The artificial intelligence industry: a race for leadership

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Abstract

As defined in economic theory, artificial intelligence (AI) can be considered an industry. In this context, two simultaneous processes are observed: concurrence and cooperation. The current dispute between China and the United States for world leadership in AI should be placed against this background. Thus, the description in this paper of concrete policies and measures that the Chinese regime pursued to promote its AI industry and identify its strategy to increase its influence on the standardization processes in the emerging industry is extremely important.

Keywords: artificial intelligence (AI); standardization; Social Credit System; China.

1. INTRODUCTION

The artificial intelligence (AI)[1] industry is recent; it could be said that, as currently perceived in public opinion, it is barely a decade old.[2] 2012 was a pivotal year for the development of AI since it was when a qualitative change occurred: automated systems capable of learning from data emerged (Wright, 2018).[3] The impact of this evolutionary leap of AI in manufacturing (new agenda for Industry 4.0), in government (State 4.0 agenda), and politics (ecosystems of care) was swift and decisive.

The Chinese government was shaken when the South Korean grand champion, Lee Sedol, was beaten at Go[4] by Google DeepMind's AlphaGo. The March 2016 event was a turning point for Chinese global leadership aspirations (Ding, 2018). Thus, the 19th Chinese Communist Party Congress held in October 2017 was the perfect sounding board for President Xi Jinping to push forward a vigorous agenda regarding the AI industry. The Chinese regime reacted quickly to the challenge, simultaneously on two levels: firstly, regarding the infrastructure of Internet services, and secondly, the AI industry.

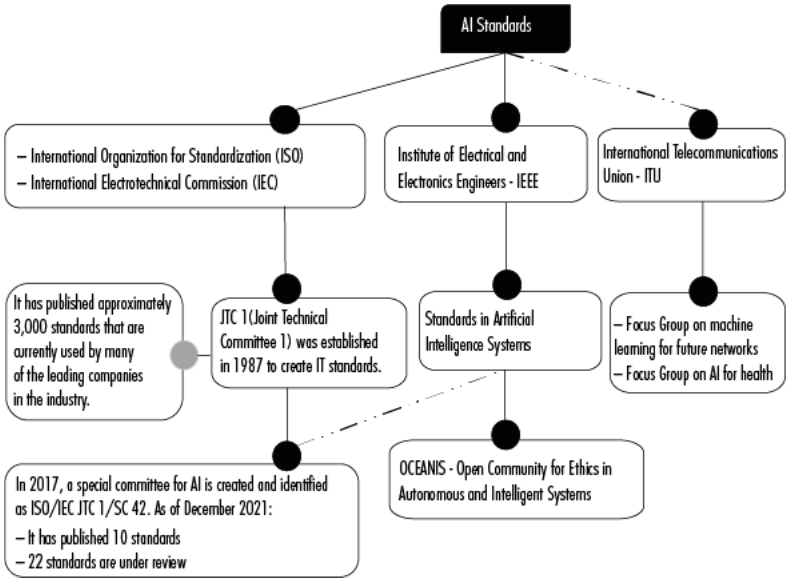
There is no argument among analysts and experts around the world regarding the impacts of the AI industry on the economy, political (in)stability, and social control; however, there is disagreement regarding the crucial issue of how to quantify, prioritize and weigh up these impacts, both on inputs and prospective evidence for the creation of public policies for the promotion of AI.[5]

Most countries want to benefit from AI, most do not want to be left behind, and a few want to lead it. However, AI leadership is implemented simultaneously on several levels. The main ones include AI-specific hardware (especially AI-specific and retrofittable semiconductors), increasingly competitive talent thresholds (human capital for deep AI architecture and algorithm development), data collection, processing, and protection, and, finally, a certain degree of influence on standardization processes in the AI industry.

Several studies quantify the economic and social benefits that AI will contribute to future society. However, it should be pointed out that the majority of these current and future benefits are made possible by the existence of standardization processes that need to be more visible and comprehensible to the general public. An effective way to characterize standardization processes and standards is to treat them as a coordinating institution. This type of invisible institution based on cooperation and concurrence (i.e., competition and competence) facilitates the expansion and growth of the industry. Also, it permits interoperability between different AI devices (Cihon, 2019).

Since this is recent activity, there are currently two organizations in charge of standardization processes: Joint Technical Committee 1 and the Institute of Electrical and Electronics Engineers (see figure 1).

Figure 1. Standardization institutions in the AI industry



Source: Compiled by the author based on data from Cihon (2019) and from the ISO/IEC JTC1/SC 42 and OCEANIS websites.

It should be clarified that, although it is evident, standards are neither voted on nor openly imposed. On the contrary, they result from a long working process in which experts reach agreements to deal with different factual disagreements. In other words, they are the result of epistemic work to coordinate production and scale competition, i.e., to build a broader market. This does not mean that the particular interests and vocations of power, both companies and governments, do not play a decisive role. However, to reach this instance of reflexivity (i.e., to participate, in this case, in the epistemic and technical domain of JTC1/SC 42), certain credentials are required that only emerge under certain specific starting conditions: technological-productive ecosystem (companies, labor force, active scientific and productive community) and public policy aimed at strengthening the presence of the country in these committees (in addition to the budget, *expertise*, vocation, and diplomatic temperament), among others.

This paper describes China's growing participation in AI industry standardization processes. The structure of the text is presented as follows: first, an account is given of China's assets towards the end of the last decade, which allowed it to host the first meeting of the AI standardization subcommittee in 2018. The second point describes the Chinese strategy to influence the standardization process. It identifies the specific tools of the Social Credit System, which are potentially attractive for the consolidation of Chinese ambitions. Finally, it concludes with two current political tensions in the Chinese AI industry that are essential for the regime's ambitions.

2. THE SO-CALLED “RIGHT TO SPEAK.”

Following the political earthquake unleashed by Go's departure in March 2016, the Chinese regime unusually and simultaneously intensified its AI policy on several fronts. Before its presentation, an overview was imposed on China’s progress over those years (2016-2018). The overall picture is based on three dimensions: business ecosystems, science parks, and human talent.[6]

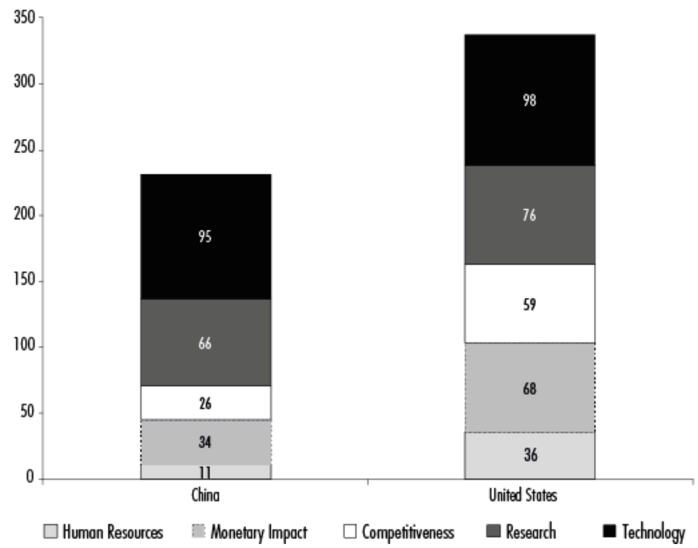
According to a joint study between the consulting firm Gartner and the China Academy of Information and Communications Technology (CAICT) (CAICT and Gartner, 2018), the total number of AI enterprises in 2018 was 2,039 companies in the United States, while China (mainland) had just over half (1,040 companies). In 2018, the consulting firm Compass-Intelligence (2019) surveyed over 100 chip manufacturing companies, and only Huawei was among the top ten. Even so, according to the "China Artificial Intelligence Development Report 2018" prepared by Tsinghua University, China has become the region with the highest investment and funding for AI (China Institute for Science and Technology Policy, 2018).[7]

In 2017, Elsevier SCOPUS ranked China as a pioneer region in the publication of scientific papers in the area of AI; however, as far as its impact is concerned, it is ranked 34th (Tan, 2018; Elsevier, 2018). For border development issues, China's influence was low in those years. Considering the standard used by the Chinese Academy of Sciences for Level 1 papers, China had a total of 248 versus 1,325 for the United States. Regarding human capital linked to publication, the United States had 4,804 scientists publishing at Level 1 versus 2,267 for China. However, since 2012, Chinese patents in the field of AI have continued growing (Tan, 2018).

Although the China AI Conference has been held annually since 2015, it is worth noting that among the top 700 most talented figures in AI, the US has more than double those of China. According to LinkedIn's "Artificial Intelligence Global Talent Report," there were 1.9 million AI professionals in 2017. Half of them were in the United States, and only about 50 thousand in China (Hersey, 2017). However, it should be noted that several AI research centers have flourished in recent years: e.g., Tsinghua University, Peking University, the Chinese Academy of Sciences University, Zhejiang University, Shanghai Jiaotong University, Nanjing University, among many others (Tan, 2018).

The AI index developed in a study conducted by Capgemini Consulting provides a relatively clear picture of the progress made by China up to then, as well as an outline of the areas or dimensions of concern for the regime (see Figure 2). According to the index above, China has 232 points, occupying fourth place, while the United States ranks first with a total of 337 points. The key point of this comparative study can be found in the "technology" category, where the two countries are in an apparently similar position (China with 95 points and the United States with 98).

Figure 2. Artificial Intelligence Index (2019). Comparison between China and the United States



Source: Compiled by the author based on data from Tinholt et al. (2019, pt. Appendix B).

Meanwhile, the Artificial Intelligence Potentialities Index (Ding, 2018) shows that the United States doubled China's score,[8] which permits the summarizing and presenting the relative advantages achieved by both countries for those years (see Table 1).

Table 1. Relative advantages in the AI industry towards the end of the last decade. Comparison between China and the United States

	Relative advantages
China	Data collection and native digital population.
	Global financing for AI start-ups.
United States	Non-specialized chips for algorithm training.
	Chips specifically designed to run deep and machine learning algorithms.
	A number of experts and publications.
	Increased number of AI companies in the world.

Source: Compiled by the author based on data from Ding (2018).

While AI played a vital role in the Chinese regime's policies and planning,[9] the turning point of Go's departure in March 2016 accelerated ambitions for global leadership and, in 2017, the Chinese government relaunched the New Generation Artificial Intelligence Development Plan.[10] The regime reacted swiftly to the new challenges on various levels:[11] *big data,* the Internet of Things, and Industry 4.0.[12] However, the forcefulness of the new policies promoted by Xi Jinping was felt simultaneously on two levels: on the one hand, in the infrastructure of Internet services (hardware and supercomputing facilities), and on the other, in the AI industry (human resources policy, business processes, and standardization processes).

The following is a brief account thereof.

In 2016, the Office of the Central Cyberspace Commission and the Cyberspace Administration issued regulations for developing and using mobile applications. The State Council published rules for using "Internet +" and the National Development and Reform Commission established specific guidelines for its promotion. During that year, the National Information Office launched the National Cyberspace Security Strategy, which led to the enactment of the Cybersecurity Act in 2017 (Sacks *et al.,* 2019). All these measures aimed to enhance and regulate (*i.e.,* control) the infrastructure for AI development.

Moreover, in September 2017, the State Council established the Office for the Implementation of the AI Development Plan in the Ministry of Science and Technology, tasked with coordinating with 15 government agencies (Triolo and Goodrich, 2018). In October of the same year, the National Development and Reform Commission announced the implementation of the AI Industry Development Alliance. This project includes the powerful Ministry of Industry and Information Technology, the Cyberspace Administration of China, plus institutes under the CAICT (Triolo and Goodrich, 2018). Finally, during the same year, the Ministry of Public Security formally authorized the use of facial recognition systems for legal processes and the maintenance of social management.

The AI Industry Development Alliance project aims to create a mega AI services platform for the industry. The objective is to have open platforms for services to the industry. For now, the alliance includes more than 200 companies; however, the so-called national start-up team for this task consists of Alibaba (smart cities), Tencent (medical imaging), Baidu (autonomous vehicles), and iFlytek (voice recognition). For example, Baidu's participation includes the Augmented Reality Lab, the Natural Language Unit, the Big Data Lab, the Deep Learning Institute, the Business Intelligence Lab, and the Robotics and Autonomous Driving Lab. As far as the latter is concerned, Baidu developed the Apollo 2.0 open platform in collaboration with the automotive industry. Thus, Baidu would be betting on Apollo becoming the Android of the autonomous vehicle industry (Triolo and Goodrich, 2018).

Pursuant to the foregoing, in January 2018, Beijing announced the creation of the largest AI park in the Zhongguancun area.[13] Despite the rivalry between Tianjin, Chengdu, and Wuhan for the consolidation of AI parks, Beijing's biggest competition is Shanghai, which is home to the innovation centers of Baidu, IFlytek, Horizon Robotics, and Cambricon. Beijing's most important assets are undoubtedly a considerable number of national-level laboratories, including the State Key Laboratory (SKL) of Pattern Recognition, the SKL of Intelligent Technology and Systems, and the Deep Learning National Engineering Lab (in partnership with Baidu). At that time, the new Xiong'an New Area (XANA), south of Beijing, was being completed. Located there, Alibaba built a data center for its smart cities project (Triolo and Goodrich, 2018). Furthermore, Alibaba's DAMO (Discovery, Adventure, Momentum, Outlook) Academy, fully aware of the need to improve the competitiveness of human capital, planned to invest USD$15 billion in labs throughout major high-tech cities (Hangzhou, Beijing, Singapore, Moscow, Tel Aviv, Silicon Valley, and the Seattle area) (Triolo and Goodrich, 2018).[14]

The Chinese government and scientists were aware of the "talent factor" in the race for global AI dominance and the talent available to the United States, their greatest (and perhaps only) competitor. For example, they were aware of the ambitious goals behind Google's DeepMind project and Microsoft's new AI lab, bringing together more than one hundred renowned experts in perception, learning, reasoning, and understanding natural language. The Chinese authorities understood that the future depended on systems that teach other techniques, such as the machine learning system introduced by Google in 2017.

That same year, the year of the relaunch of the AI Plan, just over 18,000 employees in China were working in AI, in second place behind the 29,000 workers in the United States (O'Meara, 2019).[15] In that context, towards the end of the last decade, Chinese universities planned to launch 35 new AI-related courses (Fang, 2019). In 2021, the Chinese Ministry of Education unveiled ten new university degrees related to the AI industry., perhaps as a show of "muscle." However, it appears to have been an immediate response to a specific policy of its competitor when the United States set AI and quantum information science as the budget priorities for 2022 (Li, 2021). This is human resources, not just a physical capital race. The Chinese regime is well aware of this.

Between the inauguration of the first center for the Internet of Things[16] towards the end of the 2000s and the recent creation of the National Blockchain Network (April 2021), the Chinese regime implemented a wide range of policies. It carried out one of the most ambitious social engineering projects of all time: the Social Credit System. Thus, the Chinese government considers that it has done everything necessary to sit at the small table of AI world leaders and "talk". The issue of the "right to speak" (Huayu quan 话语权) should be understood not only as an extension of diplomatic *soft power* but as a Chinese discourse of power on the international stage (Hoffman, 2018). As a first step to sit down and talk, he coordinated the first ISO/IEC JTC 1/SC 42 ISO/IEC JTC 1/SC 42 meeting and prepared a background document: *Artificial Intelligence Standardization White Paper* (China Electronics Standardization Institute, 2018).

3. THE STANDARDIZATION DISPUTE

First-tier companies make standards, second-tier companies
make technology, and third-tier companies make products.

Famous saying quoted by Atkinson (2015).

Overview

Between 1993 and 2010, China established, according to the standardization law in force since 1988, 16 technological product categories with their own standards, thus differentiating themselves from international standards, including *wireless*, mobile telephony, *Video Codec, Digital Trunking, Document Formatting, Mobile Phone Charging,* among others (Atkinson, 2015, Figure 1).

In 2004, continuing with that policy, the Chinese Standardization Office announced a study program to construct the national technology standards system, which had two primary objectives: to diagnose and act (Atkinson, 2015). On the one hand, the aim was to show how the management of technological standards negatively affects China's future and, on the other hand, that, to counteract this negative effect, local or domestic technical measures needed to be increased and made more effective.

Two years later, in 2006, the Chinese regime launched the National Medium and Long-Term Plan for the Development of Science and Technology (2006-2020). In contrast to the Deng Xiaoping era, domestic high-tech production was formally beginning. The proposal of this plan was to place China at the heart of technology production: it included 402 projects, including for example, smart vehicles, high-performance computers, etc. (Atkinson, 2015).[17]

Table 2. Working groups to advance the standardization strategy

Working group	*Key subject matter*	*Key issue for standardization*
1. Standard Information Security and Coordination System	Security review of network services and products	Cybersecurity Review Regime
2. Security of the classified information system	Certification and evaluation of critical network devices and specific cybersecurity products	Routers, switches, servers, firewalls, web applications, intrusion detectors and preventive systems, and network auditing systems, among others
3. Encryption standards	Secure and controllable products and services	CPU, operating systems, software suites (servers and hardware)
4. Authentication and authorization	Multi-Level Protection Scheme (MLPS)	Reach all network operators: cloud computing, mobile communications, Internet of Things, and industrial control systems, among others.
5. IT security management	Infrastructure of critical information. Cybersecurity protection	
6. Communication security	Cross-border data transfer	Monitor the data transfer of foreign companies.
7. Information security management	Personal data and protection of critical data	Specific issue of Cybersecurity: personal information security specification
8. Big Data Security	Encryption	Blockchain technology

Source: information taken from the text of Sacks and Li (2018).

What is at stake?

The Economist magazine named the confrontation between China and the United States a chip war (*The Economist*, 2018).[18] During the last few years, the 5G network has been an important part of the battlefield, not only in terms of infrastructure (Fabre, 018) but also in the processes of standardization (Triolo and Webster, 2018).[19]

The development of AI-specific hardware is a long-term process. Currently, there are two types of this hardware: a) chips designed for other processes but used to train AI systems, such as CPUs and GPUs, or b) chips specifically designed to run deep learning, neural networks, and machine learning algorithms, such as Google's TPUs and Microsoft's FPGAs (Ding, 2018).

Since 2014, China has had a strategy of supporting its large hardware manufacturing companies (e.g., Tsinghua Unigroup) with its Integrated Circuit Fund policy. Since 2017, one of the priority targets has been manufacturing the chip[20] to run artificial neural networks (specifically Nvidia's M40 chip, which is 20 times superior to the M40) (Ding, 2018). In this context, China played a game of pincers: on the one hand, to try to acquire companies in the sector outside China and, on the other, to restrict the participation of foreign companies in the domestic context.[21] In 2017, the US Committee on Foreign Investment began to detect this phenomenon, and the results were conclusive: it banned the sale of Xeon chips to China, while in September, the White House prevented a Chinese fund from buying a semiconductor company (Ding, 2018). The tensions between China and the United States are not about commodities as the issue of trade confrontation is often presented; instead, it is about leadership in high technology, AI ecosystems, and the superconductor industry (Kania, 2017a, 2017b). China has many supercomputers, one of the fastest processors (*Sunway TaihuLight),* and a Baidu company, Cambricon (a state-owned start-up within the ZTE complex). It provides Huawei with a powerful chip that makes its products (neural processing unit) one of the fastest on the market (Ding, 2018). In short: with the Next Generation Artificial Intelligence Development Plan, China seeks to get ahead of Tesla, Facebook, and the U.S. Brain Initiative project.

Talking (and doing)

China seeks to exert its dominance on standardization processes for AI since part of the leadership for AI on a global scale is resolved in that arena. Whoever sets the standards is, in a way dictating how you compete. China arrived at this meeting with a document essentially prepared by the China Electronics Standardization Institute, belonging to the Ministry for Industry and Information Technology, and the collaboration of several large companies in the field. However, before the 2018 meeting, China had prepared the domestic political ground well.

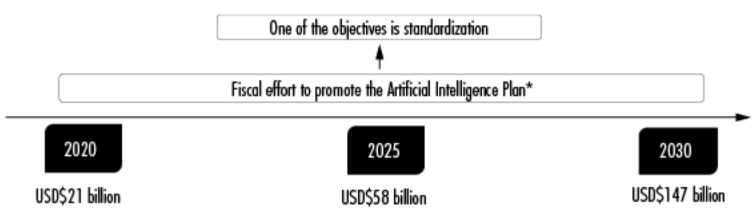
In addition to the Cybersecurity Law sanctioned in 2017, another law was issued by the National Assembly in the same year: the Standardization Law (revising the 1988 law). There are two types of standards: national, indicated by the letters GB (*guobiao* 国标), and recommended, identified by the acronym GB/T (*guobiao/tuijian* 国标/推荐) (Sacks and Li, 2018) (Sacks and Li, 2018). Thus, China came to the 2018 meeting[22] with the intention of, on the one hand, imposing domestic standards and, on the other hand, continuing on its slow path of revision. A perfect clamp in the hands of the Chinese central power.

The Cybersecurity Law has six sections. The fourth corresponds to the protection of personal data and information. Since 2010, China, through the Technical Committee on National Information Security Standards (known as TC260), has developed more than 240 regulations relating to cybersecurity (Sacks, 2018). China has the tools to use standardization in a way that involves bending the rules of the game against foreign companies. The lax or ambiguous way standardization is incorporated into and understood in legislation allows for this type of potential discrimination. Even the Cybersecurity Act provides the Chinese government with access to sensitive information on intellectual property, patents, and source codes (Sacks and Li, 2018). This flexible form of legally specifying standards ("specifications", "recommendations", "requirements", etc.) plays a dual role: inwardly, in the relationship of the State with businesses, including public companies; outwardly, in its relationship with the World Trade Organization (WTO). For example, Sacks and Li (2018) report that in 2017 over a thousand standards reported to the WTO were "downgraded" from requirements to recommendations. However, this legislation will be seen in operation with future standardizations. And the new law may prove to be as vague as almost all Chinese legislation (Inkster, 2017). However, that is just what plays in China's favor in the competition for AI leadership.

Table 3. Status of standardization in the AI industry in 2018

	Already issued	*Already issued*	*Being study*	*To be developed*	*Total*
Fundamentals	Terminology	4		1	5
	Data	1	2		3
	Reference architecture	1	1	1	3
	Testing and evaluation			1	1
Platforms and supports	Smart sensors and networks		9		9
	Cloud computing	5	4		9
	AI Platforms	3	6		9
	Intelligent Edge Computing			4	4
	IA chips			1	1
	Chips para IA			1	1
Key technology	Computer vision		4	4	8
	Natural language processing		1		1
	Human-computer interaction	5	9	8	22
	Recognition of biometric characteristics*	18	10		28
	Virtual and augmented reality		3	3	6
Products	Robots **	11		1	12
	Smart terminals	4	4		8
	Smart delivery vehicles and systems	3			3
Applications and services	Smart home	10		2	12
	Smart logistics	4			4
	Smart manufacturing			5	5
	Smart cities	3		7	10
	Smart transportation	2	2		4
	Health care	1	14	1	16
	Finance	3			3
Security		2	7	1	10

Notes: * there are 19 standards with an adopted standard number and degree of adoption which are under review or seeking equivalence; ** 1 standard is requesting equivalence.



Source: compiled by the author based on the China Electronics Standardization Institute (2018, sec. Appendix 1). Budget projection data was taken from Roberts et al. (2021).

Scoring, the joint punishment system, and the struggle for standardization

The official launch of the Social Credit System (SCS) was scheduled for 2020; however, it was postponed with no new date. While the SCS emerged between 1999 and 2002, it was under Xi Jinping's leadership that it became a colossal work of social engineering. The SCS is a system of surveillance systems that records, either through scores or lists, the behavioral history of individuals in those aspects or dimensions that are of interest to the regime, especially "breach of trust". Thus, individuals who "break" trust somewhere in social interaction receive punishments throughout the system of social interaction, i.e., in access to socially valuable goods. Therefore, the ultimate goal of the SCS is to regulate access to socially valuable goods through the history of reliable behavior. This mechanism applies to individuals, companies, and civil society organizations, except the Communist Party of China and the Chinese government agencies that directly depend on it.[23] For this reason, and although it is not its fundamental purpose, the SCS can become a powerful tool in the struggle for standardization. I will go into more depth about this idea below.

The SCS is made up of multiple scoring systems and lists, both on institutional as well as territorial levels; in straightforward terms, the majority converge into two major systems: the Social Integrity Score managed by the National Development and Reform Commission and the Financial Credit Score managed by the People's Bank of China. The latter is of interest in this paper, with its two identifiable subsystems. The first, known as Market Credit Information, has two scoring systems: Quality Grades and Financial Credit Ratings. The second is Public Credit Information and comprises two-point systems: Comprehensive Public Credit Ratings and Compliance-Based Ratings. The latter two are potentially relevant to China's leadership in the AI industry.

While the People's Bank of China monitors the Comprehensive Credit Grades scoring system and Compliance-Based Ratings, the ultimate overseer is a web of state agencies, the top of which is the all-powerful National Development and Reform Commission. The Commission monitors all registered businesses and entities in the points system by giving them a score of excellent, good, fair, and poor. The second system records compliance with laws, rules, and regulations and covers all companies subject to restrictions, i.e., almost all of them. Thus, the information from companies and corporations ends up on the three major information platforms regarding breach of trust: National Credit Information Exchange Platform, Credit China, or National Credit Information Publicity System for Businesses.

Therefore, a low Comprehensive Credit Rating or non-compliance in the Compliance-Based Rating registry leads to companies and corporations being blacklisted. Entry onto such lists leads to companies and corporations being subject to collective punishments, i.e., they are subject to penalties in multiple dimensions of their business interaction (e.g., denial of licenses, access to land or real estate, credit, etc.). It is essential to highlight that the SCS, by monitoring companies and corporations, also holds managers accountable when trust is breached so, in the event of a breach of trust, it is not only the company or corporation that suffers the consequences but also its managers. In this respect, the SCS causes much uncertainty in the business world and, as some corporations (Yahoo, LinkedIn, among other recent ones) argue, the business climate is aggressive. The government can use the SCS to tilt the playing field, i.e., to monitor and punish certain companies and sectors. Therefore, the SCS may prove to be a powerful tool available to the Chinese government in its quest for standardization in the AI industry.

4. CONCLUSIONS

In 2018, Professor Tan Tieniu (Deputy Secretary-General of the Chinese Academy of Sciences) gave a special lecture to the National People's Congress. Tan (2018), in tune with Chinese government-driven policies, highlighted three limiting factors for AI development. These are the "three calculations": algorithms (suanfa, 算法), computing power (suanli,算例) and data (shuju, 数据).

As I have tried to demonstrate in this article, China made systematic progress on all three fronts, and its presence in the international arena has been felt.[24] The two years of the SARS-CoV 2 pandemic served as a global stage for international public opinion to become aware of China's strength in AI, not only in surveillance, the facial recognition industry, and population tracking but also to more accurately identify China's pivotal role in the industry, specifically in supply chains and telecommunications.[25]

China's ambition for global leadership in AI was powerful enough to set off alarm bells in the U.S. government. In June 2021, the Global Emerging Technology Summit was held in Washington. The National Security Commission organized the event on Artificial Intelligence: The United States and the European Union cannot allow China to manage, in commercial terms, AI standards and to control, in political-military terms, AI not aligned with democracy and human rights (Fang, 2021). A sign of this shared vision among Western powers is the creation of the EU-US Trade and Technology Council, officially launched in June 2021 (European Union, 2021, June 15).[26] This complex issue unfolds, using the distinction proposed by Tan (2018), in two dimensions: the infrastructure ("computing power") and the legal framework for the use of algorithms and data.

Following this line of analysis, the next two reflections were reached by way of conclusion:

First, a relevant part of AI expansion (investment and talent employability) is carried out by US companies such as IBM, Intel, and the Microsoft conglomerate (Huang, 2017). So, it is only sometimes clear what the future reaction of these companies will be if the SCS becomes more incisive or coercive with them. However, as long as China has an aggressive Silicon Valley startup buying position (Bennett et al., 2018), perhaps the Chinese regime can use the SCS more as a veiled threat than as a specific tool vis-à-vis foreign corporate employees in the AI industry.

Second, China is at a crossroads in terms of regulating "predictive machines" and data protection. According to many specialists (Werbach, 2021; Sacks, 2018), the Chinese regime currently has a policy compatible with the European Union's General Data Protection Regulation (General Data Protection Regulation-GDPR). Taking this fact into account, although it is debatable, the Chinese regime faces two tensions: on the one hand, its own AI companies demand greater flexibility in the use of data (Ding, 2018), which is vital not only for the companies but for Chinese ambitions (Tencent Research Institute et al., 2021, chap. 12). On the other hand, the system itself needs to share data to strengthen, consolidate and make the CSS more effective. This internal tension is highly relevant to China's AI ambitions.

In conclusion, while the United States is discussing how to propose a set of rights (Lander and Nelson, 2021), China launched its National Blockchain Network to share data while maintaining tight control over it. For the time being, the Chinese are beginning to outline a Cyborg law (Fang, 2021). This matter is just beginning.

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[1] There is no conventionally accepted definition of AI. In this paper we considered AI to be a conceptual umbrella term for a set of technologies that tend, in general, to produce "predictive machines" (Agrawal et al., 2019) of high complexity and accuracy (Executive Office of the President, 2016, p.7). Technologies that fall under the AI label include descriptive statistics, regression analysis, statistical inference, decision tree learning, linear classifiers, clustering, Bayesian classifiers, recurrent neural networks, transfer learning, deep learning, reinforced learning, algorithms, *big data*, among others.

[2] The interaction between *Narrow AI* (devices aimed at solving specific issues) and *General AI* (oriented to the range of cognitive tasks) is what has been driving the development of the industry for a few years now (Executive Office of the President, 2016, p.7).

[3] The Imagenet case was a turning point. After training the software with 1.2 million images, the program was able to learn from the data (Krizhevsky et al., 2012). This breakthrough enabled the development of the AlphaGo program, the successor to the famous *Atari* (Mnih et al., 2015; Lake et al., 2017).

[4] Board game for two people with simple rules, but highly complex. Chinese origin (*weiqi* 圍棋) popular throughout East Asia

[5] To learn about the interest of various countries in the elaboration of a strategy to develop AI, see Clark and Perrault (2022, ch 7).

[6] China, focused on global leadership, cannot help but compare itself with the United States in AI (Tan, 2018).

[7] Most forward-looking studies at the time projected or predicted a significant impact of AI on the Chinese economy, and even if, by 2030, AI, according to a McKinsey study (China Power Team, 2018), will eventually displace 12% of the workforce (about 100 million workers), the expected benefits from the adoption of AI are promising. According to a report by Price Waterhouse Coopers (PwC, 2017, sec. figure 2), China will be one of the economies that will gain the most from AI. It will benefit, according to that projection, with a 26% growth in Gross Domestic Product (GDP) by 2030.

[8] In general, specialists use four dimensions to make comparisons around the issue of AI leadership: chips (supercomputing hardware and facilities), access to data, research and development in algorithms, and commercial AI ecosystems.

[9] In 2006, China launched the National Medium and Long-Term Plan for Science and Technology Development (2006-2020). As a result of the program, significant resources were allocated to the Artificial Intelligence 2.0 megaproject, as well as the new launch, in 2015, of the already well-known Made in China 2025 program (Ding, 2018).

[10] In July 2017, the State Council presented the AI Development Plan proposed by the Chinese Academy of Engineering (https://bit.ly/38J1DLz) and, finally, the following year, the Three Year Action Plan for Promoting the Development of a New Generation Artificial Intelligence Industry (2018-2020) (Ministry of Science and Technology, 2017) was presented. The aim of this project was to reopen discussions regarding the Internet of Things issue and ties in with Made in China 2025 (https://bit.ly/3f6Yurf).

[11] The Thirteenth Five-Year Plan for the Development of Strategic and Emerging National Industries (2016-2020) ranked AI sixth among a set of nearly 70 policy objectives (Ding, 2018).

[12] The Ministry of Finance and the Ministry of Industry and Information Technology launched the Industrial Robotics Development Plan 2016-2020 (Ding, 2018).

[13] https://bit.ly/3iLuAuI

[14] The selection of "national champions" (companies that can be "dominant" in the market) to develop specific AI artifacts is a tool available to the State within its Next Generation Artificial Intelligence Development Plan (Roberts et al. 2021; Graceffo, 2017).

[15] For some years now, China and India have led in the number of graduates in Science, Technology, Engineering and Mathematics (McCarthy, 2017). Both countries also have the largest populations considered to be digital natives.

[16] The official start of the Internet of Things in China dates back to 2009 with the inauguration of a center in Jiansu province. This fact inspired Premier Wen Jiabao to immediately push for the creation of the *Information Sensing Centre*, also known as *Reading China Centre* (Velghe, 2019).

[17] For many analysts this signaled the beginning of an aggressive business climate. Although in China many government offices do not pay for Windows licenses, in 2014 the Central Government banned government offices from running Windows. Within months Microsoft was raided by the Chinese judiciary arguing that it violated anti-monopoly laws. Similar fates befell Apple, Qualcomm and Cisco (Atkinson, 2015). As will be seen below, this practice continues, but through more precise and ubiquitous instruments.

[18] This issue came to a head in 2019. However, this tangled issue of shortages in industrial supply chains was at the forefront of international public opinion during the first year of the Covid-19 pandemic and was clearly and forcefully experienced by the U.S. public.

[19] According to Tan (2018), a new wave of AI learning systems is observed using *TensorFlow* from Google, Facebook's *PyTorch*, Microsoft's DMTK distributed toolkit and IBM's *SystemML* . In addition, Prof. Tan agrees that major players such as Google, IBM, NVIDIA, Intel, Apple, Huaewei, the Chinese Academy of Sciences are betting on and directing their research towards AI-specific chips .

[20] For example, Chinese companies have made progress in the production of "edge chips", energy-efficient microprocessors linked to the recognition industry and consumer goods, but the Chinese semiconductor industry is still a long way from being able to compete with the Google Tensor Processing Unit or Neuromorphic Chips. The next results in China depend on the amount of budget allocated to AI and the formation of mega-projects.

[21] For now, contrary to common belief, the largest investment in AI in China is being made by private corporations. However, it should be cautioned that venture capital in China is relatively new and it is not understood how much it can overcome failure (Triolo and Goodrich, 2018).

[22] The powerful Ministry for Industry and Information Technology exerts substantial influence over the CAICT, which in turn plays a key role in standardization processes, technical opinions and authorizations.

[23] A detailed presentation on what the SCS is and how it works can be found in Avaro (2023).

[24] In mid-January 2022, MetaVerso announced the existence of AI Research Super Cluster (RSC), the largest and most efficient supercomputer, thus giving rise to a new generation of machine learning. However, these are only partial achievements compared with the long-term career. Proof of this is that the U.S. administration is preparing a (new) law to boost chip production and secure the supply chain (McCaul, 2020).

[25] A comparative presentation regarding the use of AI in dental treatment in China and Western democracies during the onset of the pandemic can be found in Avaro et al. (2020).

[26] The U.S. government's concern over Chinese progress in AI can be corroborated in several documents and reports (Executive Office of the President, 2019; Select Committee on Artificial Intelligence of the National Science and Technology Council, 2019; Department of Defense, 2018; Executive Office of the President 2018).