

# Industrial Internet

Center for Electronics and Information Studies,  
Chinese Academy of Engineering

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Research on the Development of Electronic  
Information Engineering Technology  
in China



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# Preface

## ***The Research on the Development of Electronic Information Engineering Technology in China Book Series***

In today's world, the wave of information technologies featured by digitalization, networking, and intelligence is gaining momentum. Information technologies are experiencing rapid changes with each passing day and are fully applied in production and life, bringing about profound changes in global economic, political, and security landscapes. Among diverse information technologies, electronic information engineering technology is one of the most innovative and widely used technologies, and plays its greatest role in driving the development of other S&T fields. It is not only a field of intense competition in technological innovation, but also an important strategic direction for key players to fuel economic growth and seek competitive advantages over other players. Electronic information engineering technology is a typical "enabling technology" that enables technological progress in almost all other fields. Its integration with biotechnology, new energy technology, and new material technology is expected to set off a new round of technological revolution and industrial transformation, thereby bringing about new opportunities for the evolution of human society. Electronic information is a typical "engineering technology" and one of the most straightforward and practical tools. It realizes direct and close integration of scientific discoveries and technological innovations with industrial developments, greatly speeding up technological progress. Hence, it is regarded as a powerful force to change the world. Electronic information engineering technology is a vital driving force of China's rapid economic and social development in the past seven decades, especially in the past four decades of reform and opening up. Looking ahead, advances and innovations in electronic information engineering technology will remain to be one of the most important engines driving human progress.

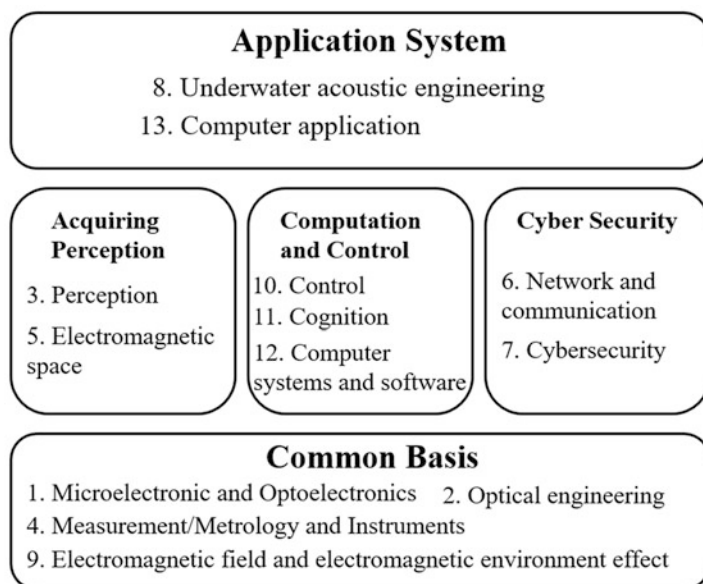
CAE is China's foremost academic and advisory institution in engineering and technological sciences. Guided by the general development trends of science and

technology around the world, CAE is committed to providing scientific, forward-looking, and timely advice for innovation-driven scientific and technological progress from a strategic and long-term perspective. CAE's mission is to function as a national high-end think tank. To fulfill the mission, the Division of Information and Electronic Engineering, under the guidance of its Vice President Zuoning Chen, Director Xicheng Lu, and the Standing Committee, mobilized more than 300 academicians and experts to jointly compile the General Section and the Special Section of this book (hereinafter referred to as the "Blue Book"). The first stage of compilation was headed by Academicians Jiangxing Wu and Manqing Wu (from the end of 2015 to June 2018), and the second one was headed by Academicians Shaohua Yu and Jun Lu (since September 2018). The purposes of compiling the Blue Book are as follows:

By analyzing technological progress and introducing major breakthroughs and marked achievements made in the electronic information field both at home and abroad each year, to provide reference for China's scientific and technical personnel to accurately grasp the development trend of the field and provide support for China's policymakers to formulate related development strategies.

The "Blue Book" is compiled according to the following principles:

1. **Ensure appropriate description of annual increment.** The field of electronic information engineering technology enjoys a broad coverage and high development speed. Thus, the General Section should ensure an appropriate description of the annual increment, which is about the recent progress, new characteristics, and new trends.
2. **Selection of hot points and highlight points.** China's technological development is still at a mixed stage where it needs to assume the role of follower, contender, and leader simultaneously. Hence, the Special Themes should seek to depict the developmental characteristics the industry focuses on, and should center on the "hot points" and "highlight points" along the development journey.
3. **Integration of General Section and Special Section.** The program consists of two sections: the General section and the Special Themes. The former adopts a macro perspective to discuss the global and Chinese development of electronic information engineering technology, and its outlook; the latter provides detailed descriptions of hot points and highlight points in the 13 subfields.



Classification Diagrams of 13 Subfields of information and electronic engineering technology

The above graphic displays 5 categories and 13 subcategories, or special themes that bear distinct granularity. However, every subfield is closely connected with each other in terms of technological correlations, which allows easier matching with their corresponding disciplines.

Currently, the compilation of the “Blue Book” is still at a trial stage where careless omissions are unavoidable. Hence, we welcome comments and corrections.

### **The Special Theme *Industrial Internet in Research on the Development of Electronic Information Engineering Technology in China* Book Series**

One year ago, the State Council released the *Guidance on Deepening the “Internet plus Advanced Manufacturing Industry” and Developing the Industrial Internet*. Since then, governments at all levels, manufacturing companies, automation companies, ICT companies, internet companies, research institutes, and other parties actively participate in the construction and promotion of the Industrial Internet. To display the phased progress of the Industrial Internet, industrial practices, and results in key industries, the core competencies and solutions of the Industrial Internet, and to clarify the innovation & development trend and direction in the future and other major aspects that have been widely concerned, *Research on the Development of*

*Electronic Information Engineering Technology in China* has investigated current developments of the Industrial Internet, collected and analyzed the latest progress and materials of it and compiled the *Special Section of Industrial Internet*. By doing so, it hopes to provide some references and guidance to participating entities from the political, production, education, research and application fields, facilitate the conclusion of industrial consensus, and promote the rapid and healthy development of the Industrial Internet.

This book starts with the birth background of the Industrial Internet, clarifying its definition, contents, and architecture; following that is a review of its development trends in China and across the world, mainly in terms of policies, networks, platforms, security, application, and standards. It finishes up with information about the integration of Industrial Internet with a series of new-generation information technologies, such as the Time Sensitive Networking, 5G, Edge Computing, Blockchain, and Artificial Intelligence. It will provide reference for studying the future trend of innovation.

This book is intended for researchers and industrial staffs who have been following the current situation and future trends of the Industrial Internet. Meanwhile, it also bears high value of reference for experts, scholars, and technical and engineering managers of different levels and different fields.

This book is divided into five chapters. Chapter 1 proposes the architecture and major elements of the Industrial Internet, and clarifies its definition and functions. Chapters 2 and 3 introduce its current progresses both at home and abroad in terms of policy measures, technological systems, industrial ecologies, and application modes. Chapter 4 discusses the potential trend of innovation and development in this field, in a bid to explore a path for large-scale application and practices. Chapter 5 is about summary and acknowledgment.

When compiling this book, we have received broad and strong supports from both Chinese and foreign enterprises. They have not only provided massive materials about their solutions and results that are based on their own development situations but also proactively helped us organize field surveys and seminars, which has greatly contributed to the formation and implementation of opinions in this book.

The Industrial Internet is a long-term development and evolution process. Considering that, we will continue with in-depth studies, and revise and update this book with new findings on a timely basis, taking into account the industrial feedback and development situations both in China and abroad.

Beijing, China

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# List of Series Contributors

The guidance group and working group of *Research on the Development of Electronic Information Engineering Technology in China* series are as follows:

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Chinese Academy of Engineering (CAE) is China's foremost academic and advisory institution in engineering and technological sciences, which has been enrolled in the first batch of pilot national high-end think tanks. As a national institution, CAE's missions are to study major strategic issues in economic and social development as well as in engineering technology progress, and to build itself into a S&T think tank having significant influences on decision-making of national strategic issues. In today's world, the wave of information technologies featured by digitalization, networking, and intelligence is gaining momentum. Information technologies are experiencing rapid changes with each passing day and are fully applied in production and life, bringing about profound changes in global economic, political, and security landscapes. Among diverse information technologies, electronic information engineering technology is one of the most innovative and widely used technologies, and plays its greatest role in driving the development of other S&T fields. In order to better carry out strategic studies on electronic information engineering technology, promote innovation in relevant systems and mechanisms and integrate superior resources, Center for Electronics and Information Studies (hereinafter referred to the "Center") was established in November 2015 by CAE in collaboration with Cyberspace Administration of China (CAC), the Ministry of Industry and Information Technology (MIIT), and China Electronics Technology Group Corporation (CETC).

The Center pursues high-level, open, and prospective development, and is committed to conducting theoretical and application-oriented researches on cross-cutting, overarching, and strategically important hot topics concerning electronic information engineering technologies, and providing consultancy services for policymaking by brainstorming ideas from CAE academicians and experts and scholars from national ministries and commissions, businesses, public institutions, universities, and research institutions. The Center's mission is to build a top-notch strategic think tank that provides scientific, forward-looking, and timely advice for national policymaking in terms of electronic information engineering technology.

The main authors of *Industrial Internet* are Xiaohui Yu, Haihua Li, Shaohua Yu, Xinyi Wang, Xinhao Jiang, Hengsheng Zhang, Yang Liu, Xiaoman Liu, Song Luo, and Nian Sun.

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