

A Research Report on the Development of

# China's Manufacturing Industry

Editors-in-Chief

Li Lianshui Du Zhanyuan

中国制造业发展研究报告



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# **A Research Report on the Development of China's Manufacturing Industry**

(中国制造业发展研究报告)

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## Introduction to the Editors-in-Chief

**Prof. Li Lianshui** was born in Tai Zhou, Jiangsu Province, in Oct. 1957, and graduated from Tsinghua University with a PhD in management science. At present he is serving as the president of Nanjing University of Information Science and Technology. He is also a professor, a tutor for PhD candidates and an expert receiving special government subsidy from the State Council of China.

Prof. Li has longtime teaching and research experience in universities. He has held a series of important posts over the past decade, including deputy director of social science department, director of economics department, director of the Institute of Taiwan Economy Research, and then deputy dean of Economic Management School in Southeast University, subprefect in charge of science and technology of Jianhu County, Jiangsu Province, vice president of Nanjing University of Finance and Economics, and now president of Nanjing University of Information Science and Technology. From 2003 to 2004, he served as an expert with a group in charge of the Office of National Medium- and Long-Term Planning for Scientific and Technological Development in China, and also a member of a team in charge of the drafting of the outline for the planning.

Besides these official posts, he is now serving as a member of the directing committee for the teaching affairs of industrial and commercial management disciplines under the ministry of education, director-general of Chinese Society of Scienology and Science & Technology Policy Study, executive member of Chinese Society of Productive Force and director of the Jiangsu Branch of the Society, deputy director of the Society of International Exchange of Science and Technology in Jiangsu Province.

His major field of academic research covers: manufacturing Industry, meteorological economics, scientific and technological innovation. His academic publications comprise over ten academic works such as “Technological Innovation Economics”, “Management Planning and Communication”, “Development of Metropolitan Zones”, over 100 research papers, and “A Research Report on the Development of China’s Manufacturing Industry” published annually since 2004.

He was conferred the First and Second Awards for Outstanding Achievements in Philosophy and Social Science in Jiangsu Province and a provincial award for Government Decision-Making Consultation. He was also conferred, in collaboration with others, the Third Award for Outstanding Achievements in Humanity and Social Science in Chinese Universities by the Ministry of Education. He received a certificate of honor for “Important Contribution to the Research on the National Medium- and Long-Term Science and Technology Development Planning Strategy” awarded by the Office of National Medium-and Long-Term Planning for Scientific and Technological Development. He is honored as “Outstanding Educator in Technological Economics” by Chinese Society of Technological Eco-

nomics. In addition, he is now enjoying a special government subsidy granted by the State Council of China.

**Dr. Du Zhanyuan** was born in Changsha, Hunan Province, in July, 1962. He graduated from MIT with a PhD. He is now serving as the vice director of the Ministry of Science and Technology of China.

He has worked for a long time in the Ministry of Science and Technology, and has assumed the posts of vice director, then director, then vice director-general, and then director-general of the Development and Planning Bureau of the Ministry of Science and Technology, and finally the vice director of the Ministry. Besides, he also holds the posts of member of the National Youth Federation, member of the Central Government Branch of the National Youth Federation, Vice Chairman of the ministerial branch of the National Youth Federation, vice secretary of Chinese Society of Edible Fungi.

**His research achievements in biological research:** He advanced a theory on the pathogenesis of apple physiological diseases during his overseas study in the US from 1989 to 1993, and published over ten papers on this topic on prestigious international journals. For his relevant research achievements, he was awarded the First Prize for Excellent PhD Treatise by the North-East US Gardening Society. **His research achievements in management research:** He published ten papers on Chinese journals of technological management as well as on newspapers. On account of his participation in the research on “the System of Projects”, he was conferred an award for research achievement by Chinese Academy of Social Sciences. **His research achievements in Economic research:** In collaboration with others, he published the book—“Small-and Medium-Size Enterprises and Technological Innovation”, which is the first one on technological innovation in China. In addition, he published over ten papers on this topic on academic journals and newspapers. From 1997 to 1998, he published several papers on knowledge economy, and cooperatively published “A Research Report on the Development of China's Manufacturing Industry” since 2004.

He received the honor of “Excellent Youth of Central Government Units” conferred jointly by the CPC Working Committee of Central Government Units, the CPC Working Committee of Youth League and the National Youth Federation. He was honored as “Excellent Overseas Students” by the Chinese consulate general in New York, and was jointly conferred the Third Award for Outstanding Achievements in Humanity and Social Science in Chinese Universities by the Ministry of Education, A second Award for Outstanding Achievement in philosophy and Social Science.

## Preface

In 2003, The Education Ministry of the PRC invited public bidding across the country for 40 “Key Projects of Philosophy and Social Science” for the first time. After stiff competition, the research team led by Prof. Li Lianshui won the bidding for “Research on Eastern Super-Metropolis Zone and the World Manufacturing Industry Center” (No. 03JZD0014), with a granted research fund of 500, 000 ¥. Later on, the team won two National Science Fund projects—“Research on the Development Path for China’s Manufacturing Industry Based on Resource-Restraint and Self-Innovation” and “Research on the Development of China’s Manufacturing Industry”, as well as a series of provincial-level research projects. When the above mentioned “Key Project of Philosophy and Social Science” supported by the Education Ministry got under way, Prof. Li Lianshui was serving as an expert with the “Office of the Team in Charge of National Medium- and Long-Term Planning for Science and Technology Development”. He had close contact and communication with Mr Du Zhanyuan, who was serving as the director of the Development Planning Bureau of the Science and Technology Ministry of China. They shared much interest in scientific innovation and new-type industrialization. After much consultation and investigation, they made a decision on writing “A Research Report on the Development of China’s Manufacturing Industry”, which was to be published annually. To accomplish this task, They set up a team consisting mostly of professors from the Ministry of Science and Technology, Tsinghua University, Southeast University. Later, experts and scholars from the National Committee of Development and Reform, the National Development Bank, Fudan University, Nanjing University of Finance and economics, and Nanjing University of Information Science and Technology were also invited to join in the team. Thanks to the collective effort of the team, the five volumes of “A Research Report on the Development of China’s Manufacturing Industry (2004, 2005, 2006, 2007, 2008)” were published annually.

While the framework of “A Research Report on the Development of China’s Manufacturing Industry (2004)” was still under discussion, Mr. Du Zhanyuan, who was the editor in chief, gave three pieces of advice: ① The concept of “a New-Type manufacturing industry” should be suggested, which would link the development of China’s manufacturing industry with science and technological innovation, energy conservation and environment protection; ② several important predictions should be made, such as predictions on tendency of the value-added of CMI, the number of employees in CMI and the pollution caused by CMI; ③ follow-up and intensive research on the development of CMI, such as the specialized research on IT application in manufacturing industry, the research on the resource restraint in manufacturing industry. After repeated discussion in a series of sponsiums held in Beijing, Nanjing and Wuxi, the principles and framework for writing the report was defined: ① the concept of “a new-type manufacturing industry” should be elaborated, which would be fol-

lowed throughout the report, and according to which, an overall evaluation of the development of CMI would be made from the three dimensions of economic innovation capability, science and technological innovation capability and environment protection capability; ② the report will consist of five parts: overall research (including concepts, methods and current situation), research on regional manufacturing industry (including provincial, east/middle/west regions and the three coastal metropolis zones), research on manufacturing sectors (including general situation, classified sectors and key sectors), research on manufacturing enterprises (including general situation, enterprises of the largest scale, enterprises of the best economic return and the most respected enterprises) and research on the most promising aspects of the development of manufacturing industry; ③ research methods: the choice of standard methods, the choice of relevant evaluation index, the establishment of evaluation system, the objective evaluation on the basis of statistical data (except for the data on manufacturing enterprises which are collected from the annual reports by listed companies, other data all comes from a variety of yearbooks.)

After the completion of the draft version of "A Research Report on the Development of China's Manufacturing Industry (2004)", Mr. Zhou Guangzhao, academician of Chinese Academy of Science and the former vice chairman of National People's Congress was invited to write a preface for the report. Mr. Zhou accepted the invitation with pleasure, and had high opinion of the report in the preface. He wrote in the preface: "the report put forth the concept of 'a new-type manufacturing industry', on the basis of which a valuation system was set up to make a systematic analysis of the development of China's manufacturing industry. As a result, many qualitative and quantitative findings were made and many constructive advices were put forward. The data quoted in the report which are provided by authoritative government departments were authentic and credible. The report is worth reading, studying and using as a source of reference by government decision-making bodies and industry research institutes, or by readers who are interested in the topic." After the completion of the draft version of "A Research Report on the Development of China's Manufacturing Industry (2005)", Prof. Li Lianshui, who was the editor in chief invited Prof Ji Baocheng, president of Renmin University of China to write a preface for the report. President Ji remarked favorably on the report. Prof Ji wrote in the preface: "in order to form an ideal pattern of development, China's manufacturing industry must step on a path of new-type industrialization; it must adopt a development pattern of energy-conservation and environment protection. 'A Research Report on the Development of China's Manufacturing Industry (2005)' is an excellent book in that it conceives the concept of harmonized development of manufacturing industry in a harmonized society." It was our great honor to invite Mr. Song Jian, Academician of Chinese Academy of Science and vice chairman of the Chinese People's Political Consultative Conference to write a preface for "A Research Report on the Development of China's Manufacturing Industry (2006)". He wrote in the preface: "it was a painful lesson in modern history for the Chinese people that the rulers of Qing Dynasty failed to notice, let alone to catch hold of the opportunity in the 18<sup>th</sup> and 19<sup>th</sup> century to develop China's industry independently, especially manufacturing industry. This is a great pity



whose impact lasts until today. We still have a fresh memory of this historical lesson” Since Prof. Li liangshui, the editor-in-chief for “A Research Report on the Development of China’s Manufacturing Industry (2007)” was an alumnus of Tsinghua University and also vice chairman of the Association of Tsinghua University Alumni in Nanjing, he wrote an invitation to the president of Tsinghua University, Academician Gu Binglin to require him to write a preface for the report. President Gu, in spite of his business with his duty, agreed with happiness to write a preface for the report. He also gave high praise to the report in the preface in which he wrote: “It gives me pleasure to read ‘A Research Report on the Development of China’s Manufacturing Industry (2007)’. ...China’s manufacturing industry is in a key phase of strengthening its capability of independent innovation, so it must step on a path of self innovation, which is advanced, original, open and competitive. Only by doing so, will China’s manufacturing industry achieve a steady and sound development in an international environment of intense competition, thus making contribution to the great revitalization of the Chinese Nation, and to the development of world economy and human civilization.” As editors in chief for “A Research Report on the Development of China’s Manufacturing Industry”, and on behalf of our research team and our readers, we express our gratitude to the praise and support given by the above respectable scholars. The year 2008 is the 30<sup>th</sup> anniversary of China’s reform and opening-up to the outside world, and also the 30<sup>th</sup> anniversary of the rapid development of China’s manufacturing industry, as well as the 5<sup>th</sup> consecutive year that our Research Report on China’s Manufacturing Industry was published. Therefore, we felt it necessary to review the history of our Research Report on China’s Manufacturing Industry. We should extend our regard and gratitude to those who have cited our report in their theses or treatises

While reviewing the five volumes of “A Research Report on China’s Manufacturing Industry” published so far, we are gratified that our research report has received widespread attention from the academic circle and government department since its first publication in 2004. Its influence in the academic circle is increasingly evident. Prof. Jin Pei, a prominent economist published an over 10,000- word book review, titled “the flourishing of China’s manufacturing industry needs the support of more original researches”, on “the world of management”. “A Research Report on China’s Manufacturing Industry (2004)” was selected as one of the “Best Books in industrial economy for the year 2004” by “China Academic Yearbook”. Our research report has been included in the references of PhD treatises and 132 papers published in such famous journals as “the World of Management”, “Management of Scientific and Technological Research” and “Statistics and Decision Making”. Our research report also receive extensive attention in the news media. A book review on this report titled “the Development of China’s Manufacturing Industry from the Perspective of the Concept of ‘New-Type’ Manufacturing Industry” was published on *the Science and Technology Daily*. The book review was later carried on 22 web sites, including *science and technology net*, *China Manufacturing Industry Net*, *China Technology and Investment Net*. “The Most Respected Chinese Manufacturing Enterprises” and prediction on the number of employees in CMI and other contents of the Report were cited by more 210 websites, including *Xinhua*

*Net, CCTV Net, Da Gong Net, Taiwan Nanke Net, Eastern Asia Economic and Trade News Net, World Chinese Net, the Association of Chinese Enterprise Net.* (3) the research findings of the Report were employed or awarded by government department. Relevant findings of “A Research Report on China's Manufacturing Industry (2004)” were used for medium- and long-term national science and technology development planning. The National Science and Technology Ministry, the National Committee of Development and Reform, the Chinese association of Science, The Chinese Academy of Science and other departments concerned also provided proof for using the findings of the report. The report was conferred the second and third awards for Outstanding Achievements in Philosophy and Social Science by the Education Ministry. In spite of the honors accorded to the report so far, we feel it urgent to come up with a rapid and precise evaluation of the development of China's manufacturing industry and the tendency of the world manufacturing industry. The concept of “a New-Type manufacturing industry” is still to be perfected both theoretically and practically. We hope to push ahead with our research from three aspects: firstly, to make an objective evaluation of the development of China's manufacturing industry from the three dimension of economy, science and technology and environment, giving emphasis to scientific innovation and resource conservation and environment protection; secondly, to carry our research in combination with national and regional policies and measures aimed at promoting the development of manufacturing industry in order to push ahead with the “New-Type” transformation of manufacturing industry; finally, to provide service for our fellow researcher in this field by building a platform for data sharing.

In 2009, “A Research Report on China's Manufacturing Industry” was selected as an excellent book to be displayed in “the Exhibition of Chinese Books” which will be held in Frankfurt, Germany. In order to better serve readers of the world, a new chapter titled “Comparative Study of Manufacturing Industry in Different Countries” is added in “A Research Report on China's Manufacturing Industry (2009)”, in which an evaluation is made of the “New-Type” transformation in the major countries where manufacturing industry is highly developed. Besides, the latest volume of “A Research Report on the Development of China's Manufacturing Industry” (English version) made a summary of the research achievement our team made in the past six years, as well as expanded on the comparative study of manufacturing industries in different countries, with an aim to investigate into the global cooperation in manufacturing industry and to explore the “New-Type” transformation of China's and world manufacturing industry in collaboration with our fellow researchers and our readers.

The successful publication of “A Research Report on China's Manufacturing Industry” (English Version) should also be attributed to the efforts by Science Press. On behalf of all the writers and readers of the report, we extend our heart-felt thanks to Mr. Lin Peng, managing director of Science Press and all the editors concerned!

Li Lianshui Du Zhanyuan

June 18, 2009

# Contents

## Introduction to the Editors-in-Chief

## Preface

<b>Chapter 1 The Development of Manufacturing Industry: Indexes and Methods</b>	1
1.1 China's Manufacturing Industry (CMI): A Review of the Past Thirty Years	2
1.2 The Development of Manufacturing: Evaluation Indexes	6
1.3 China's Manufacturing Industries (CMI): Development Evaluation	9
1.4 CMI: Development Index	23
1.5 A Brief Summary of this Chapter	32
<b>Chapter 2 China's Manufacturing Industry: The Evaluation of Regional Development</b>	36
2.1 Regional Manufacturing Industry: the Evaluation of the "New-Type" Level	36
2.2 China's Manufacturing Industry: "Top Ten Provinces"	54
2.3 The "Top Ten Cities" in China's Manufacturing Industry	121
2.4 A Brief Summary of this Chapter	140
<b>Chapter 3 Manufacturing Industry: International Comparative Study</b>	146
3.1 Ideas and Methods for International Comparative Study	147
3.2 International Comparison of Manufacturing Industry's Capability of Economic Creation	159
3.3 Comparison of Countries in Terms the Capability of Scientific and Technological Innovation in Manufacturing Industry	203
3.4 International Comparison of Manufacturing Industry in Terms of the Capability of Environmental Protection	236
3.5 Comparative Study of Manufacturing Industry in Different Countries in Terms of the Level of "New-Type" Transformation	292
3.6 A Brief Summary of this Chapter	305
<b>Chapter 4 The Development of China's Manufacturing Industry: Prediction of General Trend</b>	316
4.1 Trend of CMI's Total Amount Development	316
4.2 Prediction of CMI's Development Trend	318
4.3 Development Trend of the Rate of Value-Added of China's Manufacturing Industry	321
4.4 Prediction of the Trend of the Need for Labor in CMI	323
4.5 A Brief Summary of this Chapter	327

# **Chapter 1**

## **The Development of Manufacturing Industry: Indexes and Methods**

The methods to evaluate the development level of manufacturing industry are usually limited to economic index with economic scale and benefit as the primary components emphasizing the analysis of the single and general index. Such evaluating methods can reflect the current development level of manufacturing industry, especially its contribution to the economic development of regions and even the whole country. However, the increasing over-consumption of resources and energies as well as severe environmental pollution has already given rise to a global debate on whether manufacturing industry is really bring benefits for mankind.

Against the background of global warming and constructions of an innovation-oriented country, China's manufacturing industry must go along a road of "New-Type" manufacturing industry for further development. The so-called "New-Type" manufacturing industry refers to the type relying on scientific and technological innovations, reducing energy consumption and environmental pollution, increasing employment and economic benefits, which can realize a sustainable development. In comparison with the traditional manufacturing industry, "New-Type" manufacturing industry mainly differs in the following aspects: the mode of production, which transforms itself from the large-scale and standard production of single type of products into the small-volume production of various kinds of products according to the social needs, is more flexible and adaptable; in terms of growth pattern, it depends more on the scientific and technological progress, the reduction of energy consumption and environmental pollution so as to enhance the economic benefits, increase the scientific content and give full play to the human resources; in terms of development orientation, it focuses on the future, paying more attention to the application of IT technology, intangible assets and the ability of technological innovation and attaches more importance to conservation-and-intensification-oriented sustainable development.

In order to fully reflect the development orientation of "New-Type manufacturing industry", this chapter first looks back on the development of China's manufacturing industry in the past thirty years, followed by the construction of evaluation system consisting of related indexes such as economic benefits, scientific and technological capacity and environment and resources and then goes on to make a three-dimensional objective evaluation of the development level of China's manufacturing industry, based on which the development index of China's manufacturing industry is elaborated.

## **1.1 China's Manufacturing Industry (CMI): A Review of the Past Thirty Years**

The thirty years since China's reform and opening-up is a history of rapid growth of manufacturing industry. Since the reform and opening-up, China's manufacturing industry went through three transitions: from labor-intensive to capital-intensive and technology-intensive; from international OEM to enhancement of the capability of independent innovation; from the coastal area to inland China.

According to the basic development framework, (namely, the three-dimensional perspective of the economic creation, scientific and technological innovation and the conservation of resources and the environment) of "New-Type Manufacturing Industry" (Li Lianshui & Du Zhanyuan, 2004), the development process of China's manufacturing industry can be summarized into the following three stages:

### **1.1.1 Stage 1: Expansion of Economic Capacity (1978~1994)**

Floating exchange rate system has gradually replaced fixed rate exchanged system of Bretton Woods since 1970s. With the deepening of marketization and globalization of international economy, closer economic ties of countries in the world, international economy begins to step out of the shadow of "stagflation" and the international economic environment is increasingly loose, which provide a good external economic environment for the development of China's manufacturing industry.

In 1978, Chinese government clearly put forward that focus should be put on the economic construction; in 1984, a government document—"Decisions on Economic Structure Reform", which emphasized enhancing the vitality of enterprises, consciously employing the law of values and building reasonable price system and various types of economic responsibility system, is issued; in 1992, the goal of socialist market economic system reform was set; in 1993, another government document—"Decisions on a Number of Issues on the Establishment of Socialist Market Economic System", which clearly proposed to establish modern enterprise system, came into existence. Continuous systemic innovations provide a powerful driving force for the development of China's manufacturing industry.

Since the reform and opening-up, the increasing contradictions between great social needs and relatively less-developed social production have provided broad market and profit margin for the development of China's manufacturing industry. Under the guidance of economic construction-centered principle, economy-oriented performance concept promoted local governments to give a powerful impulse and even direct interfere to and thus accelerated the rapid development of the manufacturing industry in local regions, which gave new impetus to the development of China's manufacturing industry. In 1994, the gross output value of China's manufacturing industry was 44.825 billion Yuan, which was six times that of 1985. During this period, economic creativity was paid attention to in the development of China's manufacturing industry and the increase of gross output in Petroleum Processing and Coking, Metal Product Manufacturing, Transportation Equipment Manufacturing, Elec-

tronic and Communication Equipment Manufacturing, Electrical Machinery and Equipment Manufacturing and Chemical Fiber Manufacturing was respectively above the average level in the manufacturing industry; in 1994, the proportion of output value in Textile Product manufacturing, Ferrous Metal Smelting and Rolling Processing and Chemical Fiber Manufacturing to the gross output value of manufacturing industry was the top three, respectively with the figure of 11.4%, 9.29% and 7.11%.

Although in this period, China's manufacturing industry gained overall development, the proportion to the output value of global manufacturing industry was still very small and the development level was also low. In 1980, the values-added of China's manufacturing industry accounted for 1.5% of the global output value, only half of that of Brazil's; in 1990, the value-added of China's manufacturing industry exceeded that of, ranking the first in developing countries, however, China's manufacturing industry ranked only the eighth in the world with the proportion of 2.7% of the global output value. On the whole, priority was given to creating values and pursuing profits in this initial stage of China's industrialization, with the state-owned economy and rural-collective economy as the main carrier. In this period, manufacturing industry developed in an overall way with widening ranges and enlarged scale, and economic creative capacity was raised quickly.

### **1.1.2 Stage 2: Driven by Scientific and Technological Innovation**

Since the mid-1990s, great changes have taken place inside and outside the country, which were mainly manifested in: ① inside the country: planned-economy was transformed into market economy and socialist market economic system has gradually taken shape. The pattern with the public sector remaining dominant and diverse sectors of the economy developing side by side has been established and whole-dimensional and wide-ranging pattern of opening up to the outside world has basically formed; after the development of productivity and the cultivation of market which lasted more than ten years, the characteristics of buyers' market have been more and more obvious and the competition between enterprises has been heated day by day; many problems emerge gradually, such as unreasonable economic structure, increasing unemployment, increasing pressure from resources and environment and weak overall economic competitiveness; ② outside the country: knowledge-based economy is coming into being and cyber economy are mushrooming. Scientific and technological innovations have become the new engine of industrial development and it's been the conscious act of enterprises to emphasize self-innovations for further development; the Asian financial crisis in 1996 imposed severe effect on the economic situations in the world: the need of international market shrank and export environment of manufacturing industry deteriorated and it didn't recover until the beginning of the 21st century.

Changes of economic situations inside and outside the country and the emergence of knowledge-based economy prompted enterprises to pay more attention to the scientific and technological innovations for the industrial development. Early in 1995, a government document—"Decisions on strengthening scientific and technological progress" was issued.

Meanwhile, China advanced the strategy of developing the country by relying on science and education so as to strengthen the scientific and technological strength and the ability to transform into practical productive forces and improve the whole nation's scientific and cultural quality, shifting the economic development to the track of relying on scientific and technological progress and the improvement of the quality of workers. In 2006, China promulgated the do "Decisions on the implementation of scientific and technological planning framework to enhance the capability of independent innovation" and the guideline of scientific and technological development in the new period, which is "independent innovation, focusing on leaping forward, supporting the development and leading the future".

The unveiling and implementation of the two important documents indicates that the development of Chinese economy is relying more and more on the role of science and technology. The pattern of development has gradually transformed into the progress of technology and the qualities of labors. In 2006, the gross output value of manufacturing industry was 27457.167 billion Yuan which is 5 times that of 1995. Among the sectors of manufacturing industry, computer, electronic and communication equipment manufacturing, ferrous metal smelting and rolling processing, generation and supply of electricity and thermal power have the greatest proportion of output value, which were respectively 12.05%, 9.25%, 7.85%. During this stage, the development of Chinese manufacturing industry mainly focused on the scientific and technological strength. In 2006, R & D funding in manufacturing enterprises was 139631.428 million Yuan, funding for new products development in manufacturing industry was 160660.59 million Yuan and the number of patents was up to 25122 which were respectively 5.62 times, 6.21 times and 5.37 times those of 1995. In 2000, the value-added of Chinese manufacturing industry represented 7% of that of the whole world, which ranked the fourth, only after America, Japan and Germany. In 2006, the production of 172 kinds of products in Chinese manufacturing industry rank the first in the world, the value-added of which was up to 1095.6 billion Yuan. The achievement surpassed Japan for the first time, making China the second largest manufacturing country. This is a second historical breakthrough after surpassing Germany at the beginning of century.

Generally speaking, while focusing on the economic benefits, Chinese manufacturing industry pays more attention to the supportive role of technological innovation. Chinese manufacturing industry has been building Hi-Tech and economic development zones, relying on the rapid development of small and medium-size enterprises, actively introducing, using and innovating foreign technology, undertaking integrated innovation and original innovation, so as to strongly improve the enterprises' capability of technological innovation and put forth efforts to enhance the technology content and value-added of products. All these measures have obviously improved the capability of technological innovation and international competitiveness of Chinese manufacturing industry.

### **1.1.3 Stage 3: Piloted by the Development of Science (2007~ )**

Since the 21st century, in a steady environment of international economy, Chinese economic strength has been obviously boosted; market-oriented reform has been deepened and

individual regions in China has deepened structural innovation, enhanced the function of government, actively built service platforms, created a good environment for investment in order to attract overseas investment and actively undertaken a new round of industrial transformation in the world. All these show that Chinese manufacturing industry has been greatly upgraded. Although the capability of economic creativity and technological innovation of CMI has improved, lack of resources and environmental problems are becoming increasingly serious. For example, in 2003, Zhe Jiang lapsed into the crisis of resource shortage. Lack of water and electricity led to the high cost of production in enterprises. In 2006, owing to the heavy pollution by industry, blue green algae broke up on a large scale in Taihu Lake, in Jiangsu province.

It is specified in the Seventh National Congress (2007) of the CPC that we should comprehensively implement the Conception of Scientific Development, stick to a sound path of development characterized by development of production, prosperous life and good ecological environment, and construct the resource-saving society and environment-friendly society to realize a sustainable development by balancing speed and structure, quality and benefit and coordinating economic development with population, resource and environment. Looking back on the 30 years' history of Chinese manufacturing industry, we can see that the rapid development of Chinese economy mainly relied on the development and growth of manufacturing industry. In 1978, Chinese manufacturing industry accounted for no more than 1% of the global manufacturing industry while in 2008 the figure was 14% in, ranking the second in the world. In 1978, the total export of China was just 975 million Yuan, making no significant contribution to international trade, while in 2008 the figure was up to 1218.02 billion Yuan, ranking the third in the world. In 1978, Chinese foreign exchange reserve was just 16.7 million Yuan, while in 2008 the figure was up to 190 billion Yuan, ranking the first in the world. In 2006, the production of 172 kinds of products ranked the first in the world. The 70% of DVDs and toys, 50% of telephones and shoes and over one third of color TV sets and bags in the world were supplied by China. From 1978 to 2006, the production of Chinese air conditioners, color TV and other household appliances increased by over 10000 times; the production of integrated circuits, computers increased by over 1000 times; the production of chemical fiber and automobile increased by over 10 times.

In 2008, the self-innovation of Chinese manufacturing industry achieved breakthrough in some areas. The beginning of the construction of Beijing—Shanghai high speed railways shows that the self-innovation of Chinese high-speed railway equipment manufacturing has reached an advanced level. High-speed railway technology system mainly consists of 6 systems: track maintenance engineering, traction electricity supply, communication signal, motor train unit, running scheduling and passenger transport service. It needs to integrate on the basis of the achievement of self-innovation and it is also a huge and complex system of technological innovation. In the whole world, only several countries like Japan, France and other developed country has complete technological supporting system for high-speed railway construction. The construction of Beijing-Shanghai high-speed railway will be neces-



sary to drive creative development of various related manufacturing industries such as steel, electronic, machinery and communication manufacturing. The successful launch of Shenzhou VII manned spacecraft and the project of building large airplanes all belong to systematical integrated projects in which self-innovation is a driving force for Chinese manufacturing industry.

Looking back upon the past 30-year of development, Chinese manufacturing industry has passed the era of exchange market for technology and starts the essential era of transition from "Made in China" to "Created in China". Meeting the demands of scientific development, strengthening the supporting and leading force of technology and improving the level of Chinese manufacturing's new-type orientation are the necessary paths for Chinese manufacturing industry to take. Indeed, under the guidance of the conception of scientific development Chinese manufacturing industry are actively engaged in energy saving, pollution control and development coordination in order to integrate into global manufacturing system. The manufacturing industry has presented a good pattern of development driven by technology. However, the global financial crisis, which first emerged in 2007 and then aggravated too soon to exert a global impact, has brought about many negative factors such as the rapidly deteriorating international environment for Chinese manufacturing industry. Large numbers of enterprises, which have participated extensively in the labor division of global manufacturing industry, face severe challenges. Obviously, in order to cope with the global crisis, Chinese manufacturing industry should quicken the pace of adjusting and optimizing its structures, improve its scientific development, and catch hold of the opportunities to integrate into the world manufacturing system. If the crisis is properly handled, Chinese manufacturing industry could turn this crisis into an opportunity to realize the sustained and scientific development of manufacturing industry, and also rapidly improve the level of the "New-Type" transformation of manufacturing industry in the process of adjusting and optimizing the industry.

## **1.2 The Development of Manufacturing: Evaluation Indexes**

Evaluating the level of the development of manufacturing industry, especially the level of the "New-Type" transformation of manufacturing industry, requires the establishment of a set of index system. After discussing the location and the principle of establishing index system, we will apply the method of principal component analysis to choose evaluation index and make an evaluation of the level of the development of Chinese manufacturing industry.

### **1.2.1 The Establishment of Evaluation Index System**

According to the requirements of new-type industrialization, the development of manufacturing industry must realize the balanced development of economic benefits and resource environment. The objective evaluation of the manufacturing industry development level must take account of the capacity of resources, energy and environment in China, in accor-