Reflections and Practices on Statistical Monitoring of the Artificial Intelligence Industry

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Artificial intelligence, as a new engine of productivity revolution, is accelerating the optimization and upgrading of industries, and plays an immeasurable role in building a modern industrial system, unleashing the potential of new quality productive forces, and shaping new competitive advantages in international competition. There is an urgent need to establish an artificial intelligence industry statistical monitoring system, clarify the scope of statistics and monitoring indicators, and provide solid statistical support for promoting high-quality industrial development. This paper conducts conceptual definition of artificial intelligence, formulates a statistical monitoring system for the core artificial intelligence industry from an industrial perspective, and conducts measurement.

I. Conceptual Definition of Artificial Intelligence

Although researchers and other stakeholders have made efforts to provide clear definitions of artificial intelligence, due to the characteristics of artificial intelligence such as technical complexity, diverse forms of expression, and rapid development, there is currently no universally recognized definition of artificial intelligence in the international and domestic contexts. As a prerequisite for formulating an artificial intelligence industry statistical monitoring system, it is necessary to summarize the definition of artificial intelligence from multiple perspectives and clarify the artificial intelligence characteristics it contains.

(I) International Conceptual Definition of Artificial Intelligence

1. Three "isms" definitions from a disciplinary perspective. Artificial intelligence is an emerging discipline without a unified conceptual definition. Scholars with different scientific or disciplinary backgrounds have proposed different perspectives from many angles. Artificial intelligence has successively been referred to as symbolism, connectionism, and actionism, or alternatively as logicism, bionicsism, and physiologism. The Encyclopedia Britannica states that artificial intelligence is the capability of digital computers or computer-controlled robots in performing tasks related to intelligent biological entities. Overall, artificial intelligence is an interdisciplinary subject based on computer science, integrating multiple disciplines including psychology, philosophy, linguistics, and anthropology, researching how to

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enable machines to imitate human intelligence at the levels of neurology, psychology, language, thought, and culture.

2. International organizations and research institutions tend to classify it as software. In May 2019, the OECD proposed in the Artificial Intelligence Council that "an artificial intelligence system is a machine-based system that can make predictions, recommendations, or decisions for a given set of human-defined objectives, affecting real or virtual environments. Artificial intelligence systems are designed to possess varying degrees of autonomy." In November 2021, the Secretariat of the Inter-Secretariat Working Group on National Accounts (ISWGNA) and the Advisory Expert Group on National Accounts (AEG) recommended incorporating artificial intelligence into the SNA, defining it as "an operating system capable of performing identification and reasoning similar to that of humans, belonging to a type of computer program." Furthermore, institutions such as PricewaterhouseCoopers (PWC) and McKinsey have also conducted research and definitions from this perspective.

3. Certain countries define artificial intelligence from a "technology" perspective. Some countries and regions analyze artificial intelligence from perspectives including nature, embeddedness, and capability. First, from a nature perspective. Most definitions explicitly clarify the technological nature of AI, for example, Japan defines AI as a set of technologies or a set of technological solutions (Japan, 2016). Second, from an embeddedness perspective. AI is considered to be software embedded in systems, rarely as hardware (Brynjolfsson et al., 2019; Canada, 2019; European Union, 2020). Third, from a capability perspective. AI is capable of executing various cognitive function-related operations such as perception, learning, reasoning, and decision-making (United States, 2018; European Union, 2018; OECD, 2019). When certain countries and regions organize surveys on the use of information and communication technologies, they have separately established survey modules for artificial intelligence usage.

(II) Defining Artificial Intelligence from the Perspective of Industrial Development

Since the 1980s, progress has been made in machine learning, computational intelligence, artificial neural networks, and behaviorism. Countries have successively introduced advanced industrial and technological policies to promote artificial intelligence development. In May 2016, China's National Development and Reform Commission and Ministry of Science and Technology, together with two other departments, jointly issued the "Internet Plus Artificial Intelligence Three-Year Action Implementation Plan." Subsequently, relevant departments and research institutions have continuously released materials related to the artificial intelligence field.

In 2018, the China Electronics Standardization Institute proposed in the "Artificial Intelligence Standardization White Paper" that artificial intelligence is the theory, methods, techniques, and application systems that utilize digital computers or machines controlled by digital computers to simulate, extend, and expand human intelligence, perceive the environment, acquire knowledge, and use knowledge to achieve optimal

results. From the perspective of industrial development, the artificial intelligence industry is divided into three levels: core business formats, associated business formats, and derivative business formats.

The "Artificial Intelligence Standardization White Paper (2021)" divides the artificial intelligence industry chain into the foundation layer, technology layer, and application layer. Among these, the foundation layer includes computing power and data resources, the technology layer includes various algorithms and deep learning technologies, and the application layer represents the deep integration of artificial intelligence technology with various industries.

In 2024, the "National Artificial Intelligence Industry Comprehensive Standardization System Construction Guide (2024 Edition)" (referred to as the "Guide") issued by China's Ministry of Industry and Information Technology divides the artificial intelligence industry chain into four parts: the foundation layer, framework layer, model layer, and application layer. The foundation layer primarily includes computing power, algorithms, and data; the framework layer mainly refers to deep learning frameworks and tools used for model development; the model layer mainly refers to large models and related technologies and products; and the application layer mainly refers to the application of artificial intelligence technology in industry-specific scenarios.

II. Statistical Definition of the Artificial Intelligence Industry

(I) Statistical Content of the Artificial Intelligence Industry

Artificial intelligence is an important component of the digital economy. The digital economy industry classification comprises two parts: digital industrialization and industrial digitalization. Following this approach, the artificial intelligence industry can be divided into two major parts: the artificial intelligence core industry and the artificial intelligence application industry. Adhering to the principles of efficient innovation, scientific feasibility, addressing easy matters first and difficult ones later, and gradual improvement, statistical monitoring will first focus on the artificial intelligence core industry, which primarily involves core manufacturing, services, and core terminal applications of artificial intelligence. The artificial intelligence application industry refers to the broad integration and application of artificial intelligence technology across various fields; it will be incorporated into statistical monitoring when conditions mature.

In accordance with the "National Artificial Intelligence Industry Comprehensive Standardization System Construction Guide (2024 Edition)," we define the artificial intelligence core industry as systems, services, and products formed with data as the key factor of production, computing power as support, and machine learning and deep learning algorithms as core technologies. Computing power, algorithms, data, models, frameworks, and intelligent products constitute the core elements of the artificial

intelligence industry. Drawing on current classification methods used by various institutions and departments, and considering the complex relationships where "algorithms are used to train models and frameworks provide algorithms for models," and given that frameworks, algorithms, and models have continuity and are difficult to separate in the artificial intelligence product development process, we divide the artificial intelligence core industry into four levels: computing power services, data services, algorithm models, and intelligent terminals.

(II) Statistical Scope and Classification Principles of the Artificial Intelligence Core Industry

Production activity is the starting point of national economic statistics and the most basic activity, with products as its outcome. In the national accounting system, the scope of production is divided into five categories based on production purpose. Three categories are related to artificial intelligence production: first, the production of all artificial intelligence goods and services provided or prepared by producers for other units, including the production of goods or services consumed in the process of producing such artificial intelligence goods or services; second, the self-supply production of all artificial intelligence goods retained by producers for their own final consumption or capital formation; third, the self-supply production of artificial intelligence knowledge-bearing products retained by producers for their own final consumption or capital formation. According to this scope definition, artificial intelligence products simultaneously include three types: goods, services, and knowledge-bearing products. Therefore, the statistical scope of the artificial intelligence core industry encompasses industrial and service enterprises engaged in research and development, production, and service activities related to the artificial intelligence core industry.

To ensure the feasibility of artificial intelligence core industry statistical monitoring and the accessibility of relevant data, the artificial intelligence core industry classification must also adhere to the following principles: first, the artificial intelligence industry classification should establish a corresponding relationship with China's "National Economic Industry Classification" (GB/T 4754—2017), disaggregating and reorganizing existing industry subcategories and classifying artificial intelligence according to production activities; second, the artificial intelligence industry is an important field within the digital economy, and the national economic industry directories covered by the artificial intelligence core industry should be included within the scope of China's National Bureau of Statistics' "Statistical Classification of Digital Economy and Its Core Industries (2021)."

III. Statistical Methods and Results Analysis of Core Artificial Intelligence Industry

In accordance with the statistical definitions, statistical scope, and classification principles of the core artificial intelligence industry, a statistical methodology

combining "key industries + key enterprises" is employed. On one hand, a statistical classification directory for the core artificial intelligence industry is formulated. For enterprises that wholly fall within the scope of the core artificial intelligence industry, the industry method is adopted for statistics, whereby all enterprises within the industry are included in the artificial intelligence industry statistical monitoring range. On the other hand, for enterprises that do not fall within the statistical classification directory of the core artificial intelligence industry, intelligent screening and departmental identification methods are applied to determine key enterprises to be included in statistical monitoring.

(I) Formulation of Statistical Classification Directory for Core Artificial Intelligence Industry

Based on the classification of the core artificial intelligence industry into four tiers—computing power services, data services, algorithmic models, and intelligent terminals—and in accordance with China's National Economic Industry Classification and China's Digital Economy and Its Core Industry Statistical Classification (2021), a statistical classification directory for the core artificial intelligence industry is formulated, as detailed in the annex.

1. Computing Power Services. Computing power refers to the capability of software and hardware working in coordination to execute certain information processing demands. This is concretely manifested in three types of capabilities: first, information computing power, with computing capability as the core, supporting data and information processing; second, network transmission capacity, with network transmission performance as the core, supporting efficient flow of data elements; third, data storage capacity, with storage capacity as the core, supporting data storage and management. Electronic components and computers and other computing power infrastructure serve as the primary carriers of computing power and constitute an important component of the computing power industry, as well as an important foundational guarantee for the artificial intelligence industry. When designing the computing power services industry directory, consideration is given to incorporating industries such as integrated circuit design, integrated circuit manufacturing, and basic software development.

2. Data Services. Data, as an asset, whether structured data or unstructured data such as images, audio, or video, can provide foundational input information for artificial intelligence. From the perspective of data circulation and trading, data exchanges are key support points for providing data services to the artificial intelligence industry. Data exchanges can attract data commerce enterprises to settle in and provide data services to the market. The data services listed primarily include three categories: first, data processing and value-added services including data analysis, sorting, calculation, editing, and storage; second, various Internet of Things technology support services required for data processing; third, digital content services such as e-books, online

music, films, and games. In addition, other enterprises engaged in data-related activities that are not settled in data exchanges also provide impetus for artificial intelligence production activities. When designing the data services industry directory, consideration is given to incorporating industries such as internet data services and information processing and storage support services.

3. Algorithmic Models. Algorithmic models serve as the technological foundation of artificial intelligence. This tier relies on massive data mining and processing and machine learning modeling to develop various applied technologies, thereby solving specific categorical problems in practice. Computer vision, natural language processing, speech recognition, machine learning, deep learning, and knowledge graphs are representative technologies of this tier. Enterprises possessing these technologies primarily engage in software development, system development, or platform development. When designing the algorithmic models industry directory, consideration is given to incorporating industries such as software development support and internet technology innovation platforms.

4. Intelligent Terminals. Intelligent terminals represent the product tier of the artificial intelligence industry chain, primarily referring to electronic devices with multiple intelligent technologies embedded in traditional equipment. From the functionality perspective of such products, one category of products can substantially directly influence or even fundamentally reshape the production structure and operational modes of traditional industries, significantly enhancing production and service capabilities and efficiency, thereby substantially increasing economic efficiency, such as industrial robots and other industrial-class intelligent terminals. Another category of products merely provides auxiliary and enhancement functions and cannot fundamentally alter the traditional production or trading patterns of industries, such as domestic robots and restaurant robots and other consumer-class intelligent terminals. When designing the intelligent terminals industry directory, consideration is given to incorporating industries such as intelligent unmanned aerial vehicle manufacturing, industrial robot manufacturing, and service and consumer robot manufacturing.

(II) Selection of Key Enterprises in Core Artificial Intelligence Industry

For enterprises outside the core artificial intelligence industry directory, intelligent screening is used to generate a candidate list, which is then confirmed by relevant departments. The main procedural steps are as follows: first, with reference to artificial intelligence keyword vocabularies provided by existing research, an artificial intelligence keywords dictionary is constructed, comprising 110 terms such as "robots," "speech recognition," "intelligent manufacturing," and "deep learning." Second, utilizing enterprise basic information, enterprises whose "primary business activities (or primary products)" contain artificial intelligence keywords are identified as a candidate list. Third, relevant departments confirm whether the enterprises are engaged in production, services, and other activities in the core artificial intelligence industry.

Upon confirmation, enterprises are classified according to their specific activity characteristics into the categories of computing power services, data services, algorithmic models, and intelligent terminals respectively for statistical monitoring.

Table 2 AI Keyword Dictionary

Keywords				
Audio-Visual	Speech Recognition	Biometrics	Machine Translation	Industrial Robots
Big Data	Artificial Intelligence	Speech Synthesis	Smart Agriculture	Natural Language Processing
Robots	Smart Manufacturing	Smart Insurance	Feature Extraction	Conceptual Data Model
Computer	Intelligent Equipment	Intelligent Customer Service	Knowledge Representation	Customer Data Integration
Intelligent Agent	Machine Vision	Augmented Reality	Intelligent Chips	Data Center Hardware
Internet of Things	Deep Learning	Intelligent Speech	Pattern Recognition	AI Training
AR/VR	Feature Recognition	Smart Home	Augmented Intelligence	Deep Neural Networks
Cloud Computing	Smart Banking	Smart Finance	Big Data Platform	Recurrent Neural Networks
AI Products	Intelligent Education	Human-Machine Dialogue	Internet Technology	Digital Twin Applications
AI Chips	Robo-Advisors	Data Transformation	Service Robots	Industrial Vision Systems
Database	Smart Speakers	Machine Learning	Visualized Data	Building Information Modeling
Blockchain	Intelligent Transportation	Neural Networks	Computer Vision	Convolutional Neural Networks
Intelligent Computing	Autonomous Driving	Data Mining	Big Data Processing	Computer Programming

Intelligent Search	Business Intelligence	Human-Computer Interaction	Big Data Management	Support Vector Machine (SVM)
Voice Interaction	Intelligent Environmental Protection	Image Recognition	Distributed Computing	Service Robot Applications
Digital Twin	Data Integration	Human-Machine Collaboration	Intelligent Sensors	Industrial Robot Systems
Data Cleaning	Digital Finance	Intelligent Retail	Wearable Products	Underlying Motion Control Algorithms
Data Modeling	Integrated Circuits	Virtual Reality	Big Data Operations	Intelligent Equipment Vision Systems
Data Development	Intelligent Elderly Care	Intelligent Government Services	Big Data Risk Control	Business Intelligence Data Modeling
Reinforcement Learning	Facial Recognition	Voiceprint Recognition	Database Development	Cascading Big Data Applications
Autonomous Driving	Intelligent Healthcare	Question-Answering Systems	Big Data Marketing	Data Modeling Star/Snowflak Schema
Intelligent Supervision	Knowledge Graph	Edge Computing	Big Data Analytics	Long Short-Term Memory Robot Process Automation

(III) Basic Situation of Core AI Industry in Region A

Following the "key sectors + key enterprises" methodology, this paper conducts data analysis and calculation on core AI industry enterprises in Region A. The data demonstrates that the core AI industry in Region A has achieved considerable progress, with computing power services and data services showing rapid growth. However,

enterprise operational efficiency remains to be realized due to factors such as substantial prior R&D investments.

1. Steady Growth in Core AI Industry Scale. As of the end of 2024, the number of enterprises falling within the statistical scope of the core AI industry increased by 14.7% compared to the previous year, with operating revenue increasing by 11.6% year-over-year.

2. Structural Differentiation in Core AI Industry Profit. In 2024, the total profit of the core AI industry declined by 2.1% compared to the previous year. The computing power services sector recorded losses, with intelligent terminal profits declining by 8.4%.

IV. Conclusion

In summary, this paper defines the core AI industry and its composition from the perspective of promoting industrial development, establishes a statistical classification directory, proposes a "key sectors + key enterprises" calculation methodology, and conducts corresponding calculations. Artificial intelligence is the field with the most active innovation and rapid development, with its connotations and characteristics undergoing swift evolution. Subsequently, close attention will be paid to AI development trends, and the conceptual scope of the core AI industry will be improved in a timely manner, with the industrial classification directory revised accordingly.

Appendix

Statistical Classification Catalog of the Core AI Industry in Zhejiang Province

Major Category	Subcategory	National Economic Industry Code (2017)
Computing Power Services	Integrated Circuit Design	6520
	Integrated Circuit Manufacturing	3973
	Computer Whole Machine Manufacturing	3911
	Industrial Control Computer and System Manufacturing	3914
	Other Computer Manufacturing	3919
	Internet Access and Related Services	6410
	Basic Software Development	6511
	Internet Security Services	6440

	Information Security Equipment Manufacturing	3915
Data Services	Internet of Things Technical Services	6532
	Internet Data Services	6450
	Information Processing and Storage Support Services	6550
Major Category	Subcategory	National Economic Industry Code (2017)
	Internet Search Services	6421
	Digital Content Services for Animation and Gaming	6572
	Other Digital Content Services	6579
Algorithm Models	Support Software Development	6512
	Financial Information Services	6940
	Internet Production Service Platforms	6431
	Internet Lifestyle Service Platforms	6432
	Internet Technology Innovation Platforms	6433
	Internet Public Service Platforms	6434
	Other Internet Platforms	6439
intelligence Terminals	Manufacturing of Wearable Smart Devices	3961
	Manufacturing of Smart Vehicle-Mounted Devices	3962
	Manufacturing of Smart Unmanned Aerial Vehicles	3963
	Manufacturing of Service and Consumer Robots	3964
	Manufacturing of Other Smart Consumer Devices	3969
	Manufacturing of Industrial Robots	3491
	Manufacturing of Additive Manufacturing Equipment	3493