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**Innovation Paradigms under Internet & Big Data  
Background - Clustering Innovation**

*Plenary Session 1 :*

The impact of technology

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## Innovation Paradigms under Internet & Big Data Background - Clustering Innovation

**Abstract:** at first, the present research analyzes significant impact of all previous technological revolutions on human economic and social development, and focuses on analysis of profound change from mobile Internet, big data and other contemporary new technologies on human's work, life and social contact, and then discusses changes in human innovation paradigms in this context: from innovation paradigm 1.0 (linear paradigm), innovation paradigm 2.0 (innovation system) to innovation paradigm 3.0 (innovation ecosystem). Under innovation paradigm 3.0, clustering innovation appears as a new innovation model, and it further analyzes how to conduct innovation of clustering under the background of the Internet + and big data, by taking incubators, science parks and technology innovation platform networks as examples.

### I. Impacts of previous technological revolutions worldwide on human innovation

All previous technological revolutions have made revolutionary impacts on human production and living activities along the history of human development. In the first one million years of human history, economic and social development remained very slow. Since the Industrial Revolution, per capita GDP has risen sharply and experienced exponential growth. It is simply summarized that the wealth generated during more than one million years before the Industrial Revolution only accounts for about 3%, and 97% of the total wealth is created during the recent 250 years. The technical development & innovation is an important reason for promoting the exponential economic growth over the recent 250 years.

The first technological revolution was triggered by invention of steam engine, led mankind to enter into the age of steam, and replaced manual workshop with factory system. The second technological revolution, originated in Germany from 1870s to the early 20th Century, further promoted development of heavy industry and emergence of highly developed industrial production and mining economic zones in some developed countries, such as Northeast America, the central and southeast region in England, Germany's Ruhr region, Russia's central and southern industrial zones; compared with the previous two technological revolution, the third technological revolution is characterized by unprecedentedly fast transformation from science and technology into productivity. Technological advancement has become the driving force for increasing labor productivity and overall economic growth; based on the application of information technology, the fourth technological revolution has made the information industry develop into the world's most rapidly developing new industry. Currently, the Internet, big data and other new generation of information technologies are promoting the development of productivity with unprecedented influence, and therefore a global and comprehensive industrial revolution is coming.

### II. Impacts of development of Internet and big data on technological innovation

#### 2.1 Unprecedented progress of the Internet development and arrival of mobile Internet era

In 2014, the global number of Internet users was up to 3 billion and the Chinese Internet users were 838 million (or 28%). In 2014 Internet penetration Top 5 countries were listed as follows: China, the United States, Japan, Brazil and Russia. Internet penetration was more than 45 percent in all of the five countries. There were 2.7 billion mobile Internet users worldwide, including 557 million Chinese mobile Internet users, accounting for 20%. It is shown from the 35th Statistical Report on Internet Development in China by CNNIC:

as of December 2014, the number of mobile Internet users increased by 56.72 million in China. Compared with 81.0 percent in 2013, the proportion of mobile-type Internet users increased to 85.8 percent.

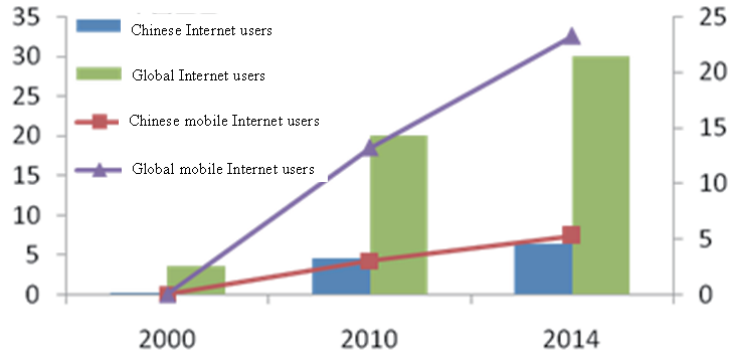


Figure 1 Overview of global Internet development

In the mobile Internet era, a user may obtain what she/he wants within an hour, such as taxi service, meals, cooking spices, groceries, document express delivery and postal service; everything can be ordered via the Internet. As of December 2014, China's online shopping users reached 361 million, increased by 59.53 million over the end of 2013, at an increase rate of 19.7%; meanwhile, the ratio of Internet online shopping users in China increased from 48.9% to 55.7%.






Past					
↓	Dull life Step-by-step	Cable television Cinema	Shopping Small radius circle	School Buying books in bookstore	Handwritten records Paper-based management
	Online communication More Entertainment	Online selection Single items	Online selection Single items	Search queries Find books	Standalone system Single management
	Colorful Life Rich program	Shopping within home	Shopping within home	Online courses Video teaching	Electronic medical record Management hospital-wide
Now	Mobile devices Obtain what you want	Fingertips Mobile shopping	Fingertips Mobile shopping	Mobile learning anytime	Telemedicine Home delivery of medicine

Table 1 Internet + changes the lives

Internet, especially the rapid development of mobile Internet, promotes exponential growth of human data. The amount of data generated over the last two years accounts for 90% of the data sum over the human history. The amount of data generated over a recent day is equivalent to the sum of data generated from beginning of human civilization to 2003. Now the total amount of human data is doubled every two years. Such exponential effects have changed people's production and life style radically, and made innovation & overturn become norm.

## **2.2 Reconstruction of traditional industries with “Internet +”**

“Internet +” not only integrates the Internet to a certain traditional industry, but also combines with ubiquitous big data, cloud computing, new knowledge, promoting innovation and upgrading of traditional industries, and also changing people's work and life style, further changing their perception and thinking way.

It is a local phenomenon that traditional Internet transforms a traditional industry. As the Internet company's platform becomes matured in the recent years, the Internet + traditional industries will present more complete integrated solutions and one-stop connectivity, so as to change innovation mode from dispersed to cluster-based, which specifically reflects in the great influence from the Internet and big data on traditional enterprises, regardless of R & D, production and sales, post-sales service. Multi-hierarchy center system production will be out of date. Differential advantage from information asymmetry will be no longer in existence.

Internet's biggest innovation is to connect among people, and it has the function of self-evolution, when all production information and data are fully linked, the entire system can develop forward in an automatic manner. For example, in the film industry, traditional rendering speed for a 2-hour movie may be six months. Render cloud platform, which is established by Alibaba Cloud, only spends less than a week on completion of the work, and saves cost by 40%. Through this cloud self-service platform, film teams from different countries are enabled to work together to produce a movie with Internet-based tools, using decentralized social coordination method.

## **2.3 Change in innovation paradigm arising from the Internet and big data, and arrival of public innovation era**

In 2013, “Embrace Innovation 3.0” by Harvard Business Review concluded the evolution features of business innovation paradigm, and proposed the evolution route of innovative model: From Business Innovation 1.0 phase (Closed Innovation, innovation sources from the enterprise), to 2.0 phase (open innovation, namely “non-local invention”, innovation sources outside enterprise are widely available), and then to 3.0 phase (embedded / symbiotic innovation, innovation behavior is more based on resource integration and symbiosis development) .

Innovation 1.0 (Closed Innovation) focuses on establishment of R & D institutions within company for independent research and development. The driving force of innovation is “double helix”: both needs and research. In a given supply & demand relation (existing market), the innovation 1.0 enhances supply capacity of manufacturers, highlights price competitiveness, cost performance, speed of delivery or service system of products or services. The innovation 2.0 aims at consumer demand, and helps manufacturers create new consumer demand or explore out potential consumer demand by changing the supply & demand method. Acquisition integration, strategic alliances, industry clusters are innovative means in supply. Open innovation emphasizes collaboration between research, predictions and educational institutions, as well as “triple helix”: government, business, universities & research institutes.

Innovation 3.0, namely embedded / symbiotic innovation, aims to further reflect “symbiotic” relationship

between research, predictions and educational institutions, as well as the “four helix”: government, business, universities & research institutes, and users. Due to the rise of prosumer and four-helix community ecological innovation, company’s core competitive advantage has sourced from the “Prosumer” fan communities, stakeholder communities, practice communities, as well as innovation ecosystems established by scientific community. Innovation ecosystem is an open, multi-dimensional, and complex co-evolution network structure, which is composed of a variety of intertwined different subjects. Each innovation ecosystem is an open ecosystem, and also a dynamical system that exchanges resources with the society and continues to adjust internally, so as to acquire features and functions that it didn’t have previously.

	Innovation paradigm 1.0	Innovation paradigm 2.0	Innovation paradigm 3.0
<b>Theoretical Foundation</b>	Neoclassical economic theory and endogenous growth theory	National innovation system	Evolutionary economics and its new development
<b>Innovative subject (relations)</b>	Emphasis on corporate internal innovation	Collaboration between research, production and education	“Symbiotic” ecosystem between research, production and education
<b>Innovative strategy</b>	Independent research and development	R & D cooperation	Creative design and customer relationships
<b>Value realization carrier</b>	Product	Services + Products	Experience + service + product
<b>Innovation driving mode</b>	Demand + research	Government + enterprise + educational institution Demand +research+ competition	Government + enterprise + educational institution + users Demand + research + competition + symbiosis
	“Double helix”	“Triple helix”	“Four-helix”
<b>Innovation Paradigm</b>	Linear paradigm	Innovation system	Innovation ecosystem

Table 2. Comparison of three generations of innovation paradigms

### III. How to promote clustering innovation - “Internet +” innovation

#### 3.1 What is clustering innovation?

Clustering innovation aims to respond to user innovation, mass innovation, open innovation trends under innovation 3.0, optimize and combine the same or related industries that are relatively clustered in a particular region, so as to give full play of the cluster effect, achieve stronger industry competitive advantage and create more social wealth. Silicon Valley, North Carolina Triangle Science Park, TusPark are all well-known as innovation clusters.

### 3.2 Main features of clustering innovation

Clustering innovation holds the following major characteristics: (1) mutual symbiosis: related sectors are closely integrated and functionally complementary to achieve broader space for survival and development; (2) resource sharing: because of clustering, companies within the cluster are more likely to achieve resource and information sharing; (3) collaborative competition. Both collaboration and competition co-exist among companies within the same clustering system; (4) local network: an invisible network, which is composed of enterprises, research institutes, governmental departments and financial institutions and other entities within the clustering system, provides convenient traffic and cultural communication approaches for resource sharing, new knowledge creation and communication.

Compared to the traditional innovation model, clustering innovation has four core strengths: the first is innovation ecosystem advantage: under innovation 3.0 era, a variety of innovative elements are gathered together to form a symbiotic relationship and an innovation ecosystem, which is more conducive to generating new ideas, technology, and mode; the second is the industrial chain advantage: when related companies gather as a cluster, a stable “demand-supply” relationship will be established, which is more conducive to integration of business resources, cooperation and win-win; the third is social network and cultural strength: An invisible network, which is composed of enterprises, research institutes, governmental departments and financial institutions and other entities within the clustering system, provides convenient approaches for resource sharing, new knowledge creation and communication. The fourth is brand strength: the development of innovative clusters generates a resultant force to build the brand image, which is more conducive to gathering advantaged resources and further promoting upgrade of innovation clustering to high-end.

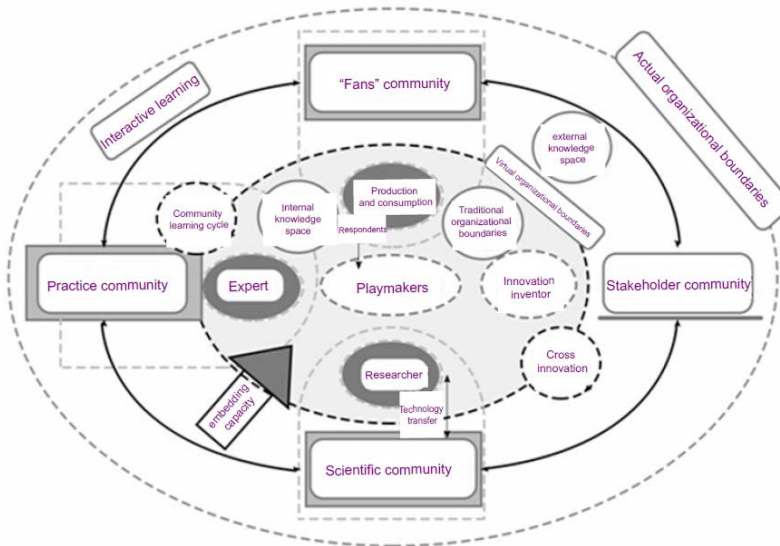


Figure 2 Enterprise Innovation 3.0 - Embedded / Symbiotic Innovation

In the industrial age, innovation is performed through traditional laboratory or closed organizational structure. Currently, a lot of personalized innovation models have appeared, such as maker or geek in the context of Internet and big data, the public innovation has been coming, where the subjects are transformed from elite to the public and “grassroots” group. Witkey and maker become the main force, and innovation becomes user experience-oriented. More new technologies and models are used as innovation support, such as big data, open source, IOT, crowd funding & crowd sourcing, mobile Internet and so on. Innovation organization is

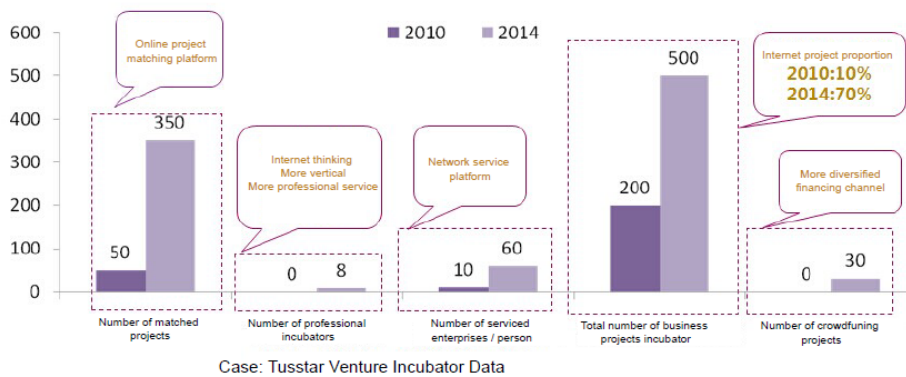
reflected in the form of organizational and personal “social innovation ecological community”, thus becoming more programmable and networked.

#### IV. Case studies

##### 4.1 Internet + Incubator

Internet + incubator is the most representative form in clustering innovation. A large number of university science and technology parks (such as TusPark) and a lot of incubators (such as TusStar) have established local innovative service system in this large system. For example, TusPark’s GAFF mode (gathering, aggregation, focus, and fusion), as well as TusStar’s “incubation + investment” model aim to integrate advantaged innovative resources and supporting power within a region to help small-sized technology companies or innovative companies grow rapidly.

The version 1.0 of TusStar incubator provides more physical space, such as policy support by local governments on entrance of high-tech enterprises. the version 2.0 runs under “incubation + investment” model, not only providing venue, relatively inexpensive rentals and other services, and also, most importantly, combining the interests of incubated business and incubator operator closely through investment, thus helping technology companies grow. The version 3.0 is the Internet + incubator. The incubator features will be subject to new changes, and gradually get rid of the restrictions on physical space. Via the Internet + model, more service is provided online or with virtual and open incubators. This is the incubator’s features in the era of the Internet +.



##### 4.2 Internet + Technology Park

Traditional science park’s main duty is to promote investment, but the Internet + technology park is based on the Internet connection. More duties are to innovate and interact for clustering effects. The core work of Internet + Technology Park is to integrate resources and create an interconnected and interworked “innovation ecosystem”. Taking “platform + content + terminal + application” as support, it creates a large number of market and cooperation opportunities, thus derives new products and business models.

The park is operated and managed under the support of big data and the Internet, thus achieving transformation and upgrading, providing intelligent business and intelligent park service. Such services is more accurate and can be integrated with enterprise big data and business needs.

The key technologies of smart business, smart park and smart city are “Perception” “Network”, “Cloud” and so on. UNIS, a company controlled by TusHoldings, developed the world’s first cloud computer, which was available in big data operation. UNIS smart city program has the following four characteristics: (1)

comprehensive IOT: sensors throughout various fields in city are capable to measure, monitor and analyze the city's core systems, providing comprehensive sensing information; (2) innovative applications of technology and services are performed on the basis of government, enterprise and individual needs, thus providing power and support for development; (3) full integration: "IOT" and the Internet system are fully connected and integrated, thereby information is fully shared in various fields; (4) collaborative operation: depending on smart-based infrastructure and innovative applications, the city's various key systems and participants collaborate in a harmonious and efficient manner to maximize the city's running effects.

	Traditional Technology Park	Internet + Technology Park
P a r k Investment promotion	People-oriented investment promotion model is operated with a large number of investment promotion staffs	Connect multiple investment promotion platform using the Internet, for wider coverage with fewer staffing
P a r k management	Property management services, administrative services, business information investigation services are independent and not uniform, or any of such service is missing. It is often difficult to perform corporate information investigation	Wifi and integrated park management platform, covering the whole park, integrate park property services, administrative services, business information, and other sub-platforms
Enterprise publicity	Mainly static promotion means, such as display panels, exhibition and other forms	Dynamic publicity means based on the new media technology, such as real-time promotion with better display effect
Interactive Management	Matchmaking or on-site visit, time-consuming, insufficient information	Park managers, enterprises, universities, research institutions and government, interact and exchange fully through the network platform, with less time consumed
Supporting services	Get the appropriate service mainly via telephone or in traditional offline manner	Park catering, entertainment, recreation, shopping and other information can be shared online, such as Wechat ordering or shopping at any time.

### 4.3 Networked Technology Innovation Platform

Through the Internet and big data technology, each independent innovation node can be organically linked to form a network of innovative platforms. Clustering innovation has become an "trigger" of sustained regional economic growth: it is available to establish (or embed) driving-type industry and promote the development of other industries in the region through the "multiplier effect", thus contributing to economic growth in other surrounding regions.

TUS-CITY is a network-based innovation platform. The TUS-CITY integrates "park, campus, and community", combines industrial function into city function, so as to build a regional innovation ecosystem. By providing opportunities of employment, it promotes the transfer of rural population, and drives innovation to optimize and upgrade regional infrastructure and industrial structure; the City brings technological innovation resources, absorbs high-tech enterprises and technology finance institution, introduces innovation training and technology innovation services. Therefore, almost every place is not only the most important center for innovation and entrepreneurship, but also the most active area in the region.