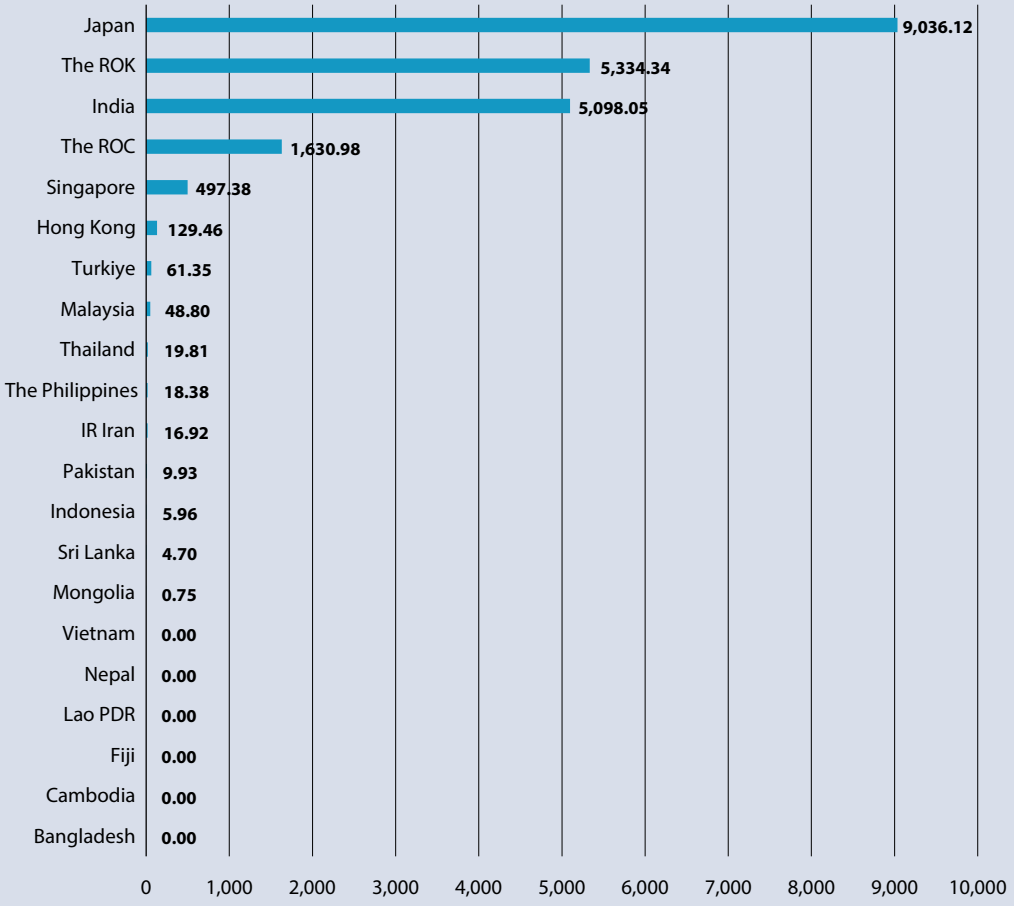
Figure 2 visualizes aggregate AI patenting activity at the USPTO by APO member economies over the same period. In terms of raw patent count, Japan is far ahead, with a total of 9,036.12 patents, testifying to its prominent role in AI innovation within the APO. The ROK follows behind with 5,334.34 patents; and is closely followed by India with 5,098.05 patents. These three countries have thus far dominated AI patenting activity in the APO bloc, illustrating their advanced capabilities and continued investment in AI R&D. The ROC is also a hub of AI patent activity, having filed a total of 1,630.98 patents with the USPTO. This highlights its emergence on the AI scene.

Meanwhile, Singapore (497.38) and Hong Kong (129.46) are modest contributors to the overall patent count. Most of the other APO members, including Turkiye, Malaysia, and Thailand, are far less active. Vietnam, Nepal, Lao PDR, Fiji, Cambodia, and Bangladesh have reported no AI patents filed with the USPTO to the OECD, meaning we have no data by which to judge their AI innovation activities.

Table 2 presents a ranking of the APO's top 10 AI patent filers (USPTO) from 2017 to 2021. We can see some changes to the rankings over the years. Japan held onto the first place from 2017 to 2020 but was surpassed in 2021 by India. The ROK has maintained a strong position over the years. India and the ROK frequently alternate between second and third places, pointing to their competitiveness in AI innovation.

FIGURE 2

AGGREGATE AI PATENT FILINGS AT THE USPTO BY APO MEMBERS, 2017–21.



Source: The authors, based on data from the OECD Data Explorer (2024).

TABLE 2

AI PATENT FILINGS AT THE USPTO BY APO MEMBERS (TOP 10).

Rank	2017	2018	2019	2020	2021
1	Japan	Japan	Japan	Japan	India
2	India	India	The ROK	The ROK	Japan
3	The ROK	The ROK	India	India	The ROK
4	The ROC	The ROC	The ROC	The ROC	The ROC
5	Singapore	Singapore	Singapore	Singapore	Singapore
6	Hong Kong	Hong Kong	Hong Kong	Hong Kong	Hong Kong
7	Turkiye	Turkiye	Turkiye	Malaysia	Malaysia
8	Malaysia	Malaysia	Malaysia	Turkiye	Thailand
9	Sri Lanka	The Philippines	Thailand	The Philippines	Turkiye
10	Philippines	IR Iran	Philippines	IR Iran	Pakistan

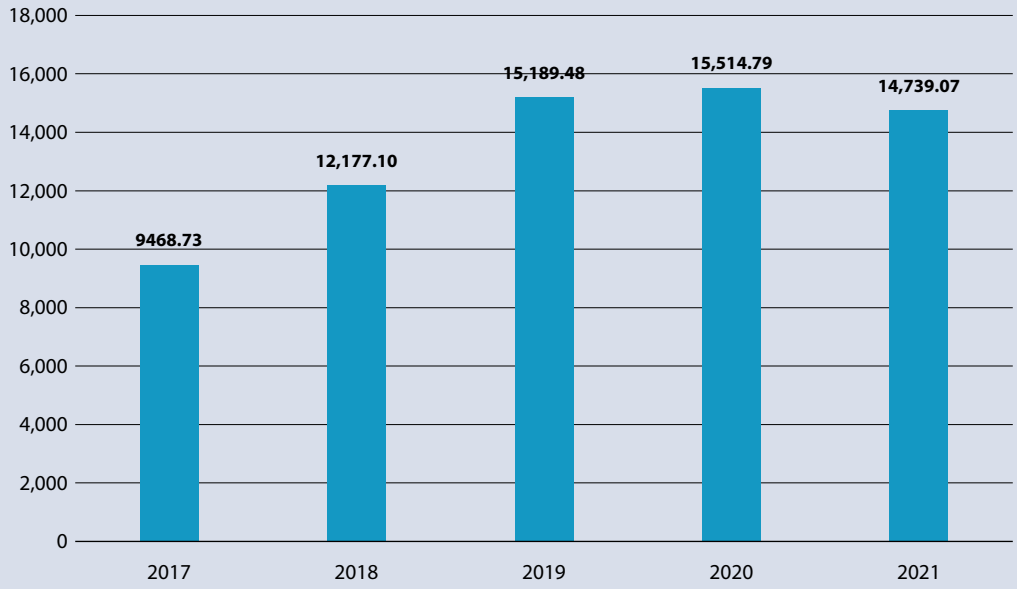
Source: The authors, based on data from the OECD Data Explorer (2024).

Figure 3 presents a graph of total AI patent filings at the USPTO by the USA, PR China, Germany, France, the UK, and Canada from 2017 and 2021.[2] We can observe a steady increase in patenting activity from 2017, when the six countries filed a total of 9,468.73 patents. Filings peaked in 2020 at 15,514.79 patents. This points to a strong commitment to AI innovation in these countries, particularly in the years leading up to 2020. We can, however, see a slight decrease in patent activity in 2021, when the total number of AI patents filed at the USPTO dropped to 14,739.07. This could be just a temporary dip in patent activity, as the overall trend suggests significant levels of investment and AI innovation by the Big Six.

Compared with APO member economies, the difference in scale is palpable. Even though the leading APO AI innovators (Japan, ROK, and India) have all filed large number of patents with the USPTO, their total filings fall short of the totals achieved by the Big Six. This points to a disparity in AI patenting capacity. The major economies of the world are the leaders in AI development, and this fact is manifested in patent filings. The Bix Six studied here demonstrate a high and consistent level of patenting activity, whereas most APO members are still building their foundational capabilities.

FIGURE 3

AI PATENT FILINGS AT THE USPTO BY THE BIG SIX.



Source: The authors, based on data from the OECD Data Explorer (2024).

Table 3 compares USPTO AI patent filings by Big Six countries with those by Japan, the ROK, and India over the same five-year period. The USA leads with 7,595.2 patents filed in 2017 and filings peaking at 11,552.2 in 2019. Over the period under observation, the USA posted a CAGR of 9.57%. PR China is also a leader in AI innovation, recording a CAGR of 25.25%. Germany, Canada, and the UK also show positive growth trends.

[2] The additional analysis focusing on a few countries such as Japan, the ROK, and India aims to highlight the gap and progression between APO member economies and global leaders in AI technology.

In comparison, Japan started strong but slowed down by 2021, posting a negative CAGR of –2.49% in the five-year period. The ROK and India, however, have continued to show substantial growth over the period, with CAGRs of 21.03% and 25.22%, respectively, as the two nations fight for a slice of the market in the competitive AI space. The ROK's patents filed at the USPTO rose from 517.4 in 2017 to 1,110.4 in 2021, while India's count soared from 568.6 to 1,398.0 over the same period.

Overall, our analysis shows that while Japan, the ROK, and India are actively pursuing AI innovations, there nonetheless remains a large gap separating the APO AI leaders both from the global frontrunner (the USA) and other members of the APO. Yet, there is room for optimism, as the strong CAGRs of the ROK and India reflect their commitment to narrowing the gap with the global leaders and expanding their presence in the AI innovation space.

TABLE 3

AI PATENT FILINGS AT THE USPTO BY THE BIG SIX AND THE LEADING APO INNOVATORS.

Member	2017	2018	2019	2020	2021	CAGR (%)
The USA	7,595.2	9,409.5	11,552.2	11,436.9	10,946.9	9.57
Japan	1,497.7	1,869.2	2,308.1	2,007.1	1,354.0	–2.49
PR China	757.6	1,291.2	1,607.5	1,914.5	1,864.2	25.25
The ROK	517.4	726.8	1,617.1	1,362.7	1,110.4	21.03
India	568.6	809.8	1,118.0	1,203.7	1,398.0	25.22
Germany	360.4	499.3	666.5	742.5	651.4	15.95
Canada	290.9	412.4	581.9	626.2	597.1	19.69
The UK	300.4	381.0	528.1	543.2	427.0	9.19
France	164.3	183.7	253.2	251.5	252.4	11.34

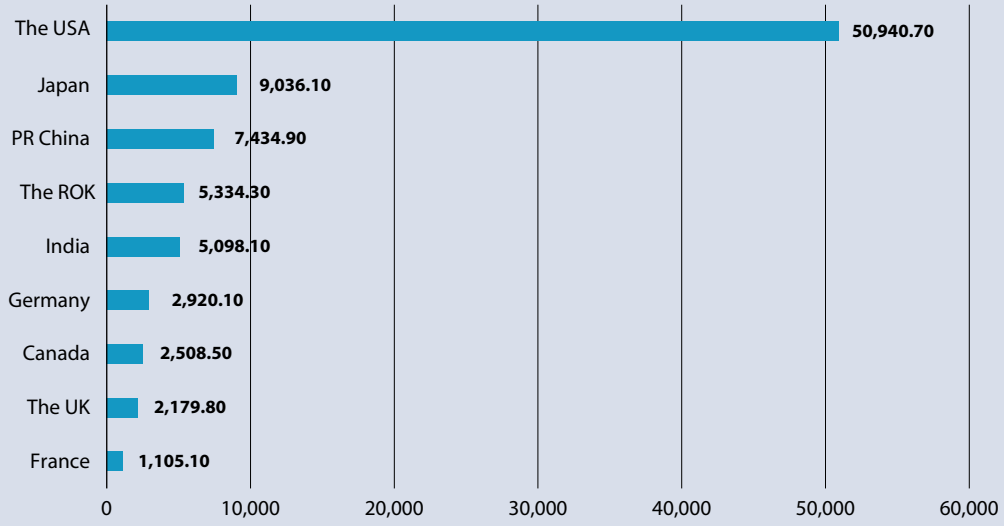
Source: The authors, based on data from the OECD Data Explorer (2024).

Figure 4 presents data on cumulative AI patent filings at the USPTO from 2017 to 2021 by the Big Six and the leading APO AI innovators (Japan, ROK, and India). The USA has filed a staggering total of 50,940.7 AI patents, befitting its dominant position in AI innovation. Japan sits in the second place, with 9,036.1 patents, trailing far behind the global leader. PR China ranks third with 7,434.9 patents, reflecting its rapid growth and investment in AI technologies. Among APO members, the ROK and India are clearly major players, having filed 5,334.3 and 5,098.1 patents, respectively.

In comparison, Germany, Canada, the UK, and France are less active in AI innovation. Germany leads this group with 2,920.1 patents, followed by Canada (2,508.5), the UK (2,179.8), and France (1,105.1). This distribution highlights the substantial disparity between the USA and everyone else. While Japan, PR China, the ROK, and India seem to be actively pursuing AI innovation, the overall patenting output of the USA is unmatched, and it remains the undisputed leader in the field. Furthermore, our comparison demonstrates the varying levels of AI innovation among these nations and the prominent role the USA plays in shaping global AI development.

FIGURE 4

AI PATENT FILINGS AT THE USPTO BY THE BIG SIX AND THE LEADING APO INNOVATORS, 2017–21.



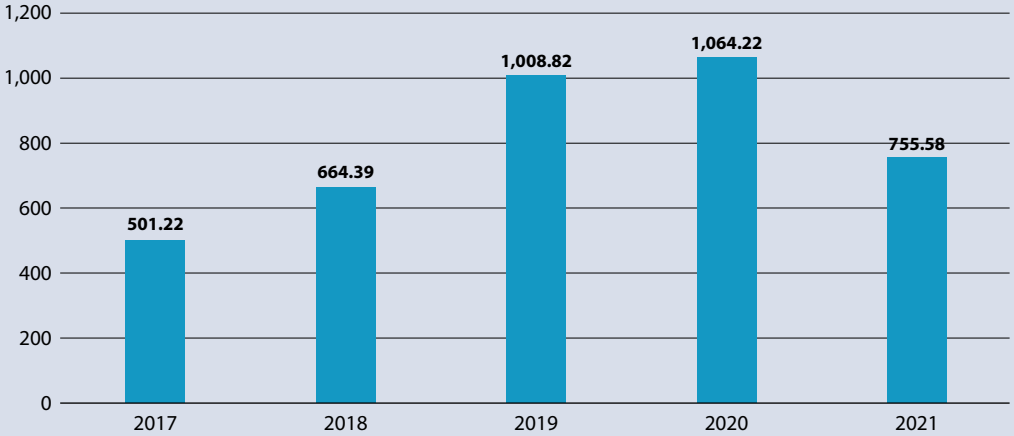
Source: The authors, based on data from the OECD Data Explorer (2024).

AI Patent Filings at the EPO by APO members

Figure 5 illustrates AI patent activity at the European Patent Office (EPO) by APO member economies from 2017 to 2021. The data reveals a steady increase in patent filings over the period under observation, with filings rising from 501.22 in 2017 to a peak of 1,064.22 in 2020. Patent data from Europe mimics the trend evident in the USA, testifying to increased investment and research in AI technologies by APO members. We can, however, observe a drop in filings in 2021, when patent filings slipped to 755.58. This could be due to a number of factors, including the fallout of the COVID-19 pandemic or other economic impacts. Overall, the trend highlights a period of robust AI patent activity and largely mirrors the filing patterns seen in other jurisdictions.

FIGURE 5

AI PATENT FILINGS AT THE EPO BY APO MEMBERS.



Source: The authors, based on data from the OECD Data Explorer (2024).

Table 4 presents data on AI patent filings at the EPO by APO member economies from 2017 to 2021 with CAGR included. Japan leads here too, having filed 299 patents in 2017 and peaking at 460.7 patents filed in 2020. Filings then dropped to 320.1 in 2021. Despite this, Japan maintained a positive CAGR of 1.73% for the period under consideration. The ROK was also a significant contributor, growing from 118.7 patents filed in 2017 to 224.5 in 2021, achieving a CAGR of 17.28%. Indian patent filings were similarly impressive, rising from 62.5 in 2017 to 157.1 in 2020 and maintaining the same level of growth all the way up to 2021, resulting in a strong CAGR of 25.91%. Overall, Japan, the ROK, and India were the main contributors of AI patents in the European jurisdiction among APO members. The ROC and Singapore also increased their filings over the period. This distribution of patent filings at the EPO largely mirrors the patterns observed at the USPTO.

TABLE 4

AI PATENT FILINGS AT THE EPO BY APO MEMBER ECONOMIES.

Member	2017	2018	2019	2020	2021	CAGR (%)
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0
Cambodia	0.0	0.0	0.0	0.0	0.0	0.0
The ROC	10.0	20.0	22.5	13.1	30.5	32.15
Fiji	0.0	0.0	0.0	0.0	0.0	0.0
Hong Kong	3.4	7.7	8.2	8.0	4.2	5.97
India	62.5	92.1	125.3	157.3	157.1	25.91
Indonesia	0.0	0.0	0.7	0.0	0.1	0.0
IR Iran	0.0	0.0	0.0	0.0	0.0	0.0
Japan	299.0	338.0	452.3	460.7	320.1	1.73
The ROK	118.7	187.7	381.0	392.7	224.5	17.28
Lao PDR	0.0	0.0	0.0	0.0	0.0	0.0
Malaysia	0.0	0.0	0.4	1.3	0.1	0.0
Mongolia	0.0	0.0	0.0	0.0	0.0	0.0
Nepal	0.0	0.0	0.0	0.0	0.0	0.0
Pakistan	0.0	0.0	0.0	0.0	0.0	0.0
The Philippines	0.0	0.0	0.0	1.5	0.0	0.0
Singapore	4.8	11.9	14.0	23.1	13.7	30.43
Sri Lanka	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.0	1.0	0.8	0.5	0.1	0.0
Turkiye	3.0	6.2	3.7	6.0	5.0	13.62
Vietnam	0.0	0.0	0.0	0.0	0.0	0.0

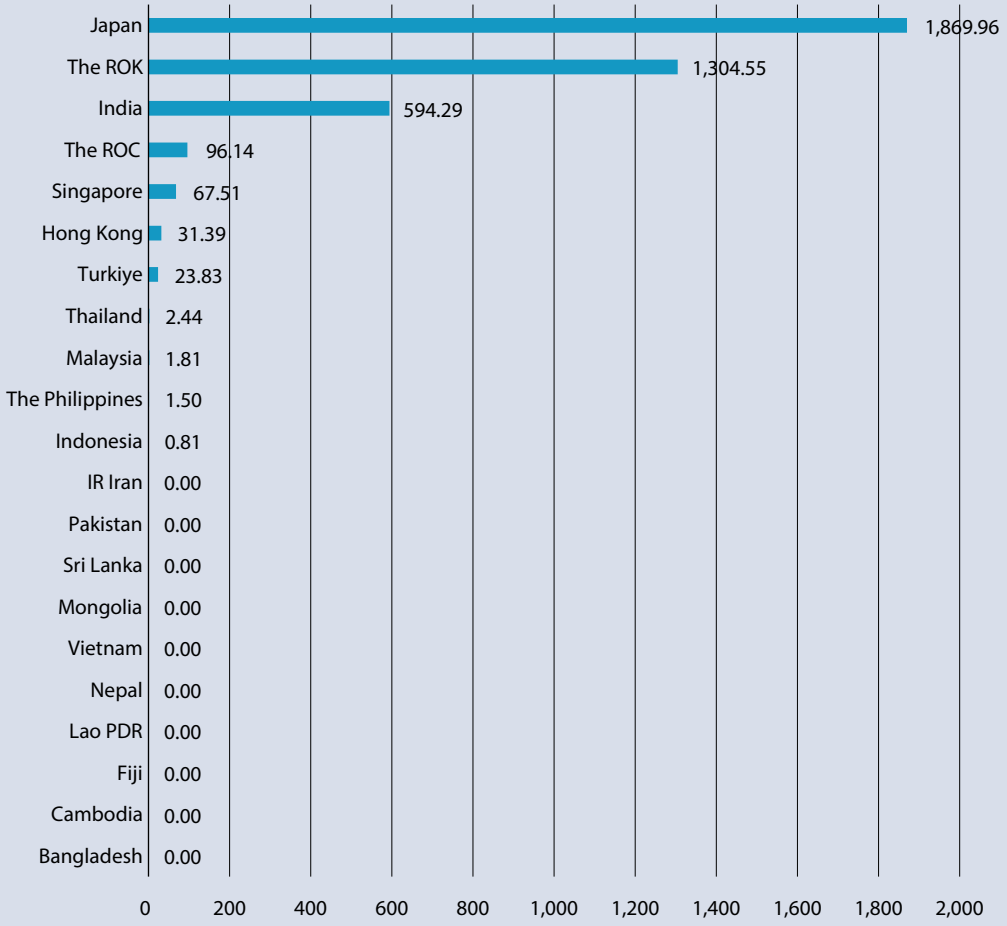
Source: The authors, based on data from the OECD Data Explorer (2024).

Figure 6 presents cumulative data on EPO patent filings by APO member economies from 2017 to 2021. Japan leads by a substantial margin, having filed a total of 1,869.96 AI patents. The ROK follows with 1,304.55 patents. India ranks third, with 594.29 patents, while the ROC and Singapore are modest contributors, having filed totals of 96.14 and 67.51 patents, respectively. Other APO

members, such as Hong Kong (31.39), Turkiye (23.83), and Thailand (2.44), are not major players. Several APO members, including Vietnam, Sri Lanka, Pakistan, Nepal, and others, have no AI patents filed at the EPO.

FIGURE 6

AI PATENT FILINGS AT THE EPO BY APO MEMBERS, 2017–21.



Source: The authors, based on data from the OECD Data Explorer (2024).

Table 5 ranks APO members by the number of AI patents filed at the EPO from 2017 to 2021, highlighting the top seven contributors. Japan filed the most patents in Europe each year of the period under consideration, affirming its commitment to protecting its AI innovations in Europe. The ROK and India were in the second and third places, respectively, throughout the period.

The ROC and Singapore ranked among the top five for the period under study, showing increasing interest in protecting their innovations under European patent law. Hong Kong ranked sixth from 2017 to 2019, while Turkiye held the seventh spot for those three years. In 2021, Turkiye moved up to the sixth position, nudging Hong Kong down to seventh.

As with the rankings of filings at the USPTO, these rankings too reflect a clear concentration of AI patent filings by the leading APO AI innovators, namely, Japan, the ROK, and India.

TABLE 5

TOP 7 APO MEMBERS BY AI PATENT FILINGS AT THE EPO, 2017–21.

Rank	2017	2018	2019	2020	2021
1	Japan	Japan	Japan	Japan	Japan
2	ROK	ROK	ROK	ROK	ROK
3	India	India	India	India	India
4	ROC	ROC	ROC	Singapore	ROC
5	Singapore	Singapore	Singapore	ROC	Singapore
6	Hong Kong	Hong Kong	Hong Kong	Hong Kong	Turkiye
7	Turkiye	Turkiye	Turkiye	Turkiye	Hong Kong

Source: The authors, based on data from the OECD Data Explorer (2024).

Figure 7 illustrates the trend in aggregate AI patent filings at the EPO by the USA, PR China, Germany, France, the UK, and Canada from 2017 to 2021. The data reveal a steady increase in patent filings, from 1,427.78 in 2017 to a peak of 3,471.06 in 2020. However, a noticeable decline follows in 2021, with total filings slipping to 2,917.73. As with filings at the USPTO, this decline likely reflects the impact of external economic conditions.

Comparing APO patent leaders Japan, the ROK, and India with the Big Six countries under study here, we can see that the APO's big three are obviously committed to protecting their intellectual property under European laws but fall behind in terms of sheer scale of patenting activity. Japan, the highest-ranking APO member, filed a total of 1,869.96 patents over this period, followed by the ROK with 1,304.55 patents, and India with 594.29 (see Figure 6). Contrasting these figures with the data shown in Figure 7, we can observe that collectively the Big Six economies under analysis filed more AI patents overall in Europe.

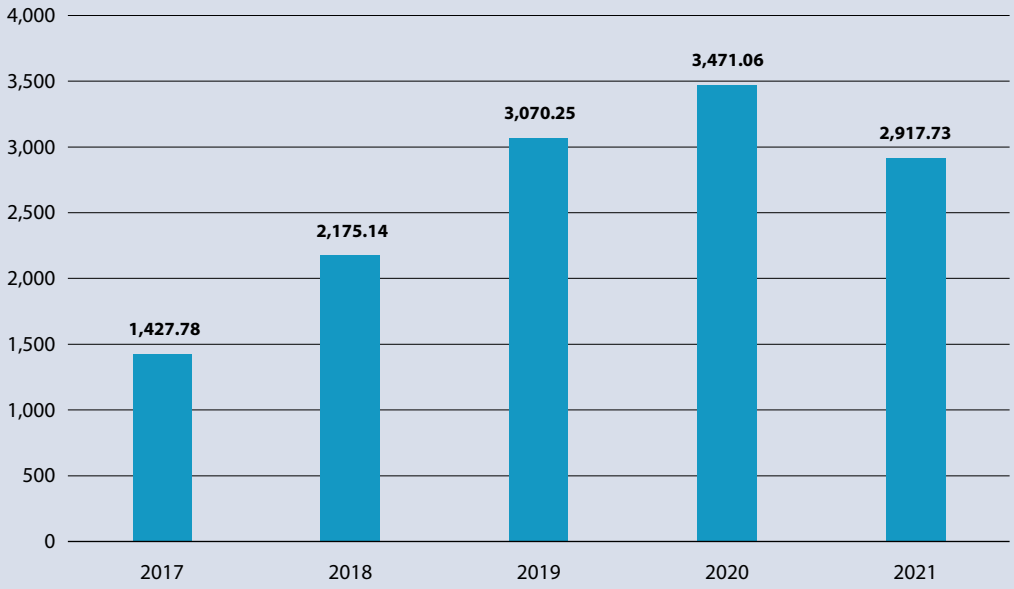
Table 6 presents data on AI patents filed with the EPO by the Big Six and the leading APO innovators (Japan, ROK, and India) from 2017 to 2021, along with their CAGRs. The USA led in terms of number of AI patent filings, beginning at 909.5 in 2017, reaching a peak of 1,902.5 in 2020, and then declining to 1,393.8 in 2021, with a CAGR of 11.26%. PR China showed a remarkable growth, increasing from 182.8 patent filings in 2017 to 656.6 in 2021, achieving the highest CAGR of 37.67% among these countries and underscoring its aggressive expansion in AI innovation in terms of patent filings at the EPO.

Japan was the top APO member in terms of total AI patents filed at the EPO, though its CAGR was relatively modest at 1.73%, with patent counts fluctuating from 299.0 in 2017 to a peak of 460.7 in 2020 and a decline to 320.1 in 2021. The ROK and India filed increasing number of patents over time, with CAGRs of 17.28% and 25.91%, respectively. The ROK filed 118.7 patents with the EPO in 2017 and 224.5 patents in 2021, while India filed 62.5 patents in 2017 and 157.1 in 2021. Patents filed by both the ROK and India peaked in 2020.

Germany demonstrated increased patenting activity over time, with a CAGR of 37.84%. The UK and France also filed more AI patents as time went by, with CAGRs of 10.89% and 29.18%, respectively. In absolute terms, Canada filed relatively fewer patents with the EPO, but its patenting activity grew over time, which is reflected in its CAGR of 23.51%.

FIGURE 7

AI PATENTING WITH THE EPO BY BIG SIX, 2017–21.



Source: The authors, based on data from the OECD Data Explorer (2024).

TABLE 6

AI PATENT FILINGS AT THE EPO BY THE BIG SIX AND LEADING APO AI INNOVATORS.

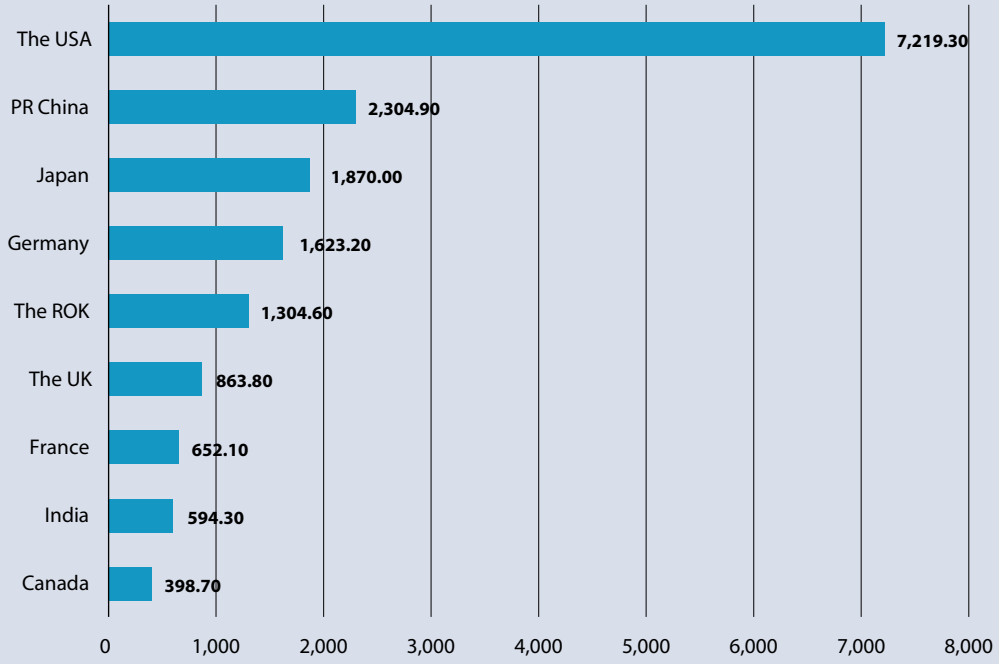
Member	2017	2018	2019	2020	2021	CAGR (%)
The USA	909.5	1,266.8	1,746.7	1,902.5	1,393.8	11.26
PR China	182.8	397.6	486.0	581.9	656.6	37.67
Japan	299.0	338.0	452.3	460.7	320.1	1.73
Germany	117.3	195.6	390.3	496.4	423.6	37.84
The ROK	118.7	187.7	381.0	392.7	224.5	17.28
The UK	112.3	166.5	194.9	220.2	169.8	10.89
France	60.2	94.2	150.9	179.0	167.7	29.18
India	62.5	92.1	125.3	157.3	157.1	25.91
Canada	45.7	54.4	101.5	91.0	106.2	23.51

Source: The authors, based on data from the OECD Data Explorer (2024).

Figure 8 compares AI patent filings at the EPO by the Big Six and the APO's AI patent leaders (Japan, ROK, and India). The USA filed more patents than any other country, with 7,219.3 patents registered at the EPO. PR China followed as the second-highest contributor, with 2,304.9 patents. Among APO member economies, Japan led with 1,870 AI patents, placing it third overall. Among European countries, Germany filed the most AI patents, at 1,623.2.

FIGURE 8

AI PATENT FILINGS AT THE EPO BY BIG SIX AND LEADING APO AI INNOVATORS, 2017–21.



Source: The authors, based on data from the OECD Data Explorer (2024).

The ROK and India were both active in filing AI patents, with 1,304.6 and 594.3 patents, respectively. The UK and France contributed 863.8 and 652.1 patents, respectively, while Canada, with 398.7 patents, rounded out the list. Figure 8 highlights the disparity in AI patenting activity between the USA and the world's other major economies, yet the relatively strong performance of APO members Japan and the ROK relative to their European counterparts stands out.

Total AI Patent Filings at the USPTO and the EPO

Table 7 presents combined AI patent filings at the USPTO and EPO by the Big Six and the leading APO innovators from 2017 to 2021. The USA holds the top position, and its patent filings have steadily increased over the period under observation at both the major patent offices (USPTO and EPO). With a CAGR of 9.75%, the USA demonstrates its stronghold in AI innovation. Among APO members, although Japan leads, its CAGR is slightly negative at –1.75%, suggesting that its AI patent filings may have recently plateaued.

PR China exhibits significant growth with a CAGR of 27.96%, reflecting its rapid expansion and aggressive AI patenting strategy in global markets. The ROK and India also display strong growth in AI patent filings, with CAGRs of 20.36% and 25.29%, respectively, as these leading APO innovators gain traction in global AI innovation. German filings have also grown over time, with a CAGR of 22.48%.

The data indicate a clear divergence: while APO leaders like Japan, the ROK, and India are strengthening their international patenting presence, there is still a substantial gap between these countries and the Big Six including the USA and PR China. This makes strategic investments and

policy support to boost AI innovation and international patenting efforts among APO member economies plainly necessary.

TABLE 7

AI PATENT FILINGS AT THE USPTO AND EPO BY THE BIG SIX AND THE LEADING APO INNOVATORS.

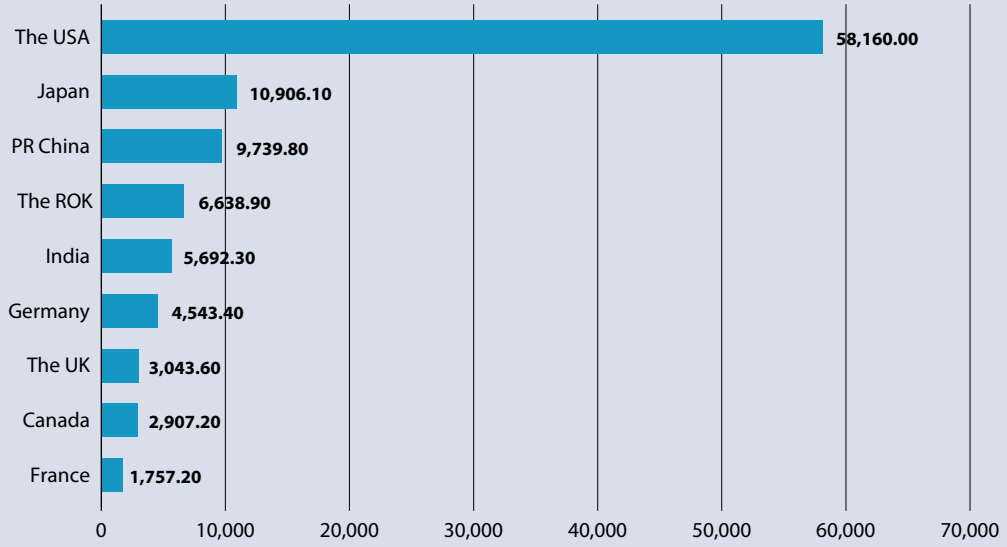
Member	2017	2018	2019	2020	2021	CAGR (%)
The USA	8,504.7	10,676.3	13,298.9	13,339.4	12,340.7	9.75
Japan	1,796.6	2,207.2	2,760.3	2,467.8	1,674.2	-1.75
PR China	940.3	1,688.8	2,093.5	2,496.4	2,520.8	27.96
The ROK	636.1	914.4	1,998.1	1,755.4	1,334.9	20.36
India	631.1	901.9	1,243.3	1,360.9	1,555.1	25.29
Germany	477.7	694.9	1,056.8	1,238.9	1,075.0	22.48
The UK	412.7	547.6	723.0	763.5	596.8	9.66
Canada	336.6	466.8	683.4	717.2	703.3	20.23
France	224.5	277.9	404.1	430.5	420.1	16.96

Source: The authors, based on data from the OECD Data Explorer (2024).

Figure 9 illustrates total AI patent filings at the USPTO and EPO by the Big Six and the leading APO innovators during 2017–2021. The USA leads by a significant margin with 58,160 patents, making obvious its dominant position in global AI innovation. It is followed by Japan with 10,906.1 patents and PR China with 9,739.8 patents, marking them significant contributors to AI advancements. Japan is at the head of the APO pack, followed by the ROK with 6,638.9 patents and India with 5,692.3 patents, suggesting that both countries are active in the AI innovation arena.

FIGURE 9

AI PATENT FILINGS AT THE USPTO AND EPO BY THE BIG SIX AND THE LEADING APO INNOVATORS, 2017–21.



Source: The authors, based on data from the OECD Data Explorer (2024).

Yet, compared with the world leaders, APO innovators lag in terms of AI patent volumes, which highlights a clear need for more intensive AI development. Germany, the UK, and Canada are strong performers among the Big Six, but all three trail the USA.

In this section, we performed a comparative analysis of AI patent filings by six major global economies (USA, PR China, Germany, France, UK, and Canada) and APO member economies at the USPTO and the EPO. Our findings show that the AI patenting activity is dominated by a handful of countries, and the member economies of the APO, despite notable achievements by Japan, the ROK, and India, have much room to grow when it comes to AI development.

SECTION 4:

GLOBAL TRENDS IN AI POLICY

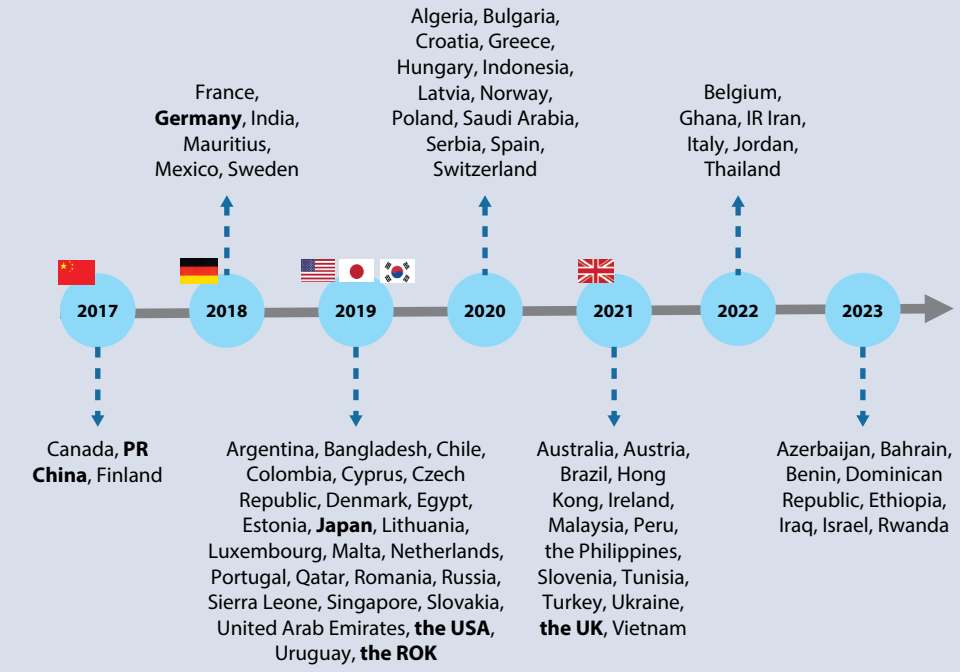
Introduction

In the latter half of the 2010s, we witnessed a surge in the development of AI policies, with countries worldwide formally acknowledging the potential of AI and putting laws on the books. In this section, we investigate global trends in AI policy, focusing on APO member economies and major world economies. We examine national AI strategies as well as more granular measures, highlighting national visions, goals, strategic directions, and specific tools for policy implementation.

In recent years, many countries began adopting national AI strategies. Among the first to do so was Canada, in 2017. As depicted in Figure 1, a multitude of nations, including the USA, PR China, Germany, the UK, Japan, the ROK, and various APO member economies, subsequently established comprehensive national AI initiatives following Canada's lead. This points to a collective recognition by the global community of AI as a pivotal driver of future socioeconomic advancement. In response, governments worldwide are formulating strategies to foster and support the progression of AI technology.

FIGURE 1

MILESTONE AI POLICY ANNOUNCEMENTS.



Source: Stanford Institute for Human-Centered Artificial Intelligence (2024). Artificial Intelligence Index Report 2024.

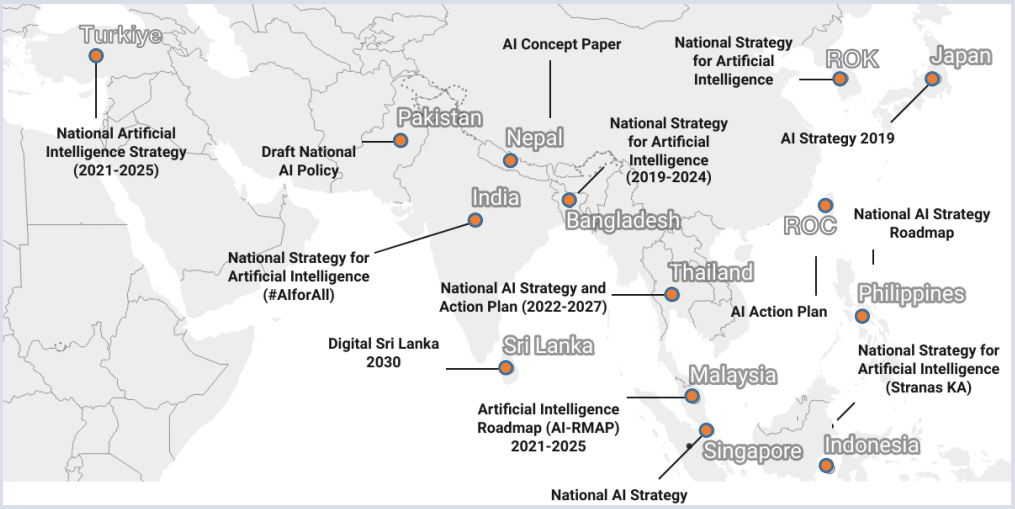
For APO member economies, this study focuses on fourteen nations that have publicly announced their national AI initiatives. It examines the key industries and technologies prioritized within these strategies and explores potential avenues for collaboration among APO member economies by analyzing their shared AI policy objectives, interests, and primary policy instruments. In comparison, major world economies such as the USA, PR China, and the European Union implemented comprehensive national AI strategies earlier than APO member economies. These leading nations subsequently introduced additional policies to further consolidate their leadership in AI. This analysis provides an overview of both the initial and subsequent AI strategies of these major economies. By examining these precedents, we aim to offer valuable insights and guidelines for APO member economies to inform their own policy development as they navigate their roles as emerging players in the global AI landscape.

AI Policies in APO Member Economies

In this section, we will investigate the state of AI policies in APO member economies. In general, we find that APO members are looking to align with global trends, and many have announced national strategies to support and nurture AI technologies, with India and the ROC leading the way, having promulgated their strategies back in 2018. This marked the beginning of a wave of AI policy initiatives that swept across the region. Now, most APO member economies have national strategies related to AI technologies in place, many of which now complement existing digital policies with broader objectives. Figure 2 provides a visual overview of these policy developments.

FIGURE 2

NATIONAL AI POLICIES OF 14 APO MEMBER ECONOMIES.



Note: Compiled by the authors.

The ROC AI Action Plan 2018–2021[1]; AI Action Plan 2.0 in 2023[2]

The ROC's AI Action Plan, launched in 2018, constitutes a strategic response to the rapid global advancements in AI (Government of the ROC, 2018). In this policy document, the Taiwanese government states its desire to position the ROC as a global hub for AI innovation by capitalizing

[1] Government of the Republic of China. (2018). AI Action Plan. Ministry of Economic Affairs.
[2] Government of the Republic of China. (2023). AI Action Plan 2.0. Ministry of Economic Affairs.

on its existing strengths in semiconductors and ICT (Executive Yuan, 2018). The plan calls for increased funding for AI research, measures to attract top AI talent, and support local industries as they look to adopt AI-driven solutions (Government of the ROC, 2018). The strategy is a crucial instrument in the ROC's fight to maintain its global competitiveness in the rapidly evolving digital economy (Government of the ROC, 2018).

In terms of specific measures for implementation, the AI Action Plan aims to develop the ROC's capabilities in AI research and application. It emphasizes enhancing AI R&D, promoting industrial innovation, and integrating AI into various sectors to boost economic productivity (Executive Yuan, 2018). The policy furthermore seeks to create a vibrant ecosystem that supports AI startups for ensuring the ROC's continued leadership in AI technology (Government of the ROC, 2023). In addition, it stresses upon the importance of international collaborations as part of a larger effort to make the ROC an integral player in the global AI environment (Government of the ROC, 2018). Governance and ethical considerations are also central to the strategy, and the government makes it clear that it wants to ensure that AI technologies are used in a responsible and secure way (Government of the ROC, 2023).

In service of these objectives, the ROC has since implemented several specific measures. One major policy ups funding for AI R&D and for building cutting-edge supercomputing facilities and AI research centers (Government of the ROC, 2023). Talent development has been another key focus, and the government has set a goal of training 10,000 AI specialists annually through comprehensive educational programs and strategic partnerships with leading universities (Executive Yuan, 2018). The plan also emphasizes building a robust data infrastructure and developing comprehensive AI ethics frameworks to address privacy and security concerns (Government of the ROC, 2018). Moreover, the ROC seeks to build out strong networks of trust and collaboration between the public and private sectors to accelerate AI innovation, particularly in areas of healthcare, finance, and manufacturing (Government of the ROC, 2023).

India's National Strategy for AI 2018; #AIforAll[3]

India introduced its National Strategy for Artificial Intelligence (#AIforAll) in 2018 in a bid to harness AI's potential for economic and societal transformation. This initiative was spearheaded by NITI Aayog (India's top public policy think tank) and aims to address the country's unique challenges and promote more inclusive economic growth by leveraging AI. The primary goal of the strategy is to establish India as a leader in AI development among emerging economies while ensuring that AI applications work for the public interest. India's vast population, diverse economy, and technological prowess provide the backdrop for this policy initiative, which focuses on how AI could improve the quality of life and contribute to the economic prosperity.

The country's strategic vision mostly focuses on using AI to drive technological and economic progress. It heavily prioritizes AI deployment in healthcare, agriculture, and education sectors, and also makes an extensive note of its potential in the field of smart cities. A common thread throughout the strategy is the importance of utilizing AI in a way that benefits all of the society. The strategy also shows how India aims to become a hub for AI innovation, focusing on AI R&D, by establishing Centers of Research Excellence (CORE) and fostering international and domestic partnerships. The policy also explores directions for improving India's position in the global AI landscape by investing in high-impact AI projects and encouraging AI-based entrepreneurship.

[3] NITI Aayog. (2018). National Strategy for Artificial Intelligence. Government of India.

The strategy refers to some more concrete actions designed to realize some of the more abstract ambitions set forward. The government has promised to invest heavily in AI R&D, emphasizing projects that directly address social challenges, notably healthcare access and agricultural efficiency. The government has also mentioned the importance of workforce reskilling, with initiatives to upskill workers and integrate AI education into academic curricula. It has also underscored the need for ethical AI development, focusing on fairness, transparency, and accountability in AI use. In addition, the strategy encourages more public–private partnerships to drive innovation, and calls for greater collaboration between the government and the industry to develop AI solutions across various sectors.

Bangladesh National Strategy for AI 2019-2024[4]

Bangladesh has launched the National Strategy for Artificial Intelligence (2019–24) to support its Vision 2021 initiative and build out the country's digital infrastructure. The strategy aims to establish Bangladesh as an AI-driven economy by improving productivity, infrastructure, and public services. Recognizing AI's transformative potential, Bangladesh seeks to leverage AI as a key technology to boost economic growth, make the delivery of public services more efficient, and foster technological advancements. The policy is also designed to prepare the country for the challenges of the Fourth Industrial Revolution (4IR).

The primary objective of Bangladesh's AI strategy is to build a sustainable AI ecosystem and integrate AI across multiple sectors to drive innovation. It places much emphasis on AI research and development, data governance, ethical AI use, and international collaboration. Specific weight has been assigned to using AI to improve public service efficiency, enhance the healthcare system, and optimize agricultural practices. Other core goals include building a supportive environment for AI startups and fostering a skilled AI workforce.

Bangladesh's approach involves creating strong data governance frameworks and promoting ethical AI standards to ensure transparency and accountability. The strategy also emphasizes the importance of data-driven decision-making, especially in areas of healthcare and agriculture. Workforce development in particular seems to be a major priority of the Bangladeshi government, with training initiatives and education programs in place to build professionals and students capable of using AI. In its national AI strategy, Bangladesh also looks to foster innovation by supporting AI startups and establishing partnerships with global tech organizations to enhance its AI capabilities.

Japan's AI Strategy 2019[5], 2022 Revision[6]

Japan introduced its own AI Strategy 2019 to facilitate the process of digital transformation and enhance the nation's industrial competitiveness (Integrated Innovation Strategy Promotion Council, 2019). The strategy grapples with a number of pressing societal issues, such as an aging population, a shrinking labor force, and lagging productivity. The strategy document shows us that Japan seeks to harness AI to facilitate a transition to what the government has dubbed "Society 5.0," a vison of a human-centric, data-driven society merging digital and physical spaces. Overall, the primary goal of the 2019 strategy seems to be to secure Japan's position as a global leader in AI while simultaneously addressing domestic challenges (Integrated Innovation Strategy Promotion Council, 2019).

[4] Government of Bangladesh. (2019). National Strategy for Artificial Intelligence of Bangladesh (2019–024).
[5] Integrated Innovation Strategy Promotion Council. (2019). *AI Strategy 2019: AI for Everyone: People, Industries, Regions and Governments (tentative translation)*.
[6] Government of Japan. (2022). *AI Strategy 2022*.

The strategy sets out to enhance AI R&D capabilities, integrate AI into workflows in traditional industries, and support the development of human capital with key AI skills (Integrated Innovation Strategy Promotion Council, 2019). Through its national strategy, Japan aims to create a comprehensive AI innovation ecosystem, calling for the establishment of advanced research centers and more collaborations with private enterprises. It also emphasizes the importance of ethical AI development, with a focus on transparency and accountability to build public trust in this new technology. The strategy is inclusive, with stated assurances that the benefits of AI are to reach all regions and demographics across the country (Integrated Innovation Strategy Promotion Council, 2019).

Japan has implemented a variety of initiatives to support AI adoption and make its strategic vision a reality across various sectors of the economy. These efforts include substantial investments in data infrastructure; measures to develop pipelines of AI talent; and programs promoting AI solutions in healthcare, manufacturing, and public services (Integrated Innovation Strategy Promotion Council, 2019). The government has also worked on building more resilient data governance frameworks and stronger AI ethics guidelines to ensure a responsible deployment of AI (Integrated Innovation Strategy Promotion Council, 2019). A review of Japan's AI policies tells us that the government is looking to boost productivity with AI, stimulate innovation, and enhance the quality of life for its citizens.

The AI Strategy Update in 2022 builds upon the basic concepts outlined in the 2019 strategy while addressing challenges in the post-pandemic era (Government of Japan, 2022). The updated strategy focuses on bolstering resilience to economic disruptions, natural disasters, and public health crises through AI. It places particular emphasis on integrating AI technologies into disaster management, healthcare, and national security (Government of Japan, 2022). Japan also seeks to utilize AI to mitigate demographic risks; and is actively exploring how AI could be used to deal with the issues raised by its rapidly aging population to foster sustainable economic development.

Japan has since provided more concrete plans to achieve the goals described in the 2022 update to its national AI strategy. These goals include boosting industrial competitiveness and developing more use cases for AI in the public sector (Government of Japan, 2022). The strategy goes on at length about the development of cyber–physical systems to create a more interconnected and resilient infrastructure. Specific initiatives call for increased investments in AI R&D, tighter public–private partnerships, and enhancement of international cooperation to keep Japan at the forefront of AI innovation. The government has also focused on strengthening AI governance by establishing guidelines for data privacy, transparency, and ethical AI use (Government of Japan, 2022).

We observe in the 2022 update repeated mentions of using AI to enhance national resilience. Japanese policymakers are looking to improve the country's disaster response capabilities by integrating AI with existing systems, with the hope that AI will allow public and private entities alike to react faster and more efficiently to emergent situations (Government of Japan, 2022). The update also emphasizes the importance of developing workers with solid AI skills to serve at the vanguard of future AI advancements. The revised strategy also underscores the significance of international partnerships, pointing to the need for collaborations with global AI leaders to tackle shared challenges (Government of Japan, 2022).

Republic of Korea's National Strategy for AI 2019[7]

The ROK unveiled its National Strategy for Artificial Intelligence in 2019. This strategy is one part of the government's larger 4IR strategy, in which it considers AI as a critical technology. The primary objective of the strategy is to position the ROK as a global AI leader by 2030, capitalizing on its strengths in ICT and manufacturing, particularly in semiconductor technology. Domestically, the strategy is seen as essential to enhancing the nation's economic competitiveness and addressing social challenges, most importantly its graying population and low birthrate.

The strategy includes a number of objectives designed to help realize this bold vision. It calls for efforts to foster an AI ecosystem, advance AI technology, and promote the integration of AI across various industries. The focus of the strategy is not only technological advancement but also ethical AI development, and the government has stressed the need for AI to serve social needs and make life better for all citizens. Specific sectoral targets include healthcare, manufacturing, and public services sectors.

The government has since implemented specific measures to actualize the vision outlined in its national AI strategy. These measures include large investments in AI R&D, development of semiconductors used specifically in AI applications, and establishment of specialized AI research centers. Other policies work to cultivate a skilled AI workforce through creation of AI-focused graduate programs and public–private partnerships. The ROK's policies also show that it is committed to ethical AI standards, as many refer to the need for transparency, accountability, and privacy in order to build public trust in AI technologies.

Singapore's National AI Strategy 2019[8]

Singapore promulgated its National AI Strategy in 2019 as part of the city-state's more comprehensive Smart Nation initiative. The strategy outlines ways to position Singapore as a global hub for AI innovation and focuses on how the country could make use of AI technologies to transform its economy and living standards. The main objective of the strategy is to ensure that Singapore remains competitive in the global AI landscape while addressing more localized issues, such as the need for more efficient and productive public services.

The strategy prioritizes boosting economic outcomes, streamlining public services, and advancing AI innovation in key industries. To this end, Singapore has focused on creating a strong AI ecosystem by applying to workflows in the public and private sectors. The country is pursuing high-impact AI projects in transport, healthcare, education, and urban management sectors to make AI applications more compatible with national priorities. The strategy also seeks to build a labor force capable of propelling AI development going forward.

To meet its objectives, Singapore has since implemented a variety of specific AI initiatives, most of which function as pilot projects designed to demonstrate the potential of AI in critical areas. Other policies instruct the government to enhance cooperation with industry and academia to drive AI research and development. Other measures establish frameworks for data governance and set out ethical guidelines. Another policy focuses on support for AI training programs. These initiatives are meant to create an environment that incubates AI innovation, with a focus on ethical and responsible use of AI technologies capable of winning public trust.

[7] Ministry of Science and ICT. (2019). National Strategy for Artificial Intelligence. The ROK.
[8] Smart Nation Digital Government Office. (2019). *National Artificial Intelligence Strategy: Advancing Our Smart Nation Journey*.

Indonesia's National Strategy for AI 2020[9]

Indonesia released its own National Strategy for Artificial Intelligence (Stranas KA) in 2020. The initiative can be seen as complementary to the Vision Indonesia 2045 and Making Indonesia 4.0 strategies. These initiatives are all part of government efforts to boost industrial competitiveness and improve the efficiency of public services. The primary objective of the country's AI strategy is to create a healthy AI ecosystem with the ability to enhance national productivity and transform Indonesia into a major AI player. The strategy also mentions the importance of responsible AI use and ethical governance, as well as the cultivation of an AI-fluent labor pool.

The strategic goals of the initiative include using AI to develop smart cities, enhance public services, and improve the country's transportation networks. To reach these objectives, Indonesia plans to invest in AI R&D and digital, form partnerships with the private sector and the academia, and create a more collaborative innovation environment. The strategy makes repeated reference to the need for an AI-competent workforce and introduces a number of training programs designed to support upskilling and reskilling.

Indonesia has a handful of policies now on the books that work to enhance its national AI capabilities. These include measures for building out the country's data infrastructure, promoting ethical AI standards, and supporting local startups through funding and mentorship programs. The government also makes AI research in agriculture and healthcare a major priority as it looks to improve efficiency and quality in these two key sectors. Policies also call for deeper collaborations between the public and private sectors and more efforts to integrate AI into process flows in various industries to drive economic growth and technological progress.

Malaysia's AI-RMAP 2021–25[10]

Malaysia's Artificial Intelligence Roadmap (AI-RMAP) 2021–2025 begins with a clear goal: to make Malaysia a high-tech nation by 2030. This national plan is the government's blueprint for leveraging AI and turning Malaysia into a major player in 4IR technology. The roadmap calls for Malaysia to build a sustainable AI innovation ecosystem to kickstart economic growth and enhance the country's global competitiveness. The strategy also describes how the COVID-19 pandemic accelerated digital transformation in Malaysia, which in turn led the government to devise a robust AI strategy.

The AI-RMAP comprises a set of strategic directions for ethical development of AI, enhancement of digital infrastructure, and fostering of public–private partnerships. The strategy discusses methods of utilizing AI in numerous sectors, from smart cities and healthcare to manufacturing, with the goal of improving national productivity and quality of life. It also calls for education and training in AI skills to prepare Malaysian workers for the AI era and ensure that Malaysia remains capable of competing on the global stage.

Malaysia has several measures in place that follow the guidelines set out in the roadmap. One active policy calls for increased cooperation between the government, the academia, the industry, and the society, which the government dubs the "quadruple helix." Other policies prioritize investments in AI R&D, establishment of innovation hubs, and promotion of AI startups. Other policy efforts exist that seek to equip workers with AI skills through education and training initiatives. And the strategy outlines a comprehensive framework for the responsible use of AI to ensure that AI applications meet certain ethical standards and support sustainable development.

[9] Government of Indonesia. (2020). National Strategy for Artificial Intelligence (Stranas KA) 2020. Ministry of Communication and Information Technology.
[10] Government of Malaysia. (2021). *Artificial Intelligence Roadmap (AI-RMAP) 2021–25*.

The Philippines' National AI Strategy Roadmap 2021[11]

The Philippines promulgated its National AI Strategy Roadmap in 2021 through the Department of Trade and Industry (DTI). The roadmap is designed to position the Philippines as Southeast Asia's leader in AI excellence. Overall, the initiative seeks to buttress the country's global competitiveness by leveraging AI to spur economic development. The strategy acknowledges the significance of AI in driving digitization, enhancing productivity, and improving the delivery of public services, particularly in the aftermath of the COVID-19 pandemic.

The Philippines' strategy describes the importance of AI R&D, enhanced data accessibility, and better integration of AI in the country's flagship industries. The roadmap also emphasizes the importance of workforce development, with a focus on upskilling and reskilling workers to meet the demands of an AI-driven economy. It also seeks to build out a collaborative ecosystem by involving the government, the industry, and the academia in AI innovation. The unique characteristics of the Philippines' economy are reflected in the industrial sectors that the roadmap targets, namely, agriculture, manufacturing, and healthcare. The strategy also describes plans to use AI to improve the country's disaster management capabilities.

The Philippines has pursued the goals outlined in the roadmap through specific actions. These include the establishment of the National Center for AI Research (N-CAIR), which will foster AI innovation. The government also focuses on creating ethical guidelines for AI deployment and upgrading data management systems. The strategy also calls for more productive public–private partnerships and emphasizes the need to develop workers fluent in AI skills through education programs and training. Finally, the Philippines also has policies on the books designed to ensure responsible and sustainable use of AI and align AI use with the country's broader economic growth and social development strategies.

Turkiye's National AI Strategy 2021–25[12]

In 2021, Turkiye promulgated its National Artificial Intelligence Strategy 2021-2025 to strengthen its AI competitiveness and at the same time address pressing economic and social challenges. The country's AI strategy is a smaller part of the larger Digital Turkiye strategic vision and also complements the National Technology Move. Taken together, these national strategies strive to establish a sustainable and agile AI ecosystem in Turkiye. The Turkish government was motivated to publish a separate AI strategy to respond to the rapid development of AI technologies. Overall, the country's AI vision focuses on maximizing the benefits of AI for Turkiye's economic, societal, and technological advancement. The broader objective is to transform Turkiye into a valuable contributor to AI innovation efforts and ensure that the country remains internationally completive.

The policy seeks to enhance AI capacities, stimulate research and innovation, and guarantee that AI applications are implemented in an ethically sound manner. The strategy is structured around six main priorities: developing AI talent, supporting AI research, improving data infrastructure, enhancing legal frameworks, strengthening international cooperation, and transforming the labor market. Collectively, these priorities are meant to ensure that AI not only contributes to economic growth but also promotes social well-being and national security.

[11] Department of Trade and Industry. (2021). "DTI launches National AI Strategy Roadmap," What's Up @ dti.

[12] Ministry of Industry and Technology & Digital Transformation Office. (2021). National Artificial Intelligence Strategy 2021–25, Republic of Turkiye.

The Turkish government prescribes several concrete policy actions for reaching these goals. These include creating AI research centers, encouraging AI entrepreneurship through incentives, and constructing platforms for data sharing and AI solutions. Other efforts are directed at improving AI governance through transparent ethical guidelines and secure data management practices. In its strategy, we can also see that Turkiye acknowledges the critical role of international collaboration in AI efforts, and is looking to form bilateral and multilateral partnerships to advance AI development and overcome common obstacles. The Turkish government states that by 2025, Turkiye will be among the top 20 leading countries in international AI rankings, and AI will become a significant factor driving economic growth. The country is also working toward building up its pool of workers with AI technology skills.

Sri Lanka's Digital Sri Lanka 2030[13]

To facilitate digital transformation and help kickstart economic recovery, in 2022, the government of Sri Lanka introduced its Digital Sri Lanka 2030 strategy. This national economic vision is designed to respond to various economic challenges, with the ultimate goal of making Sri Lanka digitally competitive by 2030. Inclusivity is one of the foundational tenets of the strategy, and the government has explicitly designed it to ensure equitable access to digital services citizens while promoting sustainable economic growth. It is generally complementary with the larger national goal of developing a vibrant, export-oriented, and socially inclusive digital economy that integrates modern technologies across sectors.

Building a competent digital workforce, increasing connectivity, and growing digital infrastructure are the strategy's primary objectives. It also focuses on enhancing cybersecurity, promoting digital literacy, and fostering innovation through public–private partnerships. The approach favored by Sri Lankan policymakers is a phased implementation, with initial efforts concentrated on setting the foundation for digital growth up to 2025, after which the government plans to introduce more comprehensive measures to integrate digital technologies in various sectors of the economy. Overall, the direction is one that pushes for sustainable development and economic resilience.

The government does lay out some specific measures. These include investing in digital infrastructure, enhancing broadband access nationwide, and developing a secure digital identity system for citizens. The government is also promoting financial inclusivity on digital platforms, sustainable digital solutions in the agriculture and energy sectors, and support for digital entrepreneurship. The strategy acknowledges the importance of a comprehensive data governance framework; and encourages transparency, innovation, and protection of user rights and personal information.

Thailand's National AI Strategy and Action Plan 2022–27[14]

Thailand introduced its National AI Strategy and Action Plan (2022–27) in 2022 as part of its broader digital transformation efforts. Through this strategy, the government hopes to transform Thailand into a leading AI hub in Southeast Asia by strengthening AI readiness and integrating AI into public services and throughout the economy. The government sees the pursuit of AI as essential to enhancing the country's economic competitiveness and adapting it to an ever-evolving digital economy.

[13] Ministry of Technology. (2022). *Digital Sri Lanka 2030: A National Digital Strategy for Sri Lanka*. Government of Sri Lanka.

[14] AI Thailand website. (2024). "National AI Strategy and Action Plan (2022-2027)". Retrieved 24 August 2024 from https://ai.in.th/en/about-ai-thailand/

By and large, the strategy outlines a framework for AI oversight, describes incentives to promote cutting-edge AI research, and calls for improved linkages between the government and the private sector. These goals are designed to create a thriving AI ecosystem capable of adapting to both domestic and international demands. The strategy also calls for efforts to cultivate a workforce with essential AI skills to equip Thailand with the ability to drive AI innovation. The government also considers ethics issues and emphasizes the need for transparency in order to build social trust in AI technologies.

Thailand has outlined a series of steps to meet its targets. Among them are development of AI ethics guidelines; creation of dedicated AI hubs; and encouraging research through cooperation between government, industry, and universities. The strategy identifies use cases for AI in smart-city initiatives as well as in healthcare, education, public services, and transportation sectors. By promoting AI innovation and international cooperation, Thailand seeks to remain at the forefront of AI development in Southeast Asia.

Pakistan's Draft National AI Policy 2023[15]

Pakistan promulgated a Draft National Artificial Intelligence Policy as a core component of its Digitalize Pakistan plan. The policy was developed in 2023 and is intended to help the country put together a competitive AI ecosystem that could drive economic growth, improve national security, and improve the overall technological level of the country. The primary goal of the strategy is to prepare Pakistan for the AI revolution by focusing on integration of AI into major economic sectors to boost productivity and efficiency. The policy is also partially designed to raise public awareness of the potential of AI and help the country get ready for the demands of a digital economy.

By promoting a supportive AI ecosystem, the strategy hopes to accelerate AI development in Pakistan and calls for increased investments in research as well as adaption in training for workers. It describes the importance of responsible AI use and highlights the need for ethical governance and data protection. By investing in AI-driven solutions, we can see that Pakistan is looking to lay the foundation for long-term economic and social development. In addition, the strategy discusses AI's potential to improve national security, healthcare, education, agriculture, and climate monitoring.

The draft policy outlines a number of actions to achieve its strategic vision. These range from creating an AI innovation fund and promoting AI-based businesses to developing AI research institutions that could enhance technological sophistication across the country. Workforce development is another major focus, and the government has workforce training plans to meet the needs of an AI-driven market. The policy also emphasizes the importance of data infrastructure and ethical AI utilization and proposes a set of guidelines for transparent and accountable AI deployment. The draft policy calls for more effective and productive collaborations between the government, the academia, and the industry to facilitate AI implementation across sectors.

Nepal's AI Concept Paper 2024[16]

The government of Nepal's main AI policy document is a 2024 concept paper that is meant to guide the country's first steps into AI development and governance. This document constitutes the government of Nepal's initial response to the global rise of AI technologies and the recognition of

[15] Paradigm Shift. (2023). *Draft National* Artificial Intelligence Policy. Retrieved 24 July 2024 from https://www.paradigmshift.com.pk/draft-national-ai-policy-pakistan/

[16] What the Nepal. (2024). First Ever AI Concept Paper Prepared in Nepal. Retrieved 2 September 2024 from https://whatthenepal.com/2024/07/04/first-ever-ai-concept-paper-prepared-in-nepal/

AI's potential impact on economic and social growth. The government's stated objective is to create a responsible AI ecosystem that aligns with Nepal's needs and priorities. The policies described therein are formulated to regulate AI use, foster innovation, and ensure that AI technologies are deployed ethically and transparently.

The paper sets a handful of specific goals: establish a foundation for AI governance; promote AI research and development; and enhance data security. Nepal will focus on AI utilization in public services, healthcare, education, and agriculture, where it deems that AI can have the greatest positive impact. The policy document also calls for upgrading the country's digital infrastructure to support AI applications and enhance efficiency in service delivery.

In the paper, the Nepalese government provides a simplified blueprint for accomplishing these objectives. One key initiative is the creation of a national AI portal to serve as a central hub for research, collaboration, and knowledge sharing. It also has guidelines in place to protect privacy, increase transparency, and foster accountability in AI use. The government has also pushed for strong public–private partnerships to advance AI innovation and specialized training and education programs designed to develop a skilled workforce capable of supporting AI growth.

TABLE 1

OVERVIEW OF NATIONAL AI POLICIES OF 14 APO MEMBER ECONOMIES.

No	Country	Policy	Vision	Goal	Key Strategy	Key Sectors
1	The ROC	AI Action Plan (2018)	Global AI hub	Enhance AI innovation and competitiveness	• AI R&D • International collaboration • AI governance	• Healthcare • Smart cities • Finance • Manufacturing
		AI Action Plan 2.0 (2023)	Advanced AI industry	Strengthen AI ethics, expand international partnerships	• Talent development • Enhanced AI governance • R&D	• Healthcare • Transportation • Finance
2	India	National Strategy for AI (#AIforAll) (2018)	AI for social good and inclusive growth	Use AI to improve social and economic sectors	• AI for healthcare • Agriculture • Education • Smart cities	• Healthcare • Agriculture • Education • Mobility
3	Bangladesh	National Strategy for AI (2019-2024)	AI-driven economy by 2024	Enhance productivity and public service delivery	• AI R&D • Data governance • Workforce development	• Public services • Healthcare • Agriculture • Smart mobility
4	Japan	AI Strategy (2019)	National resilience and industrial competitiveness	Address demographic and societal challenges	• AI in healthcare • Industrial automation • Cybersecurity	• Healthcare • Manufacturing • Cybersecurity • National security
		AI Strategy Update (2022)	National resilience and sustainability	Strengthen economic resilience and security	• AI for disaster response • Ethical AI • R&D expansion	• Disaster response • National security • Healthcare

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No	Country	Policy	Vision	Goal	Key Strategy	Key Sectors
5	The ROK	National Strategy for AI (2019)	Global AI leader by 2030	Leverage ICT and semiconductor strengths	• AI chips • Public services • AI talent • R&D hubs	• ICT - public services • Healthcare • Manufacturing
6	Singapore	National AI Strategy (2019)	Global AI hub	Drive economic gains and improve public services	• National AI projects • Governance • Global AI standards	• Healthcare • Education • Municipal services • Transportation
7	Indonesia	National Strategy for AI (2020)	Strengthen industrial competitiveness	Improve productivity and public services	• Ethical AI • Infrastructure • Talent development • R&D	• Smart cities • Public services • Mobility
8	Malaysia	AI-RMAP	Sustainable AI ecosystem	Foster innovation and accelerate AI adoption	• AI governance • Talent • Public–private partnerships • R&D	• Smart cities • Healthcare • Manufacturing • Digital economy
9	The Philippines	National AI Strategy Roadmap (2021)	AI center of excellence in Southeast Asia	Boost global competitiveness through AI	• Talent development • AI governance • Public–private collaboration	• Agriculture • Manufacturing • Healthcare • Disaster management
10	Turkiye	National AI Strategy	Sustainable AI ecosystem	Enhance competitiveness and technological capacity	• AI talent • R&D • International cooperation • Ethical AI	• Healthcare • Manufacturing • Public services • Education
11	Sri Lanka	Digital Sri Lanka 2030 (2022)	Digitally empowered nation	Digital transformation and economic recovery	• Digital infrastructure • AI talent • Public–private partnerships	• Financial services • Agriculture • Education • Cybersecurity
12	Thailand	National AI Strategy and Action Plan (2022-2027)	Global AI hub in Southeast Asia	Integrate AI into public and economic sectors	• AI governance • R&D • Public–private partnerships	• Smart cities • Public services • Healthcare • Transport
13	Pakistan	Draft National AI Policy (2023)	Raise AI awareness and national security	Establish a competitive AI ecosystem	• AI ethics • Infrastructure • Talent reskilling	• Healthcare • Education • National security • Agriculture
14	Nepal	AI Concept Paper (2024)	Responsible AI deployment	Create a foundational AI ecosystem	• National AI portal • AI ethics • Public–private partnerships	• Public services • Education, healthcare • Agriculture

Sources: References in the previous section on national policy analysis. Compiled by the authors.

Other APO Economies

Our analysis of policy trends in APO member economies has thus far suggested that many APO members possess a shared understanding of AI's significance and the necessity of AI support policies. They have all released AI-specific national strategies and policy documents, which we have analyzed in detail. But not all APO members have done so. In this subsection, we will look into the AI policies of APO members that lack national AI strategies but have some AI policies nonetheless, namely, Cambodia and Hong Kong.

While they may lack national-level policies, our analysis shows that these economies nonetheless recognize the importance of fostering AI through digital policies and R&D efforts. Both Cambodia and Hong Kong have incorporated AI-related topics in their national research initiatives and have policies in place regarding the operation of advanced technology and ethical governance.

Cambodia addresses AI's potential in its National Research Agenda 2025[17]. This planning document highlights the role of emerging technologies like AI in driving advancements in digital health, smart agriculture, and cloud services as key components of Cambodia's vision for technological progress (MISTI, 2023). AI is viewed as an essential tool to increase efficiency and productivity, particularly in precision agriculture and digital healthcare applications. The Cambodian government's approach calls for enhancing research capacity in innovative technologies to keep pace with global trends and supports inclusive and sustainable development by 2030 and 2050 (MISTI, 2023). This emphasis on innovation reflects the country's commitment to better integrating AI to promote national growth.

The government of the Hong Kong Special Administrative Region refers to AI in two key documents: the Guidance on the Ethical Development and Use of Artificial Intelligence (2021) and the Hong Kong Innovation and Technology Development Blueprint (2022). The Ethical Guidance focuses on ensuring that AI systems adhere to robust governance standards, prioritizing accountability, fairness, and data privacy. This is particularly relevant in Hong Kong, which is dominated by financial and public services sectors.[18] On the other hand, the I&T Blueprint aims to cultivate a strong AI ecosystem; and stresses the importance of R&D and labor force development for smart city applications and in the fields of healthcare and finance.[19]

While AI policies across APO member economies generally aim to advance economic growth and improve public services, they diverge in their strategic priorities, target sectors, and methods of supporting AI development. These differences reflect each nation's distinct socioeconomic characteristics, technological capacities, and long-term goals.

Key Features of APO Members' AI Policies

Our analysis of APO members' AI policies reveals several basic commonalities. First, the members view AI as a critical technology for driving economic growth and enhancing national competitiveness. Second, virtually all member economies heavily emphasize the importance of AI R&D to spur innovation and improve productivity. Third, APO members seem to be in broad agreement that educating and training workers with essential AI skills is critical to prepare future generations for an AI-driven economy. And finally, most members understand that having robust data infrastructure

[17] Ministry of Industry, Science, Technology & Innovation. (MISTI) (2023). *National Research Agenda 2025*. Royal Government of Cambodia.
[18] Office of the Privacy Commissioner for Personal Data. (2021). *Guidance on the Ethical Development and Use of Artificial Intelligence. The Government of the Hong Kong Special Administrative Region of the People's the Republic of China.*
[19] Innovation, Technology and Industry Bureau. (2022). *Hong Kong Innovation and Technology Development Blueprint. The Government of the Hong Kong Special Administrative Region of the People's the Republic of China.*

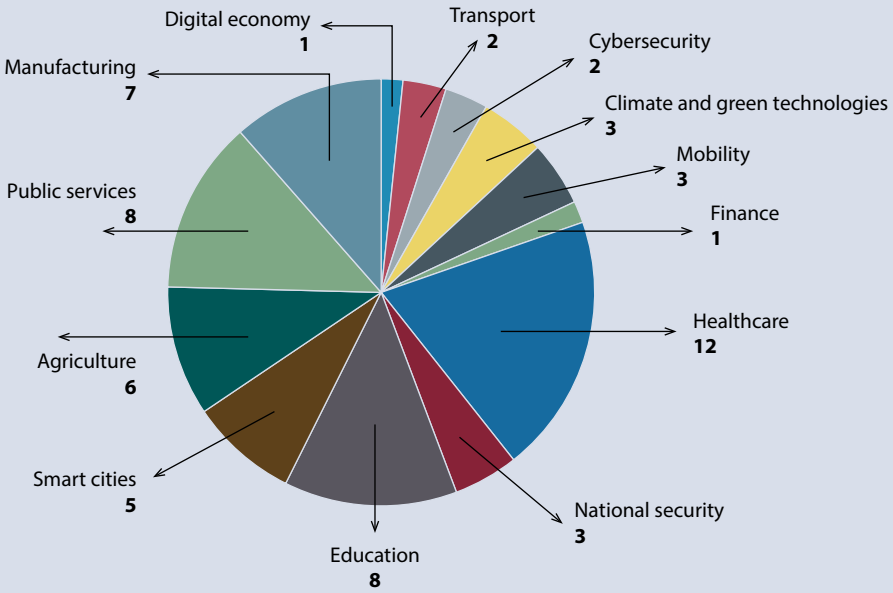
and AI governance systems in place to ensure ethical use is crucial to the successful adoption and implementation of AI technologies.

(1) **Visions and goals:** Most APO member economies outline strategic visions that are designed to foster economic growth and strengthen national competitiveness. Many economies explicitly aim to become global AI hubs to maximize the benefits of AI in their industrial sectors and public services. And yet we did observe some differences in the specific kind of policies emphasized by various APO members. India, Bangladesh, and Nepal have all made social inclusion and economic equity a basic pillar of their AI strategies and hope to utilize AI for the greater social good. In contrast, the ROK and Japan focus more industrial competitiveness, quality of life improvements, and using AI to enhance disaster response. We can also see that some countries place more emphasis on ethical AI and sustainability, while others are more concerned with realizing economic gains through technological advancements.

(2) **Key sectors:** The majority of APO members are looking to apply AI to use cases in public services, healthcare, and education sectors (see Figure 3), with 12 APO members directly calling for AI development in the medical industry, reflecting a common understanding that AI can significantly enhance medical services, patient care, and healthcare accessibility. Eight members have announced strategies for using AI in education. Thus, we can see that APO members are committed to pursuing AI advancements that directly improve the well-being of their citizens and help their societies develop further. However, this does not hold true for all sectors. Only the ROC has an AI plan for the finance industry, for example, and only a handful of APO members have announced AI policies for cybersecurity and national security.

FIGURE 3

KEY SECTORS FOR AI POLICIES OF 14 APO MEMBER ECONOMIES.

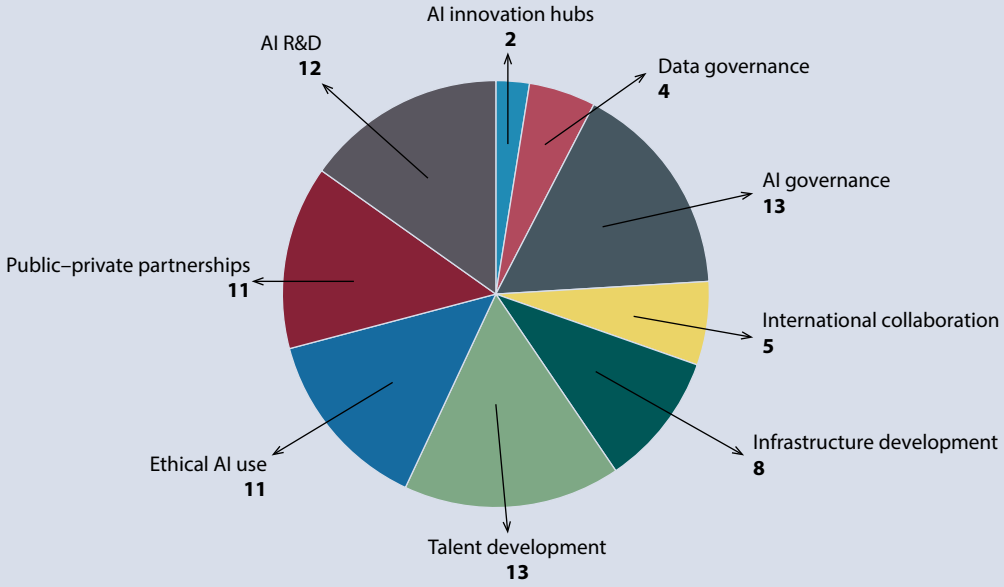


Note: The references for each country's policy details can be found in the policy analysis.
Source: Compiled by the authors.

(3) **Instruments for implementing AI policy:** Many APO members place strong emphasis on the importance of AI governance, an AI-competent workforce, and support for AI R&D (see Figure 4). The ROC, Japan, and the ROK have all promulgated AI governance frameworks, and seem committed to ensuring that AI is used responsibly and ethically within their borders. India, Singapore, and Malaysia focus more heavily on training the AI-fluent workforce of the future, and place relatively more importance on nurturing a skilled workforce capable of innovating in the AI arena. AI R&D is also a key strategy for many countries, including Bangladesh, Indonesia, and the Philippines, and these countries are all working to enhance their research capabilities and increase their technological competitiveness. Some strategies are more distinct, however. For example, Japan and India are among the few APO members that have policies in place to establish dedicated AI innovation hubs. Thailand and Turkiye, meanwhile, are especially focused on international collaboration and developing the kind of digital infrastructure necessary to support AI adoption.

FIGURE 4

AI POLICY TOOLS OF APO MEMBER ECONOMIES.



Source: Compiled by the authors.

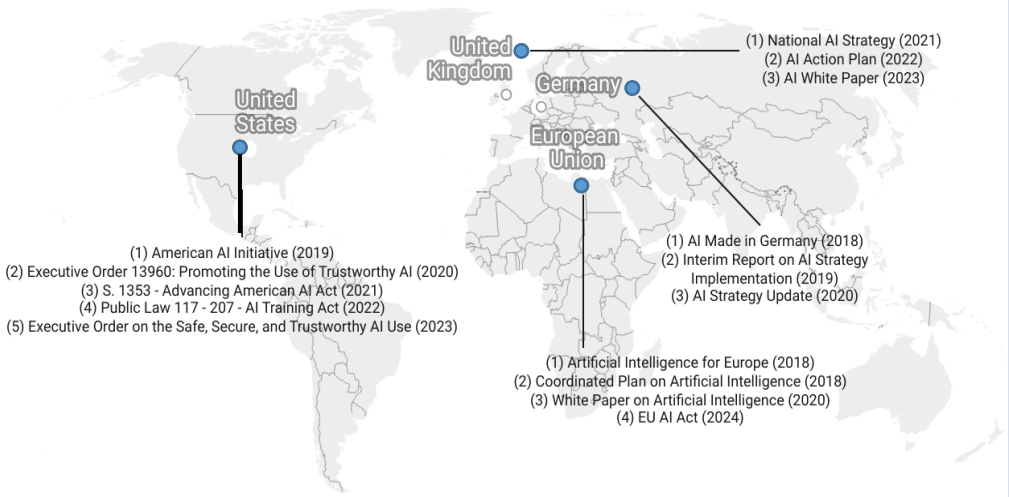
AI Policies in Non-APO Economies

In this section, we will survey the policy landscape of the global AI leaders. The findings of the analysis may be used to inform policies in APO member economies.

Since 2017, the USA and the European Union have taken significant strides in formalizing their national AI policies through both legislative frameworks and subsequent strategic initiatives. The UK and Germany have followed suit, implementing their own comprehensive AI strategies. Figure 5 presents the key AI policies in these nations. We can see that these countries have adopted a strategic approach to AI policy development, establishing initial national strategies and then implementing targeted follow-up measures to adapt to the rapid evolution of AI technology. In the following material we will dig more deeply into the granular details of each country's AI policies, examining both foundational national strategies and subsequent policy developments.

FIGURE 5

KEY AI POLICIES IN THE USA, THE EU, AND THE UK.



Source: Compiled by the authors

The USA

The AI policy landscape began to crystallize in the USA in 2019. The American AI Initiative, launched in 2019, marked the inception of these efforts (The White House, 2019). In 2020, Executive Order 13960 demonstrated policy initiative toward the development of trustworthy AI applications (The White House, 2020). Subsequent developments include the Advancing American AI Act of 2021, which is designed to bolster AI capacity across diverse sectors (US Congress, 2021), and the AI Training for the Acquisition Workforce Act, which calls for increased AI training in workforce development programs (Office of the Federal Register, National Archives and Records Administration, 2022). And in 2023, a new Executive Order was issued to facilitate safer, more secure, and more reliable deployment of AI technologies (The White House, 2023). These policies collectively reflect the USA's unwavering commitment to AI innovation, coupled with a resolute focus on addressing ethical and security considerations (see Table 2).

TABLE 2

KEY AI POLICIES OF THE USA.

Year	Key AI policies
2019	American AI Initiative
2020	Executive Order 13960: Promoting the Use of Trustworthy AI
2021	S. 1353 - Advancing American AI Act
2022	Public Law 117 - 207 - AI Training Act
2023	Executive Order on the Safe, Secure, and Trustworthy AI Use

National AI policy: American AI Initiative (2019)[20]

The first major national AI program was the American AI Initiative (AAII), announced in 2019 under the administration of Donald Trump. The primary goal of the AAII is to solidify America's

[20] The White House. (2019). Executive Order on Maintaining American Leadership in Artificial Intelligence. Retrieved from https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/

position as the global AI leader as the technological landscape continued to develop rapidly. The policy can be seen as a direct response to intensifying global competition in the AI space and is clearly designed to ensure the USA's continued dominance in AI innovation. The AAII emphasizes the strategic importance of incubating cutting-edge research in AI, cultivating a highly skilled AI workforce, and establishing robust ethical guidelines to lay the foundation for future AI advancements within the country. The AAII furthermore aims to position the USA as the global leader in AI to drive economic growth and technological progress as well as to safeguard national security. The policy has directed federal agencies to dedicate budgetary resources to AI investments, incorporate AI into educational curricula, and promote collaboration with international partners on relevant issues. The AAII also serves as a kind of national vision, settings guidelines for the ethical and responsible deployment of AI technologies to ensure that they protect privacy and promote transparency, the two key American values.

The AAII directs the federal government to achieve these and other objectives through several mechanisms. First, the initiative calls for increased funding for AI R&D and encourages public–private partnerships to accelerate AI innovation. The AAII has also resulted in efforts to establish AI education programs designed to build AI competencies, and the initiative also sets clear standards for ethical AI use, particularly within government operations. Together, the measures of the AAII seek to create a robust and accountable AI ecosystem, ensuring sustained American leadership in AI.

Follow-up Policies

Executive Order 13960 - Promoting the Use of Trustworthy AI (2020)[21]: In December 2020, Executive Order 13960 was issued to ensure a responsible and ethical use of AI within federal operations. This order was designed to enhance public trust in AI by setting detailed guidelines for fairness, accountability, and transparency in AI deployment. Federal agencies were directed to assess AI systems for security, accuracy, and ethical standards. The order also encouraged collaborations with the private sector and the academia to better align AI developments with ethical guidelines.

S. 1353 - Advancing American AI Act (2021)[22]: The Advancing American AI Act was passed by Congress in April 2021. The law is designed to reinforce the USA's leadership in AI R&D. Specific measures call for the establishment of higher ethical standards and stricter data security measures, and also instruct the government to develop an AI-capable federal workforce. The measures include funding provisions for AI research and training programs, and emphasizing collaboration between the government, the private sector, and the academia to ensure responsible use of AI.

Public Law 117 - 207 - AI Training Act (2022)[23]: The AI Training Act, enacted in October 2022, was passed to build AI capacity in the federal workforce. It focuses on educating government employees on the proper and effective management of AI technologies, with an emphasis on AI ethics and data management. The law seeks to fill knowledge gaps in AI within the government and equip the federal staff with the tools needed to handle AI systems and integrate them into government operations.

[21] The White House. (2020). Executive Order 13960: Promoting the Use of Trustworthy AI in the Federal Government. Retrieved from https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-promoting-use-trustworthy-artificial-intelligence-federal-government/
[22] Senate, Congress. (2021). S. 1353 - Advancing American AI Act. Retrieved from https://www.govinfo.gov/app/details/BILLS-117s1353is
[23] Office of the Federal Register, National Archives and Records Administration. (2022). Public Law 117–207 - AI Training Act. Retrieved from https://www.govinfo.gov/app/details/PLAW-117publ207

Executive Order 14110 - Safe, Secure, and Trustworthy AI Use and Development (2023)[24]: In October 2023, the White House promulgated an order designed to strengthen AI safety, bolster AI security, and facilitate its ethical development. It calls for a secure deployment of AI to protect national security and act in the public interest. The policy emphasizes ethical AI practices, stronger data privacy measures, and enhanced cybersecurity standards. It also calls for deeper collaborations between the public and private sectors to foster innovation in AI security and strict ethical standards.

European Union

The European Union has been at the forefront of shaping the global AI landscape through a series of major policy initiatives (see Table 3). In 2018, the EU promulgated a vision for future AI development and regulation dubbed Artificial Intelligence for Europe (European Commission, 2018a). That same year, the European Commission (EC) published its Coordinated Plan on Artificial Intelligence to enhance regulatory collaboration among member states (European Commission, 2018b). Two years later, the EC released a white paper on AI that focused on the development of reliable AI systems and explored a suite of regulatory options (European Commission, 2020). And in 2024, the EU AI Act assumed legal authority. The AI Act is a comprehensive legal framework meant to govern AI development and utilization across Europe (European Union, 2024). Its various provisions are to be phased in gradually from 2024 through 2030.

TABLE 3

KEY AI POLICIES OF THE EUROPEAN UNION.

Year	Key AI policies
2018	Artificial Intelligence for Europe
	Coordinated Plan on Artificial Intelligence
2020	White Paper on Artificial Intelligence
2024	EU AI Act
2023	Executive Order on the Safe, Secure, and Trustworthy AI Use

National AI Policy: Artificial Intelligence for Europe (2018)[25]

The EU announced the Artificial Intelligence for Europe strategy in April 2018. In this set of documents, the EC describes pathways establishing a solid foundation for AI development across Europe, driven by a desire to maintain European competitiveness in global AI advancements. It focuses on promoting an ethical approach to AI that aligns with European values and standards. The strategy can be seen, in part, as a response to increasing global competition in AI and the widespread recognition of AI as a critical technology capable of generating real economic growth. The EU looks to position itself as a leader in AI while ensuring that AI technologies benefit the society as a whole. This strategy laid the groundwork for collaborative efforts and regulatory measures that followed.

The primary goals of the strategy include promoting investment in AI, fostering collaboration among EU member states, and establishing ethical guidelines. It looks to incentivize AI R&D that takes ethical considerations seriously. The strategy also emphasizes the need to develop

[24] The White House. (2023). Executive Order on the Safe, Secure, and Trustworthy AI Use. Retrieved from https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/

[25] European Commission. (2018a). "Artificial Intelligence for Europe." Retrieved from https://digital-strategy.ec.europa.eu/en/policies/ai

AI-competent workers across Europe and support the adoption of AI tech by small and medium-sized enterprises (SMEs). The strategy suggests that Europe's main AI objectives can be achieved through both national and EU-level initiatives by focusing on the creation of a robust AI ecosystem.

The strategy includes a handful of more concrete policy recommendations. It calls for increased funding for AI research and innovation using monies allocated to the Horizon 2020 research and innovation program. The EU also encourages public and private partnerships to drive AI advancements. The strategy also calls for the establishment of Digital Innovation Hubs to help SMEs adapt to and utilize AI technologies. Throughout the document, the EU stresses the importance of AI education and skills development to cultivate an AI-fluent workforce in Europe. Finally, the strategy consistently underscores the importance of ethical AI development and offers a set of preliminary guidelines to better align AI applications with European values.

Follow-up Policies

Coordinated Plan on Artificial Intelligence (2018)[26]: The EC promulgated the Coordinated Plan on Artificial Intelligence in December 2018 and updated it in 2021. The plan's goal is to enhance cooperation among EU member states to unify the continent's approach to AI. It defines actions and funding instruments for spurring AI research and ensuring that AI development aligns with ethical standards. In addition, the plan looks to boost competitiveness and address social challenges. To achieve these goals, the plan has outlined 70 joint actions, including efforts to improve AI education, attract AI talent, and promote cross-border cooperation.

White paper on AI (2020)[27]: The EC published a white paper on AI in February 2020. The study set out a policy framework to regulate AI in a way that promotes both excellence and trust. The authors addressed the need for a coordinated European approach to AI and identifying specific areas of concern, such as transparency and ethical use. To achieve its goals, the paper proposed a mix of regulatory measures and investments, including a focus on high-risk AI applications that may require stricter oversight.

EU AI Act (2024)[28]: The EU AI Act became a law in 2024 (its various provisions will be phased over time). The Act functions as a legal framework for AI applications in Europe. Its purpose is to ensure that AI technologies are safe, trustworthy, and aligned with EU values. The Act regulates high-risk AI applications while fostering innovation in less sensitive sectors. To meet these objectives, it proposes a set of compliance requirements that developers must meet, and introduces a rubric for classifying AI risks.

Germany

Germany first announced its Mission KI national AI initiative in 2018. This policy aims to establish Germany as a leader in AI innovation, focusing on ethical standards and technological advancement (Federal Government of Germany, 2018). In 2019, the federal government released an interim report on the implementation of the country's AI strategy, assessing progress and identifying areas for improvement (Federal Government of Germany, 2019). The report highlights the need for deeper collaborations between the industry, the academia, and the government. In 2020, Germany

[26] European Commission. (2018b). "Member States and Commission to work together to boost artificial intelligence 'Made in Europe'." Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/IP_18_6689
[27] European Commission. (2020). White Paper on Artificial Intelligence: A European approach to excellence and trust. Retrieved from https://ec.europa.eu/info/sites/default/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf
[28] European Union. (2024). *Regulation (EU) 2024/1689 of the European Parliament and of the Council, 13 June 2024.*

updated its AI strategy to address emerging challenges and opportunities in the AI sector (Federal Government of Germany, 2020). These efforts underscore the country's commitment to fostering a responsible and competitive AI environment (see Table 4).

TABLE 4

KEY AI POLICIES OF GERMANY.

Year	Key AI Policy
2018	Mission KI
2019	Interim Report on AI Strategy Implementation
2020	AI Strategy Update

National AI Policy: Mission KI (2018)[29]

In 2018, Germany promulgated its national Mission KI strategy, which is designed to strengthen the nation's position in AI technology. The primary objective of the strategic plan is to enhance AI R&D and facilitate the application of AI across various economic sectors and in the realm of public services. The vision was developed through consultations with experts and stakeholders from various sectors, including the federal Ministries of Education, Economic Affairs, and Labor. Mission KI emphasizes the necessity of supporting AI innovation while at the same time ensuring that AI is developed ethically and responsibly. A central focus of this strategic AI vision is on the creation of a robust AI ecosystem harmonized with European values and standards.

The strategy focuses on turning Germany into a hub for AI research and advancing the digital sector. It includes proposals for AI R&D investments, AI research center construction, and AI integration in manufacturing and healthcare. The strategy goes to great lengths to emphasize the importance of ethically responsible AI development, reflecting the country's commitment to responsible AI use. Overall, the strategy seeks to balance technological innovation with social values, ensuring that the benefits of AI reach all segments of the German society.

To achieve the goals laid out in the Mission KI strategy, Germany has implemented several targeted measures. These include funding initiatives to support AI startups, increased investments in AI research, and establishment of AI research clusters. Furthermore, the government has created specific programs to attract and train AI experts with the goal of cultivating a skilled workforce capable of innovating in the AI arena. Additional efforts have been made to improve data infrastructure and create platforms for data sharing, thus enabling more effective AI deployment. Germany has also continually emphasized collaboration with its European partners to develop AI standards and foster a more unified AI ecosystem within Europe.

Follow-up Policies

Interim Report on AI Strategy Implementation (2019)[30]: In 2019, Germany published a report reviewing the state of its Mission KI national strategic AI initiative. The report evaluates progress toward stated goals and identifies areas that require attention. It highlights Germany's achievements in expanding AI research and supporting startups through dedicated funding. It also emphasizes the importance of ethical guidelines for AI development, particularly in relation to data privacy and transparency, recommending additional measures to enhance AI infrastructure and strengthen collaboration between research institutions and major industrial players.

[29] Federal Government of Germany. (2018), Mission KI
[30] Federal Government of Germany. (2019), Interim Report on AI Strategy Implementation.

AI strategy update (2020)[31]: Germany updated its Mission KI strategy in 2020 with the aim of addressing the evolving technological landscape and calling for more AI integration across the economy, especially in areas of healthcare, mobility, and environmental sustainability. The updated strategy focuses on increasing investment in AI research and fostering a robust AI ecosystem within Europe. It goes to even greater lengths in emphasizing the crucial role of international cooperation, with the goal of positioning Germany as a leading AI research hub globally. The update adds new objectives for Germany to meet, including the development of AI governance frameworks, utilizing AI in sustainable development initiatives, and putting AI to use in responding to the COVID-19 pandemic.

The United Kingdom

The UK announced a comprehensive suite of AI policies in its AI Sector Deal policy paper published in 2018 under the government of Theresa May. The package aims to establish the country as a global AI leader (HM Government, 2018) and lays the groundwork upon which the government could build a more exhaustive AI strategy. These efforts bore fruit when in 2021, the government unveiled its National AI Strategy. This strategy reflects a vision of the UK in which AI plays a pivotal role in driving economic growth and technological innovation (HM Government, 2021). It has since been followed by several subsequent policies that refine and expand upon the original strategy. Together, these policies aim to address emerging challenges and leverage AI to enhance national competitiveness (UK Government, 2022; 2023). The UK's overall approach emphasizes a judicious balance between fostering innovation and ensuring ethical AI development (see Table 5).

TABLE 5

KEY AI POLICIES OF THE UK.

Year	Key AI policies
2021	National AI Strategy
2022	AI Action Plan
2023	AI White Paper

National AI Policy: National AI Strategy (2021)[32]

The National AI Strategy was promulgated in 2021. It seeks to enable all stakeholders to wield AI in a way that benefits the UK's economy and society. The policy was developed to respond to the rapid advancements in AI technology and the need to maintain a competitive edge in the global market. The main goal of the strategy is to spark long-term economic growth, reform public services, and ensure that AI is used ethically and responsibly. It also aims to make the country a global AI leader, and places a particularly strong focus on research, innovation, and training AI-fluent workers.

The strategy consists of three fundamental pillars: advancing AI research, promoting the benefits of AI across the society, and creating a global AI ecosystem with the UK as a central hub. The plan includes measures to construct a robust AI governance structure, support the growth of AI startups, and integrate AI into critical sectors such as healthcare and public services. The policy also emphasizes the importance of ethical AI, with measures to ensure transparency, accountability, and data protection.

[31] Federal Government of Germany. (2020). AI Strategy Update.
[32] HM Government. (2021). National AI Strategy. Command Paper 525.

To reach these objectives, the UK has outlined several specific measures. These include increasing investment in AI R&D, enhancing digital infrastructure, and promoting AI education and skills training. The strategy also focuses on fostering public–private partnerships to drive innovation and ensure that AI benefits are widely distributed. The government plans to support the creation of AI hubs and accelerate the adoption of AI across industries. The strategy makes extensive reference to the importance of ethical guidelines and governance frameworks that can ensure that AI is responsibly developed and utilized.

Follow-up Policies

AI Action Plan (2022)[33]: The UK promulgated its AI Action Plan 2022 as a follow-up to the 2021 National AI Strategy. This plan aims to hasten AI adoption and propel the UK to a leadership position in AI innovation. The policy highlights the importance of creating a thriving AI ecosystem comprising public and private players. Stated goals include increasing AI investment, improving digital infrastructure, and expanding international AI partnerships. Other noteworthy measures include policies for AI workforce development curricula and improved access to high-quality AI training data. The plan also emphasizes the need for responsible AI use and adherence to ethical guidelines.

AI white paper (2023)[34]: The UK further refined its AI strategy in a 2023 white paper. The document outlined best practices for building a world-beating AI development framework, focusing on innovation, safety, and trustworthiness. It laid out several objectives: better AI governance; economic growth through AI; and innovation in emerging AI fields. It also introduced a set of new to support SMEs and foster innovation in niche AI applications and highlighted the need for adaptive regulations that could keep up with technological advancements. Of note has been the government's continued emphasis on ethical AI use and development, reflecting the UK's commitment to developing AI technologies that align with its national values.

Key Features of AI Policies in Major Economies

When examining the AI strategies of major economies, several common themes emerge. Most nations have policies in place to advance AI R&D and enhance their national standing in the AI space. Most policies place a strong emphasis on fostering innovation through AI, particularly by promoting collaborative efforts between the public and private sectors. Many countries focus on equipping workers with competitive AI skills, recognizing the importance of human capital in driving future AI advancements. Ethical AI use is another critical element, and government policies by and large aim to ensure that AI is built and used in a responsible manner. Finally, most governments view the building of a robust AI ecosystem with good digital infrastructure and effective data governance as a key priority.

In general, the AI policies we described in the previous section reflect each country's pursuit of global AI leadership. Each government has placed a distinct focus on one area or the other. The USA emphasizes maintaining technological supremacy and safeguarding national security. The EU, on the other hand, prioritizes ethical AI development and sustainable progress, aiming to create human-centered AI. Germany's vision centers on strengthening industrial competitiveness while seamlessly integrating AI into society. The UK emphasizes fostering an innovative and open

[33] UK Government. (2022). National AI Strategy - AI Action Plan. Retrieved from https://www.gov.uk/government/publications/national-ai-strategy-ai-action-plan/national-ai-strategy-ai-action-plan

[34] UK Government. (2023). "AI White Paper: UK unveils world-leading approach to innovation in first artificial intelligence white paper to turbocharge growth." Retrieved from https://www.gov.uk/government/news/uk-unveils-world-leading-approach-to-innovation-in-first-artificial-intelligence-white-paper-to-turbocharge-growth

AI environment that can support economic growth while adhering to ethical standards. Despite these nuanced differences, the overarching goal remains technological leadership, coupled with ethical AI use.

A comparative analysis of key strategies reveals some intriguing differences (see Table 6). While all nations invest heavily in AI R&D and workforce training and development, the EU and Germany in particular emphasize the vital role of strong ethical AI guidelines and the safeguarding of data privacy. In contrast, the USA clearly prioritizes AI integration in critical sectors such as national security and defense, with a focus on technological dominance. The UK's strategy is more concerned with fostering innovation through strategic partnerships and open AI ecosystems. We can see that each country tailors its strategies to align with specific national priorities, reflecting a delicate balance between global leadership and domestic needs.

The sectors targeted by these countries illustrate their diverse approaches to AI. Healthcare, public services, and manufacturing are the commonly highlighted sectors, suggestive of a widespread belief in AI's transformative industrial and social potential. The USA and Germany emphasize cybersecurity, while the European Commission distinguishes itself by focusing on ethical AI, digital infrastructure, and data-driven services. The UK's AI policies lean toward the finance and education sectors, suggesting that UK policymakers desire to leverage AI for economic and social gains. This points to a well-rounded AI strategy that spans diverse sectors.

TABLE 6

OVERVIEW OF AI POLICIES OF THE USA, THE EU, GERMANY, AND THE UK.

Country/ Region	Policy	Vision	Goal	Key strategies	Key sectors
The USA	American AI Initiative (2019)	To maintain technological leadership and national security	Lead in global AI innovation and protect national interests	• Invest in R&D • Support public–private partnerships • Enhance AI talent	• Defense • Healthcare • Manufacturing
European Union	Artificial Intelligence for Europe (2018)	To promote human-centered AI development with ethical standards	Establish ethical and sustainable AI progress across Europe	• Focus on ethical frameworks • Boost AI research • Ensure data privacy	• Healthcare • Public services • Digital infrastructure
Germany	Mission KI (2018)	To strengthen industrial competitiveness and integrate AI into society	Become a leader in AI-driven industries and technologies	• Promote industrial AI applications • Develop standards • Increase AI research funding	• Manufacturing • Smart industry • Mobility

(Continued on next page)

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Country/ Region	Policy	Vision	Goal	Key strategies	Key sectors
The UK	National AI Strategy (2021)	To create an innovative and open AI environment supporting economic growth	Foster an AI ecosystem that enhances the economy while maintaining its ethical use.	• Encourage innovation through collaboration • Build infrastructure • Promote education	• Finance • Education • Public services

Sources: References in the previous section on national policy analysis. Compiled by the authors.

The Future of APO AI Policies

To foster practical AI cooperation within the APO community, we propose that APO member economies work to generate synergies based on shared goals and interests as outlined in their AI strategies. APO economies can effectively achieve these objectives through two primary methods of cooperation: sector-focused collaborations and instrument-focused collaborations. By doing so, member economies can pool resources and expertise and make positive outcomes of collaborative endeavors more likely.

Sector-focused Collaboration

Sector-focused engagement between APO member economies should concentrate on areas of high interest and those with the greatest potential effects. We identify healthcare, industrial automation, and smart cities as fields most suitable for international partnerships and in line with global trends and regional needs.

Healthcare: Improving medical outcomes is a major priority for many APO economies, as AI could significantly enhance medical services, and, by extension, public health. Collaborations in this sector should focus on AI-based telemedicine, diagnostics, and personalized treatments. Joint research centers could help countries develop regional standards for AI-based medical technologies to ensure better compatibility and reliability. Such efforts could also facilitate access to advanced AI-driven healthcare solutions across the region.

Industrial automation and manufacturing: Industrial automation is another sector with significant potential for collaboration. The ROC's advanced manufacturing sector is a treasure trove of best practices in robotics, AI-integrated supply chains, and smart manufacturing. APO economies should work to establish consortia with ROC private-sector entities and government agencies to exchange knowledge, implement pilot projects, and adapt AI solutions for local industries, particularly SMEs. Such partnerships could help APO members modernize their industrial operations and boost economic competitiveness across the region.

Smart cities: Smart-city technologies and applications are also strong candidates for regional cooperation among APO members. The ROK, Japan, and the ROC have made significant progress in AI technologies in the fields of urban management, energy efficiency, and public safety. By

working together, APO economies could standardize smarty-city AI technologies to facilitate increased data sharing and hammer out best practices. Such collaborations would promote more sustainable urban development; lead to infrastructure improvements across the bloc; and ideally lead to safer and more efficient cities throughout the region.

Policy Instrument-focused Collaboration

To advance AI development within the APO community, member economies should focus on collaboration via specific implementation instruments. We recommend pursuing cooperative endeavors through the following instruments: competency development programs; public–private partnerships; and regional AI governance and ethics bodies. Tailoring strategies around these areas could help APO members establish a healthier AI ecosystem that satisfies both global standards and meets regional needs.

AI competency development programs: Most governments understand that highly skilled workers are at the heart of AI development. APO economies can collaborate through regional educational platforms and training centers, leveraging the expertise offered by advanced APO members such as Japan and the ROK. We propose developing standardized AI curricula, establishing joint scholarships, and founding new exchange programs to train AI workers. Such initiatives could help establish a baseline level of expertise, thereby enabling a reliable talent pool to drive innovation and support AI deployment across member economies.

Public–private partnerships: Our extensive review of the literature on AI and survey of government AI policies tells us that public–private partnerships are essential for accelerating AI adoption. APO economies should establish regional networks that engage governments, private enterprises, and academic institutions in joint R&D and AI commercialization projects. Drawing from successful models in the ROK, Japan, and the ROC, the APO could help facilitate the establishment of regional funding mechanisms to support AI startups. Governments and private-sector entities should also hold regular AI meets to share knowledge and promote technology transfers. Only through a collaborative approach could APO members hope to create thriving AI ecosystems capable of competing internationally.

Regional bodies for AI governance and ethics: APO members can learn from each other and from non-APO economies alike when it comes to AI governance. The USA, Germany, and EU all openly acknowledge the importance of AI ethics and data security as the institutional pillars of a reliable and trustworthy AI ecosystem. APO can and should adopt similar standards, focusing on ethical AI practices, data privacy, and transparency. Creating a regional AI ethics commission to oversee the development of ethics guidelines and ensure compliance would better align the bloc with global benchmarks. And regional commissions would be more adaptive to local contexts. Critically, doing so would establish the credibility of APO members in AI ethics.

Conclusion

In this section, we analyzed the AI policies of APO members as well as a number of other major players in the global economy. The national AI strategies of APO member economies are diverse, but fundamentally we find that they are much alike, as all seek to exploit AI in the common pursuit of national development. Some common themes can be found in any APO member's AI strategy. Economic growth, workforce training and education, and responsible AI governance are conceptually present in all published national AI visions.

However, each country tailors its policies to wrestle with unique challenges and tackle some priorities before others. And yet, the near-universal focus on healthcare, education, and public services demonstrates a shared commitment to using AI to make the society better, even as targeted initiatives in areas such as cybersecurity and finance point to specific national interests. Ultimately, these AI policies reflect national ambitions to build healthy and thriving AI ecosystems that balance technological innovation with ethical considerations and help lead to economic prosperity in the long term and improve the everyday lives of people. Through a combination of common goals and specialized strategies, APO member economies are positioning themselves to more effectively and safely navigate choppy AI waters (see Figure 6).

FIGURE 6

AI COOPERATION AMONG APO MEMBERS.

Individual AI policies +

Type of collaboration	Priority areas/tools	Examples of collaboration measures	Expected Outcomes
Asian Productivity Organization Sector-focused collaboration	Healthcare	• Establish joint research centers for AI in telemedicine, diagnostics, and personalized treatments	Enhance economic competitiveness Improve public welfare
	Industrial automation and manufacturing	• Form consortia for sharing knowledge and pilot projects • Adapt AI for local industries and SMEs	
	Smart cities	• Standardize AI for smart cities • Promote data sharing • Adopt best practices	
Asian Productivity Organization Policy instrument-focused collaboration	AI competency development	• Establish regional educational platforms and training centers	Foster skilled talent Ensure ethical AI deployment build a comprehensive AI ecosystem aligned with global standards Enhance AI competitiveness
	Public–private partnerships	• Develop regional educational platforms and training centers • Create standardized AI curricula and joint scholarships	
	AI governance frameworks	• Form a regional AI ethics committee • Adopt similar ethical standards of leading countries on data privacy, and transparency	

Source: Compiled by the authors.

SECTION 5:
AI AND PRODUCTIVITY

In this section, we examine the relationship between the adoption of AI and productivity. We begin by surveying the extant literature on the topic and identifying the economic outcomes that the research suggests can be achieved through use of AI. We then investigate specific AI applications, problem-solving approaches, and performances through a set of case studies of AI use in the private sector. We include this analysis in the report in the hope that its insights may inform AI policies crafted by policymakers in APO member economies.

AI Adoption and Economic Outcomes

AI Take-up

In this subsection, we explore AI adoption in two major global economies: the USA and the ROK, the latter being an APO member. Despite the versatility of AI technologies, take-up rates in both the USA and the ROK remain low, based on the results of empirical analyses using survey data covering a wide spectrum of firms in both the countries.

According to the 2018 Annual Business Survey, which covered 850,000 USA firms, fewer than 6% of respondents reported using AI-related technologies. AI technology in this context includes autonomous and guided vehicles, machine learning, machine vision, natural language processing, and voice recognition.[1] Very large firms were found to be more likely to adopt AI technologies, but the overall AI take-up rates were very low.

In the ROK, although AI adoption among firms has been increasing, survey data still suggested that adoption is proceeding at a snail's pace. Results of a more recent survey did show that the number of firms using AI rose from 174 in 2017 to 620 in 2022, reflecting a rapid annual growth of around 29%. But the percentage of all firms utilizing AI remained low, growing from 1.4% in 2017 to 4.5% in 2022, which marked an increase of 3.1 percentage points over five years. This time-series trend tells us that while AI adoption may be growing quickly, take-up remains concentrated among a small number of companies. Moreover, the data is based on a survey that focused on relatively large companies. We know that larger firms are generally more proactive in adopting new technologies, and so the adoption rate across the broader economy is likely even lower.

Economic Expectations

A Boston Consulting Group report (Ransbotham et al., 2022) found that individuals who derive value from AI were significantly more satisfied at work, with around 64% of survey respondents reporting moderate to extensive personal benefits from AI, which amounted to a 3.4-fold increase in job satisfaction. Furthermore, firms where employees found value in AI, were 5.9 times more likely to reap significant financial benefits (see Table 1).

[1] McElheran, K., Li, J. F., Brynjolfsson, E., Kroff, Z., Dinlersoz, E., Foster, L., & Zolas, N. (2024). AI adoption in America: Who, what, and where. Journal of Economics & Management Strategy, 33(2), 375–415.

In a 2020 McKinsey survey of global firms utilizing AI, about 66% of firms that had adopted AI reported increased revenue, with 40% noting that AI had lowered costs as of 2019. A report published by chip giant Intel (2018) argued that one could expect increased productivity, thanks to AI's ability to streamline operational and administrative processes, which reduce processing time and costs. In one study (Chui et al., 2023), an analysis of 63 generative AI use cases found that AI could generate economic impacts of between USD2.6 trillion and USD4.4 trillion in revenue terms, depending on the industry.

Bughin et al. (2018) meanwhile estimated potential GDP growth owing to AI across various countries. The paper forecasted that AI could lead to percentage point gains of GDP growth from 2017 to 2030 of 1.7% in Sweden, 1.6% in the ROK, 1.55% in the UK, and 1.5% in the USA. Goldman Sachs Research (2023) projected that if tools leveraging advancements in natural language processing technologies such as generative AI became widely utilized, global GDP could increase by as much as 7% (approximately USD7 trillion), with productivity growth rising by 1.5 percentage points over the next decade. And according to Chui et al. (2023), the economic impact of generative AI on the global economy could range from USD6.1 trillion to USD7.9 trillion annually. Acemoglu (2024) provides a more conservative forecast, estimating that in the next ten years, total factor productivity (TFP) could grow by 0.53% to 0.66%, and GDP could increase by 0.93% to 1.16% or 1.4% to 1.56%, depending on the level of AI-driven investment.

TABLE 1

EXPECTED ECONOMIC OUTCOMES OF AI ADOPTION.

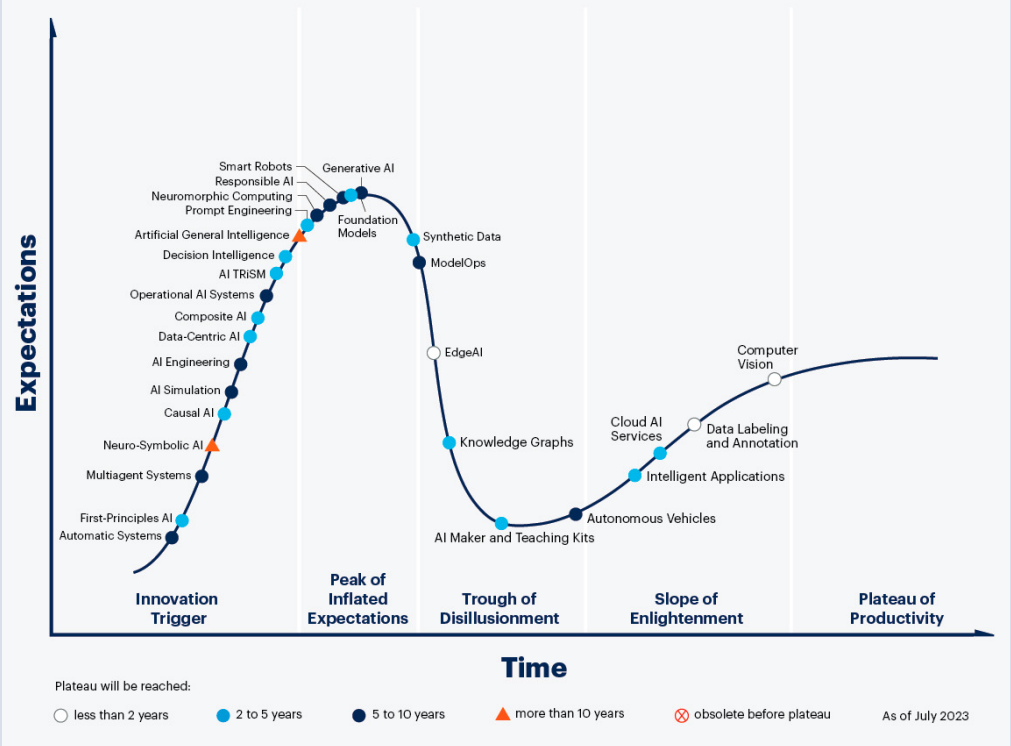
Level	Source	Expected outcomes
Individual	BCG Report (Ransbotham et al., 2022)	64% of individuals report moderate to extensive benefits from AI, resulting in a 3.4-fold increase in job satisfaction.
Firm	McKinsey & Company (2020)	66% of AI-adopting firms reported revenue increases; 40% reported cost reductions.
	Intel (2018)	AI is expected to enhance productivity by streamlining processes and reducing costs.
	BCG Report (Ransbotham et al., 2022)	Firms where employees find value in AI are 5.9 times more likely to achieve significant financial benefits.
Industry	Chui et al. (2023)	Economic impact of generative AI is estimated between USD2.6 trillion and USD4.4 trillion, depending on the industry.
National	Bughin et al. (2018)	Estimated annual GDP growth from AI (2017–30): Sweden 1.7%, the ROK 1.6%, the UK 1.55%, the USA 1.5%.
	Acemoglu (2024)	Forecast for TFP growth: 0.53% to 0.66%; GDP growth: 0.93% to 1.56% over the next ten years, depending on AI investment.
Global	Chui et al. (2023)	Global economic impact of generative AI projected between USD6.1 trillion and USD7.9 trillion annually.
	Goldman Sachs Research (2023)	If widely utilized, generative AI could boost global GDP by 7% (~USD7 trillion) and productivity growth by 1.5% over a decade.

Source: Compiled by the authors.

However, it is reasonable to expect that economic growth may lag technological advancements. A 2023 Gartner report shows that, after the emergence of new technologies, there is often a delay before the projected economic outcomes become a reality (see Figure 1). In case of AI too, we think it will take time for companies to recognize the practical uses of AI. This tells us that, to facilitate the diffusion of AI technology, we need to expect some volatility before tangible economic outcomes are realized. And thus, we should formulate strategies that utilize AI in ways that are most likely to produce results.

FIGURE 1

THE AI "HYPE CYCLE" FOR AI.



Source: Gartner Hype Cycle for Artificial Intelligence (2023).

Empirical Studies on AI and Productivity

Most general reports on the outlook for AI are very optimistic about the potential of AI to effect real economic outcomes. But in the literature on AI and productivity, the actual degree of economic impact remains uncertain. So, any discussion of effective AI policies should begin with an understanding of the rigorous empirical findings on the outcomes of corporate AI utilization.

To establish effective AI policies, we should first seek to grasp the economic impacts of AI at a micro level. This involves identifying various micro-level factors, such as the characteristics of companies actively investing in or utilizing AI, the actual performance outcomes resulting from AI adoption, changes in employment, and the types of companies where these changes are most commonly observed. Only by doing so can we devise more concrete measures, identify potential target beneficiaries, and set scale, scope, and duration of support needed.

There remains a dearth of research on AI and productivity using firm-level data, although many projects are now underway. There are numerous challenges to measuring the effects of AI adoption and utilization though, and an overall lack of data makes it difficult for researchers to produce consistent and replicable findings (Raj and Seamans, 2018). For the most part, we simply do not have direct empirical data on firm-level adoption of AI technologies and AI utilization.

Given this lack of data, many empirical studies on cutting-edge AI technologies have developed various proxy measures of AI use (see Table 2). Proxies include take-up rates of automation systems or industrial robotics, the number of AI-related patent filings, and measured changes in labor demand. Studies use these proxies to serve as variables indicating AI adoption or utilization by companies. For example, Graetz and Michaels (2018) analyzed the impact of robot adoption on GDP growth rates using panel data from 17 countries for the period 1993 to 2007. Acemoglu and Restrepo (2019) examined the decline in wages and employment due to the adoption of industrial robots in the USA from 1990 to 2007.

AI use could also be measured through analyses of AI-related patents (Damioli et al., 2021; Alderucci et al., 2020; Foster et al., 2019). Foster et al. (2019) analyzed the regional and industrial distribution of AI firms from 2000 to 2016 using patent data. The study's findings revealed that the number of AI patent families began to increase in 2013, with a significant surge occurring in 2015 and 2016, predominantly concentrated in the software and electronics manufacturing sectors. The regional distribution showed an increase in PR China, Japan, the ROK, and the USA, in that order.

Alderucci et al. (2020) utilized the presence of AI-related patents as an explanatory variable in an analysis of USA data from 1997 to 2016. The analysis found a 4.15% productivity increase across all industries. However, in the manufacturing sector, results varied significantly depending on the estimation method employed. Results ranged from an increase of nearly 8.9% to statistically insignificant data, making it difficult to draw firm conclusions from the findings. Damioli et al. (2021) examined the productivity impact of AI across 5,237 global companies with AI-related patent histories from 2000 to 2016. The findings were mixed and depended largely on corporate and industrial characteristics. Productivity increases were observed at smaller firms that adopted AI, while AI adoption at larger firms was not found to lead to increased productivity. The study also found that AI had a significant effect on productivity in the service sector but had no statistically significant impact in manufacturing.

Other studies have utilized more indirect methods of estimating AI utilization (Alekseeva et al., 2021; Babina et al., 2024). Babina et al. (2024) estimated AI investment using job postings for workers with AI skills as a proxy along with workforce data from USA companies. The work analyzed differences from 2010 to 2018 to assess corporate growth in terms of revenue, employee count, and market value resulting from investment in AI, but found no significant impact on productivity.

More recent workers in the literature have sought to use more direct measurements of AI take-up and utilization (Song et al., 2021; Czarnitzki et al., 2023). One landmark work in the literature is of Song et al. (2021), which used data from a Korean government survey of firms that featured questions explicitly asking about AI utilization. The study used this novel dataset to investigate any emergent productivity effects in the manufacturing sector, employing an instrumental variable (IV) model as a control for endogeneity. The analysis revealed no statistically significant relationship between AI utilization and productivity in the Korean manufacturing sector as a whole, but did confirm that multi-plant firms that adopted AI technologies had statistically more likely experienced increased productivity.

The findings of the paper suggest that AI utilization is perhaps most effective in the early stages of technology adoption, highlighting the need for policy support to facilitate its rapid implementation. Rather than a one-size-fits-all approach to promoting AI adoption and utilization, we recommend tailoring policy approaches to corporate or industrial characteristics to maximize the chances of productivity gains. The paper also identified specific drivers of productivity enhancement, such as the productivity convergence effect among different business entities within multi-entity firms. This supports the argument that companies should look to enhance overall productivity and efficiency across affiliated entities through enterprise-wide AI utilization. In a similar work, Czarnitzki et al. (2023) found positive effects on productivity at German companies, based on responses about AI utilization from the German contribution to the Community Innovation Survey of the European Commission. This work also made use of an IV model to address the endogeneity issue.

TABLE 2

EMPIRICAL STUDIES ON AI ADOPTION.

Study	Methodology	Findings
Graetz and Michaels (2018)	Panel data analysis (17 countries, 1993–2007)	Analyzed the impact of robot adoption on GDP growth rates.
Acemoglu and Restrepo (2019)	Panel data analysis (USA, 1990–2007)	Examined the decline in wages and employment due to robot adoption.
Foster et al. (2019)	Patent analysis (2000–16)	Found a significant increase in AI patent families starting in 2013, especially in software and electronics manufacturing, with a regional focus on PR China, Japan, the ROK, and the USA.
Alderucci et al. (2020)	Patent analysis (USA, 1997–2016)	Found a 4.15% productivity increase across all industries; results varied in manufacturing, with inconsistencies based on estimation methods.
Damioli et al. (2021)	Analysis of 5,237 global companies with AI patents (2000–16)	Observed productivity increases in smaller firms, while larger firms showed no impact. Service sector demonstrated positive effects, but manufacturing showed no significant impact.
Alekseeva et al. (2021)	Labor demand analysis via job postings	Indirectly estimated AI utilization based on changes in labor demand for AI-related job postings.
Babina et al. (2024)	Analysis of AI-related job postings (USA, 2010–18)	Estimated AI investment variables but found no significant impact on productivity despite observed growth in revenue, employee count, and market value.
Song et al. (2021)	Direct survey questions from Statistics Korea's business activity survey (2017–19)	Verified productivity effects in the manufacturing sector; found no significant relationship between AI utilization and productivity, although productivity increases were noted in multi-entity firms.
Czarnitzki et al. (2023)	IV model based on responses from the German Community Innovation Survey 2018	Discovered positive productivity effects for German companies regarding AI utilization.
Yang (2022)	Patent analysis (Electronics industry in the ROC,2002–18)	AI has positive relationship with productivity and employment.

Source: Compiled by the authors.

Overall, the findings of the relevant empirical literature on AI and its effects are mixed, and empirically robust results that testify to a definite positive relationship between AI and productivity are not commonly observed. This phenomenon, where advancements in new technologies do not immediately correspond with economic growth, is, however, explainable (see Brynjolfsson et al., 2019).

First, it takes time for firms and individuals to adopt new technologies on an economy-wide scale, and also for technologies themselves to become useful to a large slice of the population. The most common AI technologies are based on machine and deep learning techniques, which make them fundamentally more complex from the more primitive automatons and robots that are programmed by humans and to which humans are already well accustomed; it could take more time for firms and workers to adapt to and internalize these technologies before their benefits become apparent. Moreover, as we discussed in the introduction to this study, AI is a general-purpose technology (GPT), like electric power generation or the Internet, and is characterized by a broad range of potential applications that can reasonably be expected to have substantial aggregate spillover effects on the larger economy. But these impacts may not be immediately evident following their initial adoption.

Second, we should acknowledge the potential for the benefits of AI technologies to first accrue primarily to a small handful of companies, making it difficult to detect macroeconomic impacts. The OECD (2019) has suggested that productivity gains from digitalization may be concentrated in only a subset of firms. Cutting-edge digital technologies like AI, 5G, virtual reality, and augmented reality all require firms to make significant investments in R&D, labor, and technological infrastructure. And when these technologies are still new, it may only be feasible that firms with the most resources or other specific characteristics are able to benefit from adopting them. During the formative period of digitalization, for example, only companies with diverse talent pools, sufficient assets, technical expertise, and high levels of productivity had the ability to digitalize their operations and take advantage of new digital technologies. With AI, the hyper-concentration of AI technologies among a few firms could also manifest itself at the national level, raising the risk that productivity and growth disparities between countries may widen in the era of AI. This points to a pressing need to explore specific policy strategies that allow APO members to pursue AI in ways that are more likely to generate tangible productivity improvements and economic growth.

Best Practices in AI Utilization

In this subsection, we examine case studies of corporate AI use. The findings of previous studies on the productivity effects of AI are decidedly mixed; and given that the period of accumulated data on the utilization of cutting-edge AI technologies is relatively short, case analyses are a useful method for coming to grips with the practical applications of AI. Here, we seek to identify how AI is actually being utilized in the real world, take a look at some of the problems that AI addresses at companies, and assess some of the outcomes achieved. In addition, we will derive mechanisms for the dissemination of results stemming from AI utilization.

According to the criterion of versatility, a requirement of GPTs, the application of AI technology is widespread across industries and can be observed throughout various areas of business activities. As shown in Table 5.3, AI is being applied across different business functions within each industry, including demand forecasting, design, predictive maintenance, operations, and quality control. Additionally, the versatility of AI across industries is evident, as Table 3 presents AI use cases in various sectors such as manufacturing, finance, and retail.

TABLE 3

EXAMPLES OF AI APPLICATION BY INDUSTRY AND ACTIVITY.

Industry	Activity	Key issues	Use cases	Achievements
Automotive	Design	Product differentiation, cost competitiveness	Used Autodesk's CAD software with generative AI technology to reduce weight and strengthen parts	Applied lightweight and high-strength parts to 14 models, reducing weight by over 150 kg on average
	Predictive maintenance	Early identification and prevention of potential equipment failures	Real-time detection of malfunction symptoms such as power consumption fluctuations, abnormal conveyor movements, and barcode readability degradation, with alerts to maintenance center and technicians	Prevented about 500 minutes of downtime per year in the vehicle assembly process
	Operations	Quality Control	Automated transportation of key components using Automated Guided Vehicles (AGV)	Increased production efficiency by 25%
Semiconductor	Operations	Increased operating costs for IT teams	AI chatbot tailored for ASML, integrated with Microsoft Teams to respond to IT inquiries and connect users with experts	Achieved 90% success rate in query prediction, expected to help reduce IT operation costs
Chemical	Equipment operation	Increased efficiency	Replaced manual control of distillation process by operator with autonomous AI control to reduce substandard product production, optimizing raw material use	Reduced steam usage and CO2 emissions by 40%
Construction	Design	Reduced design time and cost savings	Automated steel structure design system improves design time and efficiency, with AI machine learning algorithms suggesting optimal structure for construction feasibility	Reduced steel structure design time from 3–4 days to under 10 minutes, reduced design costs by over 20%

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Industry	Activity	Key issues	Use cases	Achievements
Battery	Predictive maintenance	Cost reduction	Developed model to analyze vibration data to predict cutter lifespan	Predicts cutter replacement needs with 99% accuracy one day prior, 85% three days prior, reducing costs
	Design	Shortened design time	New AI recommendation model immediately generates optimal battery designs based on customer requirements	Reduced optimal battery design time from two weeks to one day
Railroad	Operations	Cost savings	Automated repetitive administrative tasks through RPA, reducing task processing time	Saved 34,253 hours annually
Retail and logistics	Demand forecasting	Increased revenue	Retail Media Network (RMN) advertising based on proprietary data collection and analysis for demand forecasting, enabling personalized ads	Generated USD31 billion in revenue through RMN alone in 2022
	Operations	Reduced processing time	AI automated system checks compliance with international shipping regulations upon receipt of deliveries; additional checks performed if regulations are unmet	Reduced processing time by 25% with 90% accuracy in identifying items
Finance	Operations	Efficiency enhancement	Adopted COiN, a contract intelligence tool for analyzing legal documents and extracting key data points and clauses	Reduced review time for 12,000 annual commercial credit contracts from approximately 360,000 hours to seconds
Bio	Development	Reduced development time	Developed INS018_055, the first drug to prioritize targets using biological AI and generate molecules through protein generation AI	Reduced costs to one-tenth and time to one-third; initiated phase 1 clinical trial 2.5 years post-project start

Source: Compiled by the authors.

Innovations in Automotive Product Design

Through its collaboration with computer-aided design (CAD) firm Autodesk, USA-based carmaker General Motors (GM) has introduced generative AI technology into its product design processes, accelerating innovation and significantly enhancing cost efficiency. In the automotive industry, even minor changes to component design typically necessitate extensive performance testing, which incurs high costs. Generative AI revolutionizes this design process by rapidly generating thousands of design options, allowing designers to select the optimal design within a short timeframe. This approach not only reduces time and costs but also greatly enhances the diversity and quality of designs. AI-driven design extends beyond simple weight reduction to enhanced product performance and contributes to reduced carbon emissions. Lightweight components improve fuel efficiency, thereby helping to minimize the environmental impact. GM has employed generative AI with the goal of reducing the weight and improving the strength of vehicle components. By utilizing 3D printing technology, GM has achieved mass-producible designs, incorporating AI-designed lightweight components in 14 Chevrolet models, thus successfully reducing vehicle weight by over 150 kilograms on an average. Additionally, GM has used generative AI software to develop a seat bracket that is 40% lighter and 20% stronger than conventional components, thereby improving the overall efficiency.[2]

Maintenance Systems Innovations in the Automotive Industry

German luxury automaker BMW has implemented an AI-based predictive maintenance system at its plant in Regensburg, to maximize production efficiency.[3] The primary goal of this system is to predict equipment failures in advance, minimize production downtimes, and reduce maintenance costs. Unlike traditional maintenance practices, which involve reactive measures after equipment malfunctions, the AI system continuously monitors equipment conditions by analyzing real-time data, allowing it to detect early signs of failure. In deploying this system, BMW has enhanced maintenance efficiency without the need to install additional sensors, instead leveraging data already collected from existing production lines. For example, AI analyzes data from the conveyor system used at the Regensburg plant, identifying potential problem areas in advance. This enables BMW managers to adjust maintenance schedules or take preventive actions proactively, resulting in both improved maintenance efficiency and cost savings. The introduction of the AI predictive maintenance system has allowed BMW to reduce production downtime by approximately 500 minutes annually. By minimizing unplanned stoppages due to equipment malfunctions, this system has significantly improved overall productivity and maximized equipment uptime, thus greatly enhancing operational efficiency at the plant. Furthermore, it has extended the lifespan of equipment and reduced unnecessary maintenance, resulting in lower maintenance-related costs. Building on the success of this AI-based predictive maintenance system, BMW plans to extend its application to other plants. This expansion is expected to further reduce downtime and maintenance costs across BMW's global production network. AI has thus evolved from a simple data analysis tool to a transformative technology, fundamentally improving process efficiency in manufacturing. BMW's smart maintenance system is widely regarded as a successful application of this advanced technology.

Intelligent Automotive Manufacturing Processes

German luxury giant and BMW competitor Mercedes-Benz has also established a future-oriented production system that leverages AI and digital technology at its Factory 56 in Sindelfingen,

[2] Kwon, Bo Kyung. 2024. *"Innovation Cases and Implications in the AI Era: Manufacturing Sector."* POSCO Research Institute. (In Korean)

[3] Graser. (2023), "Smart maintenance using artificial intelligence", November 11, BMW Group. Retrieved from https://www.press.bmwgroup.com/global/article/detail/T0438145EN/smart-maintenance-using-artificial-intelligence?language=en

Germany.[4] This facility is the fruit of a EUR 730 million investment; and was designed ground up to set a new standard in the automotive industry, with a focus on flexibility, efficiency, and sustainability. A key feature of the factory is its ability to flexibly manufacture a wide range of vehicle models on the same production line. From compact cars to SUVs, hybrids, and electric vehicles, production adjustments can be made swiftly in response to market demand. The entire production process at Factory 56 has been optimized using AI and digitalized systems, resulting in 25% increase in production efficiency compared with traditional plants. At the core of its digital infrastructure is Mercedes' MO360 digital ecosystem, which automates real-time data management and production processes. This system enables integrated production management across more than 30 Mercedes-Benz plants worldwide by continuously monitoring data from each production stage, thereby maximizing productivity and systematically managing quality. Factory 56 is also committed to sustainable production, achieving carbon neutrality as part of its operations. The factory generates 30% of its annual electricity needs through solar power and has implemented an energy storage system based on vehicle batteries to enhance power efficiency. Overall, Factory 56 has reduced energy consumption by 25% compared with other plants, eliminated paper use, and introduced other eco-friendly initiatives. In addition, the factory employs an AI-powered automated guided vehicle (AGV) system for moving parts around the plant, adding to the factory's technological flexibility by enabling rapid adjustments in assembly processes. Mercedes-Benz plans to gradually implement these innovative technologies across all its plants, positioning Factory 56 as a critical model for achieving a sustainable future in automotive manufacturing.

Intelligent Management of Semiconductor Equipment Operations

Dutch semiconductor equipment manufacturer and national champion ASML has introduced a customized AI chatbot called Violet to streamline IT support. Developed in 2023 using generative AI technology, Violet builds upon ASML's ServiceNow IT Service Management (ITSM) solution, which was initially implemented in 2008.[5] Co-designed with inputs from around 3,000 employees, Violet is integrated with Microsoft's Teams enterprise communication software, which allows it to answer IT-related inquiries or quickly connect users to specialists on demand. Within just a few weeks of its launch, over 6,000 employees had engaged with Violet, achieving a prediction accuracy rate of 90%. And through continuous machine learning, Violet is capable of improving its own performance, contributing to a reduction in ASML's IT operational costs.

Operational Innovation through Autonomous Control AI in the Chemical Industry

Japanese bulk chemical conglomerate Yokogawa has successfully implemented an autonomous control AI technology at its ENEOS Materials plant. Called Factorial Kernel Dynamic Policy Programming, the AI technology has helped Yokogawa to make great strides in its operational efficiency.[6] Following approximately one year of field testing, this technology has contributed to reducing the environmental impact while stabilizing product quality, marking the world's first application of reinforcement learning AI for official plant control. From January to February 2022, the AI system underwent an 840-hour testing period and demonstrated an ability to control distillation processes through AI. This system may potentially replace traditional proportional integral derivative (PID) control methods. During this period, the autonomous control AI achieved stable liquid-level control and maximized waste heat utilization year-round, resulting in the production of high-quality products. Yokogawa's autonomous control AI technology delivered four primary benefits. First, it

[4] Mercedes-Benz (n.d.), "Factory 56" Retrieved from https://group.mercedes-benz.com/innovation/digitalisation/industry-4-0/opening-factory-56.html

[5] Kiwoom Securities Research Center. 2023. *"Global AI Use Cases You May Not Know About."* Kiwoom Securities Corp. (In Korean)

[6] Yokogawa. 2023. *"Yokogawa's Autonomous Control AI Officially Adopted at ENEOS Materials Chemical Plant, a World First."* Yokogawa Electric Corporation, March 30. Retrieved 9 October 2024 from https://www.yokogawa.com/kr/news/press-releases/2023/2023-03-30/ (In Korean)

maintained stable operations despite extreme temperature fluctuations, ensuring consistent quality throughout the year. Second, by eliminating the production of off-spec products, it enabled efficient use of energy and raw materials, achieving a reduction of 40% in both steam usage and CO_2 emissions. Third, it reduced the need for manual operator intervention, lowering mental stress and enhancing operational safety. Lastly, the system proved robust, demonstrating the ability to consistently operate with the same AI model despite maintenance or changes in operational conditions. Through these achievements, Yokogawa has established autonomous control AI as a powerful tool for enhancing operational efficiency and energy conservation in plant operations. Yokogawa plans to further collaborate with ENEOS Materials to extend this technology to additional processes and provide global consulting services for factory automation, supporting clients in their digital transformation. Yokogawa remains committed to addressing labor shortages and driving sustainable productivity in the petrochemical industry through continuous innovation.

Innovative Applications of AI in Engineering Design

Hyundai Engineering, one of the ROK's industrial engineering leaders, is at the vanguard of transformative advancements in design using AI. The company has developed an automated design system powered by AI that plays a critical role in the structural design of steel frameworks for industrial plants, achieving significant improvements in design efficiency and cost reduction. Compared with traditional manual methods, this technology dramatically reduces the time required for design and enhances design quality. Previously, the plant's structural design required engineers to manually input every design parameter and conduct structural analysis using specialized software. This approach was time intensive and often relied on subjective judgment, leading to inconsistencies in design standards. In addition, variations in design criteria for each project and the need for revisions introduced extra costs and time, thereby limiting efficiency. In contrast, Hyundai Engineering's AI-driven automated structural design system addresses these challenges. By simply entering basic design conditions such as building size, load, and shape, the AI algorithm analyzes these inputs to propose an optimal structural configuration, completing the design automatically. Structural designs for steel frameworks that traditionally took three to four days can now be completed within 10 minutes, resulting in a revolutionary reduction in design timelines. AI optimizes the design process by analyzing data to propose optimal structures, thereby reducing material quantities and minimizing discrepancies between design and construction. This has resulted in shorter construction timelines and approximately 20% reductions in design costs. Furthermore, the AI-based automation system enables immediate modifications when design changes are needed, saving additional time and expenses. Hyundai Engineering is extending this technology across all areas of plant design. The automated design system, powered by AI, enhances bid competitiveness and contributes to cost savings during project execution. Building on the success of the automated structural design system for steel frameworks, Hyundai Engineering is also developing other AI-driven design automation technologies. These include converting 2D drawings into 3D models, automating piping and cable routing designs, and creating systems for automatic design of all trades and material quantity estimation. These AI-driven design automation systems perform data analysis and optimization throughout the plant design process, significantly enhancing Hyundai Engineering's technological competitiveness in the field. The company remains committed to advancing design quality and reducing costs through continuous use of AI technology in the design process.

Innovations in Battery Design and Manufacturing

The ROK battery powerhouse LG Energy Solution is revolutionizing battery design and manufacturing processes by leveraging AI. The company has recently developed an AI model called "Optimal Cell Design AI Recommendation Model," which has significantly reduced the

battery cell design time, from two weeks to just one day. This AI solution enables customers to input desired performance specifications, quickly deriving optimal cell compositions and accelerating the production of high-performance batteries. As a result, LG Energy Solution can promptly respond to customer demands while maximizing operational efficiency and achieving cost savings. This AI model was built using 30 years of accumulated experience and expertise at LG and was trained on approximately 100,000 battery design data entries. Consequently, it allows for consistent quality in cell designs to be achieved at a steady pace, regardless of the designer's skill level. The company plans to not only apply this technology to battery cell design but also expand its use to battery module and pack design in future. Moreover, LG Energy Solution has applied AI technology to enhance the cutting processes in battery manufacturing. By utilizing AI-based Prognostics and Health Management (PHM) technology, the company has developed a model that diagnoses the lifespan of cutters and predicts potential failure points. This model provides real-time notifications for cutter replacement and has achieved over 95% accuracy in predicting replacement timing. This proactive approach reduces unnecessary costs and improves operational efficiency.[7] Through this series of AI technology implementations, LG Energy Solution effectively addresses potential issues in battery design and manufacturing processes, thus contributing to enhanced customer value and strengthened market competitiveness. The company also plans to establish an integrated AI platform that will incorporate generative AI technologies across various operational areas, including procurement, production, and processes. This initiative aims to empower employees to leverage accumulated knowledge effectively, thereby further improving productivity and quality.

Innovations in Operations and Customer Service in Rail Transit

The Korea Railroad Corporation (KORAIL) actively utilizes AI technologies to maximize operational efficiency and enhance customer service.[8] Since 2020, KORAIL has implemented a Robotic Process Automation designed by Samsung SDS to automate 47 repetitive administrative and clerical tasks, resulting in an annual reduction of approximately 34,253 hours of labor. This strategic initiative not only minimizes unnecessary work hours but also lays the groundwork for providing superior services to customers. One of the key solutions involves automating the ticket booking monitoring system, which is available to users 24 hours a day. Previously, employees had to manually monitor the system for errors to make any necessary corrections. However, with the introduction of the RPA, the system can now be monitored in real time automatically, providing immediate alerts to employees if and when issues arise. This advancement significantly enhances the customer's booking experience. In addition, KORAIL has automated the task of notifying employees about the validity periods of their qualifications. This system effectively manages the validity of licenses for train drivers and related personnel by consolidating licensing information from regional headquarters and business units. By notifying employees in advance of the timing for competency evaluations, the system helps prevent any lapses in licensure, thereby enhancing safety. The RPA has also streamlined the review of applications and document management related to the hiring process. This automation reduces errors such as information omissions and enables the staff to process applications more swiftly. Previously, thousands of applications were handled manually, but the introduction of RPA has significantly alleviated this burden. Ultimately, KORAIL's implementation of RPA has resulted in significant improvements to the overall operational efficiency and has greatly improved the quality of public service, thus enhancing the

7 Kim, Dongwon. 2021. "LG Energy Solution Applies AI Technology to Battery Electrode Cutting Process... Used for Cutter Lifespan Analysis." *AI Times,* May 26. Retrieved 9 October 2024 from https://www.aitimes.com/news/articleView.html?idxno=138710 (In Korean).

8 Won, Jongcheol. n.d. "Automation for National Journeys - Korean Railway Customer Case." *Samsung SDS Customer Case Studies.* Retrieved 9 October 2024 from https://www.samsungsds.com/kr/case-study/case-study-brityrpa-korail.html (In Korean).

welfare of citizens. Moving forward, KORAIL plans to continuously expand the application of AI technologies to minimize working hours and provide even better services to the public.

Innovations in Demand Forecasting and Logistics Operations in the Retail Industry

Amazon actively leverages AI and automation technologies in its logistics, advertising, and customer experience operations. Its Retail Media Network (RMN) maximizes advertising revenue through automated, data-driven targeted advertising strategies. RMN digitizes traditional in-store advertising, utilizing Amazon's extensive customer data to deliver personalized advertisements to consumers based on their purchase histories. This approach enhances advertising effectiveness by providing relevant information to consumers, resulting in USD31 billion in advertising revenue and establishing Amazon as the third-largest advertising company in the USA behind Google and Meta. In the USA market, RMN is experiencing an annual growth of over 50%, contributing to significantly improved profitability for retailers.[9] In its warehousing operations, Amazon has made significant advancements with its autonomous picking robot, Robin, which efficiently processes items using AI and computer vision technology. Robin bots have successfully handled over one billion items, reducing repetitive tasks and allowing employees to focus on more complex responsibilities, thereby enhancing workplace safety and contributing to a more effective logistics system.[10]

Amazon is constantly looking for ways to enhance productivity at its logistics centers through robotics and AI. Since acquiring Kiva Systems in 2012, it has developed various robotic systems for use in its logistics operations; and currently has over 520,000 robotic devices installed at its warehouses. This automation plays a crucial role in improving experiences for both customers and employees, while also establishing a safer working environment.[11] Overall, Amazon's adoption of AI and robotic technologies has significantly increased operational efficiency and customer satisfaction. These innovations are critical to maintaining Amazon's competitiveness in the cutthroat global e-commerce market and we expect Amazon to be at the forefront of AI advancements in future.

Innovations in AI-powered Logistics

Global logistics firm DHL is at the forefront of innovation in the logistics industry, leveraging AI technologies to address various challenges. It has done so to a great effect.[12] AI plays a crucial role in several areas at DHL, including demand forecasting, inventory management, and route optimization. First, DHL utilizes an AI-based supply chain risk management platform called Resilience360 to quickly identify and tackle supply chain hiccups and bottlenecks. The platform visualizes the entire supply chain, allowing for real-time detection of potential risks and automatically adjusting delivery routes in response to any emergent issues. This allows DHL to tell customers beforehand to prepare for unexpected disruptions, which helps prevent production stoppages and sales losses and ultimately lowers costs. Second, the integration of AI and robotics has allowed DHL to largely automate its logistics centers. DHL Korea has recently introduced

[9] Heo, Chul. 2022. "RMN That Grew Amazon into a $31 Billion Advertising Revenue Powerhouse." *Maeil Business Economy,* April 22. Retrieved 9 October 2024 from https://www.mk.co.kr/economy/view.php?sc=50000001&year=2022&no=359399 (In Korean).

[10] Lee, Sungwon. 2023. "Amazon's Picking Robot 'Robin' Handles 1 Billion Items in Logistics Warehouses." *Robot News,* May 3. Retrieved 9 October 2024 from http://m.irobotnews.com/news/articleView.html?idxno=31515 (In Korean).

[11] Kim, Dalhun. 2022. "Amazon Reveals Robots and Related Technologies in Logistics Centers." *CIO Korea,* June 23. Retrieved 9 October 2024 from https://www.cio.com/article/3501622/아마존-물류-센터-로봇과-관련-기술-공개html (In Korean).

[12] DHL. 2024. "The Logistics Industry Embraces Transformation with AI Technology." *DHL,* September 23. Retrieved 9 October 2024 from https://www.dhl.com/discover/ko-kr/logistics-advice/ai-transform-logistics (In Korean).

small parcel sorting robots controlled by AI. These devices significantly improve the efficiency of the sorting process, handling up to 1,000 items per hour with an accuracy rate of 99%, thereby reducing labor costs and increasing processing speed. Finally, DHL has also applied AI to last-mile delivery with strong results. By analyzing historical delivery data, AI can predict traffic conditions and weather, enabling real-time updates that optimize delivery routes. This technology helps DHL shorten delivery times and reduce fuel consumption, while enhancing the customer's delivery experience and lowering costs.

Innovations in Contract Intelligence in the Financial Industry

The USA banking giant JP Morgan has developed and implemented an AI program called Contract Intelligence (COiN) to maximize efficiency and accuracy in the delivery of financial services.[13] COiN automates the review and extraction of data from legal documents, particularly commercial credit agreements. This has revolutionized the company's operations. Previously, JP Morgan employees were tasked with manually reviewing 12,000 credit contracts. These tasks consumed 360,000 hours of labor annually, but with COiN, these reviews can now be completed in just a few seconds,[14] allowing JP Morgan to reallocate personnel to more strategic and creative tasks. The AI algorithms used in COiN can also identify and extract data with greater accuracy than human reviewers, minimizing the risk of errors and providing consistent results, which is important for financial institutions managing numerous contracts and agreements.

COiN also offers scalability. This system enables JP Morgan to process more contracts without a proportional increase in staff, allowing for quick adaptation to new document types or regulatory changes. COiN has also transformed the role of legal professionals at JP Morgan, as they are now freed of busywork to do more analytical and creative work. This shift allows focus on high value-added risk assessment and advisory services, while also providing opportunities for workers to develop their AI and data analysis skills. The successful implementation of COiN not only demonstrates JP Morgan's commitment to innovation but also highlights the potential of AI in the financial sector and beyond. As AI technologies continue to advance, we expect tools like COiN to proliferate across various industries.

Innovations in New Product Development in the Pharmaceutical Industry

Hong Kong-based Insilico Medicine has adopted a new drug development platform using AI called Pharma.AI.[15] This platform comprises three core components: PandaOmics, which analyzes patient genetic information to identify therapeutic targets; Chemistry42, which designs chemical structures for drugs suited to these targets; and inClinico, which predicts the success probability of drug candidates during Phase 2 clinical trials. Recently, the treatment INS018_055, designed using Pharma.AI, has entered Phase 2 clinical trials, marking a significant milestone as it is the first instance of AI in target discovery and molecular design in drug development. Traditionally, the process of developing drugs takes over 10 years, and about 90% of candidate treatments fail along the way, making the process exceptionally risky and costly. However, Insilico Medicine has reduced costs by a factor of ten and shortened the time horizon by one-third through its use of AI. This innovation has allowed the company to commence Phase 1 clinical trials just two-and-a-half

[13] THE AI ZONE(2024), "How JPMorgan Chase's COiN is Revolutionizing Financial Operations with AI", June 27, Medium, Retrieved 9 October 2024 from https://medium.com/@the_AI_ZONE/how-jpmorgan-chases-coin-is-revolutionizing-financial-operations-with-ai-120a2938dab7

[14] Samil PwC Management Research Institute. 2024. *"The Current State of Business Utilizing Generative AI." Samil Insight.*

[15] Park, Chan. 2024. "Insilico Medicine Unveils 'First AI-Generated and AI-Discovered Drug'." *AI Times,* March 11. Retrieved 9 October 2024 from https://www.aitimes.com/news/articleView.html?idxno=157864 (In Korean).

years after initiating a development project. Currently, Insilico Medicine is engaged in over 30 AI drug development programs, including oncology, and has identified 12 potential candidates, three of which have advanced to clinical trials.

In this section, we explored how firms from across the industrial spectrum are using AI in every aspect of their businesses to cut costs and improve company-wide efficiency. Companies are using AI to forecast demand, design new products, carry out cutting-edge R&D, streamline production, perform maintenance and quality control, enhance logistical efficiency, and offer after-sales services in virtually every conceivable industry, with notable applications in the automotive, semiconductors, steel, biotechnology, logistics, retail, and finance sectors. As a next-generation GPT, these case studies show us how AI is leading transformative changes across sectors.

In the automotive industry, GM, BMW, and Mercedes-Benz are using AI to maximize productivity and quality. GM optimizes vehicle component designs with generative AI that helps engineers produce lightweight components through 3D printing, while enhancing fleet-wide fuel efficiency. BMW has implemented AI-based predictive maintenance systems to forecast equipment failures and reduce maintenance costs, while Mercedes-Benz is building flexible and efficient smart factories using AI and digital technologies to increase productivity. The Dutch semiconductor equipment firm ASML has introduced a customized AI chatbot to improve IT support efficiency and make resolution of customer issues faster than ever. And Japanese chemical major Yokogawa has made serious advances in process control through innovative use of autonomous AI, ensuring consistent levels of quality even under extreme environmental duress.

Our analysis of AI case studies in this section also tells us that efforts to improve performance through AI applications are not limited to the manufacturing sector. We also observed numerous AI use cases in the logistics, retail, and finance segments of the service industry. Ultimately, we find that AI is accelerating the pace of innovation across the economy; and is poised to become a crucial tool for strengthening corporate and national competitiveness.

SECTION 6:
CONCLUSION

In this study, we have analyzed the current state of AI and its relationship to the knowledge economy, AI patenting activity around the world, and global AI policies in an effort to understand the implications that AI carries for the transition to a knowledge economy and sustainable growth of APO member economies. In this section, we conclude the study by summarizing the key findings of our analyses and proposing a suite of policy recommendations for APO member economies to reference when deciding how to respond and develop policies for the advent of the AI era.

Main Findings and Implications

AI and the Knowledge Economy

Strategic investment in AI and knowledge infrastructure is an essential component of national competitiveness: AI has become a foundational component of the knowledge economy, driving data-driven innovation, productivity, and collaborative potential across sectors. Organizations that strategically invest in AI infrastructure and R&D are more likely to reap its competitive benefits. However, balanced investment in both technological and human capital, particularly through training (reskilling and upskilling) programs, is critical for countries to fully harness AI's transformative potential.

AI governance and ethical frameworks are crucial for sustainable growth: As AI becomes increasingly intertwined with economic and social structures, it poses several new risks: the loss of data privacy; algorithmic bias; job displacement; and massive energy consumption with concomitant environment impacts. Governments must develop transparent and resilient governance frameworks and ethical standards for AI to grapple with these inherent risks and mitigate the damage they can cause to citizens. Policymakers should make transparency, accountability, fairness, and sustainability in AI deployment paramount to foster public trust and ensure responsible AI development.

Lifelong learning and workforce adaptation are keys to inclusive economic growth: Our study of the knowledge economy suggests that adaptability is now an essential skill. As AI adoption picks up across the economy, there has emerged a growing need for workers with specialized AI skills and workers with hybrid skills that combine expertise in legacy domains with new AI competencies. Lifelong learning initiatives, such as digital literacy programs, flexible online learning, and workplace upskilling are essential tools that governments can use to prepare workers for a labor market in which AI competencies are in high demand. By investing in workforce development, both public and private sectors can work together to facilitate an inclusive socioeconomic transition that benefits workers as well as organizations, while addressing potential inequalities and maximizing the potential of workers.

Cross-sector collaborations accelerate innovation and promote more active exchanges of knowledge: Innovation ecosystems comprise close partnerships between the academia (and research organizations), the government, and the industry. In preparing this report, we have found

that these systems play a critical role in AI and knowledge economy development. Cross-sector collaborations channeled through these ties accelerate the diffusion of knowledge across the socioeconomic spectrum, foster technological advancements, and strengthen national competitiveness on the global stage. We think supporting policies and platforms that encourage public–private partnerships will be fundamental to advancing collective intelligence and fostering a more dynamic knowledge economy.

AI Capabilities in APO Member Economies

There is a digital divide in AI capabilities within the APO: Our analysis in Section 3 revealed a wide disparity in AI patent filings by APO member economies. We found Japan, the ROK, and India to be the leaders among APO members in AI innovation, while other members lagged behind. This points to a need for the APO's AI leaders to support other members in building basic AI capabilities. Potential areas of regional and international cooperation in this regard include enhancing AI infrastructure; providing targeted R&D funding; and fostering cross-border collaboration within the APO.

AI Is Dominated by a Handful of Major Global Leaders

The dominance of the USA, Japan, and PR China in AI patent filings shows how AI innovation is concentrated within a few leading economies. These economies are likely to continue shaping global AI standards, regulations, and technological directions. If APO members want to strengthen their global competitiveness in AI, it is essential that they better align their national policies with international standards while strategically fostering indigenous AI research to build up local competencies, overcome national obstacles, and take advantage of the unique opportunities that AI offers to their countries.

Two Emerging AI Innovation Hubs within the APO

Our analysis shows that the ROK and India have been filing more and more AI patents in recent years. These two countries could eventually become influential global players in AI innovation. Policymakers in other APO economies can draw lessons from the ROK's and India's successful AI strategies, which include heavy investments in AI R&D, strong policy support for AI adoption, and partnerships with global tech firms.

Collaborative and Open Innovation Models Are Crucial to AI Development

Given the differences in AI capacity among APO members, we propose that open innovation models, e.g., joint R&D initiatives, shared patent pools, and technology transfer programs, should be employed to help the less developed APO economies to take advantage of AI pioneered by the bloc's leading members. Strengthening collaborative networks within the APO and establishing partnerships with global innovators can help accelerate AI knowledge diffusion and enhance overall regional innovation.

Need for Robust Policy Support and Investment in Digital Infrastructure

Our analysis consistently highlights the crucial role of government support and strategic investments in digital infrastructure for advancing AI development, adoption, and innovation. Leaders in AI like Japan, the ROK, and the USA benefit from strong policies that recognize and foster AI as a strategic industry and engine of economic growth. For APO economies that want to enhance their own AI capabilities, policymakers should focus on building robust AI ecosystems by incentivizing AI research, workforce development, and upgrading of digital infrastructure in both the public and private sectors.

There Are Many Opportunities in Regional Specialization

Our analysis of AI patent activity shows what kinds of industries APO AI innovators tend to focus on. APO members could strategically concentrate on specific AI application areas that match their industrial strengths, whether those strengths lie in manufacturing, healthcare, or even agriculture. By utilizing complementarities in AI capabilities, APO economies can generate synergies in a broad range of AI applications, thereby strengthening the bloc's overall position in the global AI economy.

AI Policies of APO Members

AI features heavily in economic growth and competitiveness policies: As in major global economies elsewhere in the world, most of the APO member economies share the common goal of promoting economic growth and enhancing competitiveness through AI. While the USA and PR China, the global leaders in AI, emphasize technological superiority and national security in their AI policies, our analysis of AI policies in APO member economies shows that they are more likely to be concerned with how AI can impact social development, improve equality, and make life better for their citizens. Most countries highlight the importance of AI R&D, workforce training and education, and establishment of ethical AI governance and institutions.

Policies vary to a large degree from country to country: Every country emphasizes specific aspects of AI in their national policies and strategies. Major countries tend to concentrate on building out advanced digital infrastructure and investing in strategic industries. By contrast, APO member economies seem to view AI as a key driver for economic growth and superior public services, and place strong emphasis on social inclusivity and economic equity. Members have policies in place that deal with the application of AI technology in fields related to social welfare, such as healthcare, smart cities, and education.

AI and Productivity

The findings of empirical research on the effects of AI on productivity remain mixed, and AI take-up rates remain low.

Few doubt that AI has significant growth potential owing to its widespread usability in large swaths of the economy. Despite this, research on AI using data from the USA and the ROK reveals that the overall firm AI adoption level is below 10%. Moreover, recent empirical studies on AI and productivity have produced inconsistent results. We do not yet know for sure if AI has a universally positive impact on productivity.

The Digital AI Divide Between Firms Is Growing

Case studies of firms using AI technology indicate that its implementation is currently concentrated among a small number of firms that are generating tangible results. This phenomenon appears to be a natural outcome of varying foundational capabilities among different adopters of the technology. At the same time, it suggests that the enhancement of AI competitiveness and the expansion of outcomes may increasingly be concentrated among the leaders in AI tech, i.e., the large or frontier firms with large pools of highly skilled workers in developed countries. This divide poses the risk of exacerbating economic disparities among firms, industries, regions, and countries in the future.

Policy Suggestions

Policies for Leading APO Members

The ROK and India are the APO's AI innovation hubs. They can reinforce their positions by implementing strategic policies focused on developing AI-fluent workers, infrastructure, and

collaboration. We recommend incentivizing AI R&D through tax credits and government-backed venture funds. These countries should also work to broaden their AI talent pipeline via specialized education and international recruitment, while expanding digital infrastructure with national data platforms, high-performance computing, and 5G networks. We also think that these countries need to foster enhanced partnerships both within the APO and globally through collaborative research hubs and exchange programs that promote knowledge transfer and innovation. Finally, both countries need to institute AI ethics guidelines to protect data privacy and promote fair competition, as doing so is essential to build public trust in AI applications.

In addition, leading APO members should actively foster international collaboration. To bridge the AI capacity gap separating APO members, fostering collaborative and open innovation models is essential. Policies in Japan, the ROK, and India should encourage joint R&D initiatives and establish shared patent pools with less-developed APO members. Technology transfer programs, supported by dedicated funds, would facilitate the sharing of AI expertise and resources, allowing developing countries to adopt and implement cutting-edge AI solutions. And building robust collaborative networks through regional AI research hubs and innovation clusters can foster partnerships with global AI leaders, enabling knowledge exchange and development of crucial AI skills. These policies would collectively enhance innovation capacity across the APO bloc, enabling APO members to benefit more equitably from advancements in AI.

However, the developed economies of the APO bloc do face some significant challenges. Competition for top AI talent from other global hubs, particularly from the USA and PR China, could lead to brain drain. Balancing the need for data-driven AI development with stringent data privacy regulations could be challenging. And navigating the ethical complexities of AI development and deployment, such as algorithmic bias and the potential for job displacement, requires careful consideration and ongoing dialog. Maintaining competitiveness in the rapidly evolving global AI landscape necessitates continuous innovation and investment in AI research.

Policies for Emerging Economies in the APO

For emerging and developing APO members, bridging the AI capacity gap needs to be at the top of the agenda. Doing so will require a strategic, long-term, and multifaceted approach. First, the governments of these economies need to incentivize AI adoption among SMEs. This can be achieved by implementing targeted programs to encourage AI adoption, focusing on sectors with high growth potential, and providing access to affordable AI tools and technologies, such as cloud-based AI services and open-source AI platforms. Second, programs needed to develop AI skills in the workforce are essential. We recommend investing in AI education and training programs at all levels, including vocational training, university programs, and professional development courses. And critically, collaborating with advanced APO members to develop standardized AI curricula and facilitate knowledge transfer through scholarships and exchange programs can significantly enhance AI skills across the region.

Developing and implementing AI ethics guidelines that address the specific needs and contexts of developing economies is also crucial. These guidelines should ensure equitable access to AI benefits and mitigate potential negative impacts on vulnerable populations.

However, both emerging and developing APO members must tackle some issues on their way to becoming AI-fluent. Insufficient funding for AI research, development, and deployment can hinder progress. Unequal access to technology and digital infrastructure can exacerbate existing

inequalities and limit AI adoption, and a shortage of skilled AI professionals could constrain the development and implementation of AI solutions. Many countries have only limited access to high-quality data, which can hinder the development of AI models and applications.

Suggestions for Intra-APO Cooperation

Considering the AI policy goals and key interests of APO member economies, we propose the following sector-specific cooperations and policy instrument collaborations.

First, the development of AI-based telemedicine, diagnostics, and personalized treatment solutions in the healthcare sector is an especially promising field of potential cooperation for APO members. We recommend establishing joint research centers and developing regional standards as essential first steps toward enhancing cooperation. Such efforts could enhance the quality and accessibility of healthcare services across the APO bloc.

Second, leveraging the ROC's advanced manufacturing technology could help less-developed APO members facilitate the implementation of AI solutions in their own production operations. This would be particularly useful for SMEs. Knowledge sharing and pilot projects would drive efficiency and innovation in the manufacturing sector, leading to improved productivity and competitiveness.

Smart-city initiatives in the ROK, Japan, and the ROC have already led to better AI-based urban management, improving energy efficiency and public safety. By standardizing these technologies, APO member economies can promote more sustainable urban development. We think cooperative efforts in this area could help make APO members' cities more efficient, safe, and livable.

With regard to cooperation using specific policy instruments, we propose that APO economies establish regional educational platforms and AI training centers. Through partnerships with advanced nations, they can standardize AI curricula and scholarship programs to enhance AI skills and knowledge of their own workers. Such an initiative would help ensure a steady supply of qualified AI professionals in the labor market, which is essential to promoting the growth of the AI sector. Building collaborative networks connecting governments, private enterprises, and academia is also essential for fostering AI R&D and commercializing the technologies that result from it. Public–private partnerships help accelerate innovation and bring AI solutions to market more quickly, benefiting both public and private sectors.

We must also stress the vital role of a strong AI governance structure and comprehensive ethics guidelines. Establishing regional AI ethics committees and developing guidelines on data privacy and transparency are needed to align with global standards. Creating an ethical AI ecosystem will ensure that AI technologies are developed and used responsibly. By focusing on these collaborative efforts, APO member economies can enhance their international competitiveness in the AI sector. These efforts will also support sustainable growth and promote inclusive development, ensuring that the benefits of AI are widely shared across societies.

Finally, to promote more widespread adoption of AI, we propose that APO economies work together to find a shared AI Case Platform. This platform would allow APO members to share outcomes of AI applications with each other and encourage spillover effects. Empirical analyses indicate that while AI technology is advancing rapidly, adoption rates remain low, and we still do not fully have a firm empirical grasp on the economic outcomes of AI adoption. This uncertainty is likely part of the reason many firms have not yet made significant investments in incorporating

AI into daily workflows and processes. However, as we saw in our analysis of various case studies, firms with strong foundational capabilities, such as advanced technology, skilled workers, and financial resources, are already seeing AI produce results in reduced costs and enhanced competitive edge. That the early adopters are already benefitting from AI is widening the already large gap between the leading firms, regions, and countries that effectively leverage AI and those with lower adoption rates. This is why we feel it is necessary that governments must actively promote AI adoption, not just through vague promotional strategies but by improving their grasp of AI by studying important examples of AI utilization. It is important to advocate the benefits of AI utilization from a position of understanding.

As we saw in the case analyses of Chapter 4, AI applications exist to solve problems, and AI has proven capable of solving a vast array of problems faced by companies in virtually every industry. This is why we recommend that APO member economies actively share examples of AI innovation and utilization with each other. Doing so could allow policymakers to present businesses with real-life examples of effective AI use, which could help kickstart AI adoption, fostering a positive cycle of AI take-up and utilization among APO members.

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LIST OF TABLES

SECTION 2: THE EMERGENCE OF AI AND THE TRANSITION TO A KNOWLEDGE ECONOMY

TABLE 1 Updating the definition of AI (OECD) 6
TABLE 2 AI use cases by industry and activity 7
TABLE 3 Key characteristics of a knowledge economy 12
TABLE 4 Current trends in the knowledge economy 13
TABLE 5 Critical issues in the knowledge economy 14
TABLE 6 The role of AI in the transition to a knowledge economy 16
TABLE 7 Impact of AI on workforce dynamics and knowledge work 18
TABLE 8 Challenges and ethical considerations of AI integration 19

SECTION 3: ANALYSIS OF AI UTILIZATION IN APO ECONOMIES AND ACROSS THE GLOBE

TABLE 1 AI patent filings by APO members at the USPTO 24
TABLE 2 AI patent filings at the USPTO by APO members (top 10) 26
TABLE 3 AI patent filings at the USPTO by the Big Six and the leading APO innovators 28
TABLE 4 AI patent filings at the EPO by APO member economies 30
TABLE 5 Top 7 APO members by AI patent filings at the EPO, 2017–21 32
TABLE 6 AI patent filings at the EPO by the Big Six and leading APO AI innovators 33
TABLE 7 AI patent filings at the USPTO and EPO by the Big Six and the leading APO innovators 35

SECTION 4: GLOBAL TRENDS IN AI POLICY

TABLE 1 Overview of national AI policies of 14 APO member economies 47
TABLE 2 Key AI policies of the USA 52
TABLE 3 Key AI policies of the European Union 54
TABLE 4 Key AI policies of Germany 56
TABLE 5 Key AI policies of the UK 57
TABLE 6 Overview of AI policies of the USA, the EU, Germany, and the UK 59

SECTION 5: AI AND PRODUCTIVITY

TABLE 1 Expected economic outcomes of AI adoption 64
TABLE 2 Empirical studies on AI adoption 67
TABLE 3 Examples of AI application by industry and activity 69

LIST OF FIGURES

SECTION 2: THE EMERGENCE OF AI AND THE TRANSITION TO A KNOWLEDGE ECONOMY

FIGURE 1 Technical performance comparison of AI and humans 9
FIGURE 2 Computational power for AI training, 1960–2020 9
FIGURE 3 Defining the knowledge economy 10

SECTION 3: ANALYSIS OF AI UTILIZATION IN APO ECONOMIES AND ACROSS THE GLOBE

FIGURE 4 AI patent filings at the USPTO by APO members 24
FIGURE 2 Aggregate AI patent filings at the USPTO by APO members, 2017–21 26
FIGURE 3 AI patent filings at the USPTO by the Big Six 27
FIGURE 4 AI patent filings at the USPTO by the Big Six and the leading APO innovators, 2017–21 29
FIGURE 5 AI patent filings at the EPO by APO members 29
FIGURE 6 AI patent filings at the EPO by APO members, 2017–21 31
FIGURE 7 AI patenting with the EPO by Big Six, 2017–21 33
FIGURE 8 AI patent filings at the EPO by Big Six and leading APO AI innovators, 2017–21 34
FIGURE 9 AI patent filings at the USPTO and EPO by the Big Six and the leading APO innovators, 2017–21 35

SECTION 4: GLOBAL TRENDS IN AI POLICY

FIGURE 1 Milestone AI policy announcements 37
FIGURE 2 National AI policies of 14 APO member economies 38
FIGURE 3 Key sectors for AI policies of 14 APO member economies 50
FIGURE 4 AI policy tools of APO member economies 51
FIGURE 5 Key AI policies in the USA, the EU, and the UK 52
FIGURE 6 AI cooperation among APO members 62

SECTION 5: AI AND PRODUCTIVITY

FIGURE 1 The AI "Hype Cycle" for AI 65

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