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2016 上海科技创新中心指数报告

Shanghai Science and Technology Innovation Center Index Report

《上海科技创新中心指数》研究编制组
上 海 市 科 学 学 研 究 所 著

上海教育出版社
SHANGHAI EDUCATIONAL PUBLISHING HOUSE

2016 上海科技创新中心指数报告

上海教育出版社

世纪出版

策 划 贾立群

责任编辑 隋淑光 严 岷

上海教育出版社
官方微信平台

三思派
（上海市科学学研究所）

官方网站：
www.seph.com.cn

Preface

Shanghai is in the process of implementing “Innovation-driven Development” Strategyand speeding up the construction of a science and technology innovation center with global influence.In order to grasp the rules of developing an innovation center and to evaluate the progress results, a systematic and multidimensional index system, reflecting the features and trends of Shanghai science and technology innovation is urgently required. With the instruction and support of Science and Technology Commission of Shanghai Municipality, Shanghai Institute for Science of Science formed a research team to conduct the study and compilation of the index report. The team teased out the advantages, features and inadequacies of Shanghai’s innovation industry, and supervised the building of the science and technology innovation center based on the detailed data analysis.

The team follows the developing rule for “Innovation 3.0” which is to couple science technology innovation with city function. It looks at “Five Strengths” from the perspective of innovation ecology：concentration of innovative resources, influence of scientific and technological achievements, environment friendliness to attract innovative startups, the driving force of the emerging industry and

innovation capacity of facilitating regional development. The index system includes 5 primary indicators and 30 secondary indicators. This report calculated all annual index of Shanghai science and technology innovation center since 2010 based on the data of 2010 (reference value 100).

The Shanghai Science and Technology Innovation Center Index reveals a general trend of steady rise of all indexes in recent years and a big acceleration especially after 2014. Analysis of the index shows both the annual development highlights, such as the attraction of top talents from home and abroad, the development of science and technology services, the accelerated gathering of innovation capital from the society and the outstanding performance of outbound investment on high technology; and some noteworthy issues, including a slowing of corporation R&D investment growth.

The team hereby would like to express heartfelt thanks to a great number of related departments and organizations, namely the Organization Department of the CPC Shanghai Municipal Committee, Shanghai Municipal Bureau of Statistics, Shanghai Municipal Commission of Commerce, Shanghai Intellectual Property Administration, Institute of Scientific & Technical Information of Shanghai, Shanghai Technology Market Management Office, Shanghai Scientific and Technological Information Center, Center for Knowledge Competitiveness and Regional Development of Shanghai Jiao Tong University, Shanghai Academy of Social Sciences and Shanghai S&T Statistics and Analysis Research Center, for their long-term support. The appreciation also goes to all the experts and professionals for the attention and generous help during the compilation.

Special thanks to Dr. WANG Yuan, former Executive Vice President of Chinese Academy of Science and Technology for Development and Dr. XUAN

Zhaohui, Deputy Director of Shanghai S&T Statistics and Analysis Research Center for the advices and guidance on this report.

Constant exploration and extensive research is required to evaluate regionalinnovation-driven development level, and to supervise the development of the Science and Technology Innovation Center. We look forward to all valuable opinions to improve the index system and an annual report truthfully reflecting new trends, new situations and new characteristics of Shanghai innovation. Together let us witness the great march to Shanghai's international Science and Technology Innovation Center.

Shanghai Science and Technology Innovation Center Index
Study and Compilation Group
November 2016

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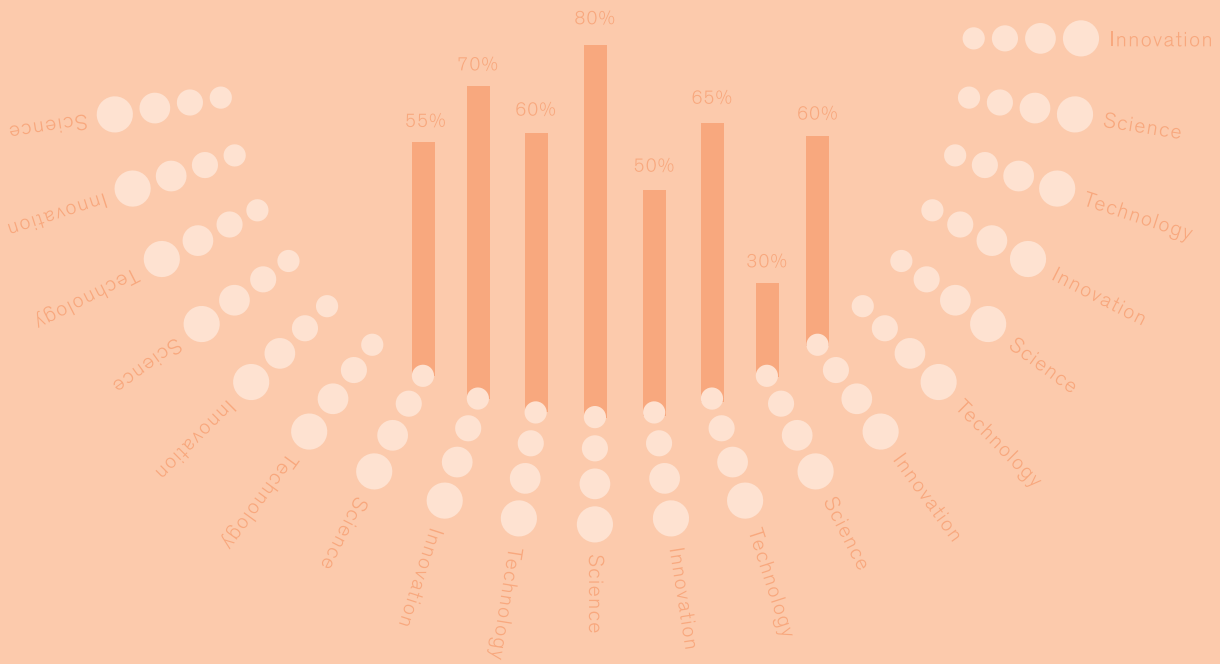
Introduction



Building a Scientific and Technological Innovation Centre is not only one of the national strategies but also an inevitable choice for Shanghai to break through the development bottlenecks and to reconstruct the developing engine. Since 2015, Shanghai has improved its innovation ecology and boosted the innovation-driven development with full energy and vigor. Shanghai has been in the process of implementing "*The National Plan for Speeding Up Innovative Reform and Building Shanghai as Science and Technology Innovation Center with Global Influence*" and the "*Opinions*" on this agenda are being addressed by the CPC Shanghai Municipal Committee and Government. The related 9 supporting policies and the "2+X" working mechanism were carried out. Shanghai is stepping into the key stage of building the center.

I. Fundamental Ideas

With the instruction and support of Science and Technology Commission of Shanghai Municipality, the research team, formed by Shanghai Institute for Science of Science in 2015 conducted the study and compilation of the index report, which not only coordinated with the national strategy but also highlighted with Shanghai's characteristics. The purpose of the report is to further master

the rules of building and developing an innovation center, and to supervise and evaluate the progress and results. A dynamic and open index system, which is of global standard with vertical comparability, has been brought out after a year's research and study. The compilation is taken into consideration of the following four aspects.

Firstly, the index system will be incorporating these "five strengths" to test and measure Shanghai's innovative function, industrial function and city function. International Scientific and Technological innovation cities normally contain following features: 1) The city must be a center of global innovative resources and possess an outstanding career platform attracting high-level talents from the world. 2) The city must be capable of outputting high-level technology achievements and influential organizations and individuals. 3) The city must have a creative and friendly business environment, inclusive and open culture, and a balanced ecosystem. 4) The city must be able to accumulate and give full play to its first mover advantages, to lead the industrial development and to support the emerging industries. 5) The city would be the driving force to surrounding areas and play a key role in global innovative network as a linking hub. The city could also represent the country in global innovative challenges and cooperation. The report focuses on the "five strengths" — concentration of innovative resources, influence of scientific and technological achievements, environment friendliness to attract innovative startups, the driving force of the emerging industry and innovation capacity of facilitating regional development, creating an index system with 5 primary indicators and 30 secondary indicators.

Secondly, the index is chosen with reference to the existing domestic and overseas index studies. 2/3 of the indicators in the report are of international

comparability. The team studied internationally recognized evaluation methods, tested and measured various indicators with international comparability. In the area of concentration of innovative resources, for example, the test and measurement of the total amount and structure of R&D input were stressed. In the area of creating friendly environment, the proportion of newly established companies and tax policies for scientific and technological innovative corporations were highlighted. Other indicators including the percentage of the number of employees in the knowledge-intensive industry to reflect high-quality employment; the increased percentage of knowledge-intensive service industry to compare features of industrial structure among different cities; the number of Fortune Top 500 nominees, the comparisonof PCT patent features, and the amount of outward investment, all these would further broaden the horizon of international comparative study.

Thirdly, to demonstrate the potential and advantages of innovative ecology, emphasizing the scientific nature and availability of the data. 50% of the indicators came from the "*13th Five-Year Plan for National Scientific and Technological Innovation*", "*13th Five-Year Planning Outline for National Economy and Social Development of Shanghai*" and "*13th Five-Year Plan for Scientific and Technological Innovation in Shanghai*", using both functional and procedural indicators to analyze key tasks in "Four Girders Eight Pillars" program. The team not only focused on the test and measurement of the programs which served national strategies, for instance, the increasing investment in fundamental researches, and the construction of Zhangjiang Comprehensive National Scientific and Technological Center, but also on subjects which represented Shanghai's openness and comprehensiveness,

such as various foreign investment R&D centers and the multiple categories of innovation subjects.

Fourthly, new situations and new trends are to be reflected in the report, however data related to statistical serials are unlisted. In the area of innovation environment attractiveness, apart from studying a second-grade indicator which is residential foreign population in Shanghai, the team also appraised the implementation effects of the "*Suggestions on the Implementation of Deepening the Institutional Mechanism Reform of Talents Work and Supporting Innovative and Entrepreneurial Talents*" introduced by local authority (hereinafter referred to as "Talents 20") in 2015. The team used statistics on IT upgrade speed and development level to demonstrate the city's information infrastructure level. For example, the data of fixed-line broadband internet download speed, released by Broadband Development Alliance, was taking as one of the references. The data helps to master and analyze new situation, new trends and new feature during the construction of the center, and are vital for data-based decision making process.

II. Methodology

To build Shanghai as a Scientific and Technological Innovation Center of global influence requires international benchmarking, attracting global innovation resources and showing its favorable city functions. The purpose is to turn Shanghai into a comprehensive and open Scientific and Technological center, a major hub for global innovative network and a main source for international science, technology and industries. Shanghai aims to establish a basic framework for the innovation center and to lay a solid foundation for future

development by 2020. Core functions of a Scientific and Technological center city would come into being by 2030, to facilitate the international Scientific and Technological cooperation. (Figure 1–1)

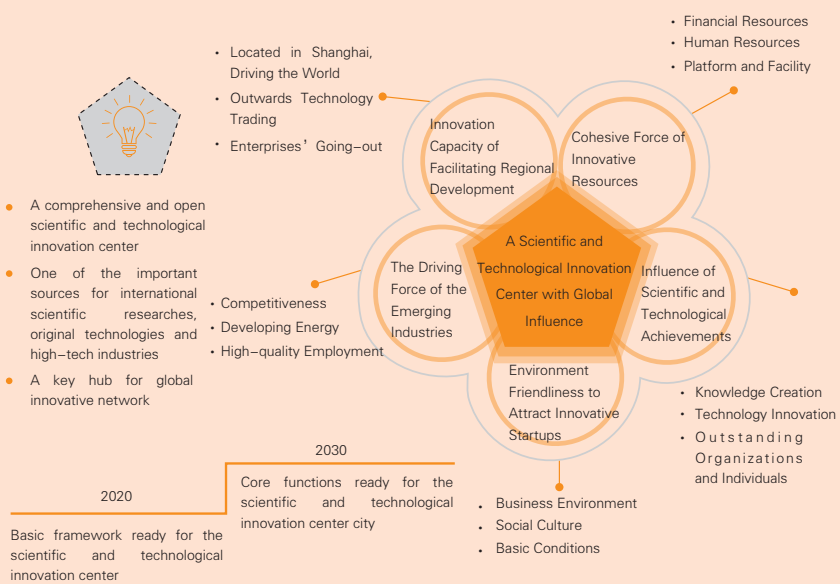


Figure 1–1 The National Strategy: Marching towards a global Scientific and Technological innovation center

The Scientific and Technological Innovation Center Index has 5 primary indicators and 30 secondary indicators (Table 1–1), which represent Shanghai's ability, position and influence of innovative development. With the connotation and function of "five strengths" , the index system is able to reflect the developing condition of the center, based on the thorough analysis of all indicators and consideration of all suggestions from various aspects.

Table 1–1 Shanghai Scientific and Technological Innovation Center Index System

Primary Indicator	Secondary Indicator
Cohesive Force of Innovative Resources	Total expenditure on R&D as a percentage of GDP (%) ★
	Percentage of R&D expenditure to business turnover (%)
	Percentage of main working-age population with higher education (%)
	Number of full time R&D researchers per ten thousand people (person-year) ★
	The ratio of basic research expenses to overall R&D expenses (%) ★
	The total amount of Venture capital and private equity (VC/PE) (100 Million RMB)
	Number of national R&D institutions
	R&D funds from enterprises used by research organizations
Influence of Scientific and Technological Achievements	Number of published international scientific and technical articles
	Number of international scientific and technical articles citations
	The number of PCT patent applications ★
	Number of invention patents owned per 10,000 people ★
	Percentage of National Science and Technology Award (%)
	Number and ranking in the global TOP 500 universities
Environment Friendliness to Attract Innovative Startups	Percentage of days with moderate and good air quality (%)
	Pretax Additional Deduction (PAD) for enterprise's R&D expenses and tax exemption or reduction for high-tech corporations
	Percentage of citizens with scientific literacy (%)
	Percentage of new enterprises this year to total number of enterprises last year (%) ★
	Permanent foreign residents in Shanghai (ten thousand people)
	Fixed broadband (FBB) access rate (Mbit/s)

(continued)

Primary Indicator	Secondary Indicator
The Driving Force of the Emerging Industry	Labor productivity (ten thousand RMB per person) ★
	Number of enterprises with over 100 million RMB revenue in the information and science and technology service industry
	Number of employees in knowledge-intensive industries as a percentage of total employment in Shanghai (%)
	Added value of knowledge-intensive services as a percentage of GDP (%) ★
	Energy consumption per 10,000 RMB GDP (tons of standard coal)
Innovation Capacity of Facilitating Regional Development	Foreign R&D centers
	Value of Shanghai technology export contracts to China and abroad as a percentage of the total transaction amount of all types of technical contracts (%) ★
	High-tech products export volume as a percentage of commodity exports (%)
	Outward direct investment of Shanghai (100 million U.S. dollars)
	Number and Rankings of Shanghai Local Enterprises in Fortune 500

Note: The index with a star means a core index.

1. The indicators for cohesive force of innovative resources. The center should be able to gather global innovative resources, especially high-level resources in talents, capital and facility. It is a cluster of social inputs, scientific and technological financial resources, high-end human resources, outstanding R&D institutions and more. The indicators include:

Financial Resources refers to the total amount, intensity and structure of R&D investment (i.e. investment intensity of private enterprises, the percentage of R&D expenses to the total turnover, the percentage of basic research funding, and the connection among different subjects). This indicator also refers

to the effectivenessof the market resources, i.e. the total amount of VC/PE.

Human Resources refers to the main working-age population with higher education(this indicator mainly representing the human resources supporting the development of scientific and technological innovation). This indicator also refers to the number of full time R&D researchers in per ten thousand people (this is one of the common measurements with global comparability in international innovation evaluation).

Platform and Facility refers to the level and effect of state key laboratories, functional platforms, new R&D institutions and services suppliers in scientific and technological innovation.

Core indicators: Total expenditure on R&D as a percentage of GDP (%), and the number of full time R&D researchers in per ten thousand people (person-year).

2. The indicators for influence of scientific and technological achievements reflect an overall situation of Shanghai scientific and technological achievements including the quantity, the quality and the ranking. The indicators include:

Knowledge Creation refers to the Number of published international scientific and technical articles (representing the increasing amount of papers), Number of international scientific and technical articles citations(one of the core indicators in the "*13th Five-Year Plan for National scientific and technological Innovation*"), the amount of highly cited papers (representing the quality).

Technology Innovation refers to the number of invention patents owned

per 10,000 people (representing a shift from quantity to quality), the number of Shanghai's PCT patent applications (one of the core indicators both in the national and Shanghai's *13th Five-Year Plan*, representing the global influence of companies' innovation capacity).

Outstanding Organizations and Individuals refers to the percentage of national level scientific and technological awards, the number of frequently cited researchers (from *Thomson Reuters Highly Cited Researchers*), the amount of top universities in Shanghai (representing global influence), the rank of Shanghai's R&D institutions from international high-level innovation index assessment, etc.

Core indicators: Number of invention patents owned per 10,000 people, the number of PCT patent applications.

3. Environment friendliness to attract innovative startups: The indicators mainly reflect the business environment, social & culture environment and basic environment.

Business Environment refers to the PAD (pretax additional deduction of R&D expenditure) and preferential tax reduction or exemption for high-new tech companies. (The implementation of the two policies represents a benefit and open tax environment for tech companies); Percentage of new enterprises this year to total number of enterprises last year (representing the demand and vigor of the market towards innovative economy. The indicator is called economic activation rates, is an important indicator, commonly used in the international community for innovative economy vitality), the ecosystem of

scientific and technological startup enterprises (technology business incubator, the service level of creation space, the atmosphere and performance of scientific and technological startups), etc.

Social Culture refers to the rate of standard civic scientific literacy (improving the scientific literacy and creating a friendly environment are of highly importance to the construction of a innovation center), the percentage of permanent foreign residents in Shanghai(representing the diversity and inclusiveness of the city) and the percentage of overseas high-level talents in Shanghai (attracting overseas experts represents a deeper connection with the global innovation network).

Basic Conditions refers to fixed broadband (FBB) access rate (basic infrastructure in the age of mobile internet, and percentage of days with moderate and good air quality (representing important living condition).

Core indicator: Percentage of new enterprises this year to total number of enterprises last year(%).

4. The driving force of the emerging industry. The main indicators include:

Competitiveness refers to Labor productivity(which is companies' contribution on capital-intensive and technology intensive products. It reflects the changing of organic composition of capital and technology. This indicator measures the effect of innovation activitieson the economy, and is also the core indicator in the "*13th Five-Year Planning Outline for National Economy and Social Development of Shanghai*"). The competitiveness also refers to energy consumption per ten thousand RMB GDP (representing the economic output

per unit energy consumption. It is one of the core indicators in the National and Shanghai's *13th Five-Year Plan*).

Developing Dynamic refers to the percentage of increased added value of knowledge-intensive service companies to GDP (building Shanghai's new industrial system of service-based economy); Number of enterprises with over 100 million RMB revenue in the information and S&T service industry (emerging of scientific and technological Services, rapid growth of related organizations and new business models are the boosters for the transformation of high-end manufacturing industry).

Quality Job Positions refers to the ratio of employees in knowledge-intensive industries to the total number of employees of the city.

Core indicators: Added value of knowledge-intensive services as a percentage of GDP (%) and Labor productivity (ten thousand RMB per person)

5. Innovation capacity of facilitating regional development. The indicators in this section reflect the situation of Shanghai's innovation driving force both in the domestic and foreign market. Indicators are listed below:

Located in Shanghai, Driving the World refers to the number of multinational corporation's headquarters in Shanghai, the layout of foreign-funded R&D center, and the new type of overseas organizations in shanghai (representing Shanghai's role as the key hub and flow channel in the global network).

Outwards Technology Trading refers to the percentage of outwards

volume of technology transaction (which is the ratio of the amount of outwards transaction, from Shanghai to other provinces in China or foreign countries, to the total amount); and the ratio of the export volume of high-tech products to total exports (representing the influence on exports and trading).

Enterprises' Going-out refers to the number and rankings of Shanghai local enterprises in Fortune Top 500, local companies' outward investment (improving companies' ability of global layout and the position in the global value chain. Outward investment and overseas M&A are trending. Private enterprises become the major counterparty of overseas M&A). This indicator also refers to the number of high-end scientific and technological innovation forums, e.g. China (Shanghai) International Technology Fair, and international conferences and exhibitions.

Core indicators: Value of Shanghai technology export contracts to China and abroad as a percentage of the total transaction amount of all types of technical contracts (%)

III. Evaluation and Analysis

Generally speaking, Shanghai Science and Technology Innovation Center Index has shown a substantial increase in recent 6 years, rising from 100 points in 2010 to 183.3 in 2015 with an annual average growth rate of 12.9%. Especially since 2014, the figure has pumped up with the sign of a good start and fruitful results of the center.

Table 1–2 The Annual Score of Shanghai Science and Technology Innovation Center Index and Its Primary Indicators

Year	2010	2011	2012	2013	2014	2015
Shanghai Science and Technology Innovation Center Index	100	109.0	123.6	138.1	159.7	183.3
Cohesive Force of Innovative Resources	100	118.3	134.6	154.4	164.9	199.3
Influence of Scientific and Technological Achievements	100	93.3	117.1	144.4	170.5	183.0
Environment Friendliness to Attract Innovative Startups	100	110.0	123.9	125.3	157.7	168.5
The Driving Force of the Emerging Industry	100	120.8	138.1	145.2	166.9	199.2
Innovation Capacity of Facilitating Regional Development	100	101.9	103.2	119.6	136.5	166.3

Note: 2010 as the baseline year (reference value 100)

The first indicator, the Cohesive Force of Innovative Resources, reveals a fast and steady growth with an annual average growth rate of 14.8% from 2010 to 2015. The Influence of Scientific and Technological Achievements went up between 2010 and 2015 with an annual average growth rate of 12.8%. **Shanghai is gathering more innovative resources with closer connection and more frequent exchanges of all stakeholders, which help to realize various results for future development.**

The rising of the emerging industryis eye-catching with an annual average growth rate of 14.8%. An upward acceleration pushed the growth rate to 16.5% during 2013 and 2015. **The first-mover advantages brought by the emerging industry are accumulating faster and better.**

The other two indicators, “The Driving Force of the Emerging Industry” and “Innovation Capacity of Facilitating Regional Development”, have boosted its figure since 2014 with the annual growth rate of 16.0% and 17.9% respectively.

The city innovation ecosystem has been improved in recent years. The spillover effect and internalization level for scientific and technological innovation has been further enhanced.

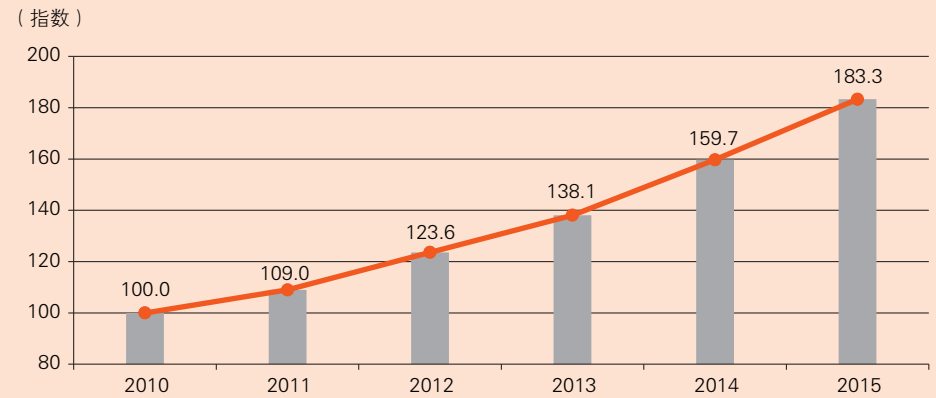


Figure 1–2 The Growth of Shanghai Science and Technology Innovation Center Index (2010–2015)

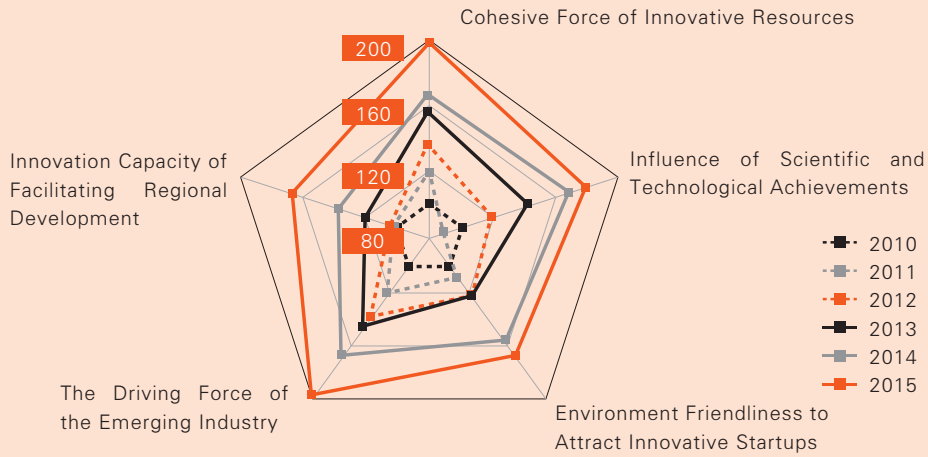


Figure 1–3 The Changes of 5 Primary Indicators of Shanghai Science and Technology Innovation Center Index (2010–2015)

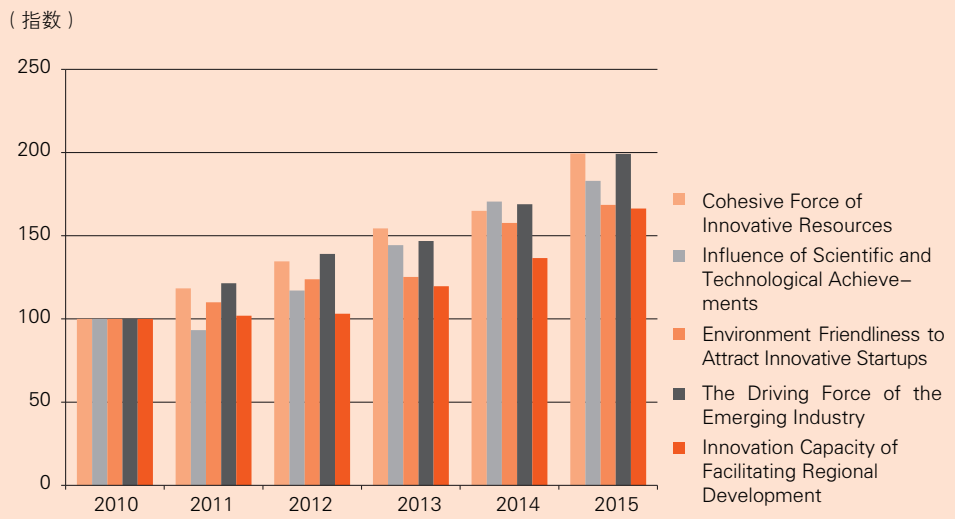


Figure 1–4 The Growth of 5 Primary Indicators of Shanghai Science and Technology Innovation Center Index (2010–2015)

IV. Annual Highlights and Inadequacies

The team analyzed the annual features of certain indicators and picked up 10 highlights in the area of discovering new engine, connecting different parties, gathering resources, optimizing the environment and powering up the driving force.

● Accelerating the Gathering of Innovation Resources, Increasing Innovative Competitiveness

1. Increased fund raising for social innovation capital. In 2015, the annual R&D funds in Shanghai went up to 93.614 billion RMB by 8.6% from a year earlier. The total expenditure on R&D as a percentage of GDP reached 3.73%, increased by 0.92% from 2010. There is still much room for the total input volume to grow, compared to the successful developed innovation cities. The

structure required optimizing. The market plays an important role in innovation investment and resources gathering. According to incomplete statistics, in 2015, the total amount of VC and PE attracted by Shanghai came up to 96.584 billion RMB, increased by 154.3% since the previous year. By September 2016, 79 companies have been listed in the NEEQ (National Equities Exchange and Quotations System), which have successfully raised 360 million RMB. The capital market starts to boost up.

2. Increasing innovative competitiveness. Labor productivity in Shanghai is 185,000 RMB per person in 2015, rising from 130,000 RMB in 2010 with an annual growth rate of 7.3%. Per-capita investment in fixed assets rises from 23,100 RMB to 26,300 RMB with an annual growth rate of 2.6%. The growth rate of productivity is 2.8 times larger than that of the fixed assets investment, which indicated the significant shift from investment-driven to innovation-driven. The ratio of employees in knowledge-intensive industries to the total number of employees of the city is in an upward trend with 24.2% in 2015. One in four people in the city works in knowledge-intensive industries, representing a substantial improvement of the industrial competitiveness.

3. Expanding scientific and technological services. A number of market-oriented, internationalized and specialized service providers were taken into shape during the *12th Five-Year Plan*. Scientific and technological services are becoming the new engine for economy development. The number of enterprises with over 100 million RMB revenue in the information and science and technology service industry has risen from 391 to 719. Most founders of specialized companies have studied abroad before or have work experiences in world top 500 companies. In 2015, the output of Shanghai scientific and

technological services accounts for 17.5% in the total output. The added value of scientific and technological services accounts for 12.2% in GDP, higher than Beijing's by 4.8%. The growth rate of added value of enterprises incubation, scientific and technological intermediary, intellectual property and other promotion services reached 13.20%. Scientific and technological financial services rose at a rate of 12.05%.

- Diversified Innovators and Closer Communication

4. Accelerating the number of innovators of different kinds. Investment in innovation sectors in different companies has been increased during the *12th Five-Year Plan*. R&D expenditure to main business income of industrial enterprises above designated size arrived 1.39% in 2015 from 0.85% in 2010. Nearly 1/3 of the R&D funds of Shanghai's R&D institutions and universities are from companies. Companies are becoming the main part of innovation investment. By the end of 2015, the city has owned 9,400 industrial enterprises whose main business turnover exceeded 20 million RMB, 2,486 of which involve scientific and technological activities, and 1,476 are R&D institutions. Total investment reaches 47.4 billion RMB. In addition, 200 "industry-university-research institute" organizations have been established with the cooperation of above municipal level companies and technology centers. The number of "hidden champion" of differnt market segments has reached 450 national wide. The number of certificated high-tech companies is up to 6,071 in 2015 from 3,129 in 2010.

5. Various platforms, which promote R&D and facilitate transformation of science and technology achievements is the critical driving forcefor Innovation.

Shanghai has preliminarily established innovation platforms including Shanghai Industrial Technology Institute, Shanghai Industrial Technology Research Institute and National Eastern Tech-Transfer Center, also a batch of specialized technical service platform providing innovative public services to the society. Thereinto, Shanghai Industrial Technology Research Institute (SITRI) focused on globally accelerating the innovation and commercialization of "More than Moore" (MtM) technologies and the Internet of Things (IoT) technologies, industrial resources and product services. National Eastern Tech-Transfer Center has formed 123 tech transfer channels for domestic and foreign technologies and created a public service platform on innovative medicine R&D, establishing a complete infrastructure for startups.

- Increasing First Class Resources Showing High Development Potential

6. Attracting talent from home and abroad. Main working-age population (20-59 years old) with higher education accounted for 35% of the total population in Shanghai, well above the national average level about 20%. Total R&D personnel per ten thousand population reached 71 (person-year), ranking the second after Beijing in China. After the release of "*Suggestions on the Implementation of Deepening the Institutional Mechanism Reform of Talents Work and Supporting Innovative and Entrepreneurial Talents*" and "*Suggestions on the Implementation of Deepening the Institutional Reform of Talents Development System and Accelerating the Construction of Science Technology Innovation Center with Global Influence*" (hereinafter referred to as "*Talents 30*"), Shanghai welcomes innovative talents to start their businesses with the support of more positive, more open and more efficient

policies. There were 184 foreign high-level talents who met the requirements of *Talents 20* received the permanent residence permit by the end of October 2016. 147 foreign high-level talents who met the requirements received the recommendation letters for 5-year talent residence permit and talent visa (Type R). In late 2015, after launching the pilot project of post graduation employment for international students, 81 students stayed and worked in Shanghai after graduation. In gathering domestic talents, by November 2016, 126 talents, from startups, innovative enterprises intermediary services, venture capital management, business management and technology companies, registered the permanent residence through the "talents green channel".

7. Emerging of high-tech achievements. Shanghai ranked second, after Beijing, in the number of published international scientific and technical articles and international scientific and technical articles citations in 10 years. Major breakthrough happens in various frontier fields, such as genomics, protein, brain sciences, regenerative medicine, quantum, nanometer and metal catalysis. In 2015, scientists in Shanghai published 18 papers oninternational academic journal Science, accounting for 26.1% of the total amount in China. One of the 18 papers is published by the first author or corresponding author, which is 3.4% of the country's total amount. 23 papers published on *Nature* (25.8%), 6 of which are published by the first author or corresponding author (14.6%). 6 papers on *Cell* (54.5%), 5 of which are published by the first author or corresponding author (55.6%). Also in the year of 2015, 42 achievements, led by Shanghai, were given National Science & Technology Awards, accounting for 13.9% of the total amount. The general office issued 3 Outstanding Prizes of National Science & Technology Awards, which Shanghai was all involved in;

17 First Prizes, which Shanghai led 1 and participated in 5.

● Vigorous Environment for Entrepreneurships and Continuously Improved Policy Environment

8. Vigorous environment for innovation and entrepreneurships. The vibrancy rate of Shanghai economy (the percentage of new enterprises this year to total number of enterprises in 2014) has risen from 15% during the first 3 years in *The 12th Five-Year Plan* to around 20% in 2014 and 2015. More than 500 creation space incubators opened with the booming enterprise ecosystem. 90% of the incubators are funded by private companies. In 2016, more than 20% of overseas participants attended the innovation and entrepreneurship competition, 1/5 of which have worked or studied abroad. Shanghai became popular destination among foreign talents from Europe, the U.S.A, South Korea, Singapore and other countries. The entrepreneurship programs are highly technologically involved. 66% of the programs are in electronic information, new energy and energy conservation and environmental protection, new material, advanced manufacturing and biomedicine.

9. Remarkable success on the implementation of Innovation Policies. In 2015, several policies, such as Pretax Additional Deduction (PAD) for enterprise's R&D expenses and tax exemption or reduction for high-tech corporations, have reduced 26.971 billion RMB for high-tech companies, growing by 37.17% since the previous year. The ratio of the tax reduction to S&T grants from local government has increased to 97.31% in 2015 from 58.69% in 2010. The chokepoint of the commercialization of research findings has been overcome, thanks to Shanghai's revision of "*Suggestions on the*

Implementation of Further Promoting the Commercialization of Research Findings" and "*the Regulation on the Commercialization of Research Findings (Draft)*" . 11 universities and institutions established the management system and procedure for commercialization and achieved initial success. For instance, University of Shanghai for Science and Technology (USST) and Shanghai Maritime University succeeded in pilot projects for commercializing their R&D findings. The number of licensed intellectual property grew by 231% from 2014 in USST, also the number of intellectual property rights transfer doubled, annual revenue of technology transfer and license up by 420%.

- Private Companies Became the Main Outwards Investors, High-tech Projectsare Getting Popular

10. Outwards high-tech investment is trending. In the recent five years, the total amount of overseas investment on M&A projects from Shanghai enterprises has come to over 6 billion U.S. dollars, accounting for nearly 25% of total outwards investment. There are only 20% of the projects related to acquiring energy resources, but 75% related to acquire foreign technology, production capacity, foreign brands or intellectual property rights. An overwhelming number of private companies participated in the overseas investment. From 2010 to 2014, the number of projects and the amount of investment private companies led, accounted for 71% and 82% of the total number and amount. In 2015, the total amount of the investment was 37.099 billion U.S. dollars, which is 64.72% of the annual project investment. Scientific and Technological Innovation Center is a long-term systematic program and requires more attention on the following issues.

1) Companies R&D investment need to be further stressed. The proportion of companies R&D expenses revealed a clear decline. In 2015, the data was 60.8%, dropping by 2.6% since the previous year. This is the first dropping to 60% in recent 10 years (68.4% in 2006, 66.7% in 2010). The growth rate of company R&D investment decreased from 23% in the early stage of *The 12th Five-Year Plan* to 4% in 2015, while over the same period, the investment from universities and institutions remained a steady growth rate of double digits. The total amount of R&D funds in Shanghai increased to 7.419 billion RMB. Companies' contribution in R&D investment is 2.285 billion RMB, accounting for 31% of the total. However, the rate is 71.1% in the national level.

2) The PCT patent application rate is relatively low in the national context. PCT patent number is a significant indicator in evaluating global influence of technology innovation. Comparing the applications from international innovation cities between 2014 and August 2015, Shanghai counted 13,000 applications. While Tokyo is 15 times of Shanghai, Seoul 5 times and Paris 3 times. Shanghai applied 1,060 PCT patents in 2015, only 3.4% of the total amount in China, while Beijing and Shenzhen counting 4,490 and 13,308 applications respectively. The year-on-year growth rate of the country is 16.7%, while 2.1% in Shanghai. A goal of doubling the application by 2020 has already been pointed out in the "*13th Five-Year Plan on National Scientific and Technological Innovation*" . Shanghai really needs to put more effort in this area.

3) The driven force of a center city needs to be strengthened. The number of permanent foreign residents is an important indicator for internationalization and driven force of a scientific and technological innovation center city. The

number in Shanghai stays around 172,000, less than 1% of the population, which is of certain differences from Tokyo (15%), London (24%) and New York (30%). From the perspective of technology movement, a scientific and technological innovation center city should play the vital role of a supplier in regional technology transfer with its great resources and R&D ability. In 2015, the turnover of export technology contracts accounted for 22% of the overall technology contracts. Most of the technology suppliers are foreign companies. As a center for innovation , Shanghai needs to step forward for technology transfer and promote mobilization of factors to the world.