IASP International Association of Science Parks and Areas of Innovation

34th IASP Annual World Conference
Istanbul, Turkey

How Science Parks Build New Carriers of Innovation By Virtue Of Innovation Ecosystems

Plenary Session 1
"Rethinking space: new habitats of innovation, new space concepts for parks and AOIs"

Author:

Herbert Chen
TUSPARK, China

HOSTED BY

teknoparkistanbul ODTÜ·TEKNOKENT ITUARI TEKNOKENT BRIGHTER TOGETHER

How Science Parks Build New Carriers of Innovation By Virtue of Innovation Ecosystems

Abstract:

Innovation is deemed as a key factor to enhance competitive strength in a continuously changing environment, and innovation-driven development has become a strategic choice of the majority of countries. Innovation elements, services, and industries are concentrated in various entities of innovation, and have transitioned into becoming centers leading global innovation and engines driving regional and urban development. The world today has now entered the era of the knowledge economy and innovative globalization, driven by scientific and technological advancement, international competition and philosophies of development. These have a profound influence on theoretical study on innovation, leading to an exploration of innovation ideas, evolvement of innovation carriers, and so on. At the same time, innovative activities are characterized by diversified subjects, a variety of forms, intersecting fields and integrated methods, ultimately leading to new understanding and requirements on innovation carriers and environments. Relevant studies have indicated that innovation ecosystems have become a new perspective for studies on innovation theories and ideas as well as reconsideration of innovation carriers and environment, and building a strong innovation ecosystem have become core factors toward building innovation spaces and implementing innovation-driven development strategies. Science parks are an important form of innovation carriers, and their development methods and characteristics are consistent with the traits of an innovation ecosystem. Science parks have been used by many countries and regions as a strategic measure for future development of hi-tech industries and enhancement of innovative capabilities. To face up to the new trends and challenges, science parks should consider how to become a new space and entities of innovation. Based on innovation theories and evolution of innovation ideas, the connotations of innovation ecosystem are reviewed, the relationships among innovation ecosystem, entities and science park are explained, and the model and experience of the innovation ecosystem in science parks formed during building and operation by TusHoldings are taken as an example to discover how science parksbecome new innovation carriers by way ofinnovativeecosystems.

1. Innovation and Innovation Carriers

1.1 Concepts of Innovation and Innovation Carrier

Innovation is generally guided by way of a different understanding from routine or normal people's thoughts based on the existing thinking model. Innovation is deemed as behaviors with beneficial effects through improvement or creative approaches, methods, elements, paths and environments to be in line with the ideal need or meet social needs under specific environments. In addition, innovation is deemed to be a key factor to enhance competitive strength in a continuously changing environment, and innovation-driven development has become a strategic choice of the majority of countries. In respect to spatial form and entities, innovative activities do not have a balanced distribution, but are concentrated in knowledge intensive sectors and areas with abundant innovation elements. These sectors and areas are known as innovation carriers.

Innovation carriers are the important resources and foundational conditions for regional innovation-driven development and important support for realizing innovation-driven development. In addition, innovation carriers are the effective organizational form and spatial form for integrating innovation elements, collecting innovative resources and innovation capital and attracting innovative talents. Innovation carriers have three basic properties. **Carrying Property** - Innovation carriers generallyhave a certain organizational form and spatial

form. Innovation carriers should have an organizational form to ensure efficient operation of technological innovative activities. In addition, innovation carriers should be responsible for innovative behavior and have a clear emphasis and method of technological innovation objectives to reflect social vale and economic benefit of technological innovation. **Transmissibility** - Innovation=new achievement + application + benefit. Therefore, the innovation objects of the innovative activities with entities should be new products, new technology and new methods that contain, carry, and transmit innovative contents rather than operation and development of economic significance. **Catalysis** - Innovation carriers should have basic conditions and means for digestion, absorption, combination, propagation and diffusion. In addition, innovation carriers can have demonstration and leading function and provide follow-up services.

1.2 Evolution of Innovation Carriers

The implications and concepts of innovation ecosystem have been continuously developed and ideas of innovation have evolved from linear idea and innovation system to innovation ecosystem. Innovation carriers have developed from conventional single R&D physical spaces to networked, platform and sharing innovation ecosystem, which has greatly expanded the communication channels of subjects of innovations, improved communication efficiency of innovation information and created innovation environment and atmosphereto a moreconvenient level. (1) **In terms of spatial form of innovation carriers**, innovation carriers have changed from the original entity space to “virtual-real combination”. With the developing of advanced technologies, such as big data, the Internet of Things (IoT) and cloud computing, relying on the virtual innovation space platform, innovation carriers provides full-chain innovation incubation service, including information service, virtual incubation, and investment and financing docking. In addition, innovation carriers connects online and offline links, reduces innovation and incubation cost. Therefore, innovation becomes more convenient and efficient. (2) **In terms of the service functions of innovation carriers**, innovation carriers have changed from simple hardware foundation facility providers to software and hardware service operation platform. The development of innovation carriers focus on software service and mechanism, integration and utilization of scientificresearch institutions, production enterprises, financing institutions, industry association as well as famous colleges and universities and associated scientific and technological enterprises. In addition, innovation carriers is developed to build inter-organization, multi-industry and cross-regional innovation service platforms. (3) **In terms of the industrialdevelopment of innovation carriers**, cooperation and interaction between enterprises, colleges and research institutions are attracting more attention within industry. Conventional entities focus on basic science exploration and basic scientific research projects. Therefore, it is difficult to connect the

science and technology chain and economy chain. However, new entities are oriented by the market and supply and can deeply and efficiently uncover R&D results of colleges and universities and scientific research institutions. In addition, new entities can introduce multiple resources for achievement transformation and accelerate to enter the market. (4) **In terms of the interaction between innovation carriers and regional development**, conventional entities always provide innovative activities based on regional talent, technology and funds and lack contribution to regional economic development. However, new entities can better benefit surrounding colleges and universities, enterprises and other social institutions with innovative achievements while integrating with the surrounding innovation environment. As a result, they can form bilateral interaction and win-win innovation ecosystemto promote the upgrading of industrial structures and development of regional economies.

1.3 Innovation Carriers: Science Parks

Science parks are a form of innovation carriers derived from the transformation and industrialization of scientific research achievements of colleges and universities. Science parks are also an important form of promotion in relation to technological innovation and the acceleration of knowledge transfer. Likewise, they are a key junction point of R&D activities and industrialization. Science parks have become an important part of regional innovation capabilities and systems. Stanford Industrial Park, established in the United States in 1951, was the first science park in the world and has closely cooperated with Stanford University. Such a relationship is typical of the first generation of science parks. In addition, the first generation of science parks shared space with colleges and universities and pursued industrialization of scientific achievements in colleges and universities. These science parks focus on functions of production and processing. With the extensive development of enterprises, colleges and institutions, in order to adapt to the rapid change in a new generation of scientific and technical revolution and market demand, the second generation of science parks focused on the guiding functions of innovation and incubation and overflow effect of industrial cluster as well as on integrated planning. Science parkshave become the strategic point for regional capabilities and the development area for emerging industry. Early science parks were mainly in Europe and America. With the deepening of globalization and industrial division, science parks in developed regions have become increasingly mature. Developing countries are starting to build and develop science parks along with the industrialization and urbanization and integrate the production, living and ecological functions as well as to create good science city, which become the main features of the third generation of science parks. With the arrival of the internet, knowledge economy and the new scientific and technological and industrial revolution, innovation theories and ideas are changing. Future science parks will emphasize the networking and localization of innovative resources and capabilities, software and hardware service promotion of science parks and building of innovation ecosystem.

Table 1 Evolution of Science Parks

	Internal systems	Spatial form	Main features
The first generation of science parks	Transformation of scientific and research achievement	University science parks	Near and closely linked with universities/research institutions
		Hi-tech industrial parks	With related industries gathering/clustering there, no clearindustrial synergistic effect
		Industrial parks	No high requirements for regional environmental conditions, insufficient supporting facilities for living and production
The second generation ofscience parks	Cooperation between enterprise, colleges and institutions	Incubator	Strengthencollaboration between enterprises, colleges and institutions and focus on incubation and innovation services
	Innovation and incubation	High-tech industrial parks	Emphasize integrated planning, innovation and cooperation and premiumeffect of industrial cluster
	Industrial cluster	Science and technologyindustrial belt	Regional emerging industrial cluster and guiding strategic high ground, insufficient comprehensive supporting facilities
The third generation of science parks	City-industry integration	Science city	Guided by the concept of “Technology, ecology, humanity and harmony” to create a good comprehensiveinnovationenvironment
	Innovation atmosphere	New science city	Emphasize innovation culture and atmosphere
	Coordinated development		Focus on collecting production, living and ecological functions and highlight city-industry integration
Future science parks	Knowledge economy	New science park	Build an innovation ecosystem and realize internal self-innovation-driven development
	Innovation network	Digital park	Adapt to new opportunities and challenges of the Internet-based knowledge economy era
	Innovation ecosystem	Knowledge city	Linked with global innovation resource and focus on openness and localization of innovation resource and network
		Innovation community	Promote upgrading of hardware service and functions in the park with informationtechnology and the internet

2. Innovation Ecosystem and Innovation Carrier

2.1 Connotation of Innovation Ecosystem

2.1.1 Proposing of Innovation Ecosystem

In the 21st century, with the great changes in the global innovative activities, a new relationship could be established between governments, enterprises, universities, scientific organizations and other subjects of innovations, and many countries and regions have

discovered new concepts to re-think the state of innovation. Innovation systemswereviewed as conditions to make economies prosperous in 1960s-1980s by the Japanese. However, since the 1990s, innovation ecosystems have been re-considered due to Japan's economic slowdown, manufacturing industry revitalization in the United States and great success of Silicon Valley and Apple. The concept of innovation ecosystems[1]was proposed based on the continuous innovation and leading research of Silicon Valley. In 2004, the concept of "ecosystems focused on innovation" was first proposed in "Maintain the National Innovation Ecosystem, Information-based Manufacturing Technology and Competitiveness" issued by

PCAST. In this report, "national technology and innovation leader status depends on vigorous and dynamic 'ecosystems focused on innovation' rather than mechanical terminal-to-terminal processes". Later, the OECD, Europe and the United States and Japan conducted relevant studies and discovered policies about ecosystems focused on innovation. China, as a developing country exploring innovation-driven economic transition, regards innovation ecosystems as a new perspective and effective approach to accelerate the building of an innovative nation. Since 2010, innovation ecosystems have become an important discussion topic for central and local decision-making levels. In the end of 2011, the Ministry of Science and Technology has held an "Innovation Round-table Conference" about innovation ecosystems. In addition, related fields, organizations and enterprises represented by Silicon Valley and Apple have begun to focus on research and building of ecosystem centered on innovation and innovation ecosystems have been discovered more thoroughly.

2.1.2 Connotation of Innovation Ecosystem

With consideration to relevant academic research, **innovation ecosystems** are a complete functional complex as well as an open and complex adaptive system. They have certain sized and specific structures of subjects of innovations and external environment through knowledge, technology and culture within certain spatial ranges. Innovation ecosystemshave a considerable quantity and diversified innovation elements. System is not a simple accumulation of elements but a networked and structural system with multi-dimensional space through nonlinear interaction.

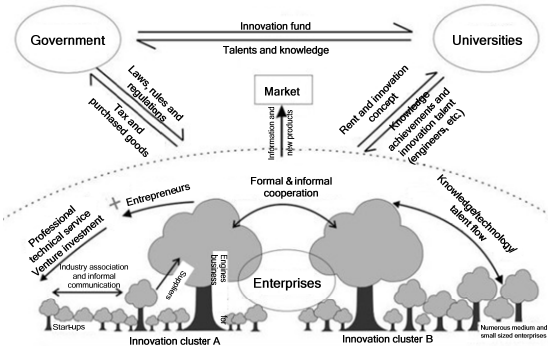

Figure 1 Diagram of Innovation Ecosystems

[1] Silicon Valley is viewed as the "habitat" of high-tech entrepreneurship. Its complexity can be explained in terms of an ecology. Apowerful knowledge ecosystem should be created to establish a powerful knowledge economy

Innovation ecosystemsprimarily have four characteristics: the first is **evolving character**. Similar to natural ecosystems, innovation ecosystems have followed four development stages, including birth, growth, maturity and decline. Innovation ecosystemsare highly likely to decline or be replaced by other new systems, or a new life may give birth in the old system to transform or upgrade the original system. The second is **complexity**. Innovation ecosystem simulate the complex economic dynamics to show interaction among different subjects of innovations. Therefore, it is possible to realize technological development and innovation. Elements of innovation ecosystem interact with oneanother to form material flow, energy flow, value flow and information flow. Therefore, innovation ecosystem has profound implications and colorful expressions. The third is **openness**. Innovation ecosystemsare large scale systems that are composed of technology, economy and society. Innovation ecosystemshave dissipative structures and are widely in contact with the outside world in all links, including technical research, development and dissipation. In addition, innovation ecosystem exchanges energy, material and information with the ambient environment. Ecosystem can be evolved like wavy development and spiral escalation in the open environment. The fourth is **ecology.** In the innovation ecosystem, many associated enterprises will gather together to carry out cluster innovation based on industry or common technical fields. They can utilize common traffic, experimental bases and instrument and equipment and other infrastructure while sharing common information technology, professional and technical personnel and risk funds to achieve resource sharing and complement advantages to overcome insufficient innovative resources and capability within a single enterprise.

2.2 Innovation Ecosystems and Innovation Carriers

2.2.1 Innovation Ecosystems at Different Levels

Since PCAST first proposed innovation ecosystems in the consulting report, governments, research institutions and scholars have sought to define “ecosystems focused on innovation” and have proposed concepts relating to “ecosystems focused on innovation” based on different academic backgrounds, research requirements and practical environments. These have included factors like enterprise technology ecosystems focused on innovation, regional technology ecosystems focused on innovation, city ecosystems focused on innovation, industrial clustering ecosystems focused on innovation, development zone ecosystems focused on innovation, discipline innovation ecosystems, etc. In view of the comprehensive related research, innovation ecosystems can be roughly divided into three levels and six perspectives. Different levels and perspective have different core bodies and concerns.

Table 2 Main Types of Innovation Ecosystems

Six perspectives	Types	Three levels	Core Actors
Global perspective	Global innovation ecosphere	Macroscopic	Governments, enterprises, universities and scientific research institutions
State perspective	State innovation ecosystem		Governments, enterprises, universities and scientific research institutions
Regional perspective	City or regional innovation ecosystem	Madhyamika	Governments, enterprises, universities and scientific research institutions
Industry perspective	Industry innovation ecosystem		Enterprises
Enterprise perspective	Enterprise innovation ecosystem	Microscopic	Enterprises
Discipline perspective	University discipline innovation ecosystem		University discipline

2.2.2New Requirements of Innovation Ecosystems on Innovation Carriers

A powerful innovation ecosystem is an important approach and objective for all levels and subjects seeking to achieve innovative development. Innovation ecosystemsare innovation systems with evolution and development in a highly ordered state. New requirements and guidance have been proposed for the core functional design of components, hardware and software facilities and organizationalmanagement of innovation carriers and are reflected in the following three respects:

The functional design of innovation carriers meets the need for interaction and collaboration of the subjects of innovation. Innovation ecosystemschange innovative activities from a simple combination of processes to collaboration and system cooperation, from product competition to platform competition and from independent development of enterprises to symbiotic evolution. Innovation carriers are the organic integral components of innovation structures and functional features with all sorts of innovation carriers therein. Therefore, for the functional design and all functional space matching ratio of innovation carriers, the need of activities of all future subjects of innovations should be considered, such as enterprise acting as technology subjects of innovation, universities and scientific research institutions undertaking knowledge innovation, educational institutions fostering innovation talent. This also includes financial institutions providing financing service, regional government agencies engaging in innovation management and coordination and intermediary organizations engaging in innovative service activities.

Construction of innovation carriers should focus on "combining software and hardware" and "virtual-real combination". Innovation ecosystems emphasize organic connection between subjects of innovation, between subjects of innovation and external innovation environment. Therefore, the construction of innovation carriers should focus on building hardware and physical spaces as well as software services and mechanism,including virtual spaces. This will

enable the construction of suitable ecosystems focused on innovation. The building of physical spaces should be combined with local development practices. Measures should be adjusted according to local conditions. Technology should be applied in building, facilities and open space to improve technology and service levels in physical spaces. Big data, the Internet of Things (IoT), and cloud computing and other advanced information technological means should be utilizes toward the construction of virtual spaces and resources in scientific research institutions, production institutions, financial institutions, industry associations, and at renowned colleges and universities. Associated technology enterprises should be integrated and utilized to create inter-organization, multi-industry and cross-regional innovation service platforms.

Innovation carriers should focus on the innovation of the organization and management and operation. The management of innovation carriers should be combined with the development stages of innovation carriers. Each development stage has different characteristics. Therefore, innovation carriers should be managed and improved according to different development stage characteristics. At the same time, innovation carriers should be managed based on dynamic changes in the environment, so as to provide solutions in a timely manner and to make correct management decisions.

2.3 Innovation Ecosystems and Science Parks

Innovation ecosystems in science parks are n economic groupscentered onadvanced technology through interaction with enterprise organizations and individuals. This includes a series of organizations and individuals, such as technology research and development, technology services, technological product production and consumption markets. This also includes technology, talent, funds and information needed for survival and development within parks. Innovation ecosystems in science parks have three marked features as follows;

Innovation ecosystems in science parks dynamically evolve from low levels to high levels and from simple to complex. When a science park is established, innovation ecosystems are in the bud. Later, innovation ecosystems enter a stage of rapid growth by constantly absorbing nutrients and obtaining a certain positional advantage in the market. As the science park develops to maturity, a series of high-tech industry chains are formed and the ecosystem gradually expands to enter a period ofmaturity. Then, the ecosystem may be upgraded and developed continuously through system innovation and enterprise development in parks or may gradually decline due to insufficient innovation and disconnection with the market.

Ecosystem members in science parks are mutually adapted and share a common destiny. Innovation ecosystems in science parks emphasize mutual competition and cooperation among enterprises rather than a “life or death” struggle through competition. The mutual competition and cooperation between enterprises can enable the entire park to expand the market space, create living environments, realize development in science parks and co-evolve enterprises. In addition, as an emerging organization and phenomenon, science parks are managed by special personnel to work to evolve enterprises in parks.

Innovation ecosystems in science parks help with and depend on innovation. Resource integration and fierce competition environment in parks are good for constant innovation in enterprises. At the same time, industry cooperation based on value chain can promote innovation diffusion and transformation and motivate the potential innovation. On the other hand, as an ecosystem, science parksdo have a life cycle and innovation is one of the dynamic factors for constant development and progress of ecosystems in science parks. If innovation is lacking, the competitive advantage will be gradually lost till innovation ecosystems are replaced by other ecosystems.

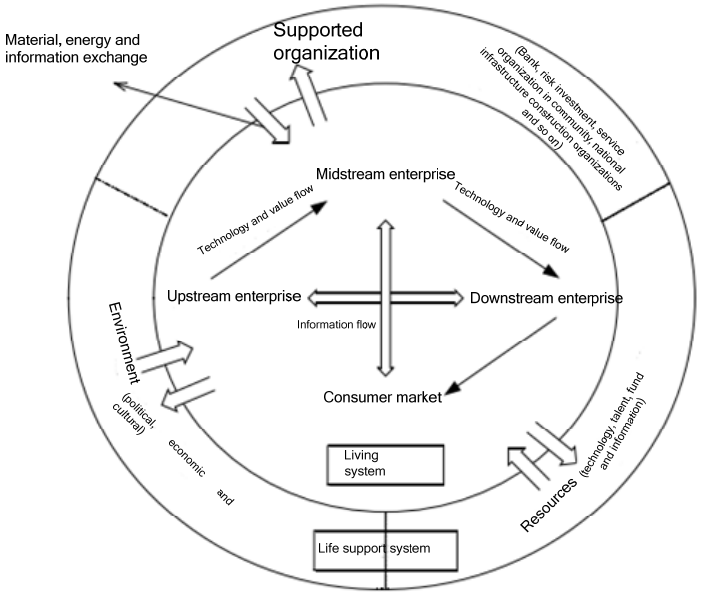

Figure 2 Diagram of Innovation Ecosystems in Science Parks

3. Experience of TusHoldings in Creating Innovation Carriers

3.1TusHoldings' Discovery of Innovation Ecosystems

TusHoldings, established in 2000, has a TusPark Development Center as a predecessor, which was established in 1994. TusHoldings is a development, construction, operation and management organization of TusPark. Guided by clustered innovation and supported by science industry, TusHoldings views science parks as entities and science and technology industry and science and technology finance as links around eight elements. These links are government, industry, university, research, finance, intermediaries, trade, and media, and are based on over 20 years of science park practice. Therefore, three-dimensional innovation ecosystems integrating "science park, science and technology industry, science and technology finance"are coordinated through development.

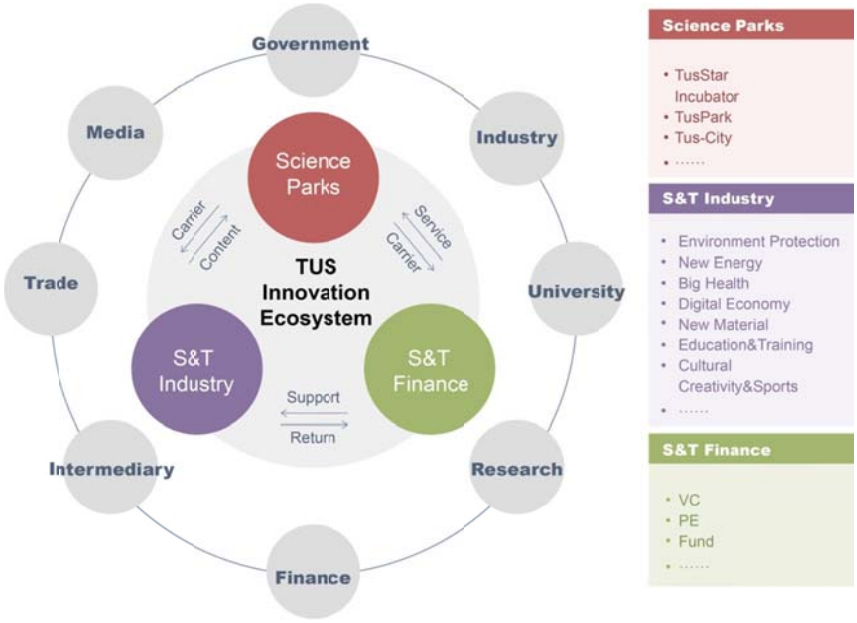

Figure 3 TusHoldings' Innovation Ecosystem

Guided by a unique innovation ecosystem, TusHoldings forms a unique development model in the science park based on the concept of a "phoenix nesting to attract a dragon". TusHoldings builds the science park, which is"nesting". "Phoenix" refers to science and technology enterprises engaging in many fields, such as health, new energy, the Internet of Things and digital technology. "Food" refers to financial instruments, such as angel investment, VC, PE of TusHoldings, merger and acquisition, parent funding and multiple funds. With "phoenix", "food" and "nest", the "dragon" will be found in the future. "Dragon" refers to the potential quality enterprises that promote local economic development. As a result, a good development model in the science park based on the approach of a"phoenix nesting to attract a dragon" is formed.

3.1.1 Elements of TusHoldings' Innovation System

There are eight innovation elements, including government (government support), industry (industry development), university (talent environment), research (research connection), finance (financial support), intermediaries (intermediary services), trade (market environment) and media (media promotion). These are summarized by TusHoldings over its 20 years of experience in operating TusPark, fostering high-tech enterprises and creating an innovative and entrepreneurial environment. TusHoldings believesthat enterprisesare the subjects of innovation and core of regional innovation. Enterprisesare the largest beneficiaries as well as direct participant and builders of innovation and the entrepreneurial environment. Mutual benefits and win-win scenarios are achieved, with innovation networksbeing formed by eight elements through complementary forces and interaction. Finally, regional innovation and entrepreneurial environments is developed.

3.1.2TusHoldings' Discovery ofApproaches for Innovation Ecosystems

A series of approaches relating to innovation ecosystems are summarized by TusHoldings during construction and operation of science parks. There is a four-pronged approach, 3D triple spiral approach, and a cluster innovation approach.

Four-gathering Approach- TusHoldings proposes four-gathering approach "congregation, polymerization, focalization and achievement" according to the exploration and practice of functions and development law in the science park to interpret the development of science park based on spatial form. This also includes element gathering, enterprise fostering and industrial development. In essence, TusHoldings has described how a series of innovative elements can generate a series of innovation effects by utilizing science parks as innovation carriers and "gathering" potential. Congregation is a physical process and refers to spatial (science park) gathering between enterprises and innovation elements.Polymerization is a chemical process. New thingsare generated by way of interaction, mutual effect and mutual communication among innovation elements. This is the essence of innovation. Focalization is to sieve and foster innovations with related service and mechanism to form enterprises with unique characteristics and competition. For example, the"Diamond Plan" launched by TusPark uses financial means to assistenterprise with proprietary intellectual property rights, fostering them to grow better and become world-class enterprises with a sense of social responsibility. Achievement, gathering to generate, gathering and focusing, gathering and changing, implying that science parksdevelop and guide the regional innovation to reach new heights. The Four-gathering approach is a dynamic evolutionary system and aims to integrate innovation elements within enterprises. Therefore, an optimized service network is established to provide all needed resources for venture enterprises while also promoting enterprises to grow ever better.

3D Triple Spiral Approach - "Government-industry-university" triple spiral approach theory is to analyze the interaction of government, industry and university in the era of knowledge economy and is an important theory for researching innovation and innovation approach. Triple spiral meanings are prolific in innovation practice under constant development. University, industry and government can be detailed and decomposed and then re-combined to derive more new spirals with different dimensions. Regarding innovation as the base point and industry as the links of the system, the 3D triple spiral approach is interweaved by "park + industry + finance", "technology + fund + industry", "government + enterprise + university" has been extracted by TusHoldings. The original"government + industry + university" approach is upgraded and developed into 3D triple spiral approach. Triple spiral approach with one dimension is upgraded into multiple dimensions. Then the 3D triple spiral system is formed. The 3D triple spiral system interacts innovation element, innovation carriers and subjects of innovation and becomes a driving factor for scientific and technological innovation and industrial upgrading.

Figure 4 TusHoldings'Innovative 3D Triple Spiral Approach

Clustering Innovation Approach - The clustering innovation approach of TusHoldings is the summary of original science park development approach and experience and also a distillation of TusHoldings and theinnovation ecosystem. The regional innovation network, including suppliers, competitors, universities, research institutions, investors and government departments, forms through clustering resources independent of the local regional advantages in the base clusters, which is TusHoldings clustering innovation. At the same time, "Internet+", big data and cloud computing technology are combined and geographic spatial boundaries that are broken by way of interaction between clusters. This achieves sharing of innovation resources and informationacross larger ranges. In addition, the industry chain and innovation chain are formed within the larger ranges. All parties involved in the innovation chain form long-term, stable and mutually beneficial relationships by sharing resources, formal

contractual relationships, or informal information communication. Finally, the “clustering cluster” innovation network and ecosystem is built and is characterized by interdependence and mutual development.

3.2 Practice of TusHoldings’ New Innovation Carriers

3.2.1 TusHoldings’ Global Innovation Service Network

TusHoldings has been involved in development, construction, operation and management of science parks since 1994. TusHoldings has successively built the global innovation service network that covers over 50 Chinese cities, such as Beijing, Shanghai, Guangzhou, Shenzhen, Hong Kong after more than 20 years of development, involving over 160 incubators, science parks and science cities in the United States, Korea, Russia and Israel. TusHoldings Science Park has the largest science park network in the world. The constructed area in the science park is 5 million square meters and the area under construction is 15 million square meters. There are more than 3,000 enterprises residing in the science park. TusHoldings global innovation network breaks throughthe boundaries of space to share and collaborate in innovation within a larger range and forms and optimizes TusHoldingsinnovation ecosystem. At the same time, TusHoldings is committed to changing from operation service provider to science service provider under an innovation and entrepreneurship ecosystem. TusHoldings has built multi-level innovation spatial system and innovation ecosystems that combine and organically link incubators, science parks and a science city through a“point, line and plane” and have actively discovered new approachesto science parks.

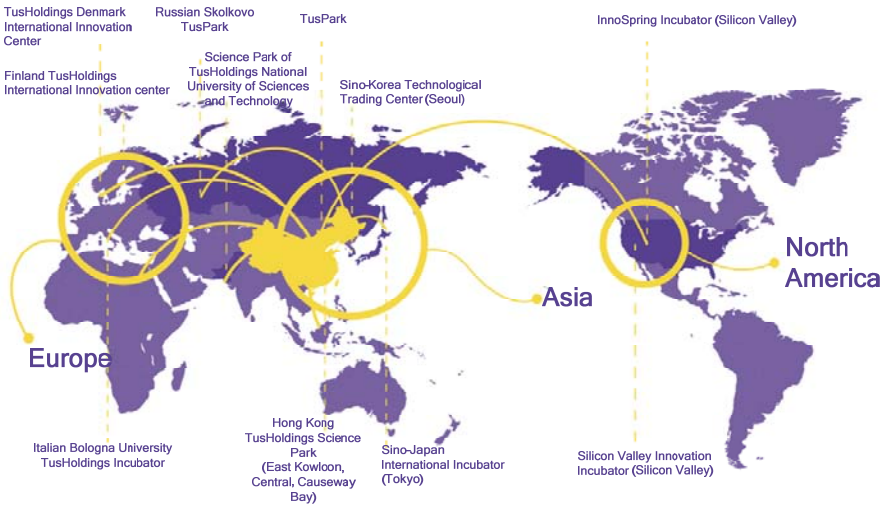

Figure 5 TusHoldings’International InnovationService Network

3.2.2 TusHoldings’ Discovery of New Approaches for Science Parks

TusHoldings has discovered a new approach tothe construction and development of science parks with a unique innovation ecosystemthrough which is achieved constant practical accumulation and exploration of various approaches. First, relying on the concept of the knowledge ecology and featuring sharing, co-building and co-governance, TusHoldings

hasbroken through geological boundaries of space and highlighted the construction of new science parks with advanced technology, networked innovation and intelligent management; second, TusHoldingshas optimized regional innovation spatial systems and strengthened multi-functional integration by applying a link between “park, community and university”. The company has committed to creating anew science city that is livable and enterprise-adaptivewith close interaction between enterprises, colleges and institutions. The company is also building new innovation spaces to meet the needsofinnovation and entrepreneurship. TusHoldings Science Park provides powerful “attraction” for industry, funding, as well astalent and other innovation elements. The clustered elements optimize the new ecosystem of entities and perfect innovation networks and have formed a self-reliant progressive science park. For example, adhering to the development concept of“clustering innovation” and the development approach of “congregation, polymerization, focalization and achievement”, TusPark has integrated the innovation resources of“government, industry, university, research, finance, intermediary, trade, media” and created an excellent science innovation and entrepreneurial environment to provide optimized value-added services for innovative science enterprises. As a result, TusPark has become a world-class university science park. TusHoldings innovation spatial network is planned and built by focusing onthis benchmarking.

3.2.3 Case Study: Kunshan TusHoldings Science Park

As a representative of TusHoldings Science Park, Kunshan TusHoldings Science Park aims to stimulate multidimensional science space and entrepreneurial environments. TusHoldings has a unique science park approach that has been fully exhibited during its development and the example of TusHoldings innovation ecosystem construction. First, government, industry and university clustering. Kunshan TusHoldings have introduce all innovation resources in Tsinghua University and Peking University, especially resources from Tsinghua alumnus resources, into Kunshan. As a second element, the “1+2+N”[2] science innovation resource network covering Beijing, Shanghai, Suzhou, Nanjing and Silicon Valley has been built to effectively expand innovation resources, clustering them in a channel to Kunshan Park. Third, the company has created a multidimensional innovation service system to provide innovation services, including business property service, science service, talent service, fund service, business promotion, technologytransformation center and an advanced manufacturing center.The fourth element is the clustering of specific industries, forming industry clusters, and developing the advanced manufacturing industry cluster involving biological medicine in Kunshan. This is being done through technology transformation, project and relevant talents and talent team introduction. In addition, an approach is being taken to transform from“Kunshan manufacturing” to “Kunshan creation” with related innovation platforms. The fifth element is fusion and radiation, with Kunshan TusHoldings Science Park having obvious achievements. This is viewed as a starting point and benchmark. TusHoldings has actively developed Nanjing TusHoldings Science City, the Qilin TusHoldings low-carbon smartindustrial park and Suzhou TusHoldings

[2] Note: “1” refers to the main park of KunshanScience Park that covers about 150000 square meters and was built in 2011; “2”refers to two large professional parks covering an area of 1000 mu--Kunshan High-tech TusHoldings Biotech Park and Kunshan High-end Equipment Manufacturing Base. “N” refers to several external innovation network nodes that establish and share innovation resources with Kunshan Science Park.

Fashion Science City, and a new generation of upgrading products and science entities in the Yangtze River Delta Region to gradually form innovation corridors in the TusHoldings Yangtze River Delta Region. At the same time, innovation services are outputted in Shanghai and Silicon Valley (Silicon Valley InnoSpring Incubator) by way of hosting and cooperation so as to optimize the TusHoldings innovation spatial network and innovation ecosystem.

4. Conclusion

Science parksare an important form of innovation space and entities. Science parksarea strategic measure for many countries and regions developing high-tech industry. They facilitate innovation capability and have become a global phenomenon. Science parks have become an important means to propel technological innovationforward, accelerate knowledge transfer, as well as promote economic development. Thus, science parksare the optimal ecosystem for innovation by enterprises and research institutions in the global knowledge economy. They are also a key junction point for research development activities and industry as well as an important source of regional and urban economic development and competition. Innovation ecosystemsare characterized by evolution, complexity, openness and ecology. They have become a new orientation within the innovation paradigm in the age of innovation globalization and new requirements and guidelines are being proposed for the construction of innovation carriers in terms of functional design, software and hardware, as well as organization management. Innovation ecosystems provide important guidance to new innovation carriers. Government functions, enterprise roles and platform modes need to be recognized within the framework of innovation ecosystems, especially when there are a series of problems and challenges for development of science parks in the era of the knowledge economy. Therefore, more and more governments, enterprises, colleges and science organizations are reviewing innovation and are conductinginnovationwithin innovation ecosystems. On the whole, science parks demonstrate the following features as new innovation carriers. First, innovation drive will be formed by innovation ecosystem as they become a core power for development of science parks. Second, there will be a focus on innovation cooperation and an emphasis on sharing of resources amongst parks and internal resources, knowledge flows and collaborative innovation. Science parks are integrated with global innovation network and combined locally. Third, with advanced hardware technology and software services, based on industry and urban integration, people-oriented integrated environments are being created to attract and cluster talent. Fourth, with an orientation from leading innovation and fostering industry, the innovation chain and industry chain are being integrated by the complementary forces of government, industry, university and research. Integration is occurring along the industry chain to create regional innovation strategic high grounds and polar nuclei. Fifth, innovation ecosystems in science parks are being maintained and optimized with long-term definite strategies, professional management teams, as well as proper operating services to promote robust and orderly development of science parks.