UNIVERSITY OF TAMPERE
School of Management
Higher Education Administration

How Innovation Intermediaries between University and Business Promote Students' Start-up in Beijing: Policy and Practice

Master in Research and Innovation in Higher Education (MaRIHE), a joint programme provided by the Danube University Krems (Austria), University of Tampere (Finland), and Osnabrück University of Applied Sciences (Germany)

Master's Thesis
June 2014
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Table of Contents

Abstract

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Title of Thesis:	How Innovation Intermediaries between University and Business Promote Student's Start-up in Beijing: Policy and Practice
Master's Thesis:	pages , 2 Appendices
Time:	June 2014
Keywords:	open innovation, innovation intermediaries, students' start-up, Beijing, China

China is under the transformation from manufacturing-oriented to innovation-oriented country. Reforms in national and regional innovation call for effective solutions. The massification in higher education sector leads to employment pressure in labor market. Thus, government encourages students' entrepreneurial activities. In order to solve the problem of mismatching between university education and entrepreneurial skills, this study explores one type of innovation intermediaries – Zhongguancun University Graduates Innovation Entrepreneurship Employment Promotion Association (Z-park for Graduates) – promote students entrepreneurship, especially start-ups with jointly efforts from university and business in Beijing, China. It is to discuss under the context of open innovation environment. The merits of closed innovation and open innovation are discussed as well as the driving force of the shifting from closed innovation to open innovation. University and business, as two of the main open innovation actors are discussed of the motivation and barriers.

Following the demands of facilitation to reduce barrier in university-business cooperation, innovation intermediaries (IIMs) is introduced. For the purpose of identifying the contribution of Z-park for Graduates in promoting entrepreneurship in college students, the typology and function of innovation intermediaries are discussed to locate Z-park for Graduate. The literature review is done to discuss different approaches to categorize innovation intermediaries.

The typology of innovation intermediaries between university and business is categorized as university-oriented IIMs, open innovation joint efforts, and business-oriented IIMs. In this way, it is intend to look at the effort devoted by university and business respectively and jointly to bridge university-business cooperation, to offer facilitation for students entrepreneurs, to nurture entrepreneurial awareness in college students.

The function of innovation intermediaries as learning infrastructure is discussed from the angle of knowledge transformation. Scharmer's framework is adopted, to explain the role of innovation intermediaries in the knowledge transformation process. There are three types of learning infrastructure to assist three types of knowledge transformation. The function of Z-park for Graduates is identified as facilitation of knowledge transformation across sectors.

Table of Figures

Table of Tables

1. Introduction

1.1 Research Problem

The higher education massification leads to large amount of increase in university graduates (Hua, Li, and Ren, 2012). The unemployment of university students has become a prominent social problem in China. The growing number of university graduates has created tremendous pressure in labor market. The graduates have reached nearly 700 million in 2013, 190,000 graduates more than 2012. Because of the difficulty in finding a job, start-up business has become the forth option for students besides finding job, continuing study, and study abroad. However, due to a skill mismatch between university and business, the Chinese university students have relatively low intention in entrepreneurship, the survival rate of students' start-up remain low (Hua, Li, and Ren, 2012). Facing abovementioned problem, government encourages students Start-up Company as one way to solve the employment issues. Start up is an organization formed to search for a repeatable and scalable business model (Blank, 2006). This study focuses on start-ups that initiated and managed by university graduate students.

In the national policy "Long-term Science and Technology Development Plan (2006-2020)", high technology is the key area to enhance national and regional innovation capacity. Beijing, as the capital city of China, possesses rich resource in technology development, such as Zhongguancun National Demonstration Zone, widely known as the China "Silicon Valley". It is also one of the important cities to implement new initiatives. Therefore, facing the employment pressure of university graduates, central and local government, universities, and business have started a non for-profit organization called "Zhongguancun University Graduates Innovation Entrepreneurship Employment Promotion Association" as a joint effort to promote entrepreneurship in students. There has not yet research been done in finding what facilitation of this organization has for students entrepreneurship and the affects on university business relation. Therefore, this research is going to identify the type and function of this organization in open innovation environment.

There are a mismatching in Chinese university education and entrepreneurial skills for business practice. University does contribute in encouraging entrepreneurial attitude. The contribution can be found in many ways, such student entrepreneurs establish initial willing together for start-up business through studying the same major or different major, or through university hold entrepreneurial competition. The university education provides the foundation for student' entrepreneurship. However, the down side of university entrepreneurial education is less adaptation of market because of lack of communication between university and business.

The communication barriers exist among three parties, namely students, university, and business, to solely provide available the options for students to encompass the vast range of possible entrepreneurial activities. Students with new ideas to for business usually have trouble to implement due to lack of entrepreneurial knowledge, skills, channels, resource, and network. University has trouble to keep up pace with business due to its long research cycle and basic research focus. Business needs fast solution for market while the demands is difficult to be fulfilled by university due to the same reason.

Open innovation provides a solution for this gap. Open innovation has become a widely accepted concept in the changing knowledge paradigm nowadays. It is defined by Chesbrough as an innovation paradigm under which ideas can emerge both inside and outside an organization and have parallel paths to market (Chesbrough, 2003). Chesbrough has coined the concept of open innovation and has made the groundbreaking research on the shifting process from close innovation paradigm to open innovation paradigm. The difference between invention and innovation require close relation between innovation and market. The innovation on innovation is to upgrade the

approach of innovation faster in innovation cycle and wider in participants. One prominent characteristic of close innovation is exclusiveness. It is discussed by Chesbrough as in the "strong self-reliance" in research and development (R&D) covering the whole process from original idea to market occupation, intellectual property right, and so on. The main contribution to distinguish two paradigms is to show us the way to maximize the utilization of innovation ideas. This is also the main difference between two paradigms. Two approaches can rule out ideas that is "false positive" but open innovation can save "false negative" by sharing those idea through the permeable organization boundaries. In doing so, "false negative" in this organization might turn out to be right idea for other companies. There are three key actors in the open innovation paradigm: Industry, Government, and University. Among which, it is worth discussing the respective contribution that industry, government and university make to the breaking down of the innovation isolation.

Because of the mismatching between university education and entrepreneurial skills, university and business need to increase cooperation. The way of industry-university cooperation is generalized by Chesbrough based on real case analysis from the perspective of firms into three types (Chesbrough, 2003).
Firstly, is to provide hardware and software resource to university by:
1> donating in equipment or services to an individual faculty member within individual research centers;
2> financing a graduate students' tuition fee;
3> giving lecture in university;

Secondly, is to integrate into university technology research by:
1> training future experts in university using some of the company's technology;
2> helping faculty member in learning company' technology, to follow what the research does with the technology;
3> being a member of the industry advisory board of one of these centers;

Thirdly, is to increase personnel exchange with university by:
1> inviting students to do class projects at the company;
2> provide visit opportunities for teachers and students to the company during summer for experience sharing, etc.

University is not only a knowledge base, but also the provider of student talents in starting new companies. Because each entrepreneurial project has specific scope, the limited resource in university does not allow implementing all of them. This leads to the question of how to promote entrepreneurship in students more efficiently. Because of the different specialty area in university and business mentioned above, both parties needs offer the answer together. Therefore, open innovation becomes one important mechanism to promote students entrepreneurship. Open innovation is to combine internal and external ideas and resources as well as outer pathways to market in the innovation development (Jovanovic et al, 2014).

It has been approved in other research that open innovation has direct positive effect on small and medium enterprises (SMEs), which includes students' enterprises (Yun et al, 2012). In this open innovation business model, the students' capabilities gained in open innovation environment to start business is contrast to the fear of failure when starting up a business (GEM, 2013). First of all, open innovation allows firms to acquire new ideas from business, university, customers, information networks and so on.

Second, the range of practitioners is extended from university to business and government. University teachers are no long the only source to spread entrepreneurial knowledge.

Entrepreneurial coach from business world can take part in the process of knowledge distribute. The form of knowledge exchanged between university and business will be discussed in theoretical framework of knowledge transformation in Chapter x.

Third, with the increasing entrepreneurial training coach in knowledge diffusion, it increases the entrepreneurial training opportunities in general, so as to increase support for entrepreneurial activities and new business opportunities. The cognition of open innovation in leadership of firm directly affect whether or not a firm can adapt quickly into open innovation environment (Yun et al, 2012). Therefore, the proactive attitude toward open innovation is one way for students to increase entrepreneurial awareness.

Fourth, in the open innovation environment, student business ideas can be scaled to suit market demands of local region. It provides a friendly environment for students. Not only other companies can adopt students' business ideas, students' start-up itself can take into other ideas to innovate their own firm (Jovanovic et al, 2014).

Open innovation provides mutual beneficial for students, university and business. Student entrepreneurship can related to real practice with guidance that start-up survival rate could be increased. For university, student entrepreneurship is an important channel for technology transfer beside others, such as university technology transfer office, university science park, and university spin-off company. For business, the utilization of fresh ideas coming from students is a way to adopt external ideas in open innovation environment. At the same time, it is also a way to establish network with university. More importantly, company innovation ideas that are not suitable to conduct internally due to funding or strategic consideration can be developed in start-ups, since it is relatively low cost and low risk.

However, because of the idiosyncratic obstacles in university and business, cross sector cooperation between these two is not easy. The increasing complexity in innovation paradigm is created by more participants and more permeable inbound and outbound channels between organization boundaries (Chesbrough, 2003). To build up better cooperation relation and clear out obstacles, innovation intermediaries (IIMs) emerge as a type of indispensable organization to assist the open innovation collaboration. Innovation intermediaries are "an organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations." (Howells, 2006, p. 720).

In this study, the innovation intermediaries are to bridge two different sectors, university and business. According to the four components in entrepreneurial education, "taught component", "business-planning component", "interaction with action component" and "university support component", innovation intermediaries can contribute in three of them. In the "taught component", entrepreneurial knowledge is delivered in the form of course or training. In order to design a good entrepreneurial course, innovation intermediaries can function as a platform to combine knowledge from university and business. In the "business-planning component", innovation intermediaries can provide students with business related information consultancy or provide guidance in business planning. In the "interaction with action component", students entrepreneurs can benefit from the wider network in innovation intermediaries through practitioner's talk or networking events.

1.2 Academic Gap and Research Purpose

To solve the mismatching, university, students, and business need to devote effort jointly. There are plenty of researches have been done on the main actors – university, industry, and government – in the field of industry-university cooperation in open innovation (European Commission, 2009; D'Costa, 2006; Reinhard, Osburg, and Townsend, 2007; UIIN, 2013), in different country context in Europe and Asia (European Commission, 2009; D'Costa, 2006, Jiang, Harayama, and Abe, 2006), in national innovation system and regional/local innovation system (Jiang, Harayama, and Abe, 2006). However, seldom has done to explore the role of innovation intermediaries in industry-university cooperation.

It is important to locate "Zhongguancun University Graduates Innovation Entrepreneurship Employment Promotion Association" (Hereinafter refers to as Z-park for Graduates) in open innovation environment. As an innovation intermediary agency, research has not been done on what type of innovation intermediaries Z-park for Graduates is and what the role of Z-park for Graduates is in the innovation process.

The research question in this study is:

How does Z-park for Graduates promote students' start-up in Beijing China?

The research question can break down into two sub-questions:

1. What type of innovation intermediary agency Z-park for Graduates is?

2. How does Z-park for Graduates facilitate innovation between university and business?

In order to answer the research questions, this study is structured as follow:

The Chapter 3 reviews literatures on open innovation, industry-university cooperation, and intermediaries. This is to serve the purpose to clarify the definition of IIMs and the type of IIMs. Through categorizing typology, it tends to specify the effort devotes by university and business in IIMs to promote students' start-up.

The Chapter 4 explores how IIMs facilitate innovation. As open innovation requires the knowledge exchange between organizations and across sectors, the knowledge exchange is no longer limited on explicit level but lay more emphasis on tacit knowledge. To analyze the function of IIMs, one theory from Scharmer's research – learning infrastructure (Scharmer, 2000) – is adopted: there are three learning infrastructures for three level of knowledge in open innovation. However, this theory has never been employed to explain IIMs as learning infrastructure to facilitate knowledge transformation between university and business.

Scharmer's learning infrastructure theory is built upon three other theories: Polanyi's study on explicit and tacit knowledge, Nonaka's knowledge spiral model, and Scharmer's theory U. To **support** the learning infrastructure framework of IIMs, these three theories are reviewed to build the background foundation for the learning infrastructure framework.

The Chapter 5 explores IIMs in the context of China. A systematic review is done on open innovation in China, IIMs in China, the relations between students' start-up and IIMs in China. The argument is supported by updated statistics and national policies review related to innovation and IIMs.

The Chapter 6 presents a case study on the "Beijing Zhongguancun National Demonstration Zone for Graduate Students' employability, innovation, and entrepreneurship (hereinafter referred to as

Z-park for Graduates)". In this case study, the type and function of Z-park for Graduate are explained in details based on previous discussion.

The general working process is as below.

Extensive literature review will be done to form the knowledge base of two approaches. In the first practical approach, literature will review the shifting innovation model from close innovation to open innovation, review the emerging concept of innovation intermediaries when facing the new demands from knowledge economy and high speed technology development.

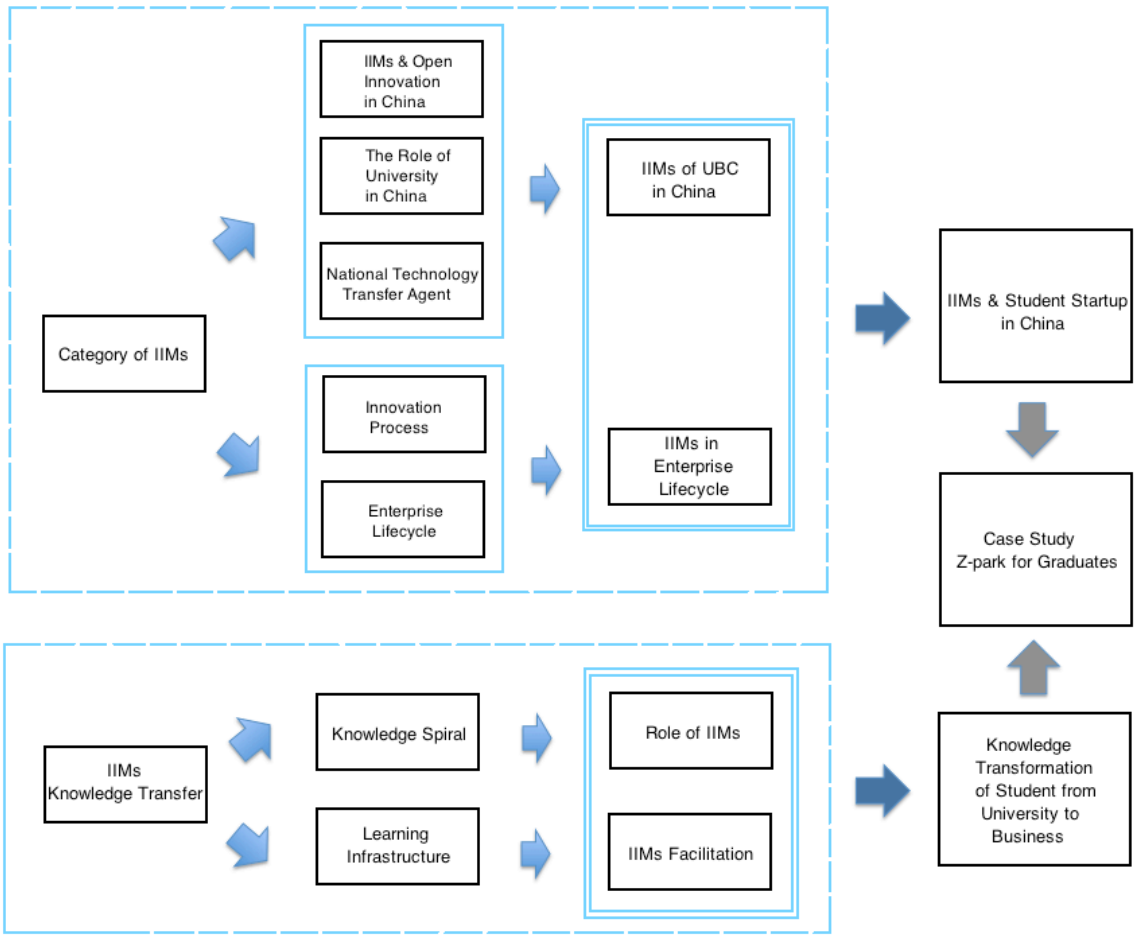
After paving for the broader picture, close look will be on innovation intermediaries in China. To achieve this goal, literature will review on innovation intermediaries and open innovation in China, the role of university in national innovation system, and national initiatives in building up technology transfer infrastructures. By examining different category methods of innovation intermediaries and combining with Chinese country characteristics, the typology is formed for the innovation intermediaries in industry-business cooperation in China.

At the same time, literature will review on innovation process and enterprise lifecycle, to specify the role of innovation intermediaries in the early stage of company lifecycle. Combined with the innovation intermediaries' typology, the research is narrowed down to analyze the support on university graduates' start-up from different types of innovation intermediaries in China.

For the second approach in theoretical framework building, literature review is the main method to explore knowledge type, knowledge creation, knowledge transfer, and common understanding in innovation partnership.

Case study is the method to examine successful practices related to innovation intermediaries. Interviews have been done with Demola (Finnish regional open innovation platform), Design Factory (Aalto Univeristy platform to combine expertise in the field of product development, media and services), Zhangguancun University Graduates Innovation Entrepreneurship Employment Promotion Association (Z-Park for Graduates) (the newly founded non-for profit association aiming at enhancing graduates' employability and facilitating students' start-up companies).

Figure 1 Study Workflow



1.3 Significance of the Study

Because currently there is a lack of literature in identifying innovation intermediaries between university and business for students start-up, it is important to point out here that the main purpose of this study is not focus on analyzing the case study, but more intent to build up a framework by clarifying the typology and functions as a contribution to the foundation for future large-scale empirical studies on this type of innovation intermediary. However, a meaningful research study needs to locate in a specific context. Thus, the case study as well as the related innovation background in Beijing, China is indispensable in this study to associate this framework with reality. This arrangement also takes into consideration of the distance between Finland, where this study is conducted, and China, which is the context of this study locates, that the first hand data is hard to collect on large scale.

This study is significant in a number of ways. It has theoretical and practical contributions.

1. Theoretical Contribution
Based on Polanyi's categorization on two types of knowledge: explicit knowledge and tacit knowledge (Polanyi, 1966), Nonaka explores the knowledge conversion process between these two knowledge (Nonaka, 1991, 1994). Based on the four stages of knowledge conversion, the role of innovation intermediaries is discussed in knowledge creation process.

Furthermore, Nonaka establishes a knowledge spiral model to explain intraorganizational and interorganizational knowledge sharing and accumulating (Nonaka, 1991, 1994). A self-organizing team within and cross company functions as a common ground for mutual communication. The concept of "Ba" is raised by Nonaka (Nonaka, Toyama, Konno, 2000). It is a shared context in motion, in which knowledge is shared, created and utilized. The relation of innovation intermediaries in this context is explored.

Based on previous research, Scharmer further specified the type of knowledge in tacit knowledge into tacit knowledge embodied and not-yet embodied tacit knowledge, which the latter is also called self-transcending knowledge. Based on this knowledge typology, three kinds of learning infrastructures are developed by Scharmer to facilitate the creation of three types knowledge (Scharmer, 2001, 2009). Innovation intermediaries, as one type of learning infrastructure, is discussed to facilitate knowledge creation process.

A model of innovation intermediaries as learning infrastructure in knowledge creation is built based on Nonaka's knowledge spiral model and Scharmer's three types of learning infrastructure.

2. Practical Contribution
The type of innovation intermediaries is explored to link both university and business into open innovation. It is aiming to clarify innovation intermediaries' function at the early stage in company lifecycle by looking at the role of innovation intermediaries in facilitating start-ups.

Under the context of China, large amount of university graduates are facing unemployment pressure. Government is taking effort to enhance students' employability by encouraging graduates to start their own business. This study tends to review and address the possible benefits that are offered by innovation intermediaries in the context of China.

1.4 Definition

Innovation: (Nonaka, 1994, p. 14, from organizational level) innovation is a process in which the organization creates and defines problems and then actively develops new knowledge to solve them.

Open innovation paradigm: An innovation paradigm under which ideas can emerge both inside and outside an organization and have parallel paths to market. (Chesbrough 2003a, p. 43)

Closed innovation paradigm: Traditional approach to innovation, where ideas have only one path to market. (Chesbrough 2003a, p. 30)

Knowledge: Justified true belief. (Nonaka, 1994), seen as in the dynamic human process of justifying personal beliefs as part of an aspiration for the truth.

Knowledge conversion: interaction between explicit and tacit knowledge.

Knowledge management: KM is about developing systems and processes that leverage information and knowledge in an organisation to promote originality, creativity, intelligence and learning (Pels and Odhiambo, 2005, p. 5).

Explicit knowledge: Knowledge that can be codified and therefore is relatively easy

to communicate, process, store and transfer over the distances. (Nonaka, Toyama, and Konno, 2000)

Tacit knowledge (embodied knoweldge): Knowledge that is personal and difficult to formalize, making it hard to transfer. (Nonaka, Toyama, and Konno, . 2000)

Self-transcending knowledge (Not-yet-embodied knowledge): such as inspiration in action or intuition in action. (Scharmer, 2009)

Information: a flow of message or meanings which might add to, restructure or change knowledge. (Machlup, 1983)

Innovation Intermediaries (IIMs): An organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties. (Howells)

Innovation Intermediaries (IIMs) **of University Business Cooperation** (UBC): An organization or body that acts an agent or broker in any aspect of the innovation process between university and business.

Intellectual Property: refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce. Types of intellectual property include copyright, patents, trademarks, industrial design, geographical indications, and so on. (WIPO, 2014. cite info. in framework)

Organization: collective action for a common purpose; organizational structure is the "sum total of the ways in which its labor is divided into distinct tasks and then its coordination is achieved among these tasks" (Scharmer, 2009)

Ba: a shared context in motion, in which knowledge is shared, created and utilised. Platform for knowedge conversion, space for self-transcendence, multi-context place (Nonaka, Toyama, and Konno, 2000)

Redundancy: the conscious overlapping of company information, business activities, managerial responsibility within an organization create a 'common cognitive ground' to facilitate the transfer of tacit knowledge.

2. Methodology

The thesis aims to examine the emerging phenomenon of innovation intermediaries in facilitating industry-university cooperation in the open innovation paradigm in China, by looking at the process of innovation, at the key actors and their interactions, as well as at the role of innovation intermediaries in this development. It also aims to investigate how innovation intermediaries help with university graduates start-up companies in Beijing regional level, against the backdrop of knowledge economy and increasing interests from university to cooperate with local innovation actors.

Because this study is done in Finland during limited time, it is difficult to collect first hand data by conducting large scale of questionnaire or survey. Therefore, this study chooses the direction of qualitative methodology based on existing literature and individual interview. The research methods employed in this study include literature review, secondary statistic analysis and interview to form a qualitative analytical approach. Among which, literature review is the main method to identify research problem and to build up theoretical framework, while the data to support case study is collected through interview of Z-park for Graduates.

The literature review is done on two resources: academic publication and national/regional policies. The method of literature review is used to build up knowledge foundation from four aspects. First, literature is reviewed on open innovation, including the closed innovation, the driving force for shifting closed innovation to open innovation, and university business cooperation in the context of open innovation.

Second, literature is reviewed on innovation intermediaries. As the open innovation encourage cross sector collaboration, IIMs play more and more important role in bridging, networking, matching actors from different sectors. This part is consisted of previous literature on defining IIMs, the functions of IIMs, the feature of start-up in company lifecycle, and the function of IIMs for start-up companies.

Third, literature is reviewed on innovation intermediaries as learning infrastructures in knowledge transformation. Because Scharmer's learning infrastructure theory is built upon the foundation of three other theories, it is necessary to include the review on these three theories to clarify the learning infrastructure framework. These three theories are Polanyi's explicit knowledge and tacit knowledge, Nonaka's knowledge spiral model, and Scharmer's theory U.

Fourth, literature is reviewed on open innovation and innovation intermediaries in China. This part starts with national and local (Beijing) policy review on innovation policy and innovation intermediaries' policy, following the historical perspective and highlight outstanding initiatives. At the same time, academic papers and reports are the main source to detect achievement and challenges in open innovation and IIMs in China.

The secondary statistic analysis is another research approach in this study. In order to have overall understanding on open innovation in China, statistics related to innovation is collected from government reports, i.e. National Bureau of Statistics, Science and Technology Statistic Center in Ministry of Science and Technology of the People's Republic of China, Institute of S&T Statistics and Analysis Chinese Academy of S&T for Development, Beijing Statistic Information Net, etc. and international database i.e. OECD StatExtracts, Eurostat, UNESCO UIS Stat.

The statistics related to open innovation are collected on three innovation actors – university, business and government, such as in high-tech industry scale, Gross Domestic Expenditure on R&D, R&D funding, R&D human resource in different sectors. Statistic analysis is done on the

activities of the abovementioned three actors in manufacturing and high-tech industry in China. IT industry is emphasized to support the Beijing case study. The IT industry is one of the priorities of the Zhongguancun National Demonstration Zone for Graduate Students' employability, innovation, and entrepreneurship (hereinafter refer to as Z-park for Graduates), as it is embedded in Zhongguancun National Demonstration Park, the leading IT industry cluster in China.

Based on literature review and statistic collection, quality analysis is done on the following aspects: to crystallize IIMs' facilitation for start-up companies, to establish the connection between IIMs with learning infrastracture theory, to categorize the typology of IIMs in China between university and business.

The method of interview is employed to get insight from IIMs between university and business in Finland and in China. The interview case in Finland is Demola, an open innovation platform in Tampere, Finland to establish connection between students and companies. Interviews were based on observation in Demola spring semester project "Be a little Noksu" and regularly taking part in Demola pitching and other relevant events.

The interview case of Demola Tampere was conducted in March 2014 face-to-face with two Demoal facilitators, one for 40 minutes, one for 20 minutes. The observation and participation of Demola activities started from January 2014 to May 2014. The interview case of China is conducted in May 2014 through international calling and skype for 20 minutes and 30 munites respectively, to one association officer and one association manager in Beijing Zhongguancun National Demonstration Zone for Graduate Students' employability, innovation, and entrepreneurship association. Due to the geographical distance between author's location in Finland and Beijing China, the interviews were done through skype and telephone other than face-to-face.

The interviewees of Demola were approached by author through taking part in Demola open events. The interviewees of Z-park for Graduates were contacted through Email, QQ chatting tool, preliminary calling through cellphone. Please see the interview details below:

Interview Case	**Interviewee**	**Interview Method**	**Discussion Topic**
Demola	Two Facilitators in Tampere Demola	Face-to-face	Open innovation platform facilitation between students and companies, multidisciplinary communication, model copy in other European countries
Z-park for Graduates	one association officer and one association manager	Skype and Telephone	Driving force and background of establishment, main activities, the way of cross sector cooperation, role of Z-park for Graduates, current barriers of being an intermediary agency

The interview follows the structure below, which is developed to cover organization basic information, organization structure, operation and management, benefit for college students in terms of start-up business, advantage and challenges in linking university with business.

Z-park for Graduates Interview Guidance:

1. General information
    a. introduction of offices: Curriculum development and teaching department, Enterprise Cooperation and Employment, University Cooperation, Scientific and technological achievements Collection, Venture Fund, International cooperation
    b. industry emphasis
2. The integration of "Innovation, Startup, Employability" in Z-park for Graduate Students: idea and activities

    a. Innovation
    b. Startup (counseling, consulting, funding resource (中小企业创业投资引导基金, 中关村大学生科技创业基金), project-based mentoring)
    c. Employability
3. Students service
    a. target group (part/full-time, level of study, return oversea students, university/vocational students)
    b. participation (training and course, working while studying, internship)
    c. soft and hard skills (tacit knowledge in working environment that would fill the gap between university education and working ability)
    d. 7 talents training modes: “校企互动“共建试”；人才培养“订单式”；产品研发“共同式”；联合经营“开放式”；校企文化“对接试”；工学结合“交替式”；顶岗实习“轮训式”
    e. preferential policy for students
    f. IPRs
    g. data available (employability rate, startup type, startup survival rate, technology transfer and achievement, etc)
4. University and business cooperation
    a. contribution and roles
    b. students culture transfer (from school to company)
    c. interaction (within universities, companies, and between universities and companies)
    d. product co-development (student participation)
    e. resource distribution (matching funding resource, university technology park, company trainee programme, open laboratory, etc)
5. Management
    a. market operation (市场化运作) how to balance
    b. membership (companies, universities, affiliation partners)
    c. students enrollment
    d. teaching staff recruitment
6. International/regional cooperation
7. Challenges and vision

Because of the time limitation and long distance between Finland and China, some latest data cannot be accessed. Therefore, the interview results is also combined with organization official website information, such as organization introduction and organization chart for interview analysis.

3. Literature Review

3.1 From Closed Innovation to Open Innovation

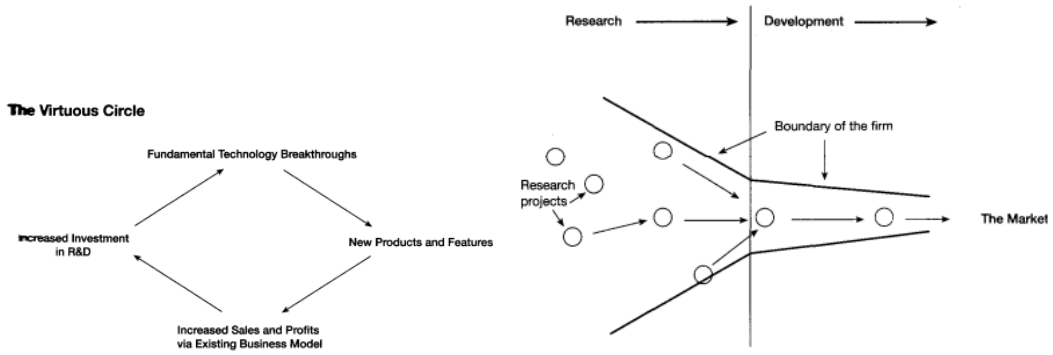
In his groundbreaking research on innovation, Chesbrough has redefined two models of innovation and the shifting process between them. Open innovation paradigm is an innovation paradigm under which ideas can emerge both inside and outside an organization and have parallel paths to market. (Chesbrough 2003a, p. 43). Closed innovation paradigm is traditional approach to innovation, where ideas have only one path to market. (Chesbrough 2003a, p. 30) To elaborate different innovation model that co-exits in the 21st century, Chesbrough lists two companies that have different type of innovation system: the internal innovation (Bell Labs) in Lucent and Cisco that partner with startups.

There are three key actors in the open innovation paradigm: Industry, Government, and University, which are also the main player in shaping open innovation from closed innovation model. Among which, it is worth discussing the respective contribution that industry, government and university make to the breaking down the innovation isolation.

3.1.1 The Closed Innovation

Although it is important to emphasis on open innovation and open resource sharing, the closed innovation is important to develop core competitiveness for companies. Closed innovation requires "successful innovation require control", "strong self-reliance", to finish the whole process from product development to financing the idea to the market, so as the company can have the best intelligence, occupy the market first, lead the market by new products, and benefit from the exclusive intellectual property. It forms a virtuous circle of generating more sales and profits for future products development, such as Thomas Edison, and Bell Laboratory. As illustrated by Chesbrough (Chesbrough, 2003, p. xxi):

Figure 2 Virtuous Circle & Closed Innovation Model



(source: Chesbrough, 2003)

The advantage of this model is to screen out those "false positive" through internal pipeline meaning to rule out projects that might not have good performance in market. To closely look at the product research and development process in the virtuous circle, the closed paradigm for managing industrial R&D is indicated as above developed by Chesbrough (Chesbrough, 2003, p. xxii):

However, the negative factor is shown from this graph that closed innovation only allow one outlet for ideas to come out into market. The problems with internal innovation are less effective and high in R&D spending, low in the research results utilization for the research finding is not always applicable for one company to later develop into good new product, which caused low utilization of investment. The competition type in closed innovation is to create research labs respectively based on one's own resource within company.

In the previous closed innovation paradigm, university and government were not main the driving forces for application of science (Chesbrough, 2003). Knowledge only stayed only in university classrooms instead of transforming into commercial practice. Government had little impact on organizing research activities. Industry was the main player in promoting innovation in R&D laboratories of applied innovation, as the external resource was unavailable in large scale.

Chesbrough discusses industry as the basic element in open innovation (Chesbrough, 2003). It conducts most of applied research and is the main source of Gross Expenditure on Research and Development (GERD) (OECD StatExtracts). However, more and more evidence shows that "other" knowledge source including universities, research institutes, small and medium sized firms are contributing innovation generally among large leading companies (Chesbrough, Lim and Ruan, 2007).

However, university and government have significant contribution in the shifting paradigm from closed innovation to open innovation. Early from 1980s, the economic barriers have been continuously breaking down by the emerging new IT technology and Internet. Commercial success is determined by knowledge and market. The large involvement of knowledge has shortened product lifecycle significantly. The cost and opportunity sharing between industry and university has been increasing (Kux, 2008). The scale of cross sector cooperation has significantly increased. Universities are enhancing its role as a major player in the open innovation community (Striukova and Rayna, 2013). As the risk and uncertainty of innovation projects, corporate usually choose to cooperate with upstream technology providers, such as university and research institutes, to reduce uncertainty. The activities in early stage of innovation project contain investing in university research on emerging technologies, joint research, seed capital in start-up ventures, and so on (Vanhaverbeke, de Vrande and Chesbrough, 2008). Firms benefit from the early evolvement of university research to gain more options and learn from new technology with small amount of investment.

University is one important source of industrial knowledge among other third parties. However, there is still a large discrepancy in patents holding between upstream technology market and downstream product market. Although university and other research institutes hold large potions of patents, they do not participate in the product market (Chesbrough, Lim and Ruan, 2007). University, seen as the institution for cultivating human capital, plays crucial role in contributing to economic growth inputs in providing qualified labor force. Besides this responsibility, the transfer of university-generate knowledge is another new task for university to apply knowledge in society. However, university focuses more on research but lack of the dissemination of knowledge. As government funding has been declining in university and there are increasing demands of expanding higher education system (Jongbloed, 2008), university is seeking out for more resource, through which university knowledge become accessible for industry. University business cooperation should be promoted (Chesbrough, 2003). Thus, the entrepreneurship in university is encouraged to maximize the benefit of university-generated knowledge to economy growth and society as a whole (Litan and Cook-Deegan, 2011).

The logic of the closed innovation is to do everything based on its own strength. This has created overlapping with university in both research and human resource. Industry research need to go

down both vertically to basic research that would support its products in general and horizontally to provide options for series of products development in a wide range. Because of the convergence of cutting-edge technology within corporation boundaries, products follow the principle of "invented here" (Chesbrough, 2003, p. 30) to ensure of quality. Elements of product are produced within company and set up high standard for suppliers outside that sometimes no qualified supplier is found. R&D staff was recruited from university only as full-time employer that leads to high cost and constraining in resource. Monopoly in leading industry is another consequence.

Two changes in university make a shift in the knowledge landscape. First, decentralization in higher education system and local funding resource created close tie with local industry in U.S. from the first half of the 20th century. Second, the raising of number and quality in university not only deliver scientists and engineers for industry, but adopted practical attitude towards science application in newly founded universities (Chesbrough, 2003, p. 25).

The influence from government has increased in funding support to research. Research network was created that has become evident driving force for national productivity. The funding allocation had changed to connect university, industry, and military for technology advance development during the World War II. The role of university has been equal to government and industry since. The innovation model among government, military, industry, and university was resisted after war, but public funding support university and industry R&D remained. The emphasis has changed from accelerating applied science in technology during wartime to compete with Europe in basic research and gain independence in research capability in the U.S. (Chesbrough, 2003, p. 27).

The driving forces for shifting closed innovation towards open innovation emerge from labor market, venture capital (VC) market, external outlet, and suppliers mainly (Chesbrough, 2003, p. 34). From the employee point of view, the safe guarded internal R&D can be eroded by the mobility of talents. The expansion of higher education sector has contributed to the growing number of skilled workers. At the same time, knowledge started to be diffused outside of organization R&D center with the mobility of well-trained workers, as the qualified workers are highly valued to bring in useful knowledge. The increasing mobility causes the loss of training investment in previous company that employee left from. The range of mobility has enlarged from company to national border as the large quantity of migration of skills "brain drain" happens in the U.S. (p. 36). However, in the context of closed innovation, hiring the "brightest" talent is not the answer for a sustainable R&D.

From the perspective of peer competitors, private venture capital (VC) extends the possibility of startup companies to grow into strong competitor by commercializing their internal research with external resource.Venture capital make the walls of company internal R&D permeable. Commercialization of research results can be done much easier with the support of VC. The attractiveness of stock market has become one of the features of new start-up companies. VC also appear to be a benchmark, base on which, startup companies start to adopt the most efficient business model that can adapt into the changing market faster. This is one advantage in contrast to the rather static business model in traditional corporations (Chesbrough, 2003, p, xxiii).

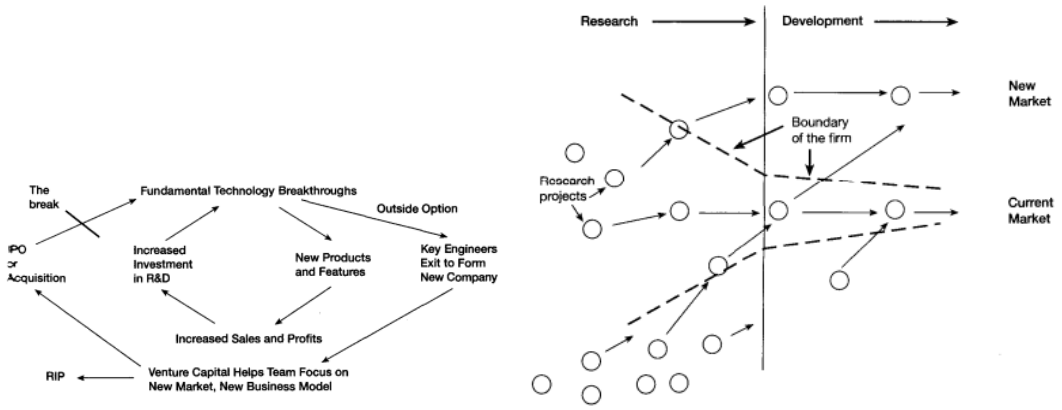
These two factors above provide extra ideas to company R&D from external outlets. Research results, which are not applicable for company current business, are leaking to market. In this way, it accelerates innovation in general.

From the perspective of diversified customers, shorter cycle of R&D for specific technology and products leads to more diversified demands from knowledgeable customers (Chesbrough, 2003, p, xxiii).

The last factor is external suppliers. The company internal R&D that controls the advance knowledge set high standard for suppliers. The increasing capabilities in suppliers enable more reliable and competent cooperation with large companies. It is worth noting that university contributes significantly in this regard because the massification of university has been increasing the quality of skilled labor. Therefore, it helps to improve the capability of external suppliers gradually (Chesbrough, 2003, p. 39).

New ideas are no longer limited within the territory of a company but open to more external options. As such, the virtuous circle is broken by the outside channels that investment and actual profits do not always exists in a row. Based on this change, open innovation theory points out the importance of utilizing external ideas for a company while having its own internal research. Ideas leakages happen commonly among startups, external licensing and departing employees. From the graph below, the boundary between companies become porous that research projects can freely come in and out of the company research pipeline during the whole innovation process. New market can be hit by "false negative" because project with less value in current business might be useful in tapping into new market (Chesbrough, 2003, p. xxv).

Figure 3 Broken of Virtuous Circle & Open Innovation Model



(source: Chesbrough, 2003)

3.1.2 The Open Innovation

As the main task for university is to cultivate talents for labor market, the linkage between university and industry has been enhanced over time. University is one of the main driving forces for establishing the open innovation paradigm and is the main players on the ground of generating innovation continuously with industry.

Open innovation is built upon abundance knowledge that can be accessed with low-cost. University started to seek funding resource from industry to support basic research as the funding from government is declining. Patents were no longer dominated by large company research lab but increasing among individual and small companies. Various new ideas become accessible before investment. Thus, it has been largely lowered the cost and risk for company R&D.

Another impetus for open innovation is intellectual property (IP). IP ensures the ownership of research results and speed up the knowledge diffusion in a smooth and legal environment. In this way, IP increase the speed of "metabolic rate" (Chesbrough, 2003, p. 58) of innovation. Patenting, licensing and markets for technology have become more important as means to appropriate the benefits from innovation (Bogers, 2012, p. 2)

As discussed before, open innovation is not contradictory to closed innovation. On the contrary, it helps in optimizing internal R&D by enhancing the awareness of external knowledge and creates more horizontal system structure. To realize the importance of open innovation does not mean to abandon internal research but to enhance the awareness of external resources with a new rationale. The important change not only happen in the way of utilization external knowledge, but also through building network and new connection to support innovation.

Besides the definition of open innovation that Chesbrough has given from firm's point of view, others define open innovation from the view of partnership, relationship, integration and collaboration (Cohen, Goto, Nagata, Nelson, and Walsh, 2002; Ahrweiler, Pyka, and Gilbert, 2011). Open innovation happens not only in formal way but also informal way inside and outside of organization as the "way" of people doing things (Striukova and Rayna, 2013). Furthermore, open innovation is discussed from cultural perspective that it is a process starts with an open up mindset to value competence and know-how of other external organizations (Gassmann, Enkel and Chesbrough, 2010).

There should be a balance for an organization to have both closed innovation and open innovation. Close innovation is the way for an organization to enhance core competence that service as the cornerstone for long-term innovation. However, open innovation is necessary in the way that it helps an organization to shorten innovation cycle, faster product development, and buy time for market (Enkel, Gassmann and Chesbrough, 2009). The balance between closed innovation and open innovation is the balance between prompt response to market and core competiveness.

This change of knowledge self-defending brings in new principles for research and innovation management. Instead of holding innovation within company boundary, talents and innovation can be anywhere to maximize the innovation as a whole because the achievements are transferable. Industries are undergoing different innovation mode, Open innovation example P&G, Hollywood film industry, cloth innovation example, nuclear reactors and aircraft engines, transition between two paradigm, (Chesbrough, 2003, p.xxvii) On the other hand, it smooth the process and widen the preference for internal R&D in the way that innovation can happen even it would not be used within company or in the near future.

The architecture of internal R&D is shifting from interdependent architecture to modular architecture in the background of open innovation. In the interdependent architecture, which is best used in internal R&D process, one company need to solve everything related to one technology. Experts are needed in every field to develop the best components for this new technology. Each component become interdependent and difficult to be weeded out or replaced because that would affect the whole system. However, in the modular architecture, interdependence is reduced because the best component can be bought from other companies. It is easier to restructure the system and to clear ambiguities among interdependent components. New technology or new products can be developed more smoothly inside system without worries of being conflict with the interests of other technologies in this system. In this way, it simplifies the knowledge management (Chesbrough, 2003, p. 60).

3.1.3 Shifting by Cooperating

One example to emphasize the implication of university and business cooperation is the process of IBM to shift from closed innovation model to open innovation model. The collaboration between IBM with Columbia University led to the field of computer science in the early stage of IBM history. This helped IBM to be successful in internal research as the salient innovation came out from laboratories and active participation in academic conferences by IBM researchers. However, with the academic mature in computer science, the knowledge diffusion, combined with VC

availability and labor mobility, gradually become a threat for IBM in its innovation. Facing dramatic decline on revenue under the tremendous competition, IBM made its strategic changing in company logic, which was from "in order to do anything, we have to do everything" to "do whatever the customer needs us to do, and work with what the customer already has" (Chesbrough, 2003, p. 102). The focus has been transformed more external-oriented. Now IBM has had two research centers in the United States, and thirteen research centers worldwide.

Other scholars also explore open innovation from different angle. Bogers discusses collaborative innovation as the core of open innovation (Bogers, 2012). Open innovation is not limited to interorganizational level. Benefits for regional development and national innovation system are obvious. The anticipation of innovation actors, meaning firms and universities, in open innovation is to form an innovation cohort that to create innovation milieu for knowledge-intensive entrepreneurial firms to emerge (O'gorman and Kautonen, 2007). University is at the central stage of the knowledge economy that needs to be responsive for four layers of new demands: the technology transfer, knowledge transfer, knowledge engagement, and knowledge environment (Reichert, 2006). Universities are expected to transfer explicit scientific and technological knowledge as well as tacit understanding cross organization boundary. This is to echo the technological, societal, economic and public problems. Innovation individuals and organizations are seeking a friendly innovation environment that research results and opinions can be exchanged with large freedom. University as one of the innovation enabler should proactively interact with regional agencies and knowledge-based business to form a "knowledge-friendly creative environments" (Reichert, 2006, p. 19).

A broader view of open innovation is explored in global context. Science today is seen as a broad global network with key players such as university, research institutes, and innovative companies (Kux, 2008). The individual based innovation community brings together globally firms and universities to achieve common goal (Raunio, Kautonen and Saarinen, 2013).
The Based on the concept of regional innovation factory (RIF), Kautonen and others expand the open innovation to the concept of cross boarder innovation network in Finnish context.

In the fast growing digital age, industry-university collaboration is largely promoted to avoid losing advantage (Kux, 2008). Knowledge access is also discussed in the perspective of dissemination channel. In the era of knowledge digitalization, the intellectual property right becomes one of the key factors to enable the knowledge access from university in open innovation (Stodden, 2011). The increasing research cooperation with industry asks for legalized channel for knowledge outflow so as to avoid ownership dispute that would hamper the knowledge application in innovation process.

3.2 Challenges in Open Innovation

The changing role of innovation put forward the reallocation of tasks among business, academia, and government. In this irreversible trend discovered by Chesbrough, less basic research is conducted in corporation's research lab, while universities, as they traditional were, will take the main responsibility for basic research. The gradually retreat of basic research funding from industry call for government and university to co-solve this imbalance. (p. 191)

Government, in this case, encounters two main conflicts from two stakeholders, namely business and university. Main resource of basic research funding comes from government. In the process of organizing research projects, allocating funding to universities, increasing public funding and how to efficiently spend public funding are challenging government in both quantity and quality

dimensions. Business has its own preference in selecting projects to fund basic research, which is the potential to bring in profit in short run. However, considering the appropriate business model for innovation, the integrated thinking in bringing in external knowledge and technology into company's architecture, short-run profit is not the best way to utilize internal and external ideas in the abundant knowledge landscape. Therefore, should government not only to form a neutral and meritocratic process for awarding government grants, but also to base the selection criteria on the academic merit instead of political connections or industry preference. Another problem remains in the publication of research results. Business usually is reluctant in publishing results due to individual interests. However, publication is an important indicator for government to monitor the use of public funds and outputs of public funding. To look at the big picture, the block of research results from publishing could slow down the use of results that hamper the vigorous innovation system in general (p. 192).

Conflicts stem from another stakeholder university as well. In order to make full use of internal and external knowledge for companies, government needs to promote and regulate intellectual property (IP) exchange through creating transparent awarding system and adjudicate competing claims to IP. For university in this regard, the Bayh-Dole Act of 1980 in the United States was issued to solve the conflict in public funded university research in IP acquisition. University was allowed to claim IP of the research results that are generated from public funded projects. However, the substantial profit possibly to make out of the patents owned by university, on the other hand, can slow down the diffusion of basic knowledge to external society. (p. 193)

Meanwhile, university and business cooperation is essential to bridge the fundamental funding and innovative products and further commercialized through respective business model. A win-win situation for both rely on the respective interests to be met, such as the research funding for university and early access to new technology for industry. From the policy perspective, to have business rely on the "seed corn" (basic research and fundamental finding) from university, it needs to find a balance for university faculties to participate in business and ensure the workload in university.

Two reasons for industry to retreat from basic R&D activities, one is the abundant knowledge landscape in open innovation that knowledge is no longer confined within organizational boundaries, two is the pressure for a firm to deliver measureable results that create reluctance in R&D investment and pressure for existing R&D to produce more measurable results. The inherent difference, as Chesbrough argued, between research and develop department lead to a buffer to solve conflicts. However, it leaves lots of ideas and innovation "on a shelf" (p. 38). On the other hand, it results in the measures disparity in goals and performance of business and research community that enlarge the innovation gap in between (Dalziel, 2010). The open innovation paradigm offers a solution to this problem. However, the theory has not specified in the one type of particular cooperation between business and university, in the intrinsic nature of two communities that would impede in-depth cooperation.

3.3 University-Industry Cooperation

Facing the challenges in diversified missions, open innovation, labor market, and research results transfer, universities in Europe have undergone a process to build up sustainable University-Business partnership (EUA, 2013). Those challenges are universal for universities around the world nowadays. University research need interaction with business world in many ways, such as diversified funding resources, research competitiveness, research topic, digital tools for knowledge and so on.

Cooperation with university, however, was good but fragmented because university research is relatively lagged behind of the fast changing market. It verified the fact that business needs to adopt appropriate business model to connect external technology into its own architecture. To make the transition from closed innovation to open innovation, harnessing university research is an important strategy. Chesbrough has briefly summarized several approaches for university-business cooperation based on real cases such as Intel, IBM, and medium small-scale companies such as (p. 189).

The way of industry-university cooperation is generalized by Chesbrough based on real case analysis from the perspective of firms into three types (Chesbrough, 2003).
Firstly, is to provide hardware and software resource to university by:
1> donating in equipment or services to an individual faculty member within individual research centers;
2> financing a graduate students' tuition fee;
3> giving lecture in university;

Secondly, is to integrate into university technology research by:
1> training future experts in university using some of the company's technology;
2> helping faculty member in learning company' technology, to follow what the research does with the technology;
3> being a member of the industry advisory board of one of these centers;

Thirdly, is to increase personnel exchange with university by:
1> inviting students to do class projects at the company;
2> provide visit opportunities for teachers and students to the company during summer for experience sharing, etc.

The university-business cooperation (UBC) is "the collaboration of university and business with the support of government for mutual and societal benefit". The university-business stakeholders include government, higher education institutions, and business (European Commission, 2009). In terms of the types of UBC, there are eight ways including collaboration in research and development (R&D), mobility of academics, mobility of students, commercialisation of R&D results, curriculum development and delivery, lifelong learning, entrepreneurship and governance (p. 5).

Schartinger and others give a more clear classification of industry-university cooperation that it includes joint research, contract research (as the consulting service financed by firms), personnel mobility, and training (as for industry staff trained in university or jointly deliver education program, or training of university staff by using industry technology, or industry staff giving lecture.) (Schartinger, Rammer, Fischer, and Frohlich, 2002). From the new demands for university in technology transferring (Reichert, 2006), the partnership is divided according to the proactive side during cooperation (Poyago-Theotoky, Beath, and Siegel, 2002). The cooperation that is spin out from university can be seen as university-push type. Likewise, the industry oriented contract cooperation is considered to be industry-pull. It vividly illustrates the initiative between university and industry.

The measurement of University-Business partnership is given by EUA based on good practices collected in FP7-EUIMA project (EUA, 2009). The assessment is divided into five parts including collaborative research processes, competitiveness and economic growth, expert services, human resources and sustainability of the collaboration. Under these five main aspects, more detailed elements are reviewed, such as multidisciplinarity, regional development, requests for consultancy, employability of graduates and master, attracting venture capital and so on.

Challenges and risks exit in UBC. The influencing factors for university to cooperate with business may contain specific barriers and situational factors such as "age, gender, years working in the HEI, years working in business, type of HEI, size of HEI and country" (European Commission, 2009).

The reasons that business is reluctant to work with university includes such as the university's activities are not directly related to company's business, company is not clear what university can offer, the collaboration is costly and time consuming, the mismatch of objectives and expectations, conflicts in long-term research and short-term solutions, and different culture and organizational language, and so on (Howells, Ramlogan, and Cheng, 2012).

The facilitation from intermediaries between university and business has been proved to be helpful in university-business partnership (UIIN, 2013). University increasingly engages in technology transfer and commercialization. Incubator, such as iMinds for ICT technology in Belgium, creates real business environment for students through the engagement with university to commercialize research results. Industry-academia liaison officer can raise awareness of university-business cooperation and establish independent personal networks. Others such as entrepreneurial education can largely accelerate students' entrepreneurial awareness and cultivate an entrepreneurial environment and culture on campus. University programmes, such as JAMK Generator in Finland, also effectively boost cross-disciplinary entrepreneurship among schools so as to enhance overall university entrepreneurial capacity. Bringing ideas into business plan is the entrepreneurial collaborative approach in Faculty of Engineering from Mondragon University (EPS-MU). University can also establish an institute to facilitate the cooperation with business, such as Cyprus University of Technology's Research Institute, which is a self-funded research institute to promote scientific research together with business world. University Spin-off Company is not only the way to realize university research results, but also the way to manage university-business cooperation, such as the project allocation process AIMday managed by Uppsala University Innovation Tools AB.

The successful examples of industry-university co-promoting students entrepreneurship are plenty. Here is to review three cases: Philips' High Tech Campus, Global Transformation Living Lab, and Demola.

Philips' High Tech Campus
Royal Philips Electronics is famous for the open innovation initiatives. Philips' High Tech Campus is a high-tech park to integrate industry, universities and research institutes in developing future technologies and products. The unique environment creates a new ecosystem for industrial employees to work with researchers from other companies and universities. The win-win situation is established on sharing of basic infrastructures, such as campus and laboratories, and state of art technologies.

The Research selected in Philips' High Tech Campus is more market-driven. The transformation from invention to innovation follows the product or service-oriented principle to create new product categories and business models. The spirit of open innovation exists throughout the innovation process from research to product development and marketing research.

This model has been successful copied to worldwide in Belgium, Britain, France, Germany, USA, China and India. The one located in Eindhoven is the biggest. By employing the world network, it enables Philips to cooperation researchers, entrepreneurs in Netherland and in other countries.

(source: European Commission, 2009)

Global Transformation Living Lab
Global Transformation Living Lab is an initiative made in MIT.
A holding place that to gather leaders and activists from all of the world, to deepen personal and collective soures of their capacity, co-inspire to connect with their emerging self and purpose. There are three elements to enable this matephor into concrete guideline. First, this community should embrace dialogue cross-culture, cross-sector, and cross-generation. ELIAS (Emerging Leaders for Innovations Across Sectors) Fellow group. This group is consisted of leaders that have potential for senior executive positions in near future. They are expected to work collectively across boundaries for possibility of innovation. Second, the ELIAS needs younger people to support. Therefore, Global ELIAS Classroom is another global platform that is consisted of MIT students from all of the world. Students will be responsible for ELIAS prototyping projects. Third, an infrastructure needs to support these activities. It should have virtual places (for example, internet website), physical space located in urban and rural areas.

In doing so, a systemic innovation platform for seed project. It benefits students in a more practical and hands-on approach comparing to a traditional university, because they have the chance to communicate with front-line innovators and leaders cross culture and cross sectors.

(source: Scharmer, 2009)

Demola
Demola is one of the best practice of university business linkage in Finland.

Demola is a Finnish open innovation platform created by the Creative Tampere Programme. It is established under the backdrop of Aho Report of 2006 and the Finnish Innovation Strategy of 2008 to improve competitive position in R&D market (European Commssion, 2009).

It brings together universities, students and regional companies to co-develop product prototype. Relying on the resource from three universities in Tampere region, students from university and polytechnic, large size of multinational companies and start-up companies, Demola is able to provide an open innovation platform for three parties to work together. Students come from different universities, disciplines, and even countries. The Demola team is formed based on multidisciplinary talents in a multicultural environment.

Entrepreneurship is promoted to large extend in this special cooperative relation. Students have frequent and in time interaction with companies regarding of team project. Facilitation such as pitching skills, technique problem solving, presentation skills are provided by Demola facilitators in regular events.

Intellectual property belong to students team in the end of the project and flexible to licensing under the agreement between team and company. The awareness of entrepreneurship is enhanced through product developing and results belonging in the relatively safe environment in Demola without full exposure to market risk. Successful project is possible to continue after the Demola project, even develop into start-up companies.

Demola, along with Protomo, Suuntaamo form an innovation platform – New Factory that recently opened – to facilitate business cooperation to bring idea into reality. The model of Demola has been spread to seven other counties within Europe.

(source: European Commission, 2009; Demola Staff Interview and Activities Participation)

From these three case studies, we can conclude three important elements for the similar kind of innovation community to scale up and spread around the world. First, a set of successful practice of the innovation community, which involve university, business, and students, are leading examples for others to learn, to follow, and to improve. Second, a theory is in need to explain why and how this type of practice can faster innovation cycle by gathering cross-sector experts into a common ground. Third, an supporting infrastructure should be focus on serving all parties in the innovation community as a "power place" for innovation opportunities, activities, prototyping, and further applications. Besides the technologies that enable people to communicate better cross sector, such as email, online network, open-source data base, this infrastructure also function as a "social technology" to bridge multiple innovation actors together to innovate collectively. This is also supported by the conclusion of Scharmer's experience (Scharmer, 2009, p. 452).

3.4 Innovation Intermediaries (IIMs)

Knowledge Transfer is the important process in Open innovation. The well communication and establishment of explicit and tacit knowledge between universities and their partners are important in forming the competitiveness of regional innovation (Reichert, 2006). The environment is a continual source of stimulation to knowledge creation within the organization (Nonaka, 1994, p. 27).
"Knowledge created by the organization can trigger the mobilization of knowledge held by outside constituents such as consumers, affiliated companies, universities or distributors." (Nonaka, Toyama, and Konno, 2000). Knowledge creation is a self-transcending process that goes beyond of boundaries of one organizations' own experience (Nonaka, Toyama, and Konno, 2000). One has to find oneself in a larger entity through the interaction with organization environment, in which it survives. Share with and integrated into other's mental world. The requisite variety is crucial for an organization to adapt into the surrounding environment in order to cope with changes and contingencies (Nonaka, Toyama, and Konno, 2000).

There is increasing complexity in innovation paradigm with diversified participants and permeable inbound and outbound channels between organization boundaries (Chesbrough, 2003). Therefore, the concept of "Innovation Intermediaries" (IIMs) is addressed to meet new demands. Firstly, knowledge and innovation become the key factors in commercial success in the open innovation paradigm (Kux, 2008; Chesbrough, 2003). Thus, the function of intermediaries under this shifting paradigm can no longer to generalized as "middleman" back in 16th century (Howells, 2006). More discussion on intermediaries is driven by the increasing openness in innovation. More research starts to examine the linkages between innovation actors and the new functions of "middleman" among them (Howell, 2006). New form of coordination within the innovation network is important (Yang et al., 2014).

Secondly, due to the complexity in open innovation picture, companies, universities, and public sectors need to have real options in dealing with challenges encountered in new innovation interrelations (Vanhaverbeke, de Vrande and Chesbrough, 2008). The network connected by systemic intermediaries could be "many-to-one-to-one", "many-to-one-to-many", "many-to-many-to-many" (Yang et al., 2014). The positive influence of intermediaries in innovation system is examined from microsystem to industrial sectors, such as IT industry (Dossou-Yovo and Tremblay, 2012), as well as in university-inducstry cluster linkage, such as TAMA in Japan (Kodama, 2008). Although open innovation has been implemented formally or informally, there is still the lack of understanding of the mechanism of organization relations and concept implementation (Enkel, Gassmann and Chesbrough, 2009). This calls for further research on the functions of new participant in facilitating innovation activities. As the role of university is changing in the knowledge economy, some new actors take part in innovation activities including government agencies, public-private partnership, consultancy companies, and innovation intermediaries to form an interface between universities and their partners (Howells, Ramlogan, and Cheng, 2009). The awareness of innovation network has been increasing. Innovation intermediaries have actively taken part in innovation activities to smooth the integration among diversified actors in innovation (Enkel, Gassmann and Chesbrough, 2009). Thus, it worth noting that it is important to distinguish innovation intermediaries with traditional concept of intermediaries, such as science and technology intermediaries (S&T Intermediaries), because of the diversified service provided to clients in different innovation paradigm.

The network created by innovation intermediaries can be viewed from outside and inside IIMs as the go-between organization. Outside, innovation intermediaries create the condition for innovation (Howells, 2006; Yang et al., 2014). Along the innovation process, innovation intermediaries provide services from exploring new technology and market, to managing networks, to facilitating learning process through learning-by-doing.

Inside, innovation intermediaries choose either neutral or non-neutral position (Yang et al., 2014). The neutral balance among multiple parties is not to choose any view or interests, whereas non-neutral intermediaries represent its own organization self-interest. Nevertheless, either position is built upon reliability as being the legitimate and accountable liaison organization.

The network, however, is not always clear presented (Agogué et al., 2013). In most of the case, innovation intermediaries deal with unknown network, meaning unclear participants, ill-defined problem, and no common interests. However, innovation intermediaries are the answer for solving conflicts in the situation of high degree unknown.

There are some reasons for innovation intermediaries necessary to exist in innovation system. One argument is supported by Ouchi's research from the perspective of transaction cost economics. The network or clan is most efficient when performance ambiguity is high and goal incongruence is low (Ouchi, 1980). Dalziel explains this theory from the perspective of innovation intermediaries. Performance ambiguity is the slow transformation of laboratory invention into commercialized products and services. Goal incongruence exists in engagement of business and university, who have different goals. In order to support cross sector groups of industry and university, who have different self-interests, innovation intermediaries need to devote ongoing effort to sustain this network (Dalziel, 2010). Innovation intermediaries is in the right place for the ongoing effort because none of the other members would be interested or capable to fulfill this function due to their own specialties in certain area.

Others explain the necessity of innovation intermediaries from the "valley of death" between product research in laboratory and commercial application development (Chesbrough, 2003; Zhao and Zheng, 2011). Due to the different nature of these two phases, unknown factors exist in applying pure research finding into market with risks from finance, technology, management and so on. The market transaction cost in seeking resource and asymmetric information are two main reasons that usually lead to market failure. Innovation intermediaries are there to minimize the uncertainty (Kodama, 2008).

To categorize innovation intermediaries is difficult. In the category done by OECD, there are four groups of actors in innovation system: firms, universities and other higher education institutions, public research establishment, and not-for-profit research organization (OECD, 2002). However, it excluded innovation intermediaries, contract research organizations, other government bodies and knowledge intensive business services firm (Howells, Ramlogan, and Cheng, 2009).

Literature on intermediaries is generalized into four groups in innovation process: First is literature on technology transfer and diffusion; Second is the role and management of innovation activities in firms; Third is literature on the systems of innovation; Fourth is research into service organizations such as Knowledge Intensive Business Services (KIBS) firms (Howells, 2006). Based on these previous researches, Howells develops a typology and framework to identify functions of innovation intermediaries in the whole innovation process, and supported by investigation in UK context.

Howells, therefore, defines IIMs as "an organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations." (Howells, 2006, p. 720).

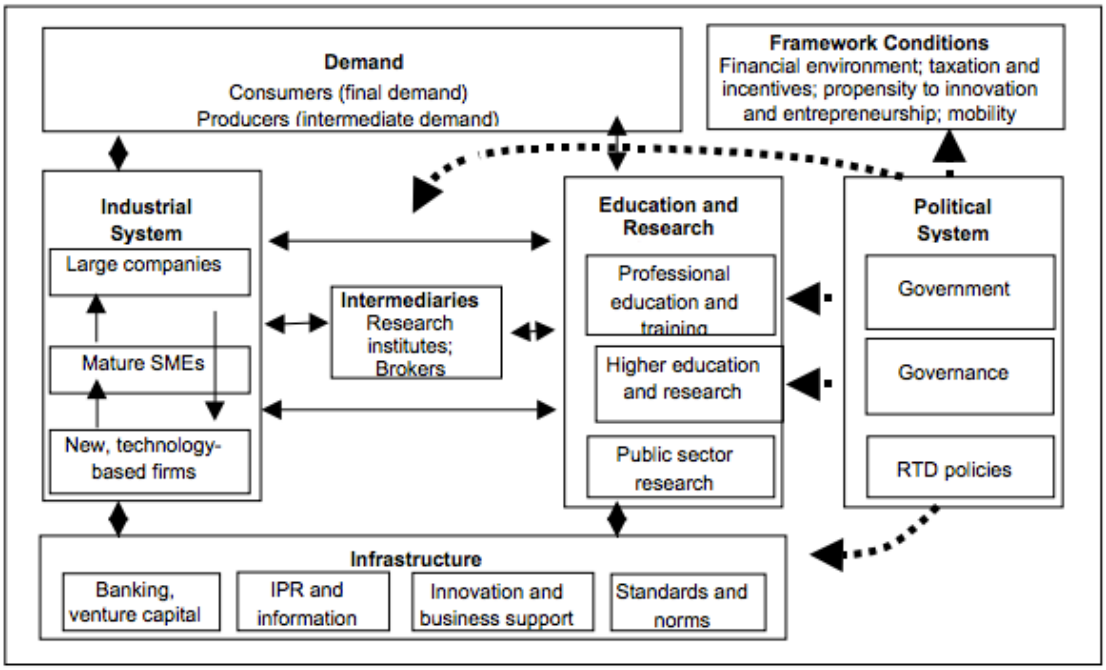
Chesbrough define the Role of intermediaries from a policy perspective. The

intermediaries have four roles in the go-between activities (Chesbrough, 2006). The four roles appear throughout the process of innovation: the problems to be solved at the beginning of innovation, the sound protection of confidential issues during the innovation process, the documentary of participation during and after the process, and finally the results of the process. The roles of innovation intermediaries require a wide range of knowledge provider on both sides of market and university.

In the triple helix model, university-industry-government relationship is the key component of this theory (Etzkowitz and Leydesdorff, 1995). As the innovation strategy theory, triple helix model explains the overlapping area where three parties cooperate. Innovation intermediaries, according to its function, locate in this overlapping area in facilitating the interaction among university, business and government.

Arnold and Kuhlman give a framework from the national innovation system perspective. The model they developed further clarifies the actors and functions in the open innovation environment. The two main characters in open innovation are enterprises and education research institutes. Intermediaries facilitate the collaboration by transferring knowledge and technology in the middle. While government takes the responsibility to build up basic infrastructure for the two key actors to meet demands from consumers and other intermediate demands between industrial system and research education institutes. Other factors such as entrepreneurship and mobility are the conditions for this framework.

Figure 4 National innovation system model



(Source: Arnold and Kuhlman, 2001)

Intermediary agency is one of the indicators for innovation policy assessment (De Jong, Vanhaverbeke, Kalvet and Chesbrough, 2008). Enterprise and policies should create an interactive environment with the engagement of university. The use of go-betweens (intermediaries) play important role in management of network and IP collaboration, among other standards such as network developing and managing skills, stimulate interaction with actors, enhancing technology market, regional knowledge cluster backup. The role of intermediaries is not only limited in matchmaking, but also more prominent in solving conflict and problems, especially in helping small

companies to conquer the cultural and cognitive problems, which usually happen during the cooperation with university directly.

In terms of the category of IIMs, Jeremy Howells generalizes four groups of literature to highlight four roles of intermediaries in the innovation process: a) literature on technology transfer and diffusion; b) more general, innovation research on the role and management of such activities and the firms supplying them; c) the systems of innovation literature; d) research into service organizations and more specifically Knowledge Intensive Business Services (KIBS) firms (Howells, 2006). Based on this literature review, Howells' study has revealed that intermediaries provide a much wider, more varied and holistic role for their clients in the innovation process than has generally been acknowledged.

Howells has also suggested the systemic value that innovation intermediaries may play in policy terms in an innovation system. First, IIMs create networks within the innovation regional/national system. Second, within this network, IIMs create new possibilities and ties among university, industry and government. As it says by Howells "This is not only in terms of improving connectedness within a system, particularly through bridging ties, but also in its 'animateur' role of creating new possibilities and dynamism within a system". (Howells, 2006, p. 726)

The difficulties in defining "innovation intermediaries" exist in the multiple natures of one organization and the service itself that innovation intermediaries provide (Howells, 2006). The intermediary service might not be the only or primary function of one company or organization (Howells, 2006; Yang et al., 2014). On the contrary, many innovation intermediaries have multiple tasks while intermediary service is one of them. Furthermore to look at the intermediary work itself, it is an indirect go-between bridging responsibility between two or more parties. Thus, the assessment of the contribution is difficult to implement in the business's value chain. What's more, this service value might cause the "willingness to pay" from private or public sector to support innovation intermediaries in long run (Yang et al., 2014). Ye and others have developed a model to evaluate performance of innovation intermediaries (Ye et al., 2012). In this model, three capabilities are included for assessment: problem defining capability, problem-solver matching capability, proposal filtering capability. These three capabilities are to evaluate by examining different functions of innovation intermediaries in the facilitating activities.

In terms of the range of innovation intermediaries can refer to Fisher's research. The innovation brokering concludes knowledge broker, knowledge intermediaries/knowledge translator, and information intermediaries (Fisher, 2010). The topology of IIMs varies according to different perspective that has employed (De Jong, Vanhaverbeke, Kalvet and Chesbrough, 2008; Fisher, 2010; Zhao & Zheng, 2011; Agogué et al., 2013). In this research, the categorization of IIMs choose to use Howells' research.

There are three dimensions in defining intermediaries (Howells, 2006, p. 720; Hargadon and Sutton, 1997, p. 725): relationship, innovation process, and innovation functions (please see table 1).

Table 1 Three Dimensions in Defining Intermediaries

Relationship	(interactions and communication between different parties)	
Process	access; acquisition; Hargadon and Sutton (1997)	storage; retrieval; output Hargadon and Sutton (1997)

Functions	Foresight and diagnostics, information scanning and exchange	Gatekeeping and brokering	Knowledge processing and combination/recombination	Testing and validation, Accreditation, Validation and regulation, Protecting the results, Commercialisation, Evaluation of outcomes

As indicated in the table above, the function is the dimension reflect most detail of innovation intermediaries to break down the general analysis in relationship and process.

Table 2 Ten Functions of Innovation Intermediaries

Innovation intermediation functions
1. Foresight and diagnostics
2. Scanning and information processing
3. Knowledge processing and combination/recombination
4. Gatekeeping and brokering
5. Testing and validation
6. Accreditation
7. Validation and regulation
8. Protecting the results
9. Commercialisation
10. Evaluation of outcomes

(source: Howells, 2006, p. 720)

In Howells' IIMs category, there are five main functions that have been recognized: scanning and information processing, knowledge processing and combination/recombination, gatekeeping and brokering, testing and validation and commercialization (Number 2, 3, 4, 5, 9 in table 2). Five other functions are undervalued such as foresight and diagnostics, accreditation, validation and regulation, protecting the results, evaluation of outcomes (Number 1, 6, 7, 8, 10 in table 2)

Along the process of innovation, Howells has generalized ten functions of IIMs. It is a universal category for both startup and mature company. Scanning means to find "new users and applications in different sectors and industries" (Howells, 2006, p. 721-722).

1. Foresight: including technology foresight and articulation of needs and requirement. Technology roadmapping (TRM) is one type of foresight to consensus a set of needs and according technology to satisfy those needs, require leadership and commitment, resource allocation. This is detailed manifestation of "common will" need two parties – university and business – to work together on)

2. Scanning: "new users and applications in different sectors and industries" (Howells, 2006, p. 719). It involves technology options, new sources of knowledge, external knowledge providers. Scanning in technology intelligence includes scoping and filtering collaborative partners and identify technological opportunities and threats, in the ever shorten technology cycle and globalization.

3. Knowledge processing, generation and combination includes two types: combinatorial processing and generation and recombination. It is not only about combining knowledge of two or more partners, but also generating in-house research and technical knowledge to combine with partner knowledge. It is inward looking functions comparing to other functions.

4. Gatekeeping and brokering contain matchmaking and brokering, contractual advice. It is highly related to the other IP function will discuss below.

5. Testing, validation and training includes testing, prototyping and pilot facility, scale-up, validation of analytic methods, joint training in use of new technologies. To be more specific, this includes "providing advice on what the client company should be doing in the future with regard to analytical activities, how it should react to the changing regulatory environment, providing hazard assessments, and outlining what improvements can be made in relation to measurement and testing techniques and so on". (Howells, 2006, p. 722)

6. Accreditation and standards includes establishing standards in specification (such as reference designs), formal, voluntary and de facto standards.

7. Regulation and arbitration contain formal and informal regulations/self regulation, arbiter between different groups, consumers and producers.

8. Intellectual property is the way to protect results. It involves assessment, IP rights, IP management.

9. Commercialization is to exploit outcomes, which is market research and business planning, sales network channels, early stage funding, prove of concept funding.

10. Assessment and evaluation contain general assessment and market evaluation in technology. It is highly related to the first foresight function.

3.5 Innovation Intermediaries and Start-up

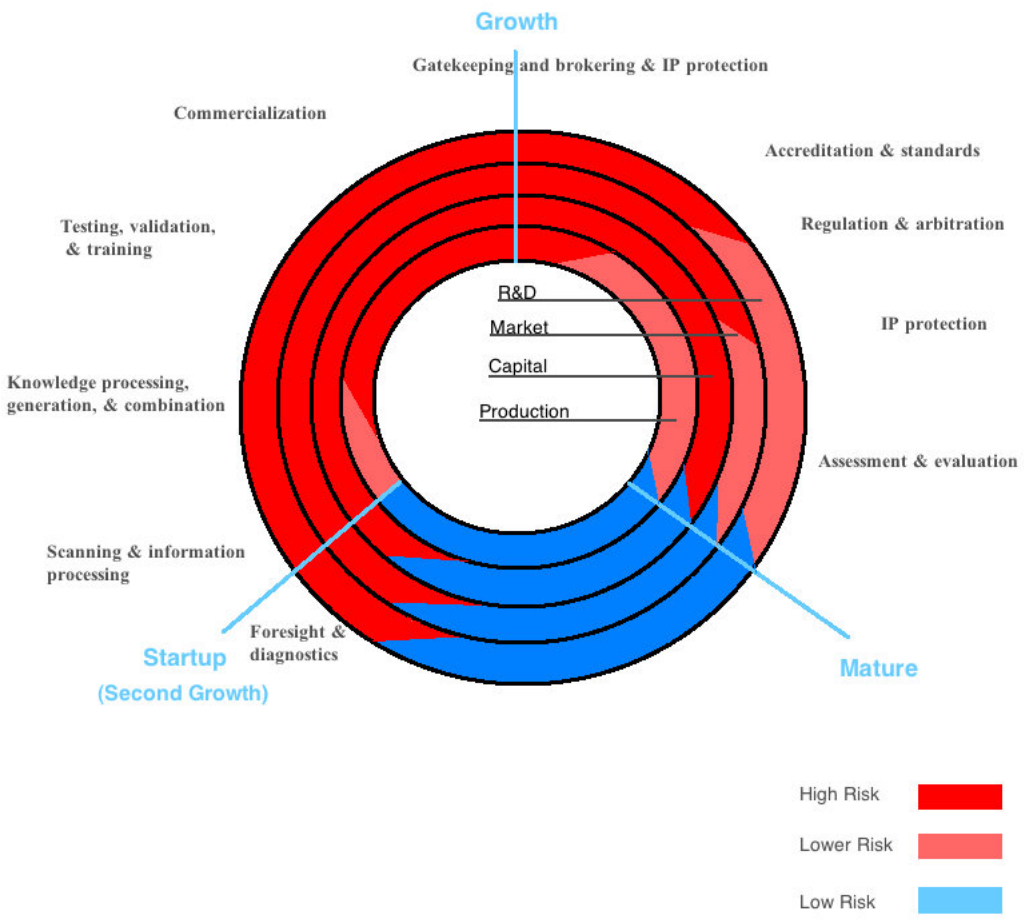
The students start-ups are new small firms, also known as start-ups, begin with an original idea from a student (Jovanovic et al, 2014). From the enterprise lifecycle point of view, enterprises usually go through three stages, namely startup stage, growth stage, and mature stage (Zhao and Zheng, 2011). This process is a cycle that when old product has reached the market saturation, a company need to develop new product, and this is the second growth stage. In the second growth stage, a company is no longer a start-up, but the new product developing process is similar to the previous one, which make the second growth stage possess some similar features of start-up stage.

In order to look at what innovation intermediaries facilitate companies on each of company lifecycle, here is to examine on each stage during the company lifecycle, what are the risks and what are the intermediary services in need.

Because the innovation process and existing risks on "second growth stage" is similar to "startup stage", it is shown as the same stage in the Figure 5. Accordingly, the facilitation from innovation intermediaries is shown in each stage to emphasize their roles in the enterprise lifecycle. However, each function is roughly divided on the basis of features on each stage. One function can be found in more than one stage during the enterprise lifecycle, such as commercialization also exists in

growth stage, IP protection cover the whole innovation process. As indicating in graph "Risk", innovation intermediaries play important role in startup and growth stages. It is decided by the main functions of innovation intermediaries: scanning and information processing, knowledge processing, gatekeeping and brokering, testing and validation, commercialization (Howells, 2006, p. 720).

Figure 5 Risks in Innovation Process & Facilitation from Innovation Intermediaries



A firm needs to consider constantly four factors during the whole development path: R&D, market, capital, and production (Zhao and Zheng, 2011). The risks vary on each stage. For start-up companies, risks are high in all four factors except slightly low in production because the product still stays on developing and testing. Before entering the growth stage, intellectual property protection is premise for scale-up production. With the product prototype developed and tested on start-up stage, it is ready for larger scale production and entering the market. On this stage, standard and assessment are in need for monitoring performance of a firm and products. On the stage of mature development, facilitation from innovation intermediaries reduces on those functions that it already fulfilled from previous stages. However, the facilitation are focus more on partner matching for new market or foresight diagnose for new demands.

Startup stage is the beginning of information gathering and technology development. The technology-centered period requires prototyping to transfer concept into preliminary model of product. Testing of technology is done before product testing in market and production. There is high risk exists in immature technology and unstable product performance. Based on all the features, capital is fundamental factor to support all the activities.

When technology become relative mature and stable, large-scale production is achievable. Risk mainly appears in cost and market uncertainty. Instead of early stage funding resource, company needs sustained capital to follow up enlarged production. Therefore, emphasis is in operating on enterprise growth stage.

On the mature enterprise stage, risk in technology and production cost decrease. However, technology updating and new technology is in need to increase competitiveness and tap into new market. In doing so, instead of declining, enterprise can enter “second growth” stage.

Therefore, the facilitation from innovation intermediaries on start-up companies is more focus on information scanning, knowledge combination, product testing, commercializing, and IP protection.

4. Theoretical Framework

Open innovation is beneficial for students' entrepreneurship as discussed. As two key actors to promote students entrepreneurship, university and business are lack of mutual understanding. Innovation intermediaries as being the middle bridge solve this problem. However, what is the role of IIMs in facilitating this process, this chapter continues the discussion from knowledge perspective: innovation intermediaries as learning infrastructure to facilitate knowledge transformation between university and business.

The knowledge transformation cycle involving explicit knowledge and tacit knowledge in the innovation ecosystem. Knowledge is of the most essence in the process of innovation, and is underlined in the era of knowledge economy. Many researches have been done on the function of innovation intermediaries in knowledge dissemination (Howell, and more). Knowledge intermediation is one important role of innovation intermediaries to facilitate knowledge co-construction by stakeholders (Yang et al., 2014). However, less attention is paid to the contribution of innovation intermediaries in knowledge transformation, while the "absorptive capacity" of tacit knowledge is particular important in university-industry linkage (Kodama, 2008). The role of innovation intermediaries in assisting knowledge exchange between university and business community is confirmed (Yusuf, 2008). Nevertheless, there left a blank which type of knowledge is transferred and how. This framework is built intending to answer this question.

The first and foremost challenge for IIMs is lack of trust from multiple stakeholders due to the difference in organization culture and goals. The fundamental problem of cooperation is that individual has only partial interests that are overlapping (Ouchi, 1980). As the coordinator among diverse participants in the open innovation process, the main task of IIMs is to match knowledge and facilitate the cross-sector cooperation. The knowledge matching is explored as one general function of IIMs in previous research. However, the discussion can go deeper to specify the type of knowledge that IIMs facilitate.

The adopted theory in this theoretical framework is Scharmer's learning infrastructure theory. By using this framework, it is intend explain how IIMs facilitate knowledge transformation as three levels learning infrastructures. Furthermore, it is to locate which type of learning infrastructure Z-park for Graduates is in this framework. Because Scharmer's learning infrastructure theory is built based on three other theories – Polanyi's two types of knowledge (explicit and tacit knoweldge), Nonaka's knowledge spiral model, and Scharmer's theory U – it is necessary to first introduce these theories and analyze how it is related to IIMs.

The relation of these three theories with learning infrastructure framework is briefly introduced here:

Polanyi divides knowledge generally into two types, the explicit knowledge and tacit knowledge (Polanyi, 1966). In Scharmer's learning infrastructure, knowledge is further divided into three types, including explicit knowledge, tacit-embedded knowledge, and tacit-not-yet-embedded knowledge. Based on these three levels of knowledge, Scharmer develops three type of learning infrastructure to facilitate knowledge transformation process (Scharmer, 2000).

Nonaka's knowledge spiral model explains how different knowledge interacts with and transform from one to the other, i.e. tacit to tacit knowledge, tacit to explicit knowledge, explicit to explicit knowledge, and explicit to tacit knowledge (Nonaka, 1991). Different type of knowledge transform and the way of knowledge transformation are two criteria to distinguish different levels of learning infrastructure (Scharmer, 2000). The activities on different level of learning infrastructures are important to analyze different facilitations of IIMs between university and business.

Scharmer's theory U analyzes knowledge transformation in organization innovation through interaction with outside environment. It emphasizes on the role of tacit-not-yet-embedded knowledge in the knowledge transform process (Scharmer, 2009). The theory U supports the analysis on type III learning infrastructure.

4.1 Theory Foundation Review

4.1.1 Two Types of Knowledge and IIMs

Information and knowledge are often referred interchangeably. The definition of information given by Machlup, is a flow of message or meanings which might add to, restructure or change knowledge (Machlup, 1983). However, information is not equal to knowledge as it is only the foundation to yield knowledge through individual processing. Knowledge is, as indicated in knowledge creation system, the result of the dynamic human process of justifying personal beliefs as part of an aspiration for the truth (Nonaka, 1994). The focus, as argued by Nonaka, should be "active" and "subjective" nature of knowledge instead of "static" and "nonhuman" nature of knowledge in the organizational creation of knowledge.

Knowledge has different types and nature. Polanyi categorizes knowledge into "explicit" and "tacit" knowledge. "Explicit" knowledge is coded, transmittable as presented in formal and systematic language. On the other hand, "tacit" knowledge, which is deeply rooted in specific context, can hardly translated into formalized language due to the personal quality it possesses.

Polanyi believes that "we can know more than we can tell" (Polanyi, 2009, p. 4), such as to recognize a face among thousands of people, yet we cannot tell how we did it. We realize this ability only by the results of recognition, but not the process when we are doing the recognition. It is the knowledge that cannot be put into words. As explained in Gestalt psychology, integration of awareness is a process to integrate particulars without being able to identify each particulars specifically. Based on that theory, Polanyi argues that the integrating is the tacit power to discover knowledge that manifested in arts, athlete, handcraft, and other intellectual and practical kind areas.

By using the example above of the human ability in face recognition, Polanyi illustrates two terms and two structures of tacit knowing. Although we all have the ability to recognize a face among thousands of faces, we cannot actually tell why it is. Those detailed and subtle features for us to distinguish different faces are fragmented. Our brain can differentiate those elements but we do not clearly aware of how we do it. There are two terms in tacit knowing that "we attend from something for attending to something else" (Polanyi, 2009, p. 10). The first term is something we "attend from" and the second term is something "we attend to".

These two terms are interlinked that "we know the first term only by relying on our awareness of it for attending to the second" (Polanyi, 2009, p. 10). Comparatively, the first/proximal term is nearer to us than the second/distal term. The proximal term is the knowledge that we may not be able to tell clearly. By applying the Gestalt theory, Polanyi explains that we usually cannot specify those elements that we are attending from, and those elements are used to form the integrated purpose we are attending to. This is called the functional structure of tacit knowing by Polanyi.

Relatedly, there is a phenomenal structure of tacit knowing. We know about proximal term of tacit knowing by the appearance of its distal term, meaning that we are aware of the distal thing we are "attending to" from the proximal term that we usually unable to tell.

By looking at the meaning that proximal term conveys to us, it is significant to understand the relation between functional structure and phenomenal structure. It is the meaning of proximal term that directs our attention to the integrated purpose. Our apprehension is formed only by the meaning of proximal term without identify the particular term.

Because of the unidentifiable elements of the proximal term, Polanyi suggests that to understand the combined meaning of tacit knowing is through dwelling in them rather than by looking at those elements. The way of mathematical theory to specify the particulars go much deeper in the sense of construction and operation, such as in machinery, comparing to the skills required to use a machine. However, the meticulous detailing still cannot specify the tacit meaning, as Polanyi states "the recovery never brings back the original meaning" (Polanyi, 2009, p. 19). It is self-contradictory that the modern science, which is built on the principle of objective knowledge, tries to only use mathematic approach to explore all the elements that universally exist in all knowledge. For example, the driving skills can never be obtained only through schooling of the motorcar theory. The tacit knowledge is embedded in the undiscovered hidden realities that provide valid anticipation for the indeterminate implications of the discoveries.

4.1.2 Knowledge Spiral Model and IIMs

The discussion of tacit knowledge by Polanyi is done in philosophical context, while Nonaka expanded the theory to a more practical direction in knowledge management. From the perspective of company, Nonaka raised up the challenge to distinguish type of knowledge instead of discussing knowledge in general (Nonaka, 1991). Unlike the belief of others to see organization as "information processing machine" (Nonaka, 1991, p. 164), Nonaka suggests to view knowledge as the core competitiveness of a company as the successful companies have excelled in knowledge management, despite the difference of knowledge management between Japan and the West. In the knowledge management, the tacit and subjective insight is more crucial than objective information processing as the serendipitous quality of innovation. Accordingly, it requires more personal commitment to embody tacit knowledge for actual use (Nonaka, 1991; Nonaka, 1994).

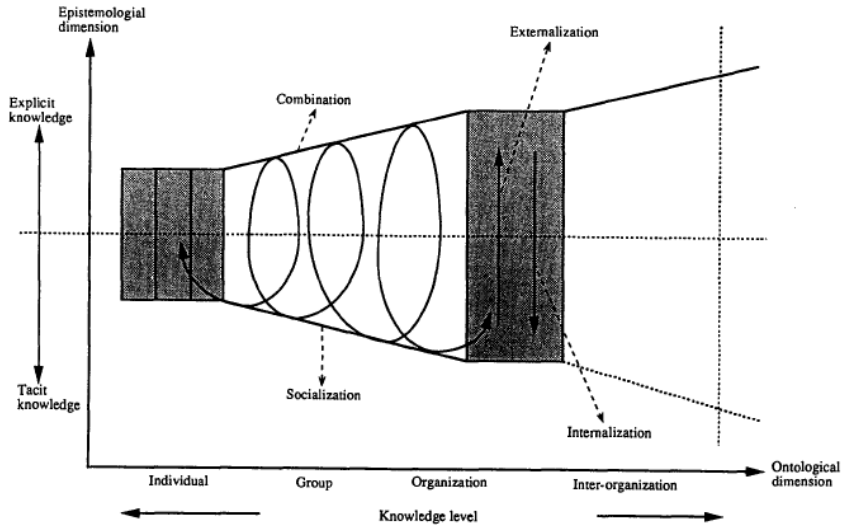
4.1.2.1 Four Modes in Knowledge Spiral Model

A knowledge-creating company is of continuous innovation and self-renewal process. The innovation within an organization exists in the process of knowledge creation. It is important for an organization to study innovation on how it create knowledge rather than how it process it.

In the process of knowledge creation, there are two types of knowledge, namely explicit knowledge and tacit knowledge. Explicit knowledge is formal and systematic that can be easily communicated and shared. Tacit knowledge is highly personal, hard to formalize, and difficult to communicate with others, which is deeply rooted in action and in individual's commitment to a specific context (Nonaka, 1991, 1994). It can be acquired without langue but through imitation, observation and practice. The tacit knowledge can be further divided into two parts: technical skills and cognitive dimension. The technical skills are "informal, hard-to-pin-down" know-how skills. While the cognitive dimension is mental models, beliefs, and perspectives that how we perceive the world (Nonaka, 1991).

By distinguish explicit and tacit knowledge, Nonaka believes there are four patterns for creating knowledge in any organization meaning from tacit to tacit, from explicit to explicit, from tacit to explicit, and from explicit to tacit.

Figure 6 Spiral of Organizational Knowledge Creation



(source: Nonaka, 1994, p. 18)

Tacit knowledge is time and space-specific shared experience (Nonaka, Toyama, Konno, 2000). Tacit knowledge can be shared with each other through observation, imitation, and practice, apprenticeship is a typical example. It is a socialized process. However, the weakness is the knowledge can hardly be utilized on organization level but rather stay within small number of individuals (Nonaka, 1991). In the mode of knowledge creation, the creation of tacit knowledge by sharing experience is called "socialization" (Nonaka, 1994).

Knowledge creation from explicit knowledge to explicit knowledge is to synthesize discrete information into a systematic set. Different sources of knowledge within or among different organizations can be collected to form a knowledge reservoir (Nonaka, 1991). New explicit knowledge is created through "sorting, adding, recategorizing, and recontextualizing" existing explicit knowledge. This knowledge creation is called "combination" (Nonaka, 1994)

The transform from tacit to explicit is to articulate and converts the tacit knowledge into explicit knowledge so as to share on organizational level. It is called "externalization", in which "metaphor" is important (Nonaka, 1994). While from explicit to tacit is to actively internalize new explicit knowledge to broaden, extend, and reframe existing tacit knowledge (Nonaka, 1991). This is called "internalization", which is associated with organizational learning (Nonaka, 1994), closely related to "learning by doing" (Nonaka, Toyama, Konno, 2000). The internalized explicit knowledge are the base to start new spiral of knowledge creation through sharing with others.

These four modes of knowledge creation model consist of the interaction between tacit and explicit knowledge. The shift between different modes of knowledge conversion among socialization, externalization, combination and internalization are called "SECI" process (Nonaka, Toyama, and Konno, 2000).

Externalization
To articulate tacit knowledge into explicit knowledge goes through three steps, as explored by Nonaka, from Metaphor to Analogy to Model. A metaphor is a figurative language to explain a concept embedded with intuition and insight, for example, a slogan for product development. This concept is proposed to confront a challenge or fulfill a goal as an overarching symbol, for example, slogan for company culture.

> "metaphor is a distinctive method of perception. It is a way for individuals grounded in different contexts and with different experiences to understand something intuitively through the use of imagination and symbols without the need for analysis or generalization." (Nonaka, 1991, p. 167)

Metaphor is an inclusive image that is distant from reality. The second step to connect metaphor with practical application is analogy. Analogy is to clarify the alike and not alike between two ideas in order to make relevance between metaphor and practical ideas, between "pure imagination and logical thinking" (Nonaka, 1991, p. 168).

The last step is design a model by using consistent and systematic logic to translate concept into conceivable system that can be widely used. These three steps are intertwined. However, it helps to clarify knowledge transformation process.

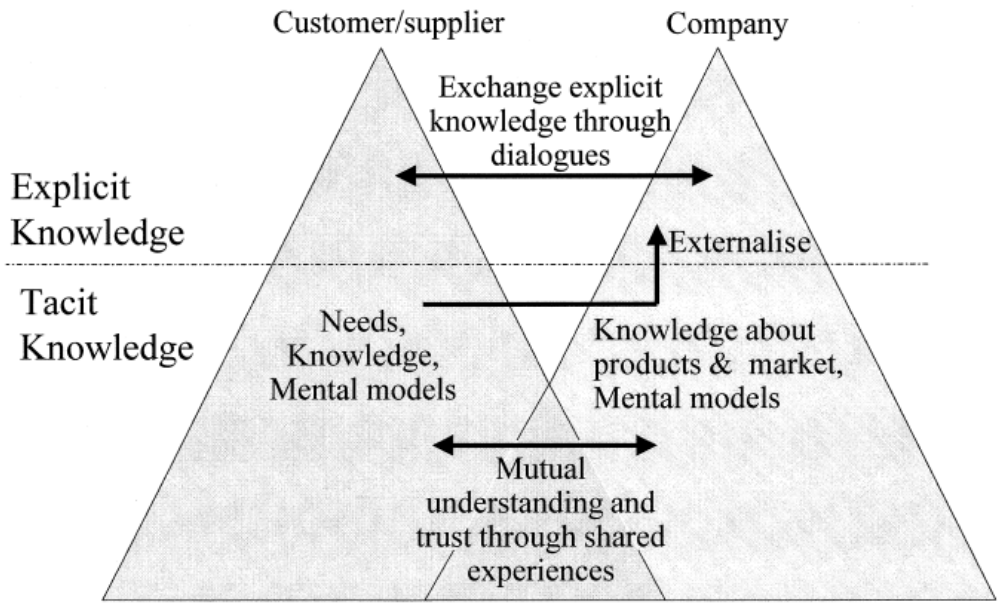
It is worthy of notice that during this process, two patterns (explicit to tacit and tacit to explicit) are more important because it require more personal commitment, which involves individual mental models and beliefs. Although four modes can generate new knowledge independently, it worth noticing that problems might appear in "socialization" and "combination". "Socialization" without concrete presence would bring problem in sharing and spreading ideas. "Combination" without personal commitment would lead to meaningless piling up (Nonaka, 1994).

The knowledge creation is an on-going and circular process. There are two dimensions of spiral in this model. The first spiral is to describe the four modes of conversion cycle as discussed above on epistemological level. The second is the upward spiral process from individual level to interorganizational level on ontological dimention, as illustrated in Figure 6. The shift through four modes of knowledge conversion shapes the spiral process (Nonaka, 1994; Nonaka, Toyama, and Konno, 2000).

The interactions between explicit and tacit knowledge are applicable to discuss in individual, collective, organizational and interorganizational level. "The interactions between tacit knowledge and explicit knowledge will tend to become larger in scale and faster in speed as more actors in and around the organization become involved." (Nonaka, 1994, p. 18). This spiral process expands from individual, to sectional, departmental, divisional and even organizational boundaries. Examples are given from business perspective on intra-firm and extra-firm of how to gather tacit knowledge, from different apartment (eg., sales, production) inside a company to multiple external stakeholders (eg. suppliers, customers, competitors) (Nonaka, Toyama, and Konno, 2000). University is one of the constituents outside of organization that taking part in the knowledge mobility with other organizations, meaning business in the discussion of Nonaka.

The four types of knowledge creation construct a process to learn of tacit knowledge, translate tacit knowledge into explicit form, apply it into practical situation for problem solving, and use the new explicit knowledge to update existing tacit knowledge. This spiral cycle is called "spiral of knowledge" (Nonoaka, 1991). Knowledge creation stemmed from individual learning than is expended to the knowledge base of a whole organization.

Figure 7 Creating knowledge with outside constituents



(source: Nonaka, 2000, p.13)

Nonaka and others illustrates the interaction between explicit and tacit knowledge between company and outside constituents (See Figure 7). As we can see, the knowledge conversion above the water surface is explicit knowledge exchange (combination). Although Externalization is aiming to convert knowledge into explicit, it is rooted in tacit knowledge. The internalization of knowledge convert knowledge into tacit for next round of socialization. It is not to address that tacit knowledge is more important than explicit. However, the needs, mental models, mutual understanding and trust are the origin of explicit knowledge and indispensable part in knowledge conversion.

Accordingly, IIMs facilitate all four modes of knowledge creation. However, discussion seldom is done in the knowledge creation perspective and is limited in "combination" and "externalization" level. This study is aiming to discuss IIMs' function in all four modes, especially in "internalization" and "socialization", that how IIMs facilitate knowledge conversion.

Table 3 IIMs in Knowledge Creation:

Knowledge creation	**IIMs Facilitation**
Socialization (tacit-tacit) Share experience	?
Combination (explicit-explicit) Exchange Mechanism	scanning and information processing; knowledge processing and combination/recombination; gatekeeping and brokering;
Internalization (explicit-tacit) Learning process	*explicit knowledge gained from university or business through IIMs to reframe existing tacit knowledge
Externalization (tacit-explicit) Conceptualization	commercialization; testing and validation; protecting the results; accreditation and standards; regulation and arbitration

When we look at the facilitations from IIMs in the knowledge conversion process, the basic functions, as discussed by Howells, are staying above the water surface in the combination and

externalization modes. The facilitation in tacit knowledge is seldom discussed (the gray filed in Table 3). Here is to analyze the function of IIMs from the perspective of how IIMs facilitate knowledge conversion.

Among all ten functions of IIMs (Howells, 2006), three functions prone to facilitate creating explicit knowledge in "combination" including scanning and information processing, knowledge processing and combination/recombination, gatekeeping and brokering. Five functions prone to facilitate the transferring of tacit knowledge into explicit, such as commercialization, testing and validation, protecting the results, accreditation and standards, and regulation and arbitration.

Evaluation of outcomes is related with foresight and diagnostics. These two functions of IIMs represent the knowledge creation of internalization (evaluation of outcomes) to externalization (foresight and detect potential future trend).

Testing and validation: as to formulate a scale or measurement to assess the maturity of one technology in the process of development. For example, the Technology readiness levels (TRLs) is widely used in dividing technology readiness into different levels according to test and validation (EC, 2013). Similarly, accreditation and standards, regulation and arbitration transfer tacit knowledge through explicit legal approach.

As in protecting the results, the target of intellectual property protection is the intangible asset. The IP is to legalize the exclusive right of mind creation (WIPO, 2014). It is also a process to build up foundation for protection through breaking down components that are formed intangible asset.

Other sample of "externalization" (tacit-explicit) is Z-park for Graduates. It is to externalize tacit knowhow and cognition in workplace into explicit knowledge in the form of course training, on-job training for university students.

The "internalization" usually happens by acquiring explicit knowledge cross-sector. Inside of an organization, "internalization" from explicit to tacit is through "enactive liaising" across different functional teams or units. Across organization, it is done by IIMs to acquire explicit knowledge. The knowledge that university learned about technology transfer and commercialization through IIMs can reframe university tacit knowledge in the way of increasing awareness of market or technology demands. The knowledge that company gained from IIMs about cutting edge technology can inspire and shape planning or even long-term vision.

There are learning activities inside of IIMs itself such as the learning of diverse domains is the first and foremost step to start intermediary work, and learning from solving new problems and integrate the knowledge in the past (Ye et al., 2012). However, this is not the emphasis here in the process of knowledge transformation where IIMs' function is bridging between different parties.

IIMs are more discussed as part of the process "combination" and "externalization" modes. In the mode of "internalization", IIMs play the role of facilitation while internalization really happens in respective organizations that IIMs facilitate, namely university and company. Because after all, IIMs are the intermediary agency to transfer knowledge from one organization to another.

It is the purpose of this research to articulate the undervalued function of IIMs in facilitating knowledge creation of "socialization". The ten IIMs functions in Howells framework did not mention this function of bridging tacit knowledge exchange and creation among different organizations.

4.1.2.2 IIMs as in Self-organizing team, Redundancy, and Ba

To facilitate knowledge creation, Nonaka points out that redundancy in organization is important. The redundancy is "the conscious overlapping of company information, business activities, managerial responsibility within an organization create a 'common cognitive ground' to facilitate the transfer of tacit knowledge" (Nonaka, 1991). Redundancy exists on intra-organizational level and inter-organizational level. Inside one organization, redundancy of information helps organizational members to transcend functional boundaries to provide information from different perspective. Through the overlapping redundancy between organizations, organization participants can access to new information from other organization's point of view. Additional knowledge would be created based on mutual sharing of existing knowledge.

There are two problems might appear from the redundancy of information. First is information overload. Second is increasing cost for creating redundancy. It requires an independent self-organizing team or organization to manage the information and create possibility for participants to share the cost. These are two reasons why IIMs exists. IIMs, as the intermediary agency between university and business, take the task of managing information from both sides. Therefore, information can be organized, matched, and spread. It is supported from multiple funding resources that save the cost to establish an self-organizing team by one single organization.

Redundancy can be built through internal competition, strategic rotation, and free access. As the conflict exists between research and development department regarding new technology research and application of the technology (Chesbrough, 2003), dialogue and communication through competition and rotation can be increased. Free access of information clears the barriers for new knowledge to spread among different units. In this way, new technology can be utilized faster within an organization. To look at redundancy from the view of open innovation, inter-organization or cross-sector communication is also necessary to build "common cognitive ground" that benefits the transfer of tacit knowledge. The access of information, under the protection of intellectual property, can facilitate cross-sector cooperation as well.

From the point of view of organizational knowledge creation, a "field" is important for members to cooperate. This "field" is called "self-organizing team". It is an autonomous and dynamic social context, within which, interdependent (rather than similar) members can articulate their perspectives and solve conflicts. As redundancy in an organization, the activities of "self-organizing team" are not only cross-unit, but also cross organization boundary to interact with environment outside of organization. What's more, it requires active learning and innovation, which can be linked to everyday work. Therefore, it is an "evolving communities" that facilitate knowledge creation (Nonaka, 1994).

It is found that "the cross-functional teams that involve members from a broad cross-section of different organizational activities is very efficient in the innovation process" (Noaka, Toyama, and Konno, 2000, p. 24)

There are two ways for self-organizing team to facilitate organizational knowledge creation. First is to build mutual trust among members as the foundation of sharing tacit knowledge. Second is to conceptualize the implicit perspective through dialogue among members. As discussed that the "externalization" is a time-consuming process, mutual trust play the role of base to exchange tacit knowledge. The main mode of knowledge creation in self-organizing team is "socialization".

Based on mutual trust, the next step is to articulate the implicit perspective into explicit concept. This process is called "conceptualization". Face-to-face dialog helps to clarify different

perspectives. However, Nonaka set up several ground rules for such dialog that it should be a multifaceted and negotiable continuity. The dialog is supported by redundant information.

An idea is established through interactive communication. The next step is to crystallize this idea into a concrete product or a system (Nonaka, 1994). The process is called "crystallization", which is done by self-organizing team to test the applicability of concept. Redundancy, again as a base here, creates possibility for critique conversation and function as the major factor to facilitate the process.

The last step is justification and quality of knowledge. In order to share knowledge outside of organization, one needs to ensure the quality of knowledge by justifying. Certain standard should be set up as quality control of "truthfulness" that can be followed on both quantitative and qualitative levels (Nonaka, 1994; Nonaka, Toyama, and Konno, 2000).

Redundancy is an important element in organization learning and networking. Company tends to learn as much as possible from trusted partners. It is addressed by Hagedoorn and Duysters that comparing two rationalities in network behaviors between efficiency-based network and learning-based network, the latter creates redundancy in information, which is one of the conditions to increase information flow as the contact between participants increase (Hagedoorn and Duysters, 2002).

From the management point of view, redundant information enables each part that hold valuable knowledge can have impact on the system. It appears as nonhierarchy in reaching consensus and extended participation. It increases the interaction with hierarchy as well in organizational structure. On one hand, nonhierachy are necessary for new knowledge generation. On the other hand, hierarchy is efficient in "implementation, exploitation, and accumulation" of new knowledge. In corresponds to the four modes of knowledge creation, combination and internalization usually happen in hierarchical organization, whereas socialization and externalization usually happen in nonhierarchical organization (Nonaka, 1994).

It is stressed by Nonaka that this model is suitable in explaining any type of organization regardless of economic, social, or culture difference. What's more, it applies to knowledge creation among individuals, organizations, and societies. Therefore, when look at IIMs in this way, it is an intermediate organization with special function in bridging different sectors in an dynamic ecosystem. In this three actors community, it performs on both nonhierarchical and hierarchical organizational structures. One as a self-organizing team to bring university and business together for cross-sector experience sharing, the other as a hierarchy organization itself to efficiently provide multi services for two parties in knowledge combination and internalization. (connect it with the IIMs table below.)

Redundancy bring together participants by providing the "field" to create relevant and convergent knowledge in order to achieve a goal or confront a challenge.

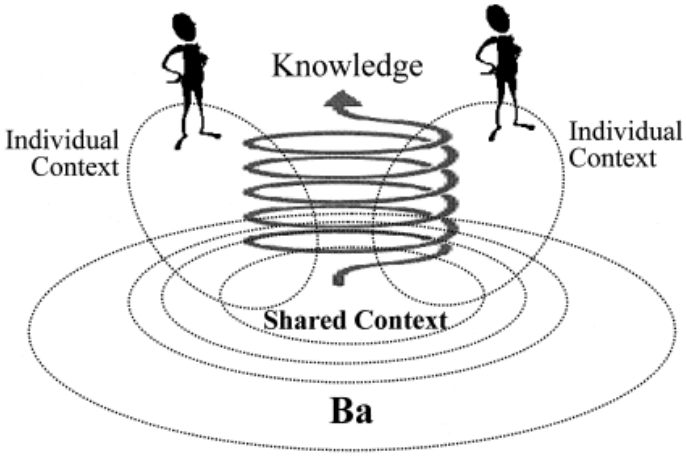
(Functioning as a nonhierarchical self-organizing team, IIMs facilitate in building up mutual trust between two sectors, and create a platform of dialog for two parties to transfer implicit ideas into concept. In the case study of Z-park for Graduates, the implicit idea is to bring university and business together for common challenge. The concept is to establish cooperation between university and business in promoting students employability and entrepreneurship, and further crystallizing this concept into a concrete non-profit innovative training system for university student approaching graduation. As a hierarchical organization, IIMs collect information to set up standard and concrete planning of operation and implementation of training, manage daily running to support all the activities.)

Table 4 General Features within Knowledge Spiral Model

Knowledge creation	Socialization (tacit-tacit)	Combination (explicit-explicit)	Internalization (explicit-tacit)	Externalization (tacit-explicit)
Activities **Organizational structure** **Ba type** **Knowledge assets** **Example**	Share experience Nonhierarchical Structure Originating Ba Experiential Knowledge Skill, trust, passion	Exchange Mechanism Hierarchical Structure Systemizing Ba Systemic Knowledge Documents, database, patents	Learning process Hierarchical Structure Exercising Ba Routine knowledge Know-how daily running, organizational culture	Conceptualization Nonhierarchical Structure Dialoguing Ba Conceptual knowledge Product concept, design

After the discussion of self-organizing team, Nonaka future develops this concept into "Ba", which is "an autonomous and self-sufficient unit that can be connected with other ba to expand knowledge." (Nonaka, Toyama, and Konno, 2000, p. 17). Ba is a shared context in motion, in which knowledge is shared, created and utilised. Platform for knowedge conversion, space for self-transcendence, multi-context place (Nonaka, Toyama, and Konno, 2000) By using theory of redundancy and ba, IIMs are the "common cognitive ground".

Figure 8 Common Cognitive Ground



(source: Nonaka, Toyama, and Konno, 2000, p. 14)

As analyzed by Nonaka that knowledge involved more personal beliefs, knowledge creation is not a context-free process. This is especially important for tacit knowledge creation. Social, culture, historical context provide the background to interpret information into knowledge.

Ba performs as a time-space nexus to share individual context on a common ground. Ba is consisted by physical space (office), virtual space (Email), and mental space (shared ideas). However, ba can be a mental or physical place. It has not to be bound to space and time. The existing of space and time is helping to form common "communication language" among participants to collect intangible knowledge into a certain space and time. To look at IIMs, it is to form a mental or

physical community for university and business to communicate, the knowledge accumulated in this community can be specialized in promoting innovation. "Knowledge creation is a dynamic human process that transcends existing boundaries." (Nonaka, Toyama, and Konno, 2000, p. 14-15) By interacting with each other, participants can create new knowledge through self-transcendence, as indicated in Figure 8 above.

Therefore, ba has two natures. One requires merging of share knowledge in a share context with boundary. The other is an "open place" where participants' context can "come" and "go" (Nonaka, Toyama, and Konno, 2000, p. 15). Scharmer reasons on the "open place" from mental space point of view. "Letting go" and "letting come" are two steps to form "open will", which is the foundation of self-transcending knowledge creation (Scharmer, 2001, 2009).

Base on four modes of knowledge conversion modes, there are four types of ba: originating ba, dialoguing ba, systemizing ba, and exercising ba. In the originating ba, the knowledge socialization happens among individuals through face-to-face communication to build mutual trust and commitment. In the dialoguing ba, knowledge externalization articulate mental model into concept more consciously and collectively. In the systemizing ba, knowledge is combined systematically to apply to wider range in the form of database or documentation and so on. In the exercising ba, the systematical knowledge is fed back to individual action. The reflection can go to the next round of knowledge spiral (Nonaka, Toyama, and Konno, 2000). Accordingly, four types of knowledge assets are stemmed from ba: experiential knowledge, conceptual knowledge, systemic knowledge, and routine knowledge.

Based on this knowledge model, it is important to utilize it to explain how companies, government and universities can work together to make knowledge creation possible (Nonaka, Toyama, and Konno, 2000, p. 30). On the ground of Ba, the knowledge formed from the spiral model can provide participants with a higher viewpoint than their own. The function of organizations, such as industry alliance and cross-sector association, can be analyzed by the theory of Ba. It provides three components of "time-space nexus" (Nonaka, 1991). More importantly, this type of IIMs builds up a common ground for participants to form "open will" (Scharmer, 2009). Tacit knowledge is spread through sharing experience in communication and dialog.

Because IIMs is an open ground, the autonomy enables participants to create unexpected knowledge (Nonaka, Toyama, and Konno, 2000). The autonomy is best achieved in the form of self-organizing team.

IIMs not only facilitate explicit knowledge spreading (matching service, information service, etc.), but also perform as a middle ground for different sectors, in which a community is formed for members to share experience, and enhance further and deeper cooperation.

The commitment is consisted by autonomy, fluctuation, and intention (Nonaka, 1994). The intermediaries, as the mutual platform for university and business, are functioning to provide a benign environment for cross-sector cooperation. In this platform, different parties enjoy equal right by offering supplementary resource and knowledge. "Autonomy" as one function of IIMs, is important to keep members together while they have different goal and nature.

Fluctuation, as the status of "order without recursiveness" (Nonaka, 1994, p.18), is different from complete chaos. It is generated in the continuous interaction with the external world. In the open innovation, inter-organizational/cross-sector cooperation encounters challenges due to diversified goals and culture. However, organization benefits from fluctuation by realizing problems in routine so as to formulate realignment and commitment. It is supported by Scharmer in his U model that

"letting go" of old recognition model is the premise of "letting come" for innovation (Scharmer, 2001).

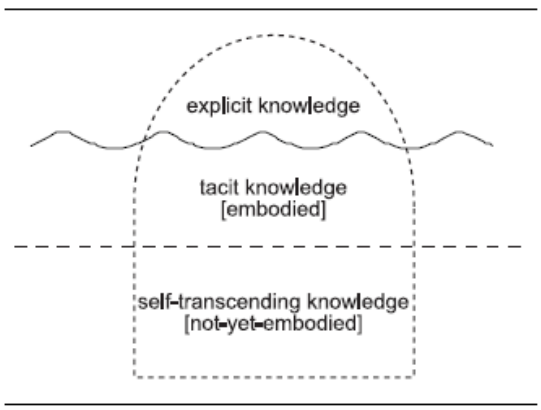
Intention is to collect information for future adaptation. The information in need is collected through two judgments. One is where the organization located in its surrounding environment because its survival environment decides the value of one organization. Second is organization vision, which is decided by "future aspiration" than current state (Nonaka, 1994). In this line, Scharmer further develops it into "learning from the future" as to accentuate that learning should be extended to the emerging opportunities across one's organizational boundaries (Scharmer, 2009).

Three out of four knowledge creation modes are closely related to organizational theory. "Socialization" is associated with organizational culture theory, "combination" with information processing, and "internalization" with organizational learning (Nonaka, 1994). IIMs facilitates in the three modes. The cross-sector "socialization" can be done within the platform created by IIMs in the form of association, forum, community, alliance of different industry or sectors. Tacit knowledge is transferred through communication, sharing experience, dialog by taking part in conference, theme seminar, meeting, visiting, staff redeployment, and other activities that build up socializing network among different sectors. The "combination" happens through IIMs resource and information matching, R&D cooperation, technology transfer,

4.1.3 Not-yet-embedded Knoweldge and IIMs

On the base of Polanyi and Nonaka, Otto Scharmer continues to specify the two types of knowledge of explicit and tacit. On the tacit knowledge level, Scharmer distinguishes the tacit knowledge as tacit-embodied knowledge and not-yet-embodied knowledge. His focus, however, is on the cognitive dimension of tacit knowledge, which is also called as self-transcending knowledge (Nonaka, 1994; Scharmer, 2000). As the example Scharmer uses to explain the different of three types of knowledge (see Figure 9). The finished painting is explicit knowledge. The painting skills and color choice used during the painting is tacit knowledge embodied. The design of composition and the meaning is going to convey through this work before start painting is self-transcending knowledge. Thing, process, and cognition represent the three types of knowledge here.

Figure 9 Three Types of Knowledge



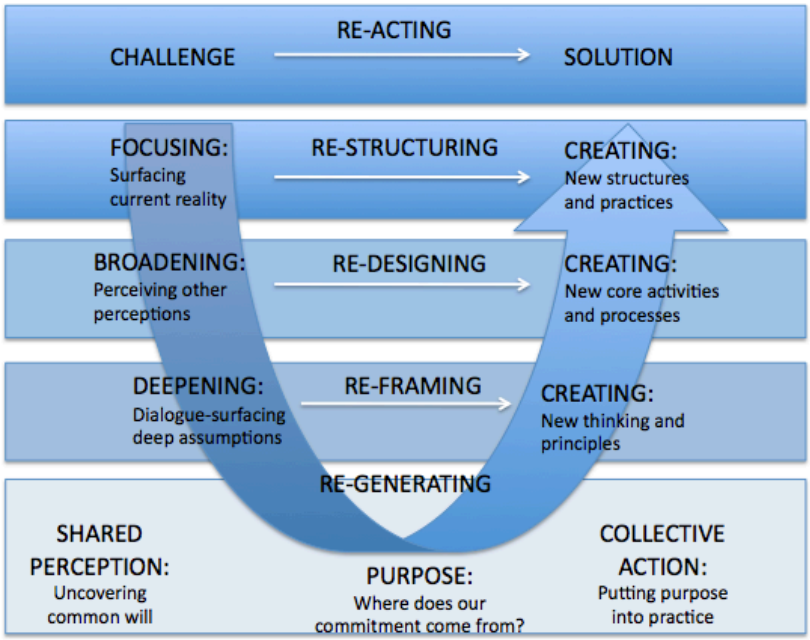
(source: Scharmer, 2009, p. 70)

The services provided by IIMs to facilitate knowledge creation mostly in explicit knowledge and tacit-embodied knowledge (technical skills) as discussed above. The example in tacit-embodied knowledge level can be the testing and standard in externalization process to crystallize technical skill into measureable knowledge. IIMs also play important role in tacit-not-yet-embodied

knowledge, such as to reach mutual trust, common motivation, common will by building up a platform that involve diversified actors in innovation.

As the nature of tacit knowledge requires communication and commitment, Nonaka distinguishes several level of social interaction to discuss knowledge creation (Nonaka, 1994). First is informal community as intermediate forum to span organizational boundaries for emerging knowledge. The knowledge creation can be expanded to interorganizational level on a formal basis through formation of alliances or outsourcing (Nonaka, 1994). Scharmer continue to discuss not-yet-embodied knowledge to sense and organize around emerging opportunities between organizations (Scharmer, 2001).

Figure 10 Five levels of change



(source: Scharmer, 2009, p. 29. Compiled by author)

In the process from facing a challenge to finding a solution, Scharmer suggests that it should go through a U-shape procedure (see Figure 10). It is a repeated process of combination, internalization, socialization, externalization, and combination again. It is the knowledge shifting from explicit knowledge (left end of "U"), to tacit knowledge (bottom of "U"), to new explicit knowledge (right end of "U"). It is important to use Nonaka's theory to explain IIMs' facilitation in knowledge creation. In addition, the essence of theory "U" is the transformation on self-transcending knowledge level at the bottom. Therefore, it is more important to use Scharmer's U model to emphasize IIMs' facilitation in self-transcending knowledge level. The self-transcending level requires shared perception to uncover common will and collective action to put purpose into practice (see Figure 10). It is the function of "self-organizing team" in Nonaka's knowledge management theory (Nonaka, 1991). Comparing with Nonaka's SECI model, "U" theory considers the self-transcending knowledge as the most important part in the process of innovation.

There are three levels of organizational change in correspondence to three types of knowledge: structure, process, and thought (Scharmer, 2009, p.28). These three factors consist the three levels of theory U. The three levels are corresponding to three types of knowledge respectively, namely explicit knowledge, tacit-embodied knowledge, and not-yet-embodied knowledge.

Nonaka's knowledge spiral model and the theory "U" are formed under the open innovation context. "Coexperience with others enables us to transcend the ordinary 'I-Thou' distinction, and open up the world of common understanding" (Nonaka, 1994, p. 22). Scharmer defines four types of relation between organization and its environment. First, "I-in-me" focuses on organization itself and reenact patterns of the past. It is to act from the center inside one's organizational boundaries. Second, "I-in-it" focuses on exterior data from outside of organization but stay at the periphery of one's organizational boundaries. Third, "I-in-you" go beyond organizational boundaries to connect with outside partners through mental-social activities. Fourth, "I-in-now" is to act from the emerging sphere across one's organizational boundaries.

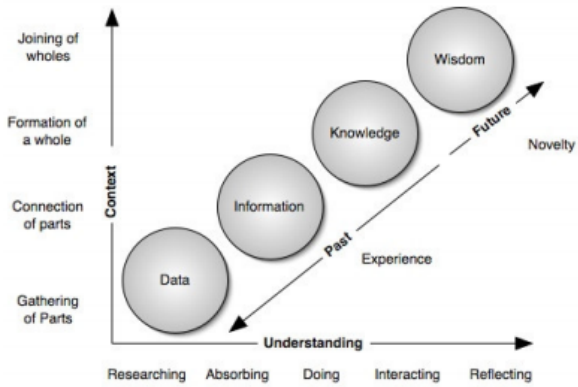
These process is breaking down into seven stages: downloading, seeing, sensing, presencing, crystalizing, prototyping, and performing, embodying.

The Definition of Each Stage in Theory U (Scharmer, 2009, p. 39)

- Downloading: reenacting patterns of the past – viewing the world through one's habits of thought
- Seeing: suspending judgment and seeing reality with fresh eyes – the observed system is separate from those who observe
- Sensing: connecting to the field and attending to the situation from the whole – the boundary between observer and observed collapses, the system begins to see itself
- Presencing: connecting the deepest source, from which the field of the future begins to arise – viewing from source
- Crystallizing: vision and intention – envisioning the new from the future that wants to emerge
- Prototyping: living microcosms in order to explore the future by doing – enacting the new through "being in dialogue with the universe"
- Performing and embodying: the new in practices and infrastructures – embedding the new in the context of the larger co-evolving ecosystems

As argued by Nonaka, the knowledge creation is a self-trascending process between "self and other", "inside and outside", "past and present" (Nonaka, Toyama, and Konno, 2000) among the four knowledge conversion modes. Nonaka's knowledge spiral model has epistemological dimension (four modes of knowledge creation) and ontological dimension (individual, group, organization and interorganization). Other scholar analyzes knowledge transformation from time dimension, such as in the DIKW Hierarchy, the transcending from data to wisdom is a process of understanding from the past to the future (Rowley, 2006;).

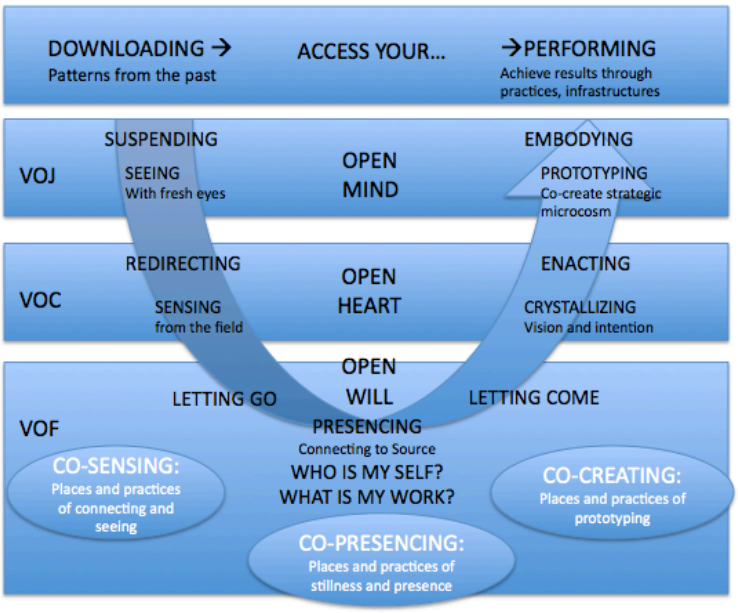
Figure 11 DIKW Hierarchy



(source: Clark, 2004 http://www.nwlink.com/~donclark/performance/understanding.html)

Not only address organization and its survival environment, Scharmer adds time dimension on Nonaka's spiral. He addresses that innovation in theory "U" is a process from "letting go" of old pattern and "letting come" of new pattern to presencing (presence and sensing) from the emerging future. The old pattern is individual effort in innovation. Whereas the new pattern is a collaborative effort in innovation community. Therefore, the "U" process of innovation is from co-initiating, to co-sensing, to co-presencing, to co-creating, to co-evolving (Scharmer, 2009, p. 425).

Figure 12 Creating Three Infrastructures



(source: Scharmer, 2009, p. 45. Compiled by author)

The importance of self-transcending knowledge is usually ignored as a blind spot. A blind spot means "the place within or around us where our attention and intention originates." (Scharmer, 2009, p. 6). The type III infrastructure facilitates the whole knowledge creation process. However, in the socialization mode, it can be divided into three sub-infrastructures in order to enhance the deepest transform in the theory U model: co-sensing, co-presensing, and co-creating (p. 44):

1. Co-sensing: the movement of the U that helps us connect with and tune in to the contexts that matte; moving into a state of seeing in which the boundary between observer and observed begins to collapse and in which the system begins to see itself.
2. Co-presencing: the movement of the U that helps us connects to our deepest sources of inspiration and stillness – and to the place from which the future possibility begins to arise. This movement merges three different types of presence: of the future, the past, and the authentic self. It shifts the place from which the self emerges to the highest future possibility – to our Self.
3. Co-creating: the movement of the U that enables us to explore the future by doing; enacting prototypes of the future by linking the intelligences of the head, heart, and hands and by iterating through the guidance of fast-cycle feedback from all stakeholders in real time.

As corresponding to three knowledge types, the three infrastructures in the bottom of U are all related to tacit knowledge, specifically with three knowledge conversion modes: internalization, socialization, externalization. Co-sensing is related to internalization from explicit knowledge to tacit embodied knowledge. Co-presensing is related to the mutual trust, commitment, common will that are built up through socialization. Co-creating is associated with externalization from concept crystallization to practice.

4.2 Learning Infrastructure Framework and IIMs

Based on the three types of knowledge Scharmer categorized (explicit, tacit-embodied, and self-transcending knowledge), different type of knowledge require corresponding learning infrastructure (Scharmer, 2001). Accordingly, Scharmer argues there are three types of learning infrastructure to facilitate each knowledge creation (see Table 5).

The type I infrastructure is to facilitate explicit knowledge dissemination. The type II infrastructure is to facilitate sharing experience to through exchanging tacit knowledge among members. It is a process of reflection on action. Type III infrastructure is to build up a common ground for different parties to reflect, to reach common will, and to give guidance for the future planning. It is easy to be confused with type II. Type III is different from type II on two aspects. First, type III includes the activities of type II. Type II infrastructure only provide a common ground for members to come together and share experience. However, in type III, a common will is established based on shared experiences. This "common will" will guide members to move on the next phase of cooperation. In the new cooperation, similar process of reflection on action and common will are done again. Thus, type III is a repeated process. Second, type II includes embodied know-how level. Whereas type II focus on both tacit knowledge embodied and self-transcending knowledge.

Table 5 Three Types of Learning Infrastructure

Type	Structure	Purpose	Example	Feature
I	one-dimensional process	disseminate explicit knowledge	Web sites, electronic databases, films, books, and other forms of self-service media.	easily scalable and replicable
II	two-dimensional processes (action and reflection on-action)	disseminate tacit knowledge through sharing experiences	parallel structures: MIT Learning Consortium	time and space, difficult to scale and replicate
III	three-dimensional processes (shared action (praxis), shared reflection, and forming shared will)	cycle of shared praxis, shared reflection, and forming shared will	distributed organizations and networks of collaboration Communities of commitment communities of creation	high quality of shared time and space, most expensive and difficult to attain

(source: Scharmer, 2001, generalized by author)

There are three kinds of capacities that are highlighted on each level of knowledge creation: open mind, open heart, and open will. Open mind is associated with our ability to access to IQ (intelligence). We deal with objective figures and facts, which is explicit knowledge. Open heart connects to EQ (emotional intelligence). It is the capacity to sense contexts that is outside of us, which is to access to tacit knowledge through internalization and externalization. Open will is about SQ (spiritual intelligence). It enables us to realize the authentic self, the ability for us to fundamental accepting or forgoing, namely "letting come" and "letting go". It is done during knowledge socialization.

IIMs as infrastructure I is to provide service in knowledge matching and integration for two or more clients. IIMs as infrastructure II is to provide a platform where organization technical know-how knowledge can be shared cross boundaries. IIMs as infrastructure III is to form an alliance for multiple actors to establish cooperation and building up long-term innovation community. In this type alliance, coded knowledge such as technology, research focus can be disseminated. The coded knowledge can be recorded into documentary and archive. Mutual understanding across

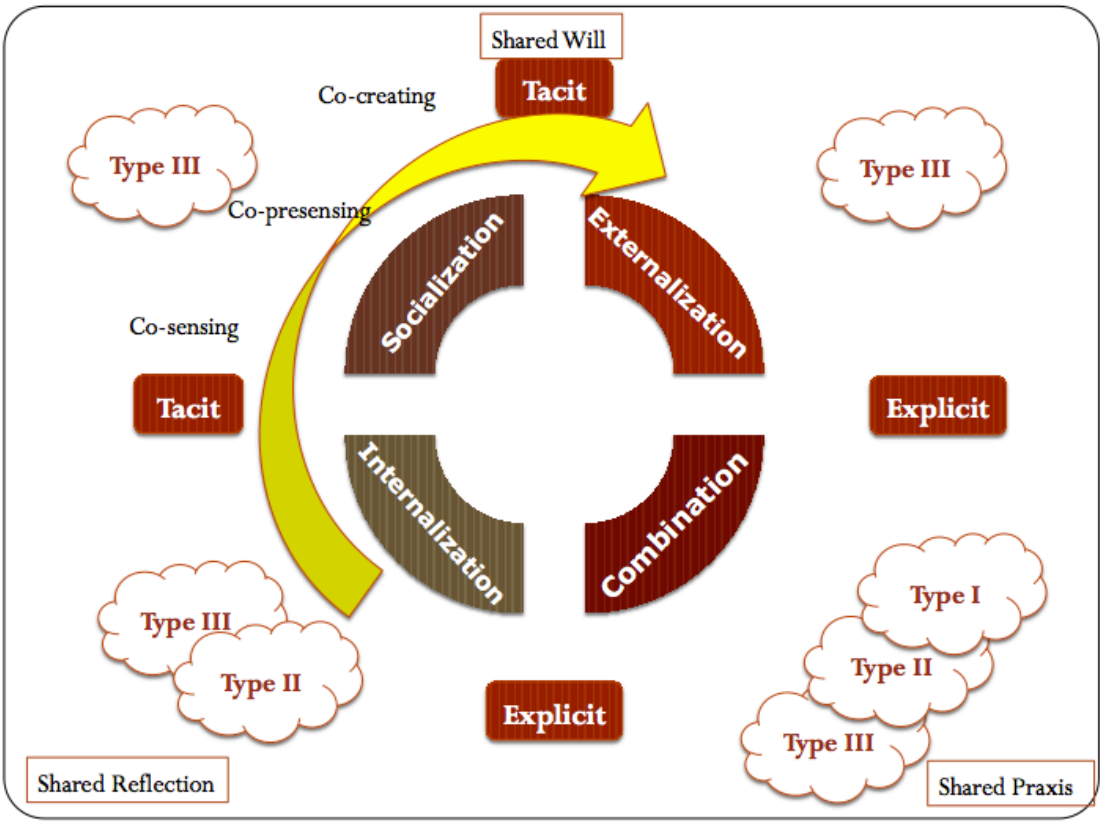
organization boundary enable the tacit knowledge sharing. The common will would lead to future joint project. This is a circulated process, in which partnership is benefit from knowledge transformation.

Table 6 IIMs as learning infrastructures

IIMs	Function	Example
Learning infrastructure I	facilitate explicit knowledge dissemination	information consulting company, intellectual property consulting firm, etc.
Learning infrastructure II	facilitate tacit know-how knowledge exchange	industry regulatory association, industry seminar or symposium organizer, industry evaluation organization, etc.
Learning infrastructure III	sustainable long-term cross sector innovation collaboration with regular meeting and exchange opinion, actively connect university, business, and government	cross- sector industry alliance, open innovation platform, regional innovation alliance

In order to help with understanding, the figure 13 describes how the IIMs learning infrastructures facilitate different knowledge conversion, in knowledge spiral model. The three levels of IIMs' facilitation in the knowledge spiral model are different (see figure 13). IIMs learning infrastructure I facilitate only explicit knowledge dissemination by providing service in knowledge matching and integration. It exists in the knowledge combination mode. IIMs learning infrastructure II facilitates the internalization of explicit knowledge into tacit experience for sharing collectively. It exists in two knowledge modes, combination mode and internalization mode. IIMs learning infrastructure III, as the intermediaries for sustainable innovation collaboration, facilitates four knowledge conversions from explicit to explicit, explicit to tacit, tacit to tacit, and tacit to explicit. Thus, it exists in all four knowledge modes: combination, internationalization, socialization, and externalization. What's more, the completion of one knowledge spiral loop is the beginning of the next round of knowledge transformation.

Figure 13 IIMs' as infrastructure in knowledge creation



Previous research focuses mostly on type I and type II for information exchange or know-how technical skills sharing. With this model, the function of IIMs as type III infrastructure can be crystallized. Moreover, this model addresses that in type III IIMs, the knowledge creation is a continuous spiral process.

The type III infrastructure and three capacities in socialization all indicate that self-transcending knowledge is an important constituent in knowledge creation. The "common will" play the role as driving force for in depth cooperation. The contribution of IIMs in bridging university and business by establishing mutual trust and commitment from both parties should not be undervalued.

It has become a common feature in many IIMs that one organization offers more than one intermediary functions (Howells, 2006). It is also apply to the situation in China. IIMs are increasingly performing one-stop service for clients that cover the whole innovation process. Vertically, it increases common understanding of innovation process among participants. Horizontally, it enlarges the socializing network for the flows of tacit knowledge. The systematic analysis of IIMs learning infrastructure in the context of China is discussed in the following chapter.

5. Innovation Intermediaries in China

5.1 Open Innovation and China

Innovation has become the strategic goal for governments to strengthen national competitiveness around the world. However, the approaches vary among countries. By looking at the three emerging economies India, China, and Brazil, China has learned from the global knowledge and heavily invested in R&D (Dahlman, 2008). In this context, firms need to utilize external resource from multiple innovation actors, some challenges have raised up from internal factor, innovation system, and cultural level (Savitskaya, Salmi, and Torkkeli, 2010). University and research institutes are also seeking out channels for research results commercialization. The national innovation system is still imperfect while the linkages between actors remain weak (OECD, 2007). The main characters in innovation system includes domestic business sector, foreign firms, the higher education system, public research organizations under the guidance of government. The R&D system has more development than research. Resource invested in facilitation of innovation system while less invested in "software". These are challenges that China has to experience during the transformation from manufacturing-based to knowledge-based production (Savitskaya, Salmi, and Torkkeli, 2010).

5.1.1 National policy in innovation

The national policy on innovation can trace back to "Open Door" policy in 1978. The "Open Door" policy built up the ground for Chinese economy development in the next three decades (OECD, 2007). After this policy, a series of policy has been issued by National S&T Conference in 1978, 1985, 1995, and 2006. Science and technology have been seen as intellectual driving force for economic growth since 1978. In 1980s, the State Council issued "Provisions on the Encouragement of Foreign
Investment", to better promote the absorption of foreign investment. From 1984 was the start of commercialization of research institutes to increase the connection between industry and research community. The decentralization measures from central government encourage a closer relationship between research and production (Wu, 2007). In 1985, some important decision have been made during the institutional reform of the S&T system, such as the establishment of R&D funding allocation mechanism, research results transformation into business, create market for technology, human resource reform in public research institutions. The policy of "Regulations of the People's Republic of China on the Administration of Technology Acquisition Contracts" (1985) and "Regulations of the People's Republic of China on Administration of Import and Export of Technologies" (2001) promote the absorption of advanced technology. The technology introduction policy was reinforced by the "Regulations of Promoting Technology Introduction, Digestion and Absorption" issued in 1986. With these measurements, market discipline was gradually introduced into S&T system.

From 1990s, the innovation has started to diversified the commercialization channel (Fu and Xiong, 2011). In 1995, facing the concern of national competitiveness by joining in World Trade Organization (WTO), the policy of "revitalising the nation through science and education strategy" has been adopted. An enterprise-centered innovation system was formed. The importance of business high-tech innovation and innovation commercialization has been enhanced in two documents: The "Law of the People's Republic of China on Promoting the Transformation of Scientific and Technological Achievements (1996)" and named "the Decision on Strengthening Technical Innovation, Development of High-tech and Realization of Its Industrialization (1999)". Later, high-tech in trade was emphasized in "Vitalizing trade by science and technology (1999)" and "Supporting the National Development Zones for New and High Technology Industries".

Start from 2000, the policy focus has changed from "introducing" to "going global" (Fu and Xiong, 2011). In the year of 2006, the policy of "Medium- to Long-Term Strategic Plan for the Development of Science and Technology" (also referred to as "the S&T Strategic Plan 2006-2020") was adopted during the National Science and Innovation Conference. Bearing "innovation-oriented" in mind, it sets out the key objectives and priorities in science and technology by the year 2020. The long term of extensive economic structure asks for "indigenous" or "home-grown innovation", which is iterated in the S&T Strategic Plan 2006-2020. The intellectual property right has drawn more attention in "the Interim Provisions on the Administration of Intellectual Property Right Relating to International Cooperation Projects in Science and Technology (2006)". In 2009, "Notice of Taxation on Issuing the State Industrial Technology Policies" issued by Ministry of Industry and Information Technology, Ministry of Science and Technology, Ministry of Finance and the State Administration, emphasized on international cooperation and exchange and reinforces the technology introduction again. The R&D "go global" was promoted in 'Opinions on Encouraging Technology Export (2009)' issued by Ministry of Commerce and Ministry of Science and Technology (Fu and Xiong, 2011; OECD, 2007).

Government plays the guiding role in innovation system. The Chinese national innovation system is constructed by two approaches, top-down policies and local bottom up efforts (Savitskaya, Salmi, and Torkkeli, 2010). The role of government in China is greater than other company due to the immature market comparing to other country. There are distorting competition and local protectionism exits in market. Financing in innovative business and SMEs is one kind of initiative from government. Second, regional unbalance is another reason for government to take larger responsibility. Third is the insufficient interaction between business enterprises and public research organizations (OECD, 2007).

On the firm level, companies cooperate with university and research institute in two ways: inbound and outbound. A survey targeted at 800 Chinese firms in Yunnan province was done to investigate open innovation in China. The results show several interesting facts of the relation between R&D intensity and inbound and outbound of open innovation (Savitskaya, Salmi, and Torkkeli, 2010). It was found that the higher the level of a firm's R&D intensity, the less the firm intend to obtain external technologies and the more likely it would tend to outbound open innovation, namely it will offer technologies for other organizations. From the perspective of company size, smaller firm tend to more likely offer technologies to large company due to lack of "complementary assets". Public funding has positive influence on open innovation.

There are barriers for Chinese firms in open innovation as well, such as the lack of desired technologies on offer, Takes too much time/resources, "Not Invented Here" cultural syndrome (Savitskaya, Salmi, and Torkkeli, 2010). What's more, most Chinese firms are not familiar with innovation policy. This requires cooperative governance to improve innovation performance in industry sector (OECD, 2007).

On the education level, the passive education model in China neglects students' creativities, which hamper the innovation and entrepreneurship (OECD, 2007). "985" and "211" project among Chinese universities significantly raising interdisciplinary research capability and expending academic resource (Wu, 2007).

Intermediary agencies are included as one of the five sub-systems in China innovation system, besides the knowledge system, the technological innovation system, the regional innovation systems, and the dual-use knowledge and technologies. It plays very important role in technology market. However, intermediaries have not fully developed. There is a shortage of complementary assets, as pointed out in OECD report that specialized infrastructure for science and technology is

lacking, especially in the area of public goods (OECD, 2007). Since the success in university technology transferring is benefit from local innovation environment, as the result of inadequacy, universities were struggled on technology transfer because the lack of intermediaries, Shanghai for example (Wu, 2007).

There are interactions between various innovation actors in the new concept of open innovation in China. Inter-firm interaction is more commonly seen within industry cluster but rare outside of S&T industry park (OECD, 2007). However, such interactions are usually promoted by government project, such as Torch Programme for indigenous innovation development. The sustainability of the dynamic interaction is low. Without the force from government, function of platforms that already established would be undermined.

The research and production have long time been separated. Through the government initiatives in building up infrastructures such as science and Technology Park, university Science Park from 1980 to 1990, the science and technology research has been included into economic reforms (Savitskaya, Salmi, and Torkkeli, 2010). Industry-science relationship is the heart of innovative network and cluster (OECD, 2007). This relationship includes many forms such as contacts between industry and academic researchers, university spin-offs, licensing and patent, training, and so on. However, the industry-science relationship in China suffers same problems as in other countries, such as insufficient demand from firms, organization culture difference in economic relevance, low mobility of researchers, and competition between public research and industry for public support.

The "2011 Program" launched in 2012 by Ministry of Education and Ministry of Finance improves University-Industry-Government cooperation. It aims at establishing a Collaborative Innovative Centers (CICs) for independent innovation capability in China. These centers absorb enterprise and research institutes, local government and international forces to cooperate in technology innovation activities. It represents the latest strategy of Chinese government to strengthen University-Industry cooperation (Fan, Zou, and Lv, 2013).

University-Industry cooperation in China has gone through a long processes and still need to enhance (Fu, 2012). The cooperation started from 1978 the "Open Door" policy. The policy was mostly copied from Soviet Model: central planning, state-owned-enterprises (SOEs), research institutions and universities are dominant actors for knowledge production. Start from 1985, market mechanism provides incentives for university and industry cooperation, as acquiring foreign technology was the main strategy. The acceleration of S&T in 1995 and "indigenous innovation" concept raised in 2006 have aiming to set up an innovative environment. The university-industry cooperation has been more promoted by the reform in legal system and public funds in various projects.

5.1.2 Statistics of Open Innovation in China

In this section, updated statistics are collected to analyze the main innovation actors – business and universities – from the R&D expenditure, technology market, patent, Gross Domestic Expenditure on R&D, human resource. As part of the national innovation goal, the technology transfer is repeated emphasized in national policies, and high technology elements of business is largely supported by the government. Therefore, some new changes and challenges in manufacturing and IT industry are demonstrated in here as well.

Business remains to be the main sector of R&D expenditure in China. There is slight difference of expenditure between Research Institutes (RIs) and Higher Education Institutes (HEIs) depending on

country. In the case of China, the expenditure in RI is 7% higher than HEIs in 2010. Whereas in Canada, it was opposite that expenditure in RI is almost 30% higher than HEIs (MOST, 2013; OECD, 2014). Comparing with other countries, China has lower R&D intensities of high-tech industries (STS). The R&D expenditure of high-tech industries as a percentage of manufacturing was 26.3% in China, while 73.3% in the United States, 62.8% in the United Kingdom, and 58.7% in Korea.

Table 7 High-tech industry ratio in eight countries

	China 2012	**US 2009**	**Japan 2008**	**Germany 2007**	**France 2007**	**UK 2007**	**Italy 2007**	**Korea 2006**
Total Manufacturing	1.1	4.0	3.4	2.3	1.7	2.6	0.7	1.9
High-tech Industries	1.8	19.7	10.5	6.9	5.6	11.4	3.8	5.9

(Source: STS, 2013. 2012 HT industry book, compiled by author)

The contract and turnover in technology market reflect the activity of technology transfer. Technology market turnover in China has increased 7 times that has reached over 6 hundred billion yuan in 2012 (National Bureau of Statistic of China (NBSC)). Business as the main seller constitute of 60.6% and 87.6% respectively in contract and contract amount in the country, while research institutes was 19.8% and 5.5% as the second technology export source. (MOST, 2008)

HEIs

In 2011, there are 2,442 HEIs in China, among which there are 1,039 engineering, agriculture and medical schools, 1,090 humanities and Social Sciences Schools. 9,225 Higher Education Research and Development organization have established with over 6 hundred thousand R&D personnel. 50% of research funding came from HEIs themselves, 30% from government, and less than 20% from business enterprise. (NBSC). The R&D funding resource of HEIs depend heavily on government appropriation. 66.6% of HEIs funding in 1990 came from government. The ratio declines slightly in recent years but still remain high. In 2012, the R&D funding structure of HEIs was government appropriation (60.7%), business funding (33.4%), and others (5.9%) (MOST, 2013). Through strengthening contact with business, one third of funding comes from business for knowledge innovation to contribute to industrial technology development (MOST, 2009a).

Comparing to research institutes, HEIs are less active in technology transfer with the growth rate lower than average. In 2012, the technology transfer contract signed by HEIs was 20.5% of the total. However, the turnover was only accounted for 4.6% of national total. Research institutes, on the other hand, have built up facilities (combined laboratory or industrial technology institute) in local region to better undertake national major projects. HEIs focus more on basic research and are responsible for over half of basic research funding nation wide. One third of applied research funding goes to university. The patent applications from HEIs remain steadily around 15% since the year of 2006.

Table 8 Domestic service invention patents by sector

	Patents Grated			
	2008	**2009**	**2010**	**2011**
Total	36955	52265	66149	95069
Higher Education	10265	14391	19036	26616
Research Institutes	3945	5299	6557	9238
Business	22493	32160	40049	58364
Other	252	415	507	851

organizations				

(source: MOST, 2013, compiled by author)

From 2008 to 2011, the patents granted to higher education sector has increased 1.5 times. The total number of patents granted to HEIs is over 2 times of research institutes (RIs). However, over 60% of patents was granted to business. HEIs produce 63.4% of domestic S&T papers. RIs and business generates much less in publication, except medical institutions have relative high ratio.

Business

Business enterprise is the main body to perform R&D activities, among two other key executive departments in China for R&D activities, namely government research institute, and higher education institutes. (MOST, 2009b). Enterprises above designated size are the main players in R&D activities (STS, 2013). The implementation of innovation product or process in manufacture firms also ascend by the size of the firm from small (25.2%), medium (55.9%), to large-sized (83.5%) in China (UNESCO, 2012; Eurostat, 2006)

"Open Door" policy started from late last century has attracted foreign direct investment (FDI). The government pressured foreign firms to do research in China. Chinese private sector firm "absorb" advanced technology from foreign firms (Chen and Kenney, 2007). The ratio of domestic enterprise is increasing in recent years in high-tech industry to around 40%, while foreign-funded enterprises has been decreasing to about 60% in 2013. (MOST, 2013).

GERD

The national Gross Domestic Expenditure on R&D (GERD) has increased from 3003.1 (100 million yuan) in 2006 to 8687.0 (100 million yuan) in 2011 in current price. (MOST, 2012).

Table 9 GERD by source of funds and sector of performance

Performance sectors / Source of funds	Total	Business	Research Institutes	Higher Education	Others
Total	8687.0	6597.3	1306.7	688.9	112.1
Business	6420.6	6118.0	39.9	242.9	19.8
Government	1883.0	288.5	1106.1	405.1	83.2
Abroad	116.2	104.7	4.9	6.0	0.7
Others	267.2	68.1	155.8	34.8	8.4

(source: MOST, 2012. Unit: 100 million yuan. Compiled by author)

Business remains the dominant funding resource (73.9%) for R&D activities, the ratio of investment goes to research institutes (RI) and higher education institutes (HEIs) is only 4.4%. In contrast to business R&D expenditure, 80% of government funding is granted to RI and HEIs.

In 2011, large percentage of R&D expenditure is on experimental development (83.5%), while applied research accounts for 11.8% and basic research 4.7%. 97% of R&D funding was used in experimental development. HEIs, however, is the main institution focusing on basic research. Comparing to university, RI spend more funding in experimental research and applied research, although the potion is around half of business.

R&D Funding

The top 7 cities and provinces on Science and Technology Progress Environmental Index are Shanghai, Beijing, Tianjin, Jiangsu, Guangdong, which are higher than national average (MOST, 2013).

Table 10 GERD by region in 2011 (100 million yuan)

Region	R&D Expenditure	Region	R&D Expenditure
Beijing	936.6	Shanghai	597.7
Jiangsu	1065.5	Guangdong	1045.5
Shandong	844.4	Zhejiang	598.1
Tianjin	297.8	Guizhou	36.3

(source: MOST, 2013, compiled by author)

The traditional high R&D investments are in Beijing and Shanghai. Guangdong, the province where Shenzhen located, also spent significant amount of funding. Jiangsu has one of the highest GDP per capital and fifth populated province in China (http://www.jssb.gov.cn/ Jiangsu Statistic Net).

In 2011, the Government S&T Appropriation was 4902.6（100 million yuan current price）, taking up 4.49% of total government expenditure, which has increased 7% comparing to 2006. In the past one decade among 2001 and 2011, the S&T appropriation from central government has been slightly diminished while slow increase coming from local government.

Table 11 Local government S&T appropriation by region (million yuan)

Region	R&D Expenditure	Region	R&D Expenditure
Beijing	18307	Shanghai	21850
Jiangsu	21340	Guangdong	20392
Shandong	10862	Zhejiang	14390
Tianjin	6017	Guizhou	2168

(source: MOST 2013, compiled by author)
The potion is similar to the GERD.

Human Resource in S&T

The number of R&D personnel in 2011 has reached 288.3 (ten thousand person), which has increased by 76% of the number in 2006. Around 75% of R&D personnel were working in business and approximately 10% working in RIs and HEIs each. More than 80% personnel were working in the field of experimental development.

Beijing is highest density of R&D personnel in the geographical distribution among all the provinces and cities in China (STS report). In 2009, the potion of R&D personnel was around the same level in business (45%) and RIs (37%). The potion of personnel in university was about 14%. However, 78% of R&D personnel with postgraduate degree (Master and Ph.D) stayed in RIs and HEIs, while less than 19% worked in business (Beijing Statistic Information Net http://www.bjstats.gov.cn/sjfb/ztdc/rdzyqc/201109/t20110913_210788.htm). As mentioned, business is doing dominantly in experimental development whereas universities concentrate more on applied and basic research. Over half of the personnel in RI hold Master degree, however, the Ph.D holders is more than Master in university R&D. This further proves the different requirement in types of research. Nevertheless, basic research builds the foundation for the rest, which is the reason that business need university research to exploit advanced technology.

Manufacturing & High-tech Industry in China

The definition of High-tech Industries was given by the National Bureau of Statistics (NBS) in the

circular of the *Catalog for High-technology Industry (Manufacturing Industry) Classification* in 2013. Five industries are included in China's high-tech industries: aircraft and spacecraft; electronic and telecommunication equipments; computers and office equipments; pharmaceuticals; and medical equipments and meters manufacturing (MOST, 2013). The definition is compatible with OECD's classification of high-technology industries.

The high-technology industry had rather low growth rate comparing to manufacturing in China (MOST, 2009c). The definition of High Technology is broad. Only some meet the common criteria from developed countries. For example, the assembling of computer might be included in computer and office equipment industry as high-tech activities (Zhang, Duan, Gao, and Liu, 2011). The R&D intensity of high-tech industry is uneven. Computer and office equipment is lower than other industries. Aerospace Manufacturing, on the contrary, was the most intense in R&D, mostly in inland provinces and the old industrial bases, such as Shanxi and Tianjin. The R&D level in electronics and communications equipment manufacturing is higher than average, mostly has clustered in Eastern China (MOST, 2009c; MOST, 2013).

Although the proportion of high-tech industry in overall manufacturing has been decreasing since 2003, the totally high-tech industry output is significant from 5708.7 billion yuan in 2008 to 10339.4 billion yuan in 2013 (CSTSN, 2013). The high-tech employee has raised to 15.1% of the total percentage of manufacturing (MOST, 2013).

Several areas in high-tech industry are highlighted by government as the national strategic emerging industry to be prioritized in the "12th Five Year Plan" - national strategic emerging industry development plan): energy saving industry (high-efficient saving, resource recycling, etc.), new generation of IT industry (Ultra-high-speed broadband, wireless communication, Internet of Things, Cloud Computing

Virtual digital, advanced semiconductors, etc.), Biological Industry (Biomedicine, Biological Agriculture, etc.), High-end equipment manufacturing industry (aviation equipment, satellite, marine engineering equipment, etc.), New Energy Industry (nuclear technology, wind, solar, etc.), New Material Industry, and so on. IT industry is very active among the rest of industries with high growth rate in contract and turnover.

Manufacturing

Manufacturing is undergoing a transformation driving by external market shifts and technological change. The low-cost labor intense model is no longer suitable to deal with the ever complex market environment, among which, technology is one of the key factor to reshape the landscape (Oxford Economics, 2013). High cost of innovation activities is the most prominent reason to hinder innovation-active manufacturing firms.

According to World Bank Data, manufacture in China, as the core in secondary industry, is accounted for over 30% of GDP. The manufacturing in China continues expanding in 2014 (National Bureau of Statistics, 2014). However, the undeniable challenges call for change toward high value-added model in this field. In this process, partnership with external organizations become important, such as supplier, customers, competitors, research institutions, universities, and so on. In 2011, the highly important information source for innovation-active manufacturing firms in China came mainly from two ways, first from external clients or customers (59.7%), the second came internally from enterprise itself (49.4%). The amount of information from government/public research institutes (24.7%) and HEIs (8.9%) are low, with former almost tripled the amount of HEIs. This is different from EU countries that except suppliers are the main character for manufacturing firms to have cooperation with, HEIs is the second important partner for innovation cooperation.

The product or process innovator in China distributed in 30% of manufacturing firms, which is lower than the European level ranging from 42% among EU 27 countries to 71.2% in Eurostat.

The innovation activities that manufacturing engaged in in China focus much more on training, machinery, and market introduction of innovation. Comparing to internal R&D, the external R&D is 3 times lower. (UNESCO, 2012; Eurostat, 2006)

The foreign companies still play the most important role in high-tech products development. In the past decade, over 70% of the high-tech products exports were done by foreign companies and joint ventures (MOST, 2013).

IT Industry

Computer and office equipment industry and electronic and communication equipment manufacturing are capital-intensive and technology-intensive industries, mostly located in economic and technological developed Chinese provinces to meet large demands. Area along the East coast (Shanghai, Beijing, Jiangsu, Guangdong, and Zhejiang), Sichuan, and Shanxi are the core area of the high-tech industry development (China Science and Technology Statistics Net, 2013). It has high level of concentration effect that leads to further concentration of the industry (Zhang, Duan, Gao, and Liu, 2011). It is one of the key areas that government supports to expand and update in the 12th Five Year Plan issued by State council in 2011.

Among all the high-tech industries, the highest funding, 55% of the total expenditure, goes to electronic and telecommunication equipments (ETE) (STS). The R&D expenditure on industrial communications equipment, computers and other electronic equipment manufacturing business stayed the highest from 2011 to 2012, same as in quantity of new product, patent application (National Bureau of Statistics of China). In the first quarter of 2014, R & D expenditure on Information transmission, software and IT services has reached more than 30% in large and medium-sized enterprises.

IT services has the fastest year-on-year rise of 17.5% comparing to other industries. In 2011, computers and telecommunications took the largest share in national exports of high-tech products, which was accounted for 71.6%. The import ranked the second place after electronics, which constituted 22.8%. The largest share (51.6%) of economic profits came from ETE, followed by computers and office equipments (COE) in 2012. It is accordingly high in both gross industrial output and revenue from principal business. The computer, electronic, and optical industry has taken export market share of 23.35 in 2011, much higher than other EU countries, Korea and Japan (OECD, 2014). Industrial communications equipment, computers and other electronic equipment manufacturing business research and experimental development staff working full-time equivalent (person-years) ranked the highest in China from 2011 to 2012 (National Bureau of Statistics of China). Software industry is one of the five main areas for venture capital investment besides traditional manufacturing in 2008 (MOST, 2009a).

In 2012, 90% revenue in computers and office equipments (COE) was generated by large-size companies. In addition, the ownership of COE 96% belong to foreign and joint ventures. It shows that R&D activities still are performed in large foreign and joint firms. Small-sized firms focus more on computer assembling.

There are two impact that high-technology has brought to China. First is asking to improve legal system, especially in intellectual property area, to follow the pace of knowledge dissemination through the omnipresence of new technologies. Second, new technology enable the forth party to form the quadruple helix, for citizens to express idea that government and university experts can

cope with the challenge of making informed decision.

5.2 Innovation Intermediaries in China

5.2.1 Typology of Innovation Intermediaries in China

Innovation intermediaries can be divided according to different typology. From the European perspective, University-Business partnership is categorized into seven types (EUA, 2012):
University- Large companies
University- Small and Medium Enterprises (SME)
University- Research and Technology Organizations (RTO)
University- Non-Governmental Organizations/Non-profit
University - Regional/Local/National Government (beyond funding)
University - Spin-Off
University - Other
However, this topology on partnership focus on collaborative doctoral education/

According to function level, the innovation intermediaries in China can be divided into state-owned, independent running firm, government funded, enterprise affiliated, government affiliated, research affiliated, association affiliated, university affiliated (Tong, 2010).

Another topology of IIMs is formed in three kinds (Agogué et al., 2013). Broker for problem solving includes diversified functions of IIMs. Broker for technology transferring contains university technology transfer offices, liaison departments, out-licensing agencies, business incubator, venture capital and so on. Network or bridger in innovation ecosystem has much wider range of participants besides companies on macro-economic level for government and national policy. Yusuf also categorize IIMs into four types: general purpose intermediary, specialized intermediary, financial intermediary, and institutional intermediary (Yusuf, 2008).

From the funding resource to distinguish intermediaries, it includes public intermediaries and private intermediaries (De Jong, Vanhaverbeke, Kalvet and Chesbrough, 2008). Go-betweens can include banks, industry associations, knowledge transfer agencies, lawyers or private consultants. Those private units can also be funded by government.

Zhao & Zheng divided S&T intermediaries into three layers. The core layer focuses on upper level of industry chain in research and testing. The supporting layer provide advisory services to solve problems in innovation process. The corresponding layer provide forum, equipment, and financial service (Zhao and Zheng, 2011).

According to Howells' framework on innovation intermediaries in innovation process, several functions of innovation intermediaries are highlighted on the stage of startup in enterprise lifecycle (see figure 5):

1. foresight and diagnostics,
2. scanning and information processing,
3. knowledge processing generation, and combination,
4. testing, validation and training,
5. commercialization,
6. gatekeeping, brokering and IP protection

Howells' limitation is in using individual organizations to exemplify each type of "innovation intermediaries", which is mostly contributed by the wide range of "heterogeneous entities" (Howells, 2006, p. 725) that can provide intermediary role. This framework can be improved by

further elaborating on the sub-category instead of case representatives. The typology in this framework is clear and helpful in analyzing innovation intermediaries in general. However, to contribute in subtype, and to better analyze innovation intermediaries between university and business, this study choose to narrow down the categorization to intermediaries between business and university in open innovation context.

The innovation intermediaries can be first simply distinguished as internal intermediaries within university and external intermediaries outside of university (Howells, Ramlogan, and Cheng, 2009). As Howells and others point out, university's dependence of innovation intermediaries is decided by the size of university itself. Some "large size university might internalize some of the functions that intermediary organizations provide" (p.5) while small size universities have large demands for external innovation intermediaries to support their research and knowledge transfer. In this way, besides the function of knowledge provider and educator of labor force, university is playing a role of intermediary function to create an ecosystem for other parties to be engaged in.

The typology adopted in this study is categorized based on the efforts that university and business devoted in innovation intermediaries to promote students' entrepreneurship. Although there are overlapping among three types of IIMs: university-oriented IIMs, open innovation joint efforts, Business-oriented IIMs. However, it is clear to tell the initiatives taken by university and business in promoting students' entrepreneurship:

University-oriented IIMs: this type of intermediaries is agencies within or spin off from university, such as university research achievement transfer office (Technical achievements and intellectual property management office), university Technology Transfer Center, university spin-off enterprise, university science park, Universities Collaborative Innovation Center. The technology transfer office plays an intermediary role in commercialization of basic research knowledge (De Jong, Vanhaverbeke, Kalvet and Chesbrough, 2008).

Open innovation joint efforts: This type of intermediaries includes multiple actors in innovation activities such as government, industry, research institutes, universities, non for-profit organizations. It works in the form of technology park or industry alliance. Knowledge cluster is usually a combination of university, research institutes, technology-providing enterprises, intermediaries (De Jong, Vanhaverbeke, Kalvet and Chesbrough, 2008)
This type of intermediaries has function in resource integration, networking, partner matching in regional and national innovation system. This type of intermediaries has China National High-Tech Industrial Development Zone, regional Scientific and Technological Garden (e.g. Zhongguancun), university-industry alliance (association), Large-scale scientific and technical consulting services center, Regional Technology Innovation Service Center (Productivity Promotion Center), Regional Knowledge Service Platform or regional Industry-Academia-Industry center (e.g. Shanghai University Knowledge Service Platform has three types of center, A-High-tech Economic Technology Industry-Academia-Industry Cooperative Development Center, B - modern service industry knowledge service center, C - Advanced Strategic Research Center)

Business-oriented IIMs: the type of agencies offer service to the whole market, with service focusing on one or more specialties. The specific function can be based on Howells' ten intermediaries functions. It provide service in one specific area for innovation activities such as legal consultancy, financing, management, start-up incubator, venture capital, start-up accelerator (e.g. Chinaccelerator), Technology Testing Center (formed by research institutes and university testing institutes). However, more and more intermediaries provide comprehensive service for customers instead of only focus on one simple service.

The innovation intermediaries in China are still at infancy stage. Although more intermediaries provide comprehensive service, it should not ignore that many of IIMs still concentrate on one particular service.

Table 12 Industry-University Innovation Intermediaries in China

Innovation Intermediaries Type	Example
University-oriented IIMs	university research achievement transfer office (Technical achievements and intellectual property management office), university Technology Transfer Center, university spin-off enterprise, university science park, Universities Collaborative Innovation Center.
Open innovation joint efforts	China National High-Tech Industrial Development Zone, regional Scientific and Technological Garden (e.g. Zhongguancun), university-industry alliance (association), Collaborative Innovative Centers, Large-scale scientific and technical consulting services center, Regional Technology Innovation Service Center (Productivity Promotion Center), Regional Knowledge Service Platform or regional Industry-Academia-Industry center (e.g. Shanghai University Knowledge Service Platform has three types of center, A-High-tech Economic Technology Industry-Academia-Industry Cooperative Development Center, B - modern service industry knowledge service center, C - Advanced Strategic Research Center)
Business-oriented IIMs	start-up incubator, venture capital, start-up accelerator (e.g. Chinaccelerator), Technology Testing Center (formed by research institutes and university testing institutes).

To better elaborate the second type of IIMs (cluster) in China, a case of industry alliance is presented here to indicate the way industry cooperates with university and the way innovation intermediaries facilitate during the innovation process. However, this intermediary organization is not designed to specifically link university and business. The representative case of university-industry linkage is in the "Chapter V Case Study".

5.2.2 Innovation Intermediaries Policy in China

The innovation intermediaries have been grown up since 2000. Therefore, the national policy reviewed related to intermediaries in this study starts at 2000. The policy benefit intermediaries mainly from three perspectives: technology transfer and technology evolution, enterprise's development lifecycle, and the open innovation R&D paradigm (Zhao and Zheng, 2011).

Table 13 Innovation Intermediaries Poicy in China

Time	Policy Document	Issuing Dept.	Focus and Main Measures
2001	Programming outline of S&T business incubators development during Tenth Five-year Plan (中国科技企业孵化器"十五"期间发展纲要)	Ministry of Science and Technology	to improve incubator service, develop incubator network, outsourcing to venture capital and intermediaries, rely on university and research institutes
2002	Opinions on energetically developing S&T intermediary (关于大力发展科技中介机构的意见)	Ministry of Science and Technology	to set up the principle to combine market force with government guidance, improve service and connection with university, research institutes and other intermediaries
2003	Much advice for improving the operation quality of high-tech enterprises (关于进一步提高科技企业孵化器运行质量的若干意见)	Ministry of Science and Technology	to clarify tasks and functions of incubator, balance social benefit with economic benefit, support funding, set up incubator sector standard and evaluation system
2003	Regulatory measures on Productivity Promotion Centre (生产力促进中心管理办法)	Ministry of Science and Technology	to clarify tasks and functions of productivity promotion centre, establishment standard and management
2003	Regulatory measures for science and technology evaluation (科学技术评价办法)	Ministry of Science and Technology	measurement for funding allocation in S&T project, institutes, human resource, achievement
2003	Decision of improve the science and technology evaluation (关于改进科学技术评价工作的决定)	Ministry of Science and Technology	improve fairness and objectiveness in S&T evaluation, establish evaluation mechanism, simplify evaluation process

2005	Regulatory measures for startups venture capital (创业投资企业管理暂行办法)	National Development and Reform Commission, Ministry of Science and Technology, Ministry of Finance, Ministry of Commerce, People's Bank of China, the State Administration of Taxation, the State Administration for Industry and Commerce, China Banking Regulatory Commission, China Securities Regulatory Commission, the State Administration of Foreign Exchange	regulatory of venture capital company set up and management, form of company, government unit in charge, detailed measurement on registered capital and personnel, operation range, investment limitation, government support
2006	Recognition and regulatory measures on High-tech Enterprises Service Centre (科技企业孵化器（高新技术创业服务中心）认定和管理办法)	Ministry of Science and Technology	define incubator function and tasks, national incubator management, implementation details
2006	Action plan of S&T business incubators development during Eleventh Five-year Plan (中国科技企业孵化器“十一五”发展规划纲要)	Ministry of Science and Technology	identify problems and challenges, set up goals and emphasis, ensure measurement
2006	Action plan of National University Science Park development during Eleventh Five-year Plan (国家大学科技园“十一五”发展规划纲要)	Ministry of Science and Technology, Ministry of Education	policy guidance on university S&T park, increase financial support, promote public innovation platform, reform university system
2006	Recognition and regulatory measures on National University Science Park (国家大学科技园认定和管理办法)	Ministry of Science and Technology, Ministry of Education	identify tasks and position, recognition and regulatory measurement, implementation steps

2007	Recognition and regulatory measures on National Demonstration Productivity Promotion Center (关于印发国家级示范生产力促进中心认定和管理办法的通知)	Ministry of Science and Technology	clarify tasks and function, business range, recognition and management, central and local government supports
2007	Announcement on improving tax regulations about S&T business incubators (关于国家大学科技园有关税收政策问题的通知)	Ministry of Finance, State Administration of Taxation	tax exemption/reduction on estate, business tax, criteria on organizations for government support
2007	Announcement on improving tax regulations about start-ups (财政部 国家税务总局关于促进创业投资企业发展有关税收政策的通知)	Ministry of Finance, State Administration of Taxation	scale of start-ups, application material for tax benefit, application procedure
2007	Regulatory measures on guide fund of S&T SMEs (科技型中小企业创业投资引导基金管理暂行办法)	Ministry of Finance, Ministry of Science and Technology	guidance funding source, support forms, funding management, target groups, definition of S&T SMEs

5.3 Students' Start-up and Innovation Intermediaries in China

5.3.1 Current social and economic macro challenge

The higher education massification leads to large amount of increase in university graduates (Hua, Li, and Ren, 2012). The unemployment of university students has become a prominent social problem in China. The growing number of university graduates has created tremendous pressure in labor market. The graduates have reached nearly 700 million in 2013, 190,000 graduates more than 2012.

5.3.2 National Policy

The nation policies on promoting university students' start-up have wide range including loan, tax, business administration registration, labor market, etc. (Cui et al., 2010). The policy on students' start-up can trace back to the "Tsinghua University Business Plan Competition" started from 1998. It was a reaction to the national strategy of "invigorating China through science and education" in the 1995 policy "Decision of CPC Central Committee on Accelerating Scientific and Technological Progress". The "Business Plan Competition" has been upgraded with supports from the Communist Youth Central League, Ministry of Education, China Association for Science, and China Students Federation in 2000.

In 1999, Ministry of Education issued "21st Century Education Revitalization Action Plan" to encourage entrepreneurial education among university staff and students and the establishment of high-tech start-ups. Same year, the "Opinions on Further Improving the 1999 employment of college graduates" issued by the State Council, indicated that graduates employment and entrepreneurship in non-state owned institutions. Former Chairman Jiang Zemin require support should go to students' start-up loan in the third National Education Conference in 1999.

Affected by economic crisis, most graduates' start-ups were closed down. In 2002, Ministry of Education initiated entrepreneurial education pilot project among nine key universities with financial and policy support. In the State Council "Opinions on Further Improving the 2003 employment of college graduates", private company run by college graduates is exempt of administrative fee such as business registration and benefit in loan application. Later this year, detailed policy on fare reduction was published. In 2004, Communist Youth Central League and Ministry of Human Resources and Social Security co-issued "Opinions on further implementation of the "China Youth Entrepreneurship Action" work to promote youth employment". In this Opinion, five aspects were emphasized to promote youth entrepreneurship: entrepreneurial awareness, entrepreneurial skills, entrepreneurial service, entrepreneurial environment, and employment service.

Wider promotions were proposed including expending entrepreneurial education pilots, developing entrepreneurial training, establishing incubator, taxation reduction, small guaranteed loans, university start-up park, college students start-up funding, and so on. The policy effort in these promotions contain "Opinions on Further Improving the 2006 employment of college graduates", "Opinions on Further Improving the 2007 employment of college graduates", "Notice on Further Strengthening entrepreneurship training to promote entrepreneurship employment" in 2007.

With the increasing pressure from large number of university graduates, multiple government departments are involved to devote efforts in boosting students' entrepreneurship. In 2010, Ministry of Education issued "Opinions on vigorously promoting innovation and entrepreneurship education

in colleges and college students' start-ups" emphasized on the combination of knowledge and working skills. This was iterated in 2011 "Government Work Report".

Recently, policy focus more on students' entrepreneurial service, such as incubation, business mentoring, such as in "Notice on the implementation of the 2010 act vigorously to promote the employment of college graduates to promote the employment of college graduates" issued by Ministry of Human Resources and Social Security (Xia, Luo, and Yan, 2012).

The most recently, Premier Li Keqiang has issued six new policies after the State Council executive meeting to guide university graduates to work and start small and micro technological enterprise. A College Students' Start-up Leading Plan (2014-2017) has been initiated and implemented by Ministry of Human Resources and Social Security, the National Development and Reform Commission, Ministry of Education, Ministry of Science and Technology, Ministry of Industry and Information Technology, Ministry of Finance, People's Bank, Industry and Commerce Administration, and the Communist Youth Central League (MOE, 2014) http://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/s8137/201406/170142.html.

Policy remain unbalanced in different regions. There are two reasons that lead to unbalanced policy. First, there are different levels of effort from municipal government policy. In cities like Beijing Shanghai, Wuxi, Xuzhou, local policy varies among abovementioned cities between key cities and non-key cities. In some cities, supports mainly come from university without local policy support (Cui et al., 2010). In Shanghai, students' start-up policy refers to wider group comparing to other cities. It more effectively cover wide range such as incubator, finance, business registration, human resource, taxation, financial subsidy, entrepreneurial training, start-up mentoring. In Wuxi, policy focuses on technology industry park. In Xuzhou, policy is related to university start-up park and other measurements such as tax reduction/dismiss, national SMEs innovation funding.

Second, the social recognition and understanding on policy is low. Beijing is the city with the least public understanding in students' start-up policy. The prominent problem with Beijing is "not familiar with startup policy" or "the policy is not helpful". It shows that policy is not well understood. This requires government to work with public media in channels and understanding of policy (Cui et al., 2010).

5.3.3 Students' start-up in China

Because of the difficulty in finding a job, start-up business has become the forth option for students besides finding job, continuing study, and study abroad. The survey result shows that eight years after graduation (usually from 26 to 35 years old) is the best period for students to form start-up company (Wang, 2013). However, students who choose to start their own business are less than 1%, among which, only 2% to 3% start-ups are successful (Wang, 2013). To encourage entrepreneurship among college students is part of university mission. The success rate of college students' start-up is only 0.3% in the nation wide, the highest rate is 4% in Zhejiang province (Hua, Li, and Ren, 2012).

Factors influence students' start-up are multiple. Hua and Ren argue that the reasons for low students' start-up rate are low quality in entrepreneurial education, low technology oriented, and low entrepreneurial skills, such as social skills, strategic planning, marketing, decision making ability (Hua, Li, and Ren, 2012).

Through an entrepreneurship intention survey, Ye concludes four factors that influence college students' intention of entrepreneurship: personality traits, entrepreneur social resources,

entrepreneurship prior knowledge and entrepreneurship cognition. The result shows that entrepreneurial family background has significant influence in students' personality trait, social resource, market knowledge, and entrepreneurship cognition, in comparison with students' without entrepreneurial family background (Ye, 2009).

Besides the family background, college students' entrepreneurial environment is another influential factor. It includes five dimensions: policy environment (enterprise establishment, loan, taxation, intellectual property protection, market behavior regulation), economic environment (The development level of the national economy, entrepreneurial enterprise's geographical location and its infrastructure, target customer groups, such as income and purchasing power), education and training environment (entrepreneurship and business skills training for college students carried out by university, government and social intermediary organizations), financing environment (accessibility to financial support for entrepreneurial activities, such as special support funds, venture capital, loans), Social culture environment (Public attitudes towards entrepreneurship and entrepreneurial failure tolerance, support from family and friends, the media, public opinion and social integrity status) (Su, 2009).

Therefore, to promote students entrepreneurship cannot success by only depending on family resource. University entrepreneurial education and social support are two musts for college students to relatively safely transfer from university environment to market environment, from ideal business planning to real business practice (Ye, 2009). The entrepreneurial education system includes college entrepreneurial education and entrepreneurial practice system. Innovation intermediaries provide intermediary service in the practice system, should draw more attention to support university teachers and students in transferring research results. (Su and Liu, 2011)

There is problems of students' start-up exist in several aspects: policy, funding, technology transfer, entrepreneurial education, and social economy environment.

On the policy level, policies related to start-up are sporadic in separate documents or mentioned in other policies. The supporting policy in start-up related areas have not been done, such as supporting policy in market information, network relation, and other start-up services. This leads to difficulty in coordination and implementation.

Second, the content of policy tend to be general and simplified, which create confusion in interpretation and uncertainty in implementation, detached from reality. Thee is insufficient co-ordination between various layers of government (OECD, 2007). The over general policy can hardly function as guidance for the unbalanced regional development.

Third, currently the focus of start-up policy is narrow. Business registration and tax are the main benefits for students' start-up, whereas start-up guidance, mentoring, training, or other related services are absent.

Fourth, there is no government department for students' start-up only. Students' start-up are mostly small and medium enterprises (SMEs). SMEs are under control of several government departments. It not only causes complex administrative procedure for students' start-up, but also contradictory understanding of policy in different government offices.

Fifth, although many policies related to student entrepreneur have been issued, the top-down policies are not well understood within government system and among public society. The general understanding of beneficial start-up policy in public still stays on superficial level of business registration and tax. Public media is not fully utilized to clarify the policy.

Sixth, the government funding for students' start-up is limited in amount and difficult to meet the standard. The policy usually set up high criteria in application. The audition procedure is complicated involved multiple government departments. Therefore, only a handful of university students can benefit from policy.

Last but not the least, the absence of evaluation system in students' start-up policy make it hard to tracking start-up performance and effectiveness in funding utilization. An assessment mechanism can avoid funding abuse in the name of students' start-up and valuable for future policy development.

However, start-up related policies do have positive influence on students' self-recognition. According to Cui and others, over half of university students believe they possess the advantage of passion, study ability, innovation skills comparing to other start-ups. Ability in utilization of technology for information and government beneficial policy are two other factors that contribute to confidence. National students startup funding supported by other national finance policies are another important driver in startup early stage. (Cui et al., 2010).

On the funding level, funding is distributed to only a few areas for college students entrepreneurship, such as enterprise registration, taxation. However, The amount of funding is not enough to support extra cost in implementation and training cost. (Su, 2009)

Second, there is not enough funding for students start-up in high technology field. Start-ups of high technology require larger amount of investment comparing to other low technology business. However, students generally have much lower funding source comparing to other entrepreneurs. On the macro level, the investment in commercialization innovation in China is low. The ratio of "laboratory research : pilot experiment : industrialization" is "1 : 0.7 : 100", which is much lower than world average ratio "1 : 10 : 100". Funding inadequacy is a main reason for college students to choose low technology area to start business. (Hua, Li, and Ren, 2012)

Third, although the funding source of students' start-up is family, government, university, market capital, 82% of financing source comes from family support. Funding support from government and university are very limited. The capital market in China is still in infancy phase. What's more, the venture capital usually set up high threshold for students' startup applicants that most of college students cannot meet the standard. Bank loan application success rate and amount are low due to low effective credit guarantee of student entrepreneurs (Su, 2009). Lack of diversified funding source has contributed to the failure of college students' start-up.

On the technology level, university technology transfer rate is less than 60%, patent rate is lower than 15% (Hua, Li, and Ren, 2012). Students' start up should utilize university research capacity and promote technology transfer to increase students' start-up competitiveness because students are less competitive in market, high technology should be the core to enhance competitiveness of start-up. Should build up an interface to connect university technology transfer and students start-up.

On the education level, Su and Liu divide the entrepreneurial education for college students into general course, professional skills courses, and experience practical courses. The general courses delivery general knowledge in entrepreneurship. The professional skills cover divergent skills such as company finance, intellectual property, technology evaluation, and so on. Experience practical courses focus on negotiation and socialization skills through teamwork. However in China, entrepreneurial course stays at low level of general knowledge. More practical course need to be designed to meet diversified demands from students (Su and Liu, 2011).

However, the entrepreneurial education system is incomplete (Su, 2009). First, the examination-oriented education model leads to indifference of entrepreneurial education. Second, the entrepreneurial education is only delivered in higher education level. Third, the content is theoretical. Training staff is lack of real business experience. College students' start-up mostly stay on theoretical level, such as "Challenge Cup" Chinese Collegiate Business Plan Competition. Business plan in these type of competition are seldom applied to real business operation. (Hua, Li, and Ren, 2012). The whole entrepreneurial education is not systematic and not continuous. The training is not tailor designed for student target groups.

On the social economic level, China has been depending on extensive economic growth. It is difficult for high technology start-up to find partner and support in this economic structure (Hua, Li, and Ren, 2012). Society is lack of entrepreneurial tradition and integrity awareness. Students mostly pursue job with stable income and guarantee instead of taking risks. Generally, there are low tolerance of failure in family and social environment (Su, 2009).

5.3.4 IIMs for students' start-up in China

Innovation intermediaries are part of driving force to smooth the establishment of students' startup. The innovation intermediaries can facilitate college students' start-up in many ways (Zhao and Yu, 2011). First is searching for funding, applying to government funding and subsidy through project application, rent subsidies, Incubator support policies implement. Second is to provide logistics services in property services and business initial start services, such as business registration, commercial inspection, application and inspection for high-tech enterprises, technology projects application, new products production appraisal, IT certification and other procedures.
Third is to offer entrepreneurial experience. Mentoring and facilitating on students' start-up can be done through training and consulting, network with university, government and industry. Fourth is consulting. The biggest value-added service is incubating, including company management and start-up consultancy, covering investment structure, marketing, accounting and financial management, legal structure, intellectual property management, team building, new product evaluation, information systems, policies and regulations, international trade, customs services, etc.

However, technology venture investment intermediaries are not very enthusiastic in supporting students' start-up in China. Take Zhejiang province for example, the investment from technology venture capital is low in quantity and amount. 54.8% venture capital invested in around 5 college students start-ups, 35.5% invested less than 100,000 RMB to students' start-up, 38.7% invested in students' start-up for one to three years (Zhao and Yu, 2011).

There are many problems of intermediaries need to be solved in funding, student customer, service, social economy and most important is in endogenous aspect.

On the funding level, investment is low in college students' start-up comparing to other companies (Zhao and Yu, 2011). There is the lack of seed funding in university start-up incubator park (Ge, Zhang, and Li, 2013). The financing channels need to be further widened (Zhao and Yu, 2011).

On the students level, first is that students' start-up team composition is not optimized. Funder and employee of start-up are mostly composed by the same specialty in knowledge. There is lack of multidisciplinary team members, mostly limited to science department students. What's more, students have low market experiences, little social working experiences, low physiological in dealing with failure, and lack of legal related knowledge (Ge, Zhang, and Li, 2013). Third, students

are lack of sufficient awareness of the importance of venture capital class science and technology intermediary service (Zhao and Yu, 2011). Fourth is low technological element in start-ups. Start-ups focus more on marketing profit. Some start-ups cannot stick to original vision but deviate the a totally different business area for profit (Ge, Zhang, and Li, 2013)

On the service level, the service is limited on logistic support and lecture training, (Zhao and Yu, 2011) but lack in service of risk evaluation, mentoring and entrepreneurial knowledge (Ge, Zhang, and Li, 2013). The level of service focus on product commercialization, in stead of research and development on early stage. . (Wu et al., 2009). The select criteria of start-up focus on short-term return on investment but neglect those start-ups with potential in long run. (Zhao and Yu, 2011)

Take university start-up incubator for example. The college students' start-up incubator have been set up for over 10 years. However, the incubation rate is generally low of 15%, especially low among students' technology SMEs of 4%, and only 2% are success in continuing running after incubation. (Qiu and Liu, 2013) Reasons for the low incubation rate are three fold. First is the short sight in economic profit. The vicious competition among collegiate incubation park for short-term economic profit leads to ambiguous selection criteria for enterprises. The function of strategic planning and resource allocation is not fulfilled. (Qiu and Liu, 2013)

On the endogenous level, first, it is hard to define technology intermediaries. Data inconsistencies exist in different investigations. (Wu et al., 2009). Second, technology intermediaries depend largely on government. Technology intermediaries have close relation with government in many ways, including funding, spin-off, and affiliation. This leads to the lack of independency and fairness in decision-making. There are few self-financing, independent technology intermediary organizations operate according to market. Thus, it causes the low quality of service and visibility in market.

Planning economy transfer to market economy, most S&T intermediaries are evolved from government secondary institutions, without independent legal personality in a strict sense. Until 2007, government has been the main driving force in the field of talent market, technology market, technology transfer, and technology consulting in Beijing. On the ownership structure, two third of intermediaries were state-owned, 54% were independent running firm, 40.5% government funded, 42.1% enterprise affiliated, 39% government affiliated, 7.2% research affiliated, 6.3% association affiliated, 4.8% university affiliated.

The mixed nature of half government half enterprise in technology intermediaries hinders the systematic management and regulation in the intermediaries sector, weak awareness of market competition, low level profit.
(Tong, 2010)

Third, no industry standard is established. The absence of professional ethics and credibility, industry management, coordination and regulation system for innovation intermediaries, has limited the development of IIMs (Wu et al., 2009). For example, there is no regulated exit mechanism for incubated start-ups. 17.3% college students' start-ups exit Incubator Park for violating incubator park regulation with outstanding overdue fee, or unfulfilled responsibility in performance evaluation. 75.6% students' start-ups have closed when beneficial support ceased after the exiting of incubator. Only 6% start-ups survive over three years. Only 2% can manage running continuously (Qiu and Liu, 2013).

Fourth, most collegiate incubators are initiated for the purpose of political achievements. Instead of being comprehensive service offering in financing, guarantee and management supports for college students, most incubators only provide benefit of rent. This leads to the lost of good entrepreneurial project on the seed stage. (Qiu and Liu, 2013)

On the social economic level, there is low degree of openness for innovation environment caused by the planned economy and monopoly of information in different organizations. There is lack of public information infrastructure to support intermediaries. It should create a better innovation-friendly environment for open resource sharing. (Wu et al., 2009) Second, internationalization is low in technology intermediaries. Little knowledge and understanding possessed in foreign clients and global demands (Tong, 2010).

However, it has to admit that innovation intermediaries do bring benefit to students' start-up. Among the five factors that affect the performance of students' start-up – entrepreneur and team, environment and opportunity, strategy – there are mainly two paths for technology incubator to affect students' start-ups: First is transformation facilitation of technology transferring. This is the real practice for college students to increase entrepreneurial awareness. Second is to create entrepreneurial environment by connecting government, industry and university to integrate policy, connection, and resource. Intermediaries have effective influence on students' start-up in competition awareness, coordination ability, and management skills, while have less influence on creative thinking and self-reflection.
(Wang, 2013)

5.3.5 Suggestions

Based on the analysis of start-up and innovation intermediaries in China, there is space for improvement.

On the policy level, government should comprehensively coordinate in the following aspects: detailed policy explanation, concrete implementation, supporting service among government offices and social service support (Cui et al., 2010). The open information resource platform and management team can provide students with shared resource for better resource integration. Innovation intermediaries need to provide diversified services such as accountant, audit, asset evaluation, technology evaluation, patent, legal consultancy, advertisement, and so on (Qiu and Liu, 2013).

On the facilitating level, because of the difficulties in policy and implementation, it should promote facilitate service such as IIMs in implementation of government policy as part of the startup supporting system, including incubator, association, start-up training, improving students entrepreneurial quality in startup planning risk, evaluation system, trust and friendly environment, publicity in public media, finance, expanding network, simplify application process in government for students. A service platform should be built to connect university technology transfer with students' start-up (Hua, Li, and Ren, 2012).

Government should provide enough support for intermediaries to support college students' start-up in funding, taxation, and policy. A financial supporting system should be built consisted of venture capital and multiple funding source channels, such as YouthBusinessChina (YBC) (Qiu and Liu, 2013).

Intermediaries itself should widen the funding channel from solely depends on government to multiple actors of universities, research institutions, firms, domestic and foreign investments. Support of students' start-up should gradually transfer from government driving to market-driving direction. Specialized innovation intermediaries for college students are the answer of how to accelerate students' start-up in China. However, because the innovation intermediaries itself in China are still catching up the international level, to establish a intermediary system for college students need the strong guidance and support from government.
(Su, 2009)

On the service level, intermediaries should provide tailor made service for college students and improve service quality and visibility among student entrepreneurs (Zhao and Yu, 2011). The clear process for incubator operation should includes three phases. First is evaluation system and effective indicators for start-ups selection. Second, good quality of service, management and tracking during incubation process are the core phase in Incubator Park. Third, exit criteria need to be set up to ensure the quality of start-ups during and after incubation (Qiu and Liu, 2013). Technology intermediaries in China are facing the problem that is to improve the education level and professional level of employees. It is suggested that technology intermediaries can be one of the field to absorb the pressure of the ever-growing number of university graduates.
(Yu, 2009)

On the regulation level, besides policy and financial support, government needs to take the responsibility in regulatory. Industry regulatory and associations need to be established to fulfill the function of supervision, evaluation, and arbitration (Qiu and Liu, 2013). Establish performance evaluation criteria of incubated companies in the following aspects: finance, customer, and internal operation. Finance aspects include current assets, asset turnover, inventory turnover and so on. Customer is a meaningful evaluation indicator that should take into consideration of market share, market position, market performance and so on. Students' start-up is different from social entrepreneurial start-up especially in management in market experiences. Thus, company management is one important indicator to evaluate performance as well (Wang, 2013).

6. Case Study

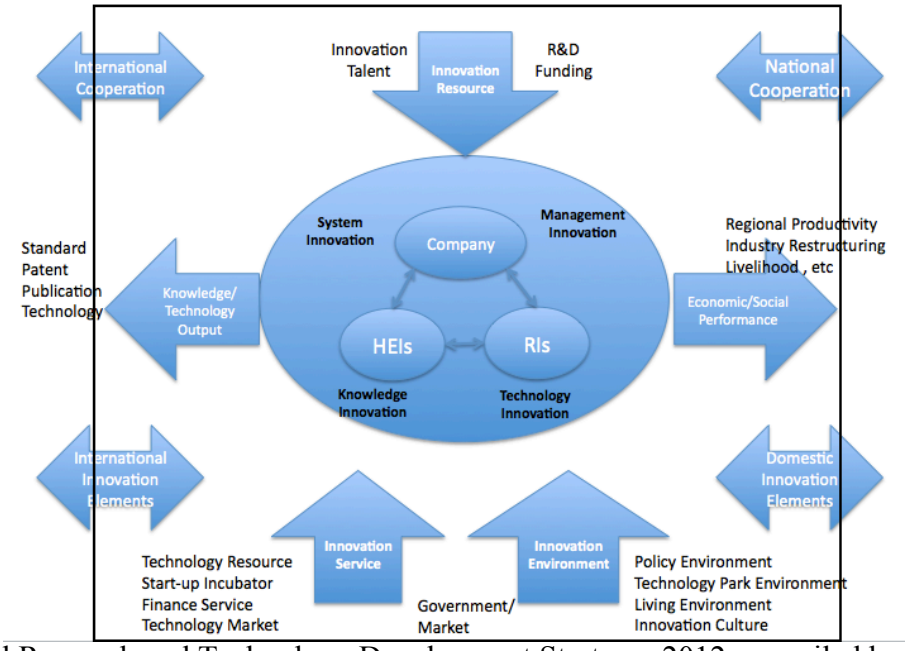
6.1 Innovation Intermediaries in Beijing

In 2011, the Ministry of Science and Technology, Chinese Academy of Science, Chinese Academy of Engineering, and Beijing Municipal Government co-founded Beijing Technology Development Strategic Research Institute, in order to build an "Innovative Beijing " as the center of national innovation system.

The policy support to build an innovation system in Beijing can trace back to 2005 document "Beijing Urban General Planning (2004-2020)" issued by the State Council. In this document, the goal is for Beijing to become a world-class city. The concept of "Innovative City" was proposed in 2006, Beijing municipal government issued "Opinions on Enhancing Independent Innovation Capacity in Building Innovative City", which led to the strategic planning for Olympic Game "Environment-friendly Beijing, Culture-enriched Beijing and Technology-empowered Beijing", with technology as the core concept in city development. In 2009, the State Council has proved the establishment of Zhongguancun Science Park National Independent Innovation Demonstration Zone. At the same year, Beijing municipal government issued "'Science and Technology Beijing' Action Plan (2009 ~ 2012 Years) - action to promote innovation". The "Innovative Beijing" was iterated in "Beijing Economic and Social Development 12th Five-Year Plan" and "12th Five-year Plan Science and Technology Beijing development and construction planning".

The Beijing innovation system is consisted of companies, higher education institutes, and research institutes (BRTDSRI, 2012). The innovation ecosystem also includes innovation resource, innovation service, and innovation environment as three indispensible elements in innovation activities. The innovation resource has talents resource and funding resource. The innovation service is service provided by innovation intermediaries, which are technology, incubation, financing, and technology market service. The national policy and innovation culture offer the support on the overarching level.

Figure 1 Beijing Innovation System



(source: Capital Research and Technology Development Strategy, 2012, compiled by author)

To value the performance of innovation service in Beijing, four indicators have been developed as technology condition, technology market, start-up incubation, and financing service (BRTDSRI, 2012). The general evaluation result shows, in 2010, financing service and technology market had the largest growth among all indicators, among which, financing service had the largest increase comparing to 2009.

In technology condition aspect, the Internet coverage rate has increased from 28.24% in 2005 to 65.54% in 2010. In the technology market aspect, this market has been growing steadily over the years from 2005 to 2010 with the improving technology transfer service. In the start-up incubation aspect, the incubator has increased from 3580 companies in 2005 to 4653 in 2010. In the financing service aspect, it fluctuates with the global economic environment. After a dip in 2008 economic crisis, the financing service has been growing in venture total capital and Zhongguancun National Innovation Demonstration Zone number of listed companies.

6.2 Z-park of Graduates (Interview Results)

Through interview with Z-park for Graduates, the interview results are presented here. The Zhongguancun National Demonstration Zone (hereinafter refer to as Z-Park) is one of the most important regional innovation clusters in Beijing, China. It was stemmed from "Zhongguangcun Electronic Street" in the early 1980s, later became New Technology Industrial Development Trial Zone, and enlarged as the first High-tech Park in China. It has been a significant model in ICT industry cluster and innovation cluster in China under the guildline of Development Plan Outline for Zhongguancun National Demonstration Zone (2011-2020).

Beijing Zhongguancun National Demonstration Zone has been often referred as "China's Silicon Valley". It is one of the important science parks for intermediaries in Beijing. Z-Park has been the demonstration of open innovation by gathering high-tech industry alliances, colleges and universities, and other higher education institutions, research institutions to promote emerging technologies research and development. It also functions as "innovation and entrepreneurial base for overseas talents" to encourage oversea returnees to start business in China bringing in new technologies. Together with Beijing Municipal Science and Technology Commission, Zhongguancun National Demonstration Zone issued the "Beijing to promote the development of a number of views of science and technology intermediary" as the guideline for Beijing regional development.

In order to close the gap between university-educated graduates and business standard skilled labor, Zhangguancun University Graduates Innovation Entrepreneurship Employment Promotion Association (Z-Park for Graduates, in Chinese: 中关村大学生自主创新创业就业促进会, official website: http://www.sciencepark.cn/index.html) has been established later in 2013. In the "death valley" between upstream technology market and downstream product market, new technology needs to be transferred into products in the innovation process (Chesbrough, 2003). Innovation intermediaries are in need to offer service in technical, market, financial and management for start-ups to safely transit this "dead valley" and reach more stable development. On one hand, universities and firms have different knowledge structure due to different organization goals and interests. On the other hand, there is lack of mutual understanding between two parties on the standard of human capital. University focuses more on basic research and pure theoretical study whereas business demands know-how and practical skills. Thus, Z-Park for Graduates is formed to break the cross sector barriers of communication, to enhance students' employability and assist graduates entrepreneur in establishing their own business.

Beijing Zhongguancun National Demonstration Zone for Graduate Students' employability, innovation, and entrepreneurship (Z-park for Graduates) is an open and independent legal cooperation organization (独立法人合作组织). Two interviews have been done to Z-park for Graduates: one from association officer and one from association manager.

An interview has been done on Z-park for Graduates combined with related literature review. Under the backdrop of the increasing employment pressure in macro economic level in China, government is taking initiatives to promote university graduates start-ups and enhancing employability. On the community level, Z-park for Graduates is to strengthen innovation and entrepreneurial awareness, to increase and integrate entrepreneurial education teaching staff, to improve quality of innovation and entrepreneurship training, to construct entrepreneurship education curriculum system.
On the curriculum level, training courses are specially designed curriculum according to specific objectives of entrepreneurship education with a reasonable knowledge structure. On the student level, it is focusing on strengthening students' entrepreneurship through entrepreneurial practice, research, and competitions organized by entrepreneurial base inside and outside of university.

University students are the key element in building an innovation-oriented country. Capacity in innovative spirit, innovative awareness, and innovative ability are required to achieve this goal. The national talents pool should combine strength from all parties, namely universities, companies, and all other organizations in this society. Z-park for Graduates perform as the platform to connect university and industry, university graduates and industry.

The establishment of Z-park for Graduates is done under some key policy and guidance:
1. State council: CPC Central Committee and State Council Decision on the Implementation of Technology Planning Framework to Enhance Independent Innovation Capability: "to implement the scientific concept of development, to build innovation-oriented country" (in Chinese: 中共中央国务院关于实施科技规划纲要增强自主创新能力的决定 2006) (Retrieved from http://www.most.gov.cn/kjzc/gjkjzc/gjkjzczh/201308/P020130823574946561083.pdf)
(In Communist Party of China 16th Central Committee of the Third Plenary Session, the scientific concept of development was formally proposed and urge the need to improve innovation.)

2. 18th National Congress of the Communist Party of China Report (in Chinese: 中国共产党第十八次全国代表大会报告 2012): reiterate the concept of "innovation-oriented country", "solve the most pressing and real problems of the greatest concern to people" (VII, Report), "Employment is crucial to the people's wellbeing" (entry2, VII), "Deliver a better job in creating employment" (entry2, VII),

3. Ministry of Education: Opinions to Promote Innovation and Entrepreneurship Education in Colleges and College Students' Startup (in Chinese: 教育部关于大力推进高等学校创新创业教育和大学生自主创业工作的意见 2010 http://cy.ncss.org.cn/cyzc/256267.shtml) Follow the development strategy of 17th National Congress of the Communist Party of China, "Improve the capability of independent innovation and building innovation-oriented country", "promote entrepreneurship to create jobs", the Opinion emphasizes four aspects in university innovation and entrepreneurial education, platform building, preferential policy, and governance to promote innovation and entrepreneurial education and college students' startup.

4. 13th People's Congress of Beijing: Zhongguancun National Innovation Demonstration Zone Ordinance (in Chinese: 中关村国家自主创新示范区条例 2010 http://www.zgc.gov.cn/zgcsfqtl/)

5. State council and Beijing Zhongguancun Science Park Administrative Committee: Zhongguancun National Demonstration Zone (2011-2020) (in Chinese: 中关村国家自主创新示范区发展规划纲要（2011-2020年）2011)

The Z-park for Graduates is founded in November 2012, is a non for-profit organization, the first base for university students' internship, startup counseling, startup incubator, university innovation, study abroad preparation, and renowned company training. It is aiming at bridging university, industry, and university graduates into innovation ecosystem to boost employability, innovation, and entrepreneurship in regional economy.

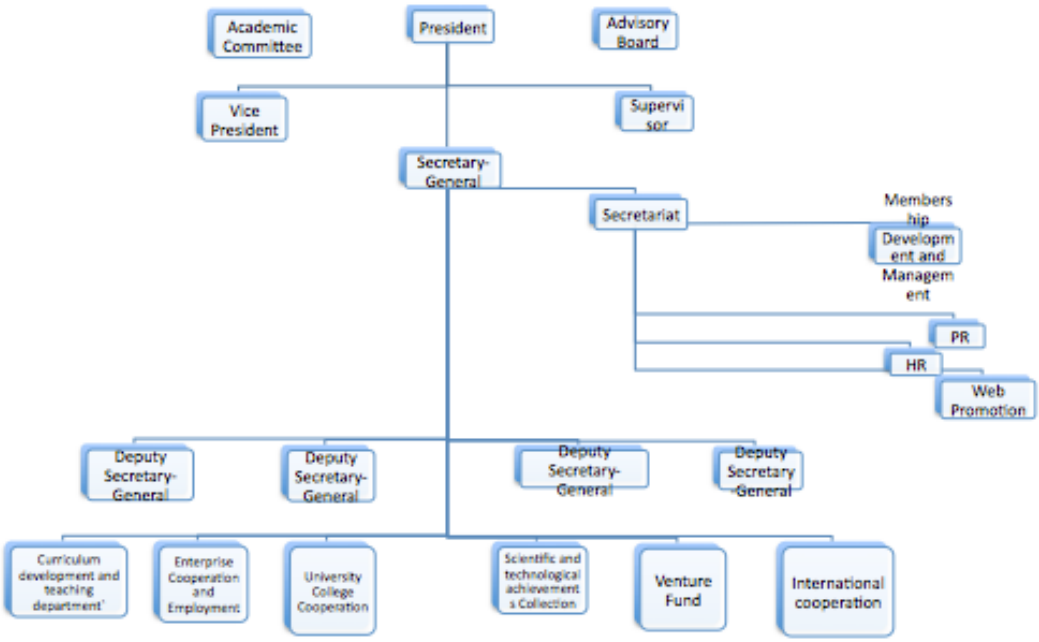
Z-park for Graduates is supported by the Ministry of Education (MoE) of the People's Republic of China, Ministry of Science and Technology (MOST) of the People's Republic of China, Ministry of Human Resources and Social Security of the People's Republic of China, and Beijing local government. It is embedded with in Beijing Zhongguancun National Demonstration Zone of 1800 square kilometers, including facilitations of 11 teaching buildings, 17 student apartments, 31 computer centers, auditorium, and 7 sports ground. There are four bases of Z-park for Graduate in Haidian, Shahe, Badaling, and North China Electric Power. One more base is under construction. It is a model that will be implemented in other provinces as well.

It is an alliance of universities and companies to serve graduate/graduating students as one stop source with multiple services. It serves as a base for technology innovation, entrepreneurship education, startup incubator, intern and employment, talent training, resources integration (universities, companies, and other institutions and organizations). The main activity is to promote university students in innovation, startups, and employability, to help university students in psychological adjustment from school to society, from classroom to working environment

It is market operated in terms of funding resource and affiliate partners. Currently, there are member of totally 98 universities, companies, and research institutions. Among which, there are 21 universities, 55 companies, 9 national research institutions, 6 Zhongguancun open lab, 3 public institutions. Other cooperative companies include 120 domestic enterprise partners, 37 World-renowned IT companies.

The Z-park for Graduates is under that management of Zhongguancun National Demonstration Zone Administrative Committee, Beijing Municipal Bureau of Civil Affairs.

Figure 2 Organization Chart of Z-park for Graduates



(source: Z-park for Graduate interview and official website http://www.sciencepark.cn/cujinhuigaikuang/zuzhijiagou/, compiled by author)

The activities in Z-park for Graduates can be roughly divided into two categories: 1) general training; 2) tailored project. The general training is done in the form of course teaching and company internship.

The General Training Curriculum in Z-park for Graduates is a joint effort by both university and business to meet respective demands. It is designed and implemented by Z-park for Graduates. Trainings are aiming to obtain knowledge and solve problem in real working environment.

Mainly there are types of courses offered in Z-park for Graduates according to official website (http://www.sciencepark.cn/kechengyushixun/) and interview results:

1. Course in entrepreneurship and employability: 14 courses in developing innovation, entrepreneurship, and employability for university students

2. Course in specialty:

IT industry employment training for college students
eg: train Enterprise-level programming habits
Financial sector training courses
eg: Bank manager negotiating strategies and techniques for corporate customers
Business Administration Training Course
Apparel industry training courses
eg: Products Development Process
Automotive industry Training Courses
eg: Technical service and sales, automobile application technology
Air Crew Training Course
eg: Flight attendants, air security guard
Hotel Management Training Course
eg: industry status, development trend analysis, investment opportunities in hotel industry

Workplace English Training Courses
eg: job hunting, office English, business English

The students target group for training course recruitment is recently graduated university students and last year university students, to those who are highly related to employability and innovation results commercialization. Training is consisted of curriculum and industry internship. The curriculum is designed to enhance employability and entrepreneurship through general content and specialized skills. Students get learning-by-doing through internship and real project in member companies. Not only the qualified training graduates would receive a qualification from Z-park for Graduates for completion of training, but receive the recommendation of job opportunities in Fortune 500 IT companies.

There is certain amount of training fee charged from students, however, due to the non for-profit nature of the organization, students could apply to loan or support from funding association to cover or partially cover the costs. The training service is different from other companies that first it is non for-profit; Second, it is specially designed for students in the transition period from university to business; Third, it is directly cooperating with university to bring in graduates student on Bachelor or Graduate study level.

The participation of companies concentrates in training course in two ways. First, the training is specifically designed according to company's requirement. It can be a kind of skill that is in need in some companies, or type of skills that a company would like graduates to possess before they start working. Second, curriculum that is designed by Z-park for Graduate team, is taking into consideration of opinions of both companies and universities. In other words, the training curriculum is co-effort from industry, university, and intermediary agency, Z-park for Graduates in this case.

The tailored project emphasizes on promoting innovation and entrepreneurship through students individual innovation project. Innovative ideas is collected and selected among student applications, with the help of universities (usually by students employability office). Selected proposals that have been reviewed and discussed by all funding associations partners, could be set up as an innovation project and incubated in Z-park for Graduates with all hard and soft facilitations. During the incubation process, support would come from government and venture capital agency and so on.

The tailored projects enjoy the service from Z-park for Graduates from business planning, venture fund application, implementation tracking, intellectual property co-management.

As a newly founded organization and the first organization to promote university students innovation, employability, and entrepreneurship, Z-park for Graduates are facing serious challenges from both university and business. First of all, university and business have divergent goal, different model of operation, different organization languages. The new model of Z-park of Graduates is difficult to attract the interests from both sides, and to be integrated into either university or business model.

Second, to be more specific, university and business have different standards for talents, which make it difficult for Z-park for Graduates to meet both standards, and even more difficult to let both sides to accept its own standard. University pays more attention on students' basic study and research ability and knowledge foundation; whereas, business requires more flexible and nimble working ability and hands-on skills.

Third, although the training is specially designed by the cooperation of university and business, the recognition of training remain low in the labor market. Even though students have taken the training

course, company still have doubts in students' working ability. This is a common feedback from company side.

Fourth, there is low level of innovation project. In the context of China and the case of Z-park for Graduate Students, innovation, entrepreneurship, and employability are closely intertwined. However, due to the lack of traditional entrepreneurial culture, biased opinion on start-ups, and difficulty in reality for start-ups regardless of beneficial national policy, the quantity and quality of graduates' innovation and entrepreneurship are much lower than employability training. Innovation and start-up business seldom in the field of high-tech but more stay on low level of innovation, such as online-shop for clothes or catering business. Because the innovation ratio is low in students' application, it is time consuming with low resource utilization. Although the organizational vision is three fold, the current situation is more concentrating on skill training.

Fifth, due to the non for-profit nature of the Z-park for Graduates activities, companies are not very interested to take part in. The participation in graduates' facilitation activities asks for extra time and resource from company side but without concrete financial return. Relatively, university has higher motivation because the employability of graduates relate directly to its own interest.

Sixth, the implementation of current model is difficult to spread. Z-park for Graduates is implementing in Beijing, Shandong, Shanxi, Heilongjiang, where co-founder organizations are located. For other provinces, it takes time for local universities and companies to accept or to meet the standard of Z-park for Graduates.

Under this situation, Z-park for Graduates is still trying to find the most suitable model to fit in both sectors. It would be a long-term effort considering the difference and hinders of cross-sector cooperation. Although there are obstacles between university-business cooperation, it also shows that it needs the facilitation of intermediary agency to close the gap and create mutual understanding.

6.3 Case Study Theoretical Analysis

Z-park for Graduates is an open innovation joint effort IIM to promote entrepreneurship in college students. It is the joint effort of Ministry of Education, Ministry of Science and Technology, Ministry of Human Resources and Social Security, key universities, research institutions, Z-park open laboratory, enterprises in China.

In this innovation intermediary agency, explicit knowledge is organized in the form of systematic course training to transfer both explicit and tacit knowledge of business, job specific skills only gain through apprenticeship, hand-on training and entrepreneurship, organizational culture.

There is a contradiction between labor market reality and the vision of better employability. To reduce graduates unemployment, as indicated in general national policy, a linkage needs to be established to solve the contradiction of government vision (reduce unemployment rate) and the reality (students lack of know-how working knowledge and culture in workplace, and associated psychological adjustment from school to workplace). The practical facilitation can be the Z-park for Graduates, to enhance students' capacity in finding a job or start own business through the learning and practicing from business world, with the support from universities. If this model is successful in implementing in long run, this model can be spread and to be implemented in wider range.

The employability and entrepreneurship of university graduates has been an issue in China that needs to be solved. However, the complex social, economic, and cultural factors increase the degree

of unknown in solving this problem. Neither the universities nor the market can solve this problem on their own. The inherent dilemma in "collective radical innovation" that open-innovation team can neither rely on internal coordinative capacity nor the market mechanism (Agogué et al., 2013). Therefore, argues that innovation intermediaries is the "architect of the unknown" to solve the dilemma with high degree of unknown.

The function of innovation intermediaries is two fold. It can facilitate knowledge transfer and strengthen the effectiveness of knowledge network (Yusuf, 2008). According to Yusuf, the university-industry linkage is suitable to disseminate codified knowledge and also to create tacit knowledge. The transformation from idea to commercial use can be done through these two parties working together with the assistance from innovation intermediaries.

The type of learning infrastructure of Z-park for Graduates belong to is difficult to define. From the knowledge transformation perspective, Z-park for Graduates is transferring both coded knowledge and tacit knowledge to customers and partners. The customers of Z-park for Graduates are students. The partners of Z-park for Graduates are university and business.

On the customer level, coded knowledge (such as skills training), and tacit knowledge (such as entrepreneurial awareness) are disseminated to students through teaching. In this sense, Z-park for Graduates has the function of type I learning infrastructure. In addition, students gain knowledge also from take part in on-job internship, learning by doing. Tacit knowledge is accumulated in this process. Therefore, Z-park for Graduates also function as type II learning infrastructure.

On the partners' level, Z-park for Graduates focus more on tacit knowledge. University and business can enhance mutual understanding through jointly taking part in training and incubation activities. Common will is established through co-designing curriculum, incubation of students' start-up companies with the facilitation of Z-park for Graduates. However, Z-park for Graduates cannot be totally categorized as learning infrastructure type III, because of insufficient communication and participation from universities and companies. The barriers are inherent problems such as different organization interests, goals in university business cooperation, social and cultural understanding on start-ups, social economic innovation environment. Z-park for Graduates as a cross sector alliance certainly is functioning as the type II learning infrastructure for members to share know-how knowledge. However, it still encounters huge difficulty in building up better negotiation between university and business. The facilitation of innovation intermediaries in knowledge transformation cycle remains at low level, such as design training according to company's demands and negotiate with university for students recruitment. The upgrade of facilitation to strategic level still needs social entrepreneurial culture and more effective policy implementation. This can not be done only by innovation intermediaries but a joint efforts from innovation actors – university, business, and government.

7. Conclusion

This research is aiming to study on the type and function of Z-park for Graduates in open innovation under the Chinese context between university and business. Open innovation as the concept raised up by Chesbrough has drawn attention into the need for innovation reform from closed innovation to open innovation. The organization boundary should no longer be the reason to stop innovative ideas to share with others. The permeable organization boundary has enabled the possibility to maximum the utilization of scientific research.

The main findings of this research on research question – *How does Z-park for Graduates promote students' entrepreneurship in Beijing China?*— contain the finding on typology and function of Z-park for Graduates to answer two sub-research questions:

1. What type of innovation intermediary agency Z-park for Graduates is?

2. How does Z-park for Graduates facilitate innovation between university and business?

Finding 1: Typology of Z-park for Graduates

The establishing of innovation intermediaries topology in China is supported by the review on open innovation in China. China has been undergoing the transformation from manufacture-oriented to innovation-oriented country. The government has taken initiatives in enhancing indigenous innovation capacity through policy and implementation. The policy to promote innovation started from “Open Door” policy in 1978 until the recent important national policy of "Long-term Science and Technology Development Plan (2006-2020)". The reforms in innovation can be seen from the changes of policy and new policies. The achievement of the efforts in innovation capacity building is apparent with research and surveys done domestically and internationally. However, there are many problems left in current promising success. The problem cannot be solved only by more effective implementation, but a profound change in national and regional innovation system. The resource of university and business should be better integrated by building up an innovation-friendly environment. What’s more, as the entrepreneurial start-ups and SMEs are also one diving force to improve the overall innovation capacity, traditional social value is the fundamental factor to be changed.

There are difficulties in defining what are innovation intermediaries. Different criteria have been adopted to illustrate a wide range of intermediaries. One of the most recognized categorization is done from the innovation process perspective. However, the typology adopted in this study is categorized based on the efforts that university and business devoted in innovation intermediaries to promote students’ entrepreneurship. There are three types of IIMs between university and business: university-oriented IIMs, open innovation joint efforts, Business-oriented IIMs. The open innovation joint effort is the most important platform to link cross sector cooperation in open innovation environment. The benefit of close innovation is to enhance core competitiveness inside a company, which is necessary to exist. Organization resource can be effectively utilized on promising research instead of waste on false positive ideas. This helps an organization to build the foundation of core technology in research. However, there are downsides and social changing factors that force organization to change the existing model. The closed innovation requires large investment in research and development. The concept of “Not Invented Here” is formed through doing all R&D inside one organization only. It leads to the question of how to balance building research capacity and optimizing finance investment. Because one organization has particular vision and planning, many the research results are put on the shelf or given up before it turn into application. The whole package of research and development in both basic research vertically and applied research horizontally is time-consuming and costly. What’s more, it not only creates waste in organization resource, but also harms researcher’s accomplishment and loyalty.

The open innovation environment is the key for university-business cooperation. The public funding reduction in higher education institutions and research institutes are pushing universities to diversify the funding resource. A complementary cooperation between business and university is formed based on two elements: knowledge and resource. By cooperating with university, business can focus on more applied research, market study, customers, and so on. By cooperating with business, university can achieve faster technology transfer and multiple funding resources.

However, because of different interest and organization inherent nature, there are obstacles exist in cooperation, for example, two sectors are incompatible in working because business need fast solution for market while university concentrate on long-term basic research. To tackle these

problems, many kinds of intermediaries provide services to smooth cooperation during the innovation process. Therefore, to better facilitate university business cooperation, the joint effort in open innovation environment should be equally devoted from two sides. The innovation intermediaries oriented from one party can lead to unequal in motivation, resource allocation, outcome distribution, and so on.

It is clear to tell the initiatives taken by university and business in promoting students' entrepreneurship. Z-park as the joint efforts from central and local government, key universities in China, and well-known enterprises, it performs as an open innovation joint efforts to facilitate university-business cooperation.

Finding 2: the Function of Z-park for Graduates

The theoretical framework of learning infrastructure contribute the most in identify which type of learning infrastructure Z-park for Graduates is in this study. The type I infrastructure is to facilitate explicit knowledge dissemination. The type II infrastructure is to facilitate sharing experience to through exchanging tacit knowledge among members. It is a process of reflection on action. Type III infrastructure is to build up a common ground for different parties to reflect, to reach common will, and to give guidance for the future planning. It is easy to be confused with type II. Type III is different from type II on two aspects. First, type III includes the activities of type II. Type II infrastructure only provide a common ground for members to come together and share experience. However, in type III, a common will is established based on shared experiences. This "common will" will guide members to move on the next phase of cooperation. In the new cooperation, similar process of reflection on action and common will are done again. Thus, type III is a repeated process. Second, type II includes embodied know-how level. Whereas type II focus on both tacit knowledge embodied and self-transcending knowledge.

As previously discussed, the function of innovation intermediaries is two fold. It can both facilitate knowledge transfer and strengthen the effectiveness of knowledge network (Yusuf, 2008). According to Yusuf, the university-industry linkage is suitable to disseminate codified knowledge and also to create tacit knowledge. The transformation from idea to commercial use can be done through these two parties working together with the assistance from innovation intermediaries.

Z-park for Graduates is transferring both coded knowledge and tacit knowledge to customers and partners. The customers of Z-park for Graduates are students. The partners of Z-park for Graduates are university and business. On the customer level, coded knowledge and tacit knowledge are disseminated to students through teaching. In this sense, Z-park for Graduates has the function of type I learning infrastructure. In addition, students gain knowledge also from take part in on-job internship, learning by doing. Tacit knowledge is accumulated in this process. Therefore, Z-park for Graduates also function as type II learning infrastructure. On the partners' level, Z-park for Graduates focus more on tacit knowledge. University and business can reach common will through jointly taking part in training and incubation activities. However, Z-park for Graduates cannot be totally categorized as learning infrastructure type III, because of the barriers between university and business in communication and participation due to such as different organization interests, goals in university business cooperation, social and cultural understanding on start-ups, social economic innovation environment.

Therefore, the function of Z-park for Graduates is identified in this study as a mix of type I, type II and type III learning infrastructure according to the type of knowledge it facilitate for students, university and business.

Based on the review of national and local policy of innovation and students start-up in China, there are policy implications can be drew from this study:

On the start-up policy level, government should comprehensively coordinate in the following aspects: detailed policy explanation, concrete implementation, supporting service among government offices and social service support (Cui et al., 2010). The open information resource platform and management team can provide students with shared resource for better resource integration. Innovation intermediaries need to provide diversified services such as accountant, audit, asset evaluation, technology evaluation, patent, legal consultancy, advertisement, and so on (Qiu and Liu, 2013).

On the facilitating level, because of the difficulties in policy and implementation, it should promote facilitate service such as IIMs in implementation of government policy as part of the startup supporting system, including incubator, association, start-up training, improving students entrepreneurial quality in startup planning risk, evaluation system, trust and friendly environment, publicity in public media, finance, expanding network, simplify application process in government for students. A service platform should be built to connect university technology transfer with students' start-up (Hua, Li, and Ren, 2012). Government should provide enough support for intermediaries to support college students' start-up in funding, taxation, and policy. A financial supporting system should be built consisted of venture capital and multiple funding source channels, such as YouthBusinessChina (YBC) (Qiu and Liu, 2013).

On the regulation level, besides policy and financial support, government needs to take the responsibility in regulatory. Industry regulatory and associations need to be established to fulfill the function of supervision, evaluation, and arbitration (Qiu and Liu, 2013). Establish performance evaluation criteria of incubated companies in the following aspects: finance, customer, and internal operation. Finance aspects include current assets, asset turnover, inventory turnover and so on. Customer is a meaningful evaluation indicator that should take into consideration of market share, market position, market performance and so on. Students' start-up is different from social entrepreneurial start-up especially in management in market experiences. Thus, company management is one important indicator to evaluate performance as well (Wang, 2013).

There are limitations of this study in aspects. First, due to long distance between Finland and China, the first hand empirical data is difficult to collect in large scale. Although interviews were done to support the arguments, there should be large-scale of questionnaire and survey to verify the results in this study. When conducting the interview of Z-park for Graduates, the limited results provided by interviewees also shows the insufficient open innovation environment in China. Future study can explore the reason for this problem and how to build up a friendly open innovation environment in China as the contribution for better university-business cooperation. The theoretical framework adopted in this study is utilized to analyze IIMs for the first time. Therefore, more study by using this theory can help to verify the significance of this theory. What's more, this theoretical framework can also be utilized to analyze other type of IIMs outside the field of university-business cooperation.

As open innovation is the trend for innovation activities in company, between organizations, regional development, and national innovation system building, it is necessary to further explore the function of innovation intermediaries have in facilitating knowledge creation and transformation with more empirical in-depth case study and large-scale survey. The validity of the learning infrastructure framework needs to be further improved by testing in other different contexts, such as other cities or other country. In addition, Z-park for Graduates is a newly founded organization and its activities only started from the end of 2012. As such, it is hard to collect valid data and give evaluation on its performance. Follow up research on Z-park for Graduates and other similar type of

organizations should be analyzed. This is beneficial to monitor effectiveness of this type of organization in bridging cross sector cooperation and to give policy recommendation for future improvement as the foundation for integration with overall national innovation system building.

Reference

Ahrweiler, P., Pyka, A., and Gilbert, N. (2011). A new model for university-industry links in knowledge-based economies. Journal of Product Innovation Management, 28(2):218-235.

Agogué, M., Berthet, E., Fredberg, T., Le Masson, P., Segrestin, B., Stoetzel M., Wiener, M., Ystrom, A. (2013). A Contingency Approach to Open Innovation Intermediaries: The Management Principles of the "Intermediary of the Unknown". Paper presented at the 13th Conference of the European Academy of Management (EURAM), "Democratizing Management", Istanbul/TR, June 26-29, 2013, published in "13th Annual Conference of the European Academy of Management, EURAM 2013, Istanbul: Turkey (2013)".

Arnold, E. and Kuhlman, S. (2001). RCN in the Norwegian Research and Innovation System, Report No.12 in the Evaluation of the Research Council of Norway, Oslo: Ministry for Education, Research and Church Affairs. Retrieved from www.isi.fraunhofer.de/isi-de/publ/download/isi01b52/rcn-norway.pdf

Beijing Research and Technology Development Strategy Research Institute (BRTDSRI) (2012). 2012 Capital Technology Innovation Development Report. Science Press, Beijing

Blank, S.G. (2006). The Four Steps to the Epiphany: successful strategies for products that win. Second Edition. K&S Ranch publisher. Retrieved from http://web.stanford.edu/group/e145/cgi-bin/winter/drupal/upload/handouts/Four_Steps.pdf

Bogers, M. (2012). Knowledge Sharing in Open Innovation: an overview of theoretical perspectives on collaborative innovation. In C. de Pablos Heredero & D. López (Eds.), Open Innovation at Firm and Public Administrations: Technologies for Value Creation (pp. 1-14). Hershey, PA: IGI Global. Copyright 2012, IGI Global.

Chesbrough, H. W., (2003). Open Innovation: the New imperative for creating and profiting from technology. Harvard Business School Press. Boston, Massachusetts.

Chesbrough, H., Lim, K. and Ruan, Y. (2007). Open Innovation and Patterns of R&D Competition. Intellectual Property Research Institute of Australia
Working Paper No. 12.07.

Cohen, W. M., Goto, A., Nagata, A., Nelson, R. R., and Walsh, J. P. (2002).
R&d Spillovers, Patents and the Incentives to Innovate in Japan and the United
States. Research Policy, 31(8-9):1349-1367. Retrieved from http://www.druid.dk/uploads/tx_picturedb/ds2001-161.pdf

Cui, G.R., Liu, W.Q., and Xu, L.Q. (2010). University Students Entrepreneurial Policy – Based on Survey of University Students' Technology Start-up in Six cities in Beijing, Shanghai and so on. Market Weekly (Disquisition Edition), 2010(12), 3-7.

Dahlman, C. (2008). Innovation Strategies of three of the BRICS: Brazil, India and China— What can we learn from Three Different Approaches? Conference Confronting the Challenge of Technology for Development Experience from the BRICS, University of Oxford 2008.

Dalziel, M. (2010). Why Do Innovation Intermediaries Exist? Paper to be presented at the Summer Conference 2010 on "Opening Up Innovation: Strategy, Organization and Technology" at

Imperial College London Business School, June 16 - 18, 2010.

D'Costa, A.P. (2006). Exports, University-Industry Linkages, and Innovation Challenges in Bangalore, India. World Bank Policy Research Working Paper 3887.

De Jong, J.P.J., W. Vanhaverbeke, T. Kalvet & H. Chesbrough (2008), Policies for Open Innovation: Theory, Framework and Cases, Research project funded by VISION Era-Net, Helsinki: Finland. Retrieved from http://www.eurosfaire.prd.fr/7pc/doc/1246020063_oipaf_final_report_2008.pdf

Dossou-Yovo, A., and Tremblay D.G. (2012). Public Policy, Intermediaries and Innovation System Performance: A Comparative Analysis of Quebec and Ontario. The Innovation Journal: The Public Sector Innovation Journal, 17 (1), article 3.

Enkel, E., Gassmann, O. and Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. R&D Management, 39(4)

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix---University-Industry-Government Relations: A Laboratory for Knowledge-Based Economic Development. EASST Review 14, 14-19.

European Commission. (2009). 30 Best Cast Studies of Good Practice in the Area of UBC Within Europe. Part of The DG Education and Culture Study on the Cooperation between Higher Education Institutions and Public and Private Organizations in Europe. Science-to-Business Marketing Research Centre.

European Commission (2013). Horizon 2020 – Wor Programme 2014-2015. Technology readiness levels (TRL). Retrieved from http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

European University Association (EUA) (2009). Collaborative Doctoral education – University-Industry Partnerships for enhancing Knowledge exchange. Borrell-Damian (eds.). Retrieved from http://www.eua.be/eua-work-and-policy-area/research-and-innovation/doctoral-education/doc-careers/

European University Association (EUA) (2013). University-Business Cooperation: Strategic partnerships for innovation and growth -from dialogue to partnership. Vth University-Business Forum Brussels, 4-5 June 2013. Retrieved from http://www.eua.be/Libraries/Newsletters_2013/2013_06_04_University-Business_Forum.sflb.ashx

Fan, H.M., Zou, X.D., and Lv. X.F. (2013). CIC: A Chinese Triple-Helix-based initiative in universities to promote U-I-G cooperation. Paper on Open Conference Systems, Triple Helix International Conference 2013.

Fisher, C. (2010). Knowledge Brokering and Intermediary Concepts: an analysis of e-discussion on Knoweldge Brokers' Forum. (www.knowledgebrokersforum.org) This document includes the full collection of contributions during and after the Knowledge Brokers' Forum first lively e-discussion on Knowledge brokering and intermediary concepts in September/October 2010. Retrieved from http://assets00.grou.ps/0F2E3C/wysiwyg_files/FilesModule/knowledgebrokersforum/20101

216052325-ugrvcfpatmivjojwi/E-Discussion_Knowledge_brokering_and_intermediary_concepts.pdf

Fu, X.L., and Xiong, H.R. (2011). Open Innovation in China: Policies and Practices. TMD Working Paper Series No. 044. University of Oxford, Department of International Development.

Fu. X.L. (2012). The International Dimension of Open Innovation: Evidence from University-Industry Collaboration in China. Lecture PPT in Haas School of Business, University of California, Berkeley.

Gassmann, O., Enkel, E., and Chesbrough, H. (2010). The Future of Open Innovation. *R&D Management* 40(3), Blackwell Publishing Ltd.

Ge, P., Zhang, Z.Y., and Li, Y.Y. (2013). Research on Business Incubator Park for College Students in Anhui Science and Technology University. Family Education World, 2013(2), 215-216

GEM. (2013). Global Entrepreneurship Monitor - Visualizations. Global Entrepreneurship Research Association. Retrieved from http://www.gemconsortium.org/visualizations

Hagedoorn, J. and Duysters, G. (2002). Learning in Dynamic Inter-firm Networks: The Efficacy of Multiple Contacts. *Organization Studies*, 23(4), 525-548.

Hargadon, A. and Sutton, R.I. (1997). Technology Brokering and Innovation in a Product Development Firm. Administrative Science Quarterly, 42(1997), 716-749.

Howells, J., Ramlogan, R. and Cheng, S-L. (2009). The Role, Context and Typology of Universities and Higher Education Institutions in Innovation Systems: A UK Perspective. Retrieved from https://www.esrc.ac.uk/.../4277a357-b5f7-4c43-857e-78335f83db53, http://www.esrc.ac.uk/my-esrc/grants/RES-171-25-0038/outputs/read/8ad1b6e3-7610-468c-8f8c-a7f52ab7815d

Howells, J.; Ramlogan, R, and Cheng, S-L (2012). Higher Education Institutions in an Open Innovation System: A UK Perspective. International Journal of Entrepreneurial Behaviour & Research,18(4).

Hua, Y., Li, S.S., and Ren, Z.P. (2012). The Significance and Countermeasures to the Transformation of Scientific and Technological Achievements for College Students' Enterprise Education. Journal of Agricultural University of Hebei (Agriculture and Forestry Education), 14(3), 1-6.

Jongbloed, B. (2008). Funding higher education: a view from Europe. CHEPS. http://www.utwente.nl/mb/cheps/summer_school/literature/brazil%20funding%20vs2.pdf

Kodama, T. (2008). The role of intermediation and absorptive capacity in facilitating university–industry linkages—An empirical study of TAMA in Japan. Research Policy, 37, 1224-1240.

Krogh, G. (1998). Care in knowledge creation. *California Management Review*; 40 (3), 133-153. Retrieved from file:///Users/qiu/Downloads/Care%20in%20Knowledge%20Creation.pdf

Kux Barbara (2008), Universities and Open Innovation: a New Research Paradigm, Royal Philips Electronics. Retrieved from http://www.essays2030.ethz.ch/onlineversion/113-124.pdf

Ministry of Education (2014). 2014 National New Policy on Employment and Entrepreneurship of College Graduates. http://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/s8137/201406/170142.html

Nonaka, I. (1991). The Knowledge Creating Company. Harvard Business Review 69 (6), 96-105.

Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, 5 (1), 14 -37. Retrieved from http://www1.uni-hamburg.de/ami/lehre/Veranstaltungen/WS_0607/Innomarketing/Rueckschau/Nonaka_OS_1994.pdf

Nonaka, I., Noboru, K. (1998). The concept of "ba": Building a foundation for knowledge creation. California Management Review, 50 (3), 40-54. Retrieved from http://kcp-research.wikispaces.com/file/view/The+concept+of+ba_building+a+foundation+for+knowledge+creation.pdf

Nonaka, I., Toyama, R. and Konno, N. (2000).SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation. Long Range Planning 33 (1), 5-34. Retrieved from http://www.ai.wu.ac.at/~kaiser/literatur/nonaka-seci-ba-leadership.pdf

Nonaka, I., David, T, eds. (2001). Managing Industrial Knowledge: Creation, Transfer, and Utilization. London: Sage. Retrieved from http://books.google.fi/books/about/Managing_Industrial_Knowledge.html?id=ld-OgMuvL6MC&redir_esc=y

Nonaka, I., Toyama, R. and Sharmer, C.O., (2001). Building Ba to Enhance Knowledge Creation and Innovation at Large Firms. Dialog on Leadership. http://www.iwp.jku.at/born/mpwfst/02/www.dialogonleadership.org/Nonaka_et_al.html

OECD, 2002. Frascati Manual: Standard Method Proposed for Surveys of Experimental Research and Development OECD, Paris. Retrieved from http://www.tubitak.gov.tr/tubitak_content_files/BTYPD/kilavuzlar/Frascati.pdf

O'gorman, C. and Kautonen, M. (2007). Policies to promote new knowledge-intensive industrial agglomerations. Entrepreneurship & Regional Development: An International Journal, 16:6, 459-479, DOI: 10.1080/0898562042000224369. To link to this article: http://dx.doi.org/10.1080/0898562042000224369

Pels, J. and Odhiambo, F. (2005).Design of and practical experiences with the Learn@WELL knowledge management module. KM4D Journal 1(2): 4-18. Retrieved from http://journal.km4dev.org/index.php/km4dj/article/viewFile/20/16

Polanyi, M. (1966). The Tacit Dimension. The University of Chicago Press. Retrieved from http://files.meetup.com/2380361/Polyani%20TacitKnowing.pdf

Polanyi M. 2009. The Tacit Dimension. The University of Chicago Press: Chicago and London. Retrieved from http://files.meetup.com/2380361/Polyani%20TacitKnowing.pdf

Poyago-Theotoky, J., Beath, J., and Siegel, D. S. (2002). Universities and fundamental research: Reflections on the growth of university-industry partnerships. Oxford Review of Economic Policy, 18(1):10-21.

Qiu, G.L. and Liu, C. (2013). Collegiate Business Park Incubation System Research. Economic Vision, 2013 (11), 42-43.

Ouchi, W. G. (1980). Markets, Bureaucracies, and Clans. Administrative Science Quarterly, 25 (1), 129-141.

Raunio, M., Kautonen, M. and Saarinen, J. P. (2013). Models for International Innovation Policy: Transnational Channels and Regional Platforms: Fostering Globalizing Innovation Communities in Finland and Abroad. Research Centre for Knowledge, Science, Technology and Innovation Studies (TaSTI) and Nokia Research Center.

Ramírez-Portilla, A., Jovanovic, M., Viveros-Perez, A., and Ramírez-Angulo, J., "Exploring the creation of disruptive innovations by student start-ups through an open innovation perspective: The case of Stu:Drive", Congreso Internacional de Investigación e Innovación 2014 – Multidisciplinario, Guanajuato (Mexico), 10th – 11th April 2014. Conference Proceedings ISBN 978-607-95635
Retrieved from
https://www.academia.edu/5687207/Exploring_the_creation_of_disruptive_innovations_by_student_start-ups_through_an_open_innovation_perspective_The_case_of_Stu_Drive

Reinhard, K., Osburg, T., and Townsend, T. (2007). The sponsoring by industry of universities of cooperative education: a case study in Germany. Asia-Pacific Journal of Cooperative Education, 2008, 9(1), 1-13.

Robert E. Litan and Robert Cook-Deegan. (2011). Universities and Economic Growth: The Importance of Academic Entrepreneurship. In Ewing Marion Kauffman Foundation (Eds.), Rules for Growth: promoting innovation and growth through legal reform (pp. 55-82). Published by Ewing Marion Kauffman Foundation.

Rowley, J. (2006). The wisdom hierarchy: representations of the DIKW hierarchy. *Journal of Information Science*, 33 (2), 163–180. Retrieved from
http://jis.sagepub.com/content/33/2/163.full.pdf+html

Savitskaya, I., Salmi, P., and Torkkeli, M. (2010). Barriers to Open Innovation: Case China. Journal of Technology Management and Innovation, 5(4), 10-21.

Scharmer, C.O. (2000). Self-Transcending Knowledge: Organizing Around Emerging Realities. Organizational Science, 33(3), 14-29.

Scharmer, C.O. (2009). Theory U: learning from the future as it emerges: the social technology of presencing. San Francisco (Calif.): Berrett-Koehler. cop. 2009.

Schartinger, D., Rammer, C., Fischer, M. M., and Frohlich, J. (2002). Knowledge interactions between universities and industry in Austria: Sectoral patterns and determinants. Research Policy, 31(3):303-328.

Striukova, L. and Rayna, T. (2013). Open innovation in practice: Evidence from British universities. Republished as "University-Industry Knowledge Exchange: An Exploratory Study of Open Innovation in UK Universities" on *European Journal of Innovation Management*, March 21, 2014

Science and Technology Statistic Center, Ministry of Science and Technology of the People's Republic of China (2013). China High-Tech Industry Data Book 2013. Retrieved from http://www.sts.org.cn/sjkl/gjscy/data2013/data13.pdf

Stodden, V. (2011). Innovation and Growth through Open Access to Scientific Research: Three Ideas for High-Impact Rule Changes. In Ewing Marion Kauffman Foundation (Eds.), Rules for Growth: promoting innovation and growth through legal reform (pp. 55-82). Published by Ewing Marion Kauffman Foundation.

Su, Y. (2009). Structural Dimensions and Problem Analysis of University Students' Entrepreneurial Environment and Countermeasures. Journal of Xuzhou Normal University (Philosophy and Social Sciences Edition), 35(6), 117-121.

Su, X., and Liu, F. (2011). Construction of Entrepreneurship Education System for College Students. 2011 2nd International Conference on Management Science and Engineering Advances in Artificial Intelligence, Vol.1-6

Tong, A.X. (2010). Takeoff and development of technology services for Beijing. Think Tank of Science & Technology, 2010(7), 42-47.

University Industry Innovation Network (UIIN) (2013). Good Practice Series 2013 – Fostering University-Industry Relationships, Entrepreneurial Universities and Collaborative Innovation Arno Meerman & Thorsten Kliewe (eds.) Published by University Industry Innovation Network.

Vanhaverbeke, W., de Vrande, V.V. and Chesbrough, H. (2008). Understanding the Advantages of Open Innovation Practices in Corporate Venturing in Terms of Real Options. Journal compilation, 17(4), 251-258.

Wang, H.D. (2013). Empirical Analysis on the Sci-tech Startup Incubator's Impact on the Performance of College Students Entrepreneurial Performance. Science&Technology Progress and Policy, 30(16), 142-146.

World Intellectual Property Organization (WIPO). What is Intellectual Property? http://www.wipo.int/about-ip/en/

Wu, C.S., Xu, Y.L., Wu, H.R., and Wu, Q. (2009). Beijing Science and Technology Intermediary Status and Development Strategies. Science and TechnologyManagement Research, 2009(10), 63-65

Wu, W.P. (2007). Cultivating Research Universities and Industrial Linkages in China: The Case of Shanghai. World Development, 35(6), 1075–1093.

Xia, R.Q., Luo, Z.M., and Yan, J. (2012). Retrospect and Prospect of Chinese College Students Venture Policy (1999-2011). Higher Education Exploration, 2012(1), 123-127.

Yang, H., et al. (2014). Functions and limitations of farmer cooperatives as innovation intermediaries: Findings from China. Agr.
Syst. Elsevier Agricultural Systems retrieved from http://dx.doi.org/10.1016/j.agsy.2014.02.005

Ye, J.H., Kankanhalli, A., and Yang, Z.B. (2012). Knowledge Brokering for Open Innovation: a case study of innovation intermediaries. Thirty Third International Conference on

Information Systems, Orlando 2012.

Ye, Y.H. (2009). Research on the Influencing Factors of University Students' Intention of Enterpreneurship. Educational Research, 2009(351), 73-77.

Yu, W.T. (2009). Legislation Research on Technology Intermediaries Development and College Students Employment. Liaoning Research Journal on the Rule of Law, 2009(03), 19-24.

Yusuf, S. (2008). Intermediating knowledge exchange between universities and businesses. Research Policy, 37, 1167-1174.

Yun, J.H.J., Avvari, M.V., Jung, W.Y. (2012). Unraveling the relationship between entrepreneurship and open innovation: A Study on one of Modern Technology Evolution Channel. Paper present in 14th ISS Conference International Joseph A Schumpeter Society, 2nd-5th July 2012. Retrieved from http://www.aomevents.com/media/files/ISS%202012/ISS%202012%20Parallel%20Program(1).pdf and http://www.aomevents.com/media/files/ISS%202012/ISS%20SESSION%207/Yun.pdf

Zhao, X.D., and Yu, F.H. (2011). The Promising Role of Science and Technology Intermediaries in Assisting College Students' Start-up. East China Science & Technology, 2011(7), 50-51

Zhao, X.Y. and Zheng, Y. (2011) Development of Chinese science and technology intermediaries and their integration into the open innovation paradigm, Technology Analysis & Strategic Management, 23:1, 25-48, DOI: 10.1080/09537325.2011.537103

Appendix 2012 GERD Index (2012 OECD StatExtracts)

	Canada	Finland	Germany	Japan	Korea	EU	US (2011)	China
GERD as % of GDP	(p) 1.73	3.55	(c)2.92	(b)3.34	(b)4.36	(b)1.97	2.77	1.98
GERD (million current ppp $)	(p) 24 801.09	7 530.10	(c)100 247.63	(b)151 837.22	(b)65 394.37	(b) 339 091.97	415 193 000	243 421.91
GERD per capital population (current ppp$)	(p) 711.06	1 391.17	(c)1 223.77	(b)1 190.44	(b)1 307.77	(b)665.77	1 318.4	179.77
% of GERD financed by industry	(p) 48.37	63.06	-	-	-	-	60	74.04
% of GERD financed by government	(cp)34.54	26.69	-	-	-	-	33.4	21.57
% of GERD performed by Business	(p) 52.28	68.72	(cp)66.92	-	-	(b)62.23	68.3	76.15
% of GERD performed by HE	(p) 38.27	21.58	(c)18.31	-	-	(b)23.88	15.2	7.58

Legend:

a	Break in series with previous year for which data is available
b	Secretariat estimate or projection based on national sources
c	National estimate or projection
g	Excluding R&D in the social sciences and humanities

p	Provisional

(Source: OECD StatExtracts http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB# Main Science and Technology Indicators, and UNESCO Institute for Statistics http://data.uis.unesco.org/)