Feature	Intensifying international cooperation and competition for developing AI rules

Hitachi Research Institute Report

Struggle for AI Hegemony through Competition and Cooperation by U.S., China, and the EU and its Impact on Industry

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The development of machine learning technology through deep learning in the 2010s has dramatically improved the level of artificial intelligence (AI) and has led to the integration of AI into various products and services. On the other hand, some issues have been pointed out, with discrimination and malfunctions caused by AI often reported in the mainstream media and other platforms. As civil life and social and industrial systems become increasingly dependent on AI, the governments of countries and regions began considering so-called AI rules in the mid-2010s to ensure the appropriate development and use of AI. Furthermore, over the past few years, there have been moves to merge AI rules that have been discussed individually in each country through international cooperation, with examples such as the OECD Principles on AI and the G20 AI Principles.
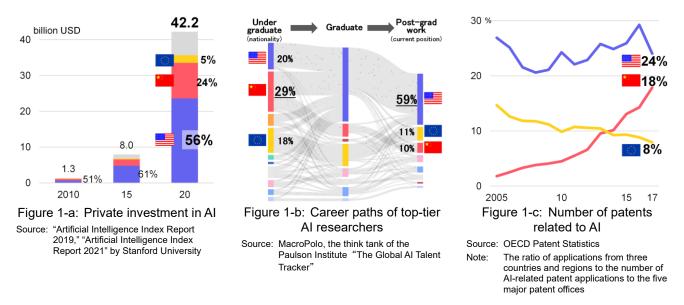
Against this backdrop, governments of countries and regions are working to build consensus in the fields of social and ethical principles, which are areas in which differences between countries and regions can be difficult to identify. These include the accountability, transparency, security, and privacy protection that are necessary when developing and using AI. Underneath the surface, they see the development and use of AI as a key factor in strengthening their own industrial competitiveness and national security, and they are competing to gain hegemony in AI by incorporating perspectives that are advantageous to them into the AI rules.

This paper discusses the status of AI rule development considerations in various countries and regions and the response of enterprises from the perspectives of both international competition and cooperation.

1. The AI Development Race of the United States, China, and the EU

1.1 Acquisition of AI development resources: U.S. ahead, China in fierce pursuit, while the EU lags behind

As indicated by Russian President Vladimir Putin's statement[1] that "whoever leads in AI will rule the world," competition in the development of AI is rapidly advancing in each country and region. AI development plays an important role in various fields, including industry, society, and military. In particular, the three bases of the United States, China, and the EU are competing to secure the funds, talent, and knowledge necessary for AI development. In terms of funding for AI development, the United States accounts for the

Figure 1-a: Private investment in AI

Source: "Artificial Intelligence Index Report 2019," "Artificial Intelligence Index Report 2021" by Stanford University

Figure 1-b: Career paths of top-tier AI researchers

Source: MacroPolo, the think tank of the Paulson Institute "The Global AI Talent Tracker"

Figure 1-c: Number of patents related to AI

Source: OECD Patent Statistics
Note: The ratio of applications from three countries and regions to the number of AI-related patent applications to the five major patent offices

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[1] Remarks made at a lecture given to students at the start of a new school term in September 2017.

majority of global private investment, and has led the development of basic and applied AI (fig. 1-a). From a talent perspective, about 60% of the world's top-tier AI researchers[2] are currently working in the United States. Looking at the origins of these researchers reveals that around 30% are from China. Currently, the Chinese government is working to bring these Chinese AI researchers back to China (fig. 1-b). Concerning knowledge, trends in the number of AI-related patents worldwide show the current status of the 3 regions—the United States is ahead, China is in fierce pursuit, and the EU is lagging behind despite having a decent position in terms of funding and talent (fig. 1-c).

1.2 Competitive strategy in the trilateral AI hegemony race

United States: Maintaining superiority over China in key technologies

In February 2019, the Trump administration announced the American AI Initiative, in which it pledged to create an environment in which AI tech companies such as GAFAM[3] can maximize their innovation in order to maintain the country's position as the world's AI leader. Furthermore, in March 2021, the National Security Commission on Artificial Intelligence (NSCAI), which was announced under the Biden administration, released its final report. This report expressed a sense of crisis that China would surpass the status of the United States within 10 years and proposed measures to prevent the outflow of technology with China in mind. Proposals included the introduction of export and investment restrictions on key technologies, the establishment of an international order through democratic alliances, and restrictions on development-related exchanges with overseas researchers and organizations.

The United States, in cooperation with its allies, is seeking to form a coalition against China from the viewpoint of national security in order to prevent China from gaining an advantage in key technologies that support hardware such as algorithms and AI chips.

China: Leveraging abundant talent to promote social implementation in China and overseas

The New Generation Artificial Intelligence Development Plan announced by the Xi Jinping administration in July 2017 declared that an AI industry worth 10 trillion yuan (Approx. 170 trillion yen) would be established by 2030, surpassing the U.S. as the world's AI innovation center. Specifically, the government has identified priority areas, designated BAT[4] and other AI tech companies to lead these areas, and supported[5] their development. At the same time, it is protecting domestic data and algorithms with regulations, and is promoting the rapid and large-scale social implementation of AI products and services and overseas expansion through the Digital Silk Road. Leading these efforts are AI talent with

advanced skills who have returned from overseas.[6]

In order to confront the U.S., which is imposing restrictions on the export and investment of advanced semiconductors and other products, China, backed by an abundance of domestic talent, has positioned AI as the top priority technology in its 14th Five-Year Plan. The country is working to establish an AI economic zone while promoting the social implementation of AI technologies in countries along the Digital Silk Road, such as Southeast Asia, Africa, and Central and Eastern Europe.

EU: Development of unique European rules with emphasis on data

Concerned about "digital colonization," in which AI tech companies from other countries, such as GAFAM in the U.S. and BAT in China, continue to dominate and exploit the region's data and markets, the EU is pursuing an alternative third path by aiming to establish its original European rules to realize European values that emphasize human rights and privacy protection. Specifically, the EU has been working to safeguard industrial data by establishing rules for transferring personal and industrial data outside the region through a series of data-related laws (EU General Data Protection Regulation [GDPR], Data Governance Act, Data Act, etc.) that it has been working on for some time as well as building a unified European cloud data infrastructure and common data space. It is also promoting intra-regional cooperation in AI development and implementation. In April 2021, the EU went on to announce a proposal for the world's first legal framework on AI (to be discussed in Chapter 3).

This series of initiatives seems to be aimed at generating the Brussels effect of exerting influence outside Europe by establishing unique rules originating in Europe that emphasize the data which the EU regards as the source of its competitiveness. In addition, this leaves room for dialogue and cooperation with its competitors of the United States and China, on the premise of sharing European values. It appears that by doing so they intend to contribute to securing the industrial competitiveness of AI tech companies in the region.

2. AI Rules: Cooperation on the Surface, Competition Behind the Scenes

In the 2010s, AI has made remarkable progress and spread rapidly and widely into civil life and social and industrial systems. At the same time, the frequent out-of-control behavior of AI algorithms, and cases of racial discrimination, misclassification, and malfunction by AI have gradually become problematic (fig. 2). It was also at this time that fears about future AI surpassing human intelligence and becoming unmanageable and uncontrollable spread throughout society. As the late Dr. Stephen Hawking said, "The primitive forms of artificial intelligence we already have, have proved very

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[2] Survey of the current organizations and universities/graduate schools of 675 authors obtained through a random sampling of 1,428 papers accepted at the 2019 annual conference of Neural Information Processing Systems (NeurIPS), a leading international society in the AI field

[3] Collective term for the five companies of Google, Apple, Facebook, Amazon, and Microsoft

[4] Collective term for the three companies of Baidu, Alibaba, and Tencent

[5] The government has identified four priority areas and designated companies to lead each area. Autonomous driving (Baidu), smart cities (Alibaba), healthcare (Tencent), speech recognition (iFLYTEK)

[6] In a separate article published in this journal, Mr.Zhou discussed China's plans for the development of next-generation AI and the use of AI talent with advanced skills.

useful. But I think the development of full artificial intelligence could spell the end of the human race."

Against this historical backdrop, since the mid-2010s, countries, regions, international organizations, and companies have been considering AI rules[7] as a mechanism for enabling humans to develop and use AI appropriately. Specifically, these rules consist of social and ethical principles, which outline the basic concepts to be guaranteed in the development and use of AI, and law and enforcement, which including laws, regulations, self-imposed regulations, and technical standards for the realization and implementation of AI (fig. 3).

International discussions have progressed on the social and ethical principles which should be ensured when developing and using AI, and a general consensus has been formed as principles for AI. For example, in May 2019, 42 countries (36 OECD member countries and 6 partners) signed the OECD Principles on AI, agreeing to build AI systems in a sound, safe, fair, and credible manner. Furthermore, in June of the same year, at the G20 Ibaraki-Tsukuba Ministerial Meeting on Trade and Digital Economy, the Ministerial Statement to promote the development and utilization of AI based on the concept of human-centeredness was issued and adopted as the G20 AI Principles.
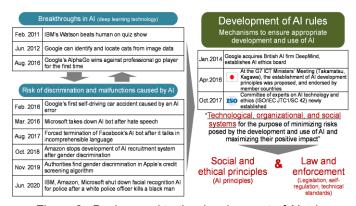
International discussions are also progressing on law and enforcement towards the realization and implementation of AI principles, particularly among the OECD and democratic countries. For example, in June 2020, 19 countries and regions, including the G7 member countries and the European Commission, established the Global Partnership on Artificial Intelligence (GPAI), which considers international rules for responsible AI development and use. In addition, initiatives to establish international standards on AI have been raised between the United States and the EU (Trade and Technology Council) and between the Quad countries, Japan, the United States, Australia, and India (critical and emerging technology working group).[8]
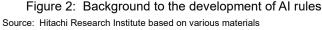
In this way, while a consensus on AI rules is being formed in a coordinated manner under international discussion, behind the scenes, the US, China, and the EU are trying to take the lead in the AI field. They are planning to incorporate perspectives that will enhance their own industrial competitiveness and be advantageous for national security in AI rules.
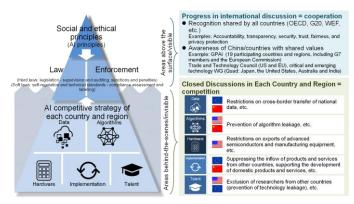
When considering AI rules, attention should be paid to surface-level cooperative aspects, which are norms that should be deduced from social and ethical principles. At the same time, it is important to take into consideration the aspect of behind-the-scenes competition, such as how and in what manner countries and regions intend to incorporate mechanisms into rules to ensure their competitiveness in the development, implementation, and operation of AI.

3. Countries and Regions Seeking Different Rules for AI Development and Use for Competitive Strategy Purposes

Each country and region has developed its own AI principles on social and ethical issues related to the appropriate development and use of AI. A comparison of the principles of the United States, China, and the EU shows a degree of convergence,[9] as they generally share the same concepts. On the other hand, the wording of these AI principles reveals the competitive strategic intentions of each country and region, with: (1) the United States wanting to emphasize innovation and leave it to companies to govern themselves; (2) China wanting its own technology standards, specifications, and peripheral technologies to become de facto; (3) the EU wanting to uphold European values such as human rights and privacy protection (fig. 4, upper part) Organized in

Figure 2: Background to the development of AI rules
Source: Hitachi Research Institute based on various materials

Figure 3: Overview of AI rule development
Source: Hitachi Research Institute

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7   With reference to documentation such as AI Governance in Japan Ver. 1.1 (July 2021) by the expert group on how AI principles should be implemented, this paper defines AI rules as technological, organizational, and social systems for the purpose of minimizing risks posed by the development and use of AI and maximizing their positive impact.

8   In a separate article published in this journal, Prof.Jitsuzumi discusses recent developments in the international debate over AI rules, and Ms.Kudo also discusses recent trends in international rule of data that is essential for AI learning and inference.

9   The World Economic Forum and the PwC analyzed more than 200 AI principles of governments, public institutions, and companies in each country and region and identified nine common denominators. Specifically, the core social and ethical principles of AI were categorized as: (1) explainability, transparency, provability; (2) reliability, robustness, security; (3) accountability; (4) data privacy; (5) lawfulness and compliance; (6) beneficial AI; (7) human agency; (8) safety; and (9) fairness.

conjunction with the composition of the trilateral struggle for AI hegemony as seen in Chapter 1, the inclinations of AI rules in each country/region, including regulations for AI principles and law and enforcement, can be summarized as follows (fig. 4, lower part).
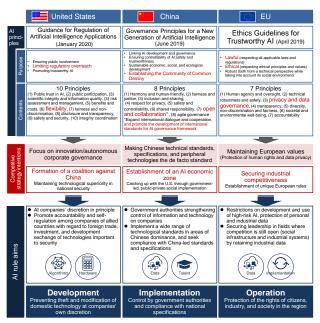
	United States	China	EU
AI principles	Guidance for Regulation of Artificial Intelligence Applications (January 2020)	Governance Principles for a New Generation of Artificial Intelligence (June 2019)	Ethics Guidelines for Trustworthy AI (April 2019)
Purpose	• Ensuring public involvement • Limiting regulatory overreach • Promoting trustworthy AI	• Linking AI development and governance • Ensuring controllability of AI safety and trustworthiness • Sustainable economic, social, and ecological development • Establishing the Community of Common Destiny	• Lawful (respecting all applicable laws and regulations) • Ethical (respecting ethical principles and values) • Robust (both from a technical perspective while taking into account its social environment)
Contents	10 Principles (1) Public trust in AI, (2) public participation, (3) scientific integrity and information quality, (4) risk assessment and management, (5) benefits and costs, (6) flexibility, (7) fairness and non-discrimination, (8) disclosure and transparency, (9) safety and security, (10) integrity coordination	8 Principles (1) Harmony and human-friendly, (2) fairness and justice, (3) inclusion and sharing, (4) respect for privacy, (5) safety and controllability, (6) shared responsibility, (7) open and collaboration", (8) agile governance "Expand international dialogue and cooperation, and promote the development of international standards for AI governance framework	7 Principles (1) Human agency and oversight, (2) technical robustness and safety, (3) privacy and data governance, (4) transparency, (5) diversity, non-discrimination and fairness, (6) societal and environmental well-being, (7) accountability
Competitive strategy/ intentions	Focus on innovation/autonomous corporate governance **Formation of a coalition against China** Maintaining technological superiority in national security	Making Chinese technical standards, specifications, and peripheral technologies the de facto standard **Establishment of an AI economic zone** Catching up with the U.S. through government-led, public-private social implementation	Maintaining European values (Protection of human rights and data privacy) **Securing industrial competitiveness** Establishment of unique European rules
AI rule aims	• At companies' discretion in principle • Promote accountability and self-regulation among companies of allied countries with regard to foreign trade, investment, and development exchange of technologies important to security *Algorithms* *Hardware* **Development** Preventing theft and modification of domestic technology at companies' own discretion	• Government authorities strengthening control of information and technology on companies • Implement a wide range of technological standards in areas of Chinese dominance, and seek compliance with China-led standards and specifications *Data* *Talent* **Implementation** Control by government authorities and compliance with national specifications	• Restrictions on development and use of high-risk AI, protection of personal and industrial data • Securing leadership in fields where competition is still open (social infrastructure and industrial systems) by retaining industrial data *Data* *Implementation* **Operation** Protection of the rights of citizens, industry, and society in the region

Figure 4: AI rule inclinations of each country and region
Source: Hitachi Research Institute based on various materials

In order to strengthen underlying technologies and expand business through technology development led by the private sector with an emphasis on corporate innovation, the United States aims to avoid excessive regulatory intervention in the development and use of AI and to strengthen governance at the discretion of companies. On the other hand, the U.S. regards AI as one of the key technologies directly linked to national security, and is deeply concerned about China's advancement, which poses a threat to its technological superiority. Therefore, in order to prevent the theft and modification of underlying technologies such as AI, which are important for security, new regulations on technology trade and investment have been established under the Export Control Reform Act (ECRA) and the National Defense Authorization Act. In addition, rules have been strengthened to prevent the leakage of information and technology through easily transferring these underlying technologies overseas and joint development with other countries. In the future, it is possible that new AI rules will be formulated for companies (in the U.S. and its allies) that have contact with China in the development of AI technologies, focusing on the development of underlying technologies, including calls for detailed accountability, strict information blocking, and

restraint in technological exchange itself.

China aims to establish the autonomy of its own AI technology through government-led and public-private joint implementation efforts and backed by an abundance of talent. At the same time, it is also aiming for AI rules for domestic and overseas companies that ensure the transparency of AI development and implementation processes, disclose technical information, and enable government intervention as necessary. This is considered to be a measure to reduce the risk of social unrest caused by the spread of AI, which would be undesirable for the government. Through the Cybersecurity Law and the Export Control Law, Chinese authorities have long been strengthening the control of information and technology, by taking actions such as prohibiting the export of Chinese data algorithms. In August 2021, China released a draft of rules for managing AI algorithms, which could disrupt national security and socioeconomic order, and declared that it would establish law and enforcement systems to control the implementation and use of algorithms[10] that could affect public opinion and social behavior over the next three years or so. Furthermore, with regard to technological fields in which China has an advantage, such as face recognition, voice recognition, and natural language processing, the country is actively promoting the social implementation of its AI products and services through smart city projects in countries along the Digital Silk Road and international dialogue and development cooperation for the safe management of AI. This is thought to be an external strategy based on a soft-law approach that calls for countries and companies to comply with Chinese-led technology standards and specifications, with the aim of making China's own technologies the de facto standard and locking vendors in by deploying China's idea of "safe and secure" AI technology in other countries.

Recognizing that it is lagging behind the United States and China in the development and implementation of AI, the EU is aiming to develop AI rules that emphasize the rights of citizens, society, and industry as well as privacy protection in the region, with a focus on operations that are closer to users. Specifically, these include draft AI regulations and proposed digital services laws that require AI developers and implementers to be accountable for high-risk AI development and use, as well as transparency and reliability. In particular, the draft AI regulations announced by the European Commission in April 2021 are attracting global attention[11] as a hard law that seeks to comprehensively control AI by prohibiting AI products and services that may threaten the fundamental rights and security of European citizens from entering the European market, or imposing severe restrictions (compliance assessments, database registration, information disclosure, etc.) at the development and use stages. These regulations are in line[12] with the EU's basic strategy to create

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[10] Although not clearly defined in the Cyberspace Administration of China's Provisions on the Administration of Internet Information Service Algorithmic Recommendation (Draft for Solicitation of Comments) dated August 27, 2021, the draft mentions matters such as algorithm operations in search ranking, recommendation function, review column, and pushing. In addition, it also stipulates that the user is allowed to choose whether or not to set a recommendation function based on an algorithm, and prohibits addictive algorithms that encourage users to pay high charges and make mass purchases.

[11] In a separate article published in this journal, Mr.Ukai discusses the characteristics of the proposed EU AI rules and their impact on industry in the region and beyond.

[12] On February 19, 2020, after Ursula von der Leyen took office as European Commission President, the European Commission announced: (1) the basic digital strategy for creating a single European digital market "shaping Europe's digital future"; as a specific measure to achieve this, (2) the "European Data Strategy" aimed at creating a European data space; and (3) the "AI White Paper" which called for Europe to become a world

a single European digital market that focuses on data and AI by establishing a mechanism to safely distribute and utilize personal and industrial data, which the EU regards as a source of competitiveness, across industries and enterprises.
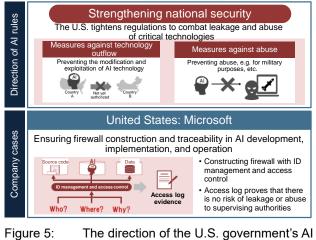
In this way, the United States is strengthening its control in the development phase, China in the implementation phase, and the EU in the operational phase. In addition, following the principle of proportionality,[13] there is a possibility that countries and companies will adopt stricter rules than others in areas to which they attach importance. Therefore, the AI rules pursued by each country and region are expected not converge into one form, but to move in different directions in the short term.[14]

4. Global Business Development in Response to AI Rules of Countries and Regions with Both Competition and Cooperation

From the perspective of national security and industrial policy, the United States, China, and the EU have been taking various measures to protect and strengthen various digital assets such as AI, data, and 5G, which are directly linked to the international competitiveness of social infrastructure and industrial systems. In particular, with regard to AI, which is one of the most advanced digital assets with anticipated rapid market growth, countries and regions have repeatedly engaged in international cooperation and competition over the development of rules. Global enterprises that develop, implement, and operate AI across multiple countries and regions need to build development, implementation, and operation management systems that respond to the characteristics of AI rules in different countries and regions, keeping in mind the increasingly fierce competition for AI hegemony among countries and regions.

For example, in the United States, where AI rules are being strengthened in development, it is important to manage information and technology leaks through overseas transfer of underlying technologies such as source code and joint development with other countries. In China, which emphasizes implementation, it is important to ensure the transparency of development and implementation processes related to systems, products, and services utilizing AI and to respond to technical information disclosure requirements. Furthermore, in the EU, where emphasis is placed on operational aspects, it is necessary to fulfill accountability requirements based on operational and failure data with regard to the safety of AI algorithms used from the viewpoint of user protection.

Advanced global companies have already established systems to appropriately manage underlying technologies, source codes, and data for learning and verification in each

country and region where they develop, implement, and operate AI. Microsoft, for example, has set up a firewall for access to source code and other technical information in the development of its AI technologies with its business partners and joint development companies who use Microsoft products and services in order to comply with the Export Control Reform Act (ECRA) of the United States. In addition, ID management, access control, and log management are implemented for each developer, enabling the early capture of unauthorized leakage, modification, and misuse of underlying technologies. This can also be used in explanations to government authorities. In this way, it is important to develop a digital trust infrastructure that ensures traceability of development, implementation, and operation through firewall configuration and access log management, explain that there is no risk of technology leakage, abuse, or misuse throughout the AI lifecycle, and ensure compliance with AI rules in each country and region (fig. 5).

Figure 5: The direction of the U.S. government's AI rules and Microsoft

Source: Hitachi Research Institute based on Microsoft publications

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leader in AI that can be used safely. In these announcements, the EU indicated plans to establish a Digital Services Act and AI regulations.

[13] The concept of seeking an equilibrium between the policy objectives to be achieved and the regulation as a policy methods taken to achieve them. For example, at the time of publication of the draft AI regulations, European Commission Executive Vice-President Margrethe Vestager explained that the AI rules envisioned by the EU are underpinned by the idea of "the higher the [potential] risk [for EU citizens and companies using AI], the stricter the rule."

[14] In a separate article published in this journal, Dr.Renda discussed the possibility of cooperation and collaboration between countries and regions in the development of AI rules.

5. Conclusion

This paper discussed the status of AI rule development in the United States, China, and the EU and the response of enterprises to the AI rules of each country and region from the perspectives of both international competition and cooperation.

Given the fact that many countries and regions have taken the opportunity of the EU's GDPR to formulate rules regarding the handling of personal data, resulting in a mosaic of rules for cross-border data distribution, it is highly likely that the aforementioned ECRA in the United States, Cybersecurity Law in China, and draft AI regulations in the EU will accelerate competition among countries and regions in the development of AI rules and further complicate direction of AI rules. In addition, the scope of the regulation may be expanded in the future as the use of AI expands to mission-critical areas such as manufacturing, health care, and transportation, where defects in inference and control may have serious adverse effects.

Enterprises with global AI operations will be required at an even higher standard to develop and provide AI products and services that meet both market demand and the policy demands of national and regional governments, after promptly and accurately grasping international trends in highly fluid AI rules and assessing their impact and direction in advance.

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