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A Review of the Development of High-tech Industries in the World[1]

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Nowadays, the high-tech industry is one of the world's fastest growing industries. Observed from its characteristics, the high-tech industry often refers to those business complexities based on high-techs, engaged in one or more high-techs, in research and development of products, production and technical services, so both high-tech manufacturing industries and high-tech service industries are included. The time for the world's high-tech industrial development is not long. American Silicon Valley is the world's first high-tech industrial zone and the world's most innovative and dynamic high-tech park today. Since the 1990s, high-tech industries in the world went into a period of steady development. In 2008, the European Union had about 50,000 high-tech manufacturing enterprises and 756,000 high-tech knowledge-intensive service enterprises. The paper here aims to give a brief historical overview of the development of high-tech industries in the world.

Keywords: Review; development; high-tech industries.

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1. THE DEFINITION OF HIGH-TECH INDUSTRIES

1.1 High-tech

High-tech (or high technology) refers to those aspects of which the progress of a country or a region's politics, economy, technology and military have a profound impact, and can form a group of advanced technological industries [1]. High and new technology, more internationally recognized, is high-tech innovations, based at the forefront of contemporary knowledge-intensive, cutting-edge science and technology. It also refers to a series of high-tech groups. High-tech in people's minds should be a concept of continuous improvement and development, and it will change with the passage of time and the development of the times. Take some present-day high-techs for example. If overtaken by newer technologies, they will gradually become conventional ones [2].

1.2 High-tech Industries

High-tech industry is one of the world's fastest growing industries [3]. Observed from its characteristics, high-tech industry often refers to those business complexities based on high-techs, engaged in one or more high-techs, in research and development of products, production and technical services, so both high-tech manufacturing industries and high-tech service industries are included. The key technology of this industry is often very difficult to be developed, but once developed successfully, the industry will have higher economic and social benefits than usual. High-tech industry should be knowledge-intensive and technology-intensive industry, with less environmental pollution, stronger leading, higher connectivity and higher added values. The dominant technology of the products should belong to the identified high-tech field and include the cutting-edge techniques or technological breakthroughs in high-tech fields.

Obviously, to have a long-term vitality, the high-tech industry must be combined closely with scientific research, production and sales. Without the high-tech propulsion, the high-tech industry will be unable to continue to grow [4]; without the exploration of markets at home and abroad or social needs, the high-tech industry would not survive, let alone development. The definition of the scope of high-tech industries is the basis of research on a variety of issues, including policy issues. However, since high-tech industries rely on high-techs, and often, people can not agree with each other on the conception of high-techs, the circle of the industry also has different views or opinions towards the definition of high-tech industries.

The main indicators to determine the high-tech industry by U.S. Department of Commerce are put forward in two aspects: First, the intensity for research and development, i.e. the proportion of research and development expenses in sales revenue; Second, the proportion of R & D personnel (including scientists, engineers, skilled workers) in the total number of employees [5]. In addition, the product must belong to the dominant technology in the field of high-techs determined, and must include the cutting edge of high-techs in the field of technology or technological breakthroughs. Canada believes that the identification of the high-tech industry is determined according to R & D funding and technical quality of the labor force, which reflects the technical level. France thinks that the high-tech industry can be called only when a new product uses standard production line with a highly qualified labor force, and they should have a certain market and have formed a new branch of industry. Australia regards the application of new technology and the manufacture of new products as a significant sign judgment. According to the development status and trends of world technology, the Science and Technology Commission of China believes that the range of high-tech industries should be microelectronics and electronic information technology, space science and aerospace technology, photonics science and mechatronics technology, life science and biotechnology, material science and new materials technology, science and new energy, energy-efficient technology, ecology and environmental science and technology, earth sciences and marine engineering technology, basic materials science and radiation technology, medical science and biomedical engineering, and other new technologies in traditional industries based on the application of new technologies. In the light of this standard, the high-tech industry may refer to a strategic industry in the national economy, which has a significant and long-term impact on the economic and social development and national security. The emerging industry could become a pillar industry of the future economic development of a country or region. Obviously, with the development of social progress and high technology, the connotation and concept of the high-tech industry will

continue to change accordingly. We have to choose and develop our strategic high-tech industries at an angle of international vision and strategic thinking. In this regard, the developmental experience and practice in a number of foreign high-tech industries is worth our study and learning [6].

2. THE DEVELOPMENTAL HISTORY OF THE WORLD'S HIGH-TECH INDUSTRIES

2.1 Initial Stage (1951-1957)

The time for the world's high-tech industrial development is not long [7]. The world's high-tech industrial development started first in Stanford University, California, USA and its surrounding areas, which is called today's "Silicon Valley", as well as the germination of science and technology park in southern Paris, France, igniting the sparks of the high-tech industrial development. Silicon Valley is the world's first high-tech industrial zone and the world's most innovative and dynamic high-tech park today. Silicon Valley is located south of San Francisco. In the north it starts from Stanford University in Palo Alto City, and in the south to San José, California. Silicon Valley was originally an orchard, even not having a name of its own. The reason why the word "Silicon" appears in the name of Silicon Valley is because the majority of local enterprises engaged in processing and manufacturing high-concentration silicon in the semiconductor industry and the computer industry. The "valley" is derived from local Santa Clara Valley, hence the name. The place has been a job site of the U.S. Navy, and its aviation research base is also located there. Later the stores of many technology companies were built up around the naval research base. At that time there were no civilian high-tech enterprises. Although there were many good universities, many students chose to go to the East Coast in search of work opportunities after graduation. A talented Stanford University professor Frederick Terman found that out, so he chose a large open space on the campus for the development of real estate, and set up a number of programs to encourage students to develop their "Venture Capital" career in local places. Under the guidance of Terman, two of his students, William Hewlett and David Packard, established Hewlett-Packard Company in a garage with only $ 538. This garage has now become a witness to the development of Silicon Valley, which has been announced as the birthplace of the Silicon Valley by the government of California, and became important attractions. In 1951, Terman had a larger vision of establishing a Stanford Research Park, which is the first high-tech industrial park located near the university. Some of the smaller industrial buildings in the park were leased to a number of small technology companies in low rents. Now, these companies have become important technical birthplaces though at that time, it was unknown at all. In 1955, the famous Bell Laboratories moved the company of developing and producing transistors to Palo Alto City, making the city the birthplace of the U.S. electronics industry. Later, more and more companies turned up, and they applied the latest scientific and technological achievements of the University. Later Terman decided that the new infrastructure should be built around the "valley". It is in this atmosphere, a famous Californian, William Shockley moved here, which is called a milestone of the semiconductor industry. For the company's development, he especially summoned eight young people from the east, among whom were Robert Norton Noyce and Gordon Earle Moore. Noyce is one of the co-founders of Fairchild Semiconductor (1957) and Intel Corporation (1968). Therefore, he has got the nickname of "Father of Silicon Valley" and "Mayor of Silicon Valley". Moore is also one of the founders of Intel and put forward "Moore's Law".

Silicon Valley is now an important electronic industrial base in the United States, and it is also a place where the world's most famous electronic industries are concentrated [8]. It is gradually formed with the rapid development of microelectronic technology, whose features are relying on some of the American top universities with strong research abilities and are based on some small and medium-sized high-tech company groups. In Silicon Valley, there are some big companies such as Cisco Systems, Inc., Intel Corporation, Hewlett-Packard Development Company, LP, called HP, Lucent Technologies, Apple Inc. and some other large companies, which integrate science and technology with production. Currently the district has more than 10,000 big or small electronic companies. The semiconductor integrated circuits and computers produced there separately accounts for about 1/3 and 1/6 of the global output in the United States. Since the 1980s, research institutions related to biotechnology, space, marine, telecommunica-tions, energy materials and so on have sprung up all over the district, which has, objectively,

become the cradle of American high-techs. In fact, Silicon Valley has already become a byword for the world high-tech gathering area. After the development of half a century, Silicon Valley has become a world high-tech centre, which owns tens of thousands of enterprises, 660,000 engineers and 48 Nobel laureates. The wealth created in the centre each year surpasses South Korea's gross national product. The reason why Silicon Valley is successful is that it has adjacent Stanford University and research institutions; perfect markets, infrastructure, plants and equipment; unique international talents; innovative mechanism guided by science and technology; good management ability; strategic location, convenient transportation; beautiful environment and pleasant climate. Therefore, Silicon Valley is a natural result of many factors, because there was not a Silicon Valley development plan at first, and the Government is only an indirect supporter [8].

2.2 Expansion Stage (1958-1969)

Driven by the revolutionary waves of new technology, the U.S. high-tech industries began to develop rapidly and gradually expanded to the whole country, affecting other countries or regions of the world. In 1959, the former Soviet Union began to create the Science City of Novosibirsk. In 1968, the Japanese government put in huge amounts of money to build Tsukuba Science City. Subsequently, France established the Science City of Sophia Antipolis. Meanwhile, Canada, Romania, Argentina, Brazil and other countries have also set up their own high-tech industrial zones.

2.3 Ebb Stage (1970-1979)

In October 1973, the Fourth Middle East War broke out. To fight against Israel and its supporters, the Arabian members of OPEC announced in December that year to draw back the right to mark the price of crude oil and its benchmark crude oil price increased from $ 3.011 to 10.651 per barrel, making oil prices suddenly rise more than twice, which triggered the worst global economic crisis after World War II. At the end of 1978, dramatic changes happened in Iran, the world's second largest oil exporter. Iran's moderate pro-American King Pahlavi went out of power, and Iran-Iraq war broke out, leading to the occurrence of the second oil crisis. As the impact of the oil crisis, the economic crisis spread to Western countries, causing economic stagnation, rising unemployment and making the development of high-tech industries severely hampered and hitting the skids. Until the late 1970s, there were only 23 high-tech parks in the world, most of which were located in the United States.

2.4 Stage of Rapid Development (1980-1990)

Since the 1980s, with the rising economy and development of many world countries, in order to promote the local economy more quickly, some regions with advanced science and technology were trying to establish their own Silicon Valleys, such as Boston's "Second Silicon Valley", "Japan's Silicon Valley", "South Korean Silicon Valley" and so on. China is no exception, having Beijing Zhongguancun Silicon Valley, Shanghai Pudong Silicon Valley and Shenzhen Silicon Valley. Under the stimulation of the development of high-tech industries in the United States, the former Soviet Union, Canada, Japan and Western European countries, the newly industrialized countries or regions did all they could to catch up, unwilling to fall behind. As a result, the climax of the development of high-tech industries came into being and the global economy began to take off. The main features of this phase were: with the rapid development of Science Parks, more than 500 new Science Parks appeared during 10 years, so the world total number reached 641; some developing countries and regions have also begun to establish their own Science Parks, making Science Parks distributed and expanded to 34 countries and regions, which, of course, were mainly located in the developed countries. For example, during the mid-1980s, only the United States set up more than 150 high-tech parks. Science Parks have played a very important role in promoting the economic development of countries and regions and industrial upgrading.

2.5 Vigorous Development Stage (Since the 1990s)

Since the 1990s, high-tech industries went into a period of steady development. At this stage, high-tech industrial development zones thrived not only in developed countries, but also in developing countries or regions. They emerged like mushrooms all over the world. Regarding the high-tech as the core, the newly emerged industries in many countries showed their vitality. According to incomplete statistics, as of 1992, there were 802 high-tech parks in the world. They were respectively the high-tech areas in

North America, based on the United States and Canada; the high-tech areas represented by Germany, Britain, France, Western Europe as well as mainland China, Japan, South Korea and Taiwan in East Asia. United States, Britain, Russia, Australia and many other countries relied largely on high-tech industries to drive their economy and development forward. From this, we can see that high-tech industries are playing an increasingly important role in enhancing their competitiveness and the world economy. Perceived from the high-tech development trend, high-tech industrial output value and the proportion of GDP increased steadily, creating a lot of employment opportunities in the meantime. Take the U.S. for example. In the growth of GDP from 1993 to 1996, 27% came from the high-tech industry, which became an important new economic growth of America. In 1996, the U.S. high-tech industry offered 9.1 million jobs, and the GDP was $ 420.3 billion. According to the statistics published by the U.S. Department of Commerce in April 1998, over the past five years, the information industry alone created 15 million jobs. According to the annual report of a U.S. Market Research Firm, Clean Edge, the output value of 2008 solar photovoltaic industry, wind energy, bio-fuels and fuel cells and other new energies reached $ 115.9 billion, an increase of 153% compared with $ 75.8 billion in 2007. 2008, the European Union had about 50,000 high-tech manufacturing enterprises and 756,000 high-tech knowledge-intensive service enterprises. EU countries with the largest number of high-tech manufacturing companies were Germany, Britain, Italy and France, whose number of high-tech manufacturing enterprises accounted for 55% of the EU total. The number of British high-tech knowledge-intensive service companies ranked first in the EU, which was 144,000, accounting for almost 20% of the EU total. Italy and Germany ranked second and third separately. In 2008, the turnover of German high-tech enterprises reached the first in the EU, and nearly doubled compared with the turnover and added value of the countries with the same number of high-tech enterprises, reaching about 128 billion euros (about 188.2 billion U.S. dollars) and accounting for nearly 25% share of the European Union. As for France and Italy, the second and third place, their turnover of high-tech enterprises were respectively 76 billion euros (about 111.7 billion U.S. dollars) and 50 billion euros (about 73.5 billion U.S. dollars). The case of the added value is similar to that. In 2008, Germany achieved nearly 41 billion euros (about 60.3 billion U.S. dollars). Followed by France and Britain, their added values were 20 billion euros each (about 29.4 billion U.S. dollars). After the international financial crisis, the development of strategic high-tech industries is becoming the policy focus of different nations. Again, developed countries realized the importance of regarding the technological innovation and the development of high-tech industries as new growth points of cultivating economy. They also realized the importance of achieving economic revitalization and seizing the commanding heights of the new international competition, so that they can manage to obtain a global competitive advantage in new high-tech industries. The European Commission launched in 2010 the "Europe 2020 strategy" to keep the EU position in the international economic order, and to enhance the overall economic competitiveness of the EU countries. Currently, the U.S., Japan, South Korea, Brazil and some other countries introduced various policy measures to encourage and support the development of national strategic high-tech industries [9].

Developmental history of the World's high-tech industries

Development stages	Development periods
Initial stage	1951-1957
Expansion stage	1958-1969
Ebb stage	1970-1979
Stage of rapid development	1980-1990
Vigorous development stage	Since the 1990s
Reforming & competitive stage	At present & future

3. CONCLUSION

Through this paper, we talk about high technology and high-tech industries, and the developmental history of the world's high-tech industries is reviewed, in whose process we analyze the development of the world's high-tech industries, hoping to provide reference and enlightenment in promoting the development of high-tech industries. However, we should be aware that, since differences exist in science and technology resources, industrial structures, the quality of talents and innovative elements involved in the interaction, different characteristics and trends in the world are gradually formed in promoting the pattern of development of high-tech industries. At present,

the world economy is still in the depth of the adjustment period and the recovery process is still slow, so innovation is regarded as the propeller that the times need. Nowadays, multinational corporations have become the main body of the development of high-tech industries in the world, and the features in the international division of labor of high-tech industries will be more and more obvious [10]. In the situation of rapid development of high-tech industries and increasing competition, whoever can continue to learn and absorb the successful experience of the development of high-tech industries in the world and promote the international cooperation according to their own reality may take the lead to win the initiative.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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