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# Governance Structures to Facilitate Collaboration of Higher Education Institutions (HEIs) and Science & Technology Parks

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## Abstract

There are very few studies on governance structure for the collaboration between HEIs and science and technology parks until today. Major activities between science parks and HEIs are R&D activities, collaborative researches, technology transfer, space provision for BIs and Technology BIs in the science parks, provision of technical, legal and financial services for start-ups and venture firms.

Governance structure for the collaboration of high education institutes with science and technology parks is the handling of complexity and management of dynamic flows of collaboration between two groups.

Three models on the governance structure for the collaboration are suggested in this study.

The first model is a governance structure that links R&D system such as universities, public research institutes and private research institutes with industrial production cluster such as a group of companies and industrial parks.

The second model is a governance structure that has four layers of hierarchy. This hierarchical governance model is composed of four levels of organizations such as central government, three actors, one center for collaboration and many individual research performers.

The third model is a governance structure that networks all the stakeholders horizontally. Under this structure, governance is conducted by the network members with no separate and unique governance entity.

## Keywords

Governance structure; Collaboration; Hierarchical governance; Network governance; Lead organization; Cognitive base

## 1. INTRODUCTION


Universities, the main providers of “contemporary knowledge, state-of-the-art for science and technology”, and the Science Park, the main entity that stands behind the commercialization

of knowledge and technology, are seen as central players that should be highly interconnected in order to determine the targeted economic growth of a region and a country.

Governance structure for the collaboration of high education institutes with science and technology parks is the handling of complexity and management of dynamic flows of collaboration between two groups. It is fundamentally about interdependence, links, networks, partnerships, co-evolution and mutual adjustment in the collaboration process (Mothe, 2001). Governance structure for collaboration shows what roles the actors in the collaboration process play, how the rules of the game work, how decisions are made and how changes in the overall collaboration system come into being.

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The focus of governance for collaboration is mutual relationships among collaboration actors rather than the priorities, strategies and outcomes of collaboration.

Governance is the way the rules, norms and actions are structured, sustained, regulated and held accountable. The degree of formality depends on the internal rules of a given organization and, externally, with its business partners. As such, governance may take many forms, driven by many different motivations and with many different results.

Governance plays an important role for the collaboration of science parks with HEIs and will often be based on an association of all the actors and the observance of general governance principles (Gursel, 2014). Such an association must be given clear coordination tasks. The management team must match the needs and expectations of the public and private stakeholder and agreement between the association, the developer, the planning contractor and the partners should link the various aspects of the science park project (prospecting of companies, development of installations and facilities, coordination, promotion, etc.). There should be consultation procedures and coordination bodies, to promote the development of mutual trust, and an arbitration body, to settle disagreements between partners. A board of directors should be set up, which groups the founding partners, including their elected representatives, into various bodies. Economic and financial players, and researchers and academics, should also be grouped into relevant bodies for governance.

Traditionally the main role of universities was to provide education services to the student. However, these days, universities are becoming centers of industrial activities also. When there was a complementary relationship between universities and science parks, synergistic effect would be generated. However, researches on a governance structure for the collaboration between HEIs and science parks are not found yet. The aim of this study is to try to build a governance structure for the collaboration between universities and science and technology parks.

## 2. THEORETICAL REVIEW ON GOVERNANCE

### 2.1 Definition of Governance

Governance is defined with many different versions based on for what it is used. One of the simple but broadly cited definition is that governance is the way the rules, norms and

actions are structured, sustained, regulated and held accountable (Wikipedia, February 2009). There is another definition, which is often used by many experts in business world. Governance is an establishment of policies, and continuous monitoring of their proper implementation, by the members of the governing body of an organization (Business Dictionary, July 2016).

There are many definitions on governance. United Nations Development Program defines that governance is the complex mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights and obligations, and mediate their differences (UNDP, 1997). Stoker (1996) defines that governance is an organized network, whose features are mutual reliance, exchanging resources and autonomy free from nation and regulations. Pierre and Peter (2000) define that governance is a management system which networks actors and solve public problems by coordinating policies. Peters and Pierre (2001) defines that governance is a pattern of public decision making, where the interested parties in the institutionalized policies such as central and local governments, civil organizations, and variety of vocational representatives participating in the policy making process and solving the problems.

Since governance means different things to different people, goals to be achieved and the approach being followed should be set in advance when we define governance. Working definition of governance for this research could be that “governance is a cooperative management system that achieves maximum effect by sharing mutual experience and knowledge through the participation and cooperation from variety of subjects such as science and technology parks, universities and research institutes”.

### 2.2 Components in Governance

Components in governance came out with many types, however four factors are commonly cited from many researches. Those four factors are actors, organization & institution, process, and context surrounding the structure of governance (Ministry of Environment, 2004).

Firstly, actors in governance should be composed of representatives with balance from many different social sectors such as public, private and voluntary sectors. Actors in governance are composed of three representatives such as public, private and voluntary sector. And each representative should be qualified with spontaneity and responsibility to protect and enhance public value. Like this, participants from variety of

social sectors who speak for interest groups become to foster capacity to find common tasks, forming public opinions and solve problems together through the process of communication and mutual learning in the governance system.

Secondly, the main tasks in governance as a structure are who would be participants and what role each participant should play under a certain institution and conditions, etc. There are a few forms of structures for this such as hierarchies, networks, communities but each structure has a different effective working area based on the spatial and timing consideration.

It is desirable that learning process through communication should be institutionalized to promote close mutual interchange between public and visible institutional sectors and informal and invisible institutional sectors.

### Hierarchical governance structure

A hierarchical governance structure is a governance structure where every entity in the organization, except one, is a subordinate to a single other entity (Hill, 2004). This arrangement is a form of a hierarchy. In an organization, hierarchy usually consists of a singular/group of power at the top with subsequent levels of power beneath them. This is the dominant mode of governance structure among large organizations; most corporations, governments, and organized religions are hierarchical organizations with different levels of management, power or authority.

Members of hierarchical governance structures chiefly communicate with their immediate superior and with their immediate subordinates. Structuring organizations in this way is useful partly because it can reduce the communication overhead by limiting information flow; this is also its major limitation.

### Network governance structure

Network governance forms can be categorized along two different dimensions such as participant-governed network and lead organization-governed network (Provan and Kenis, 2007).

Governance in this form can be accomplished either formally, for instance, through regular meetings of designated organizational representatives, or more informally, through the ongoing but typically uncoordinated efforts of those who have a stake in network success.

At one extreme, participant-governed networks can be highly decentralized, involving most or all network members

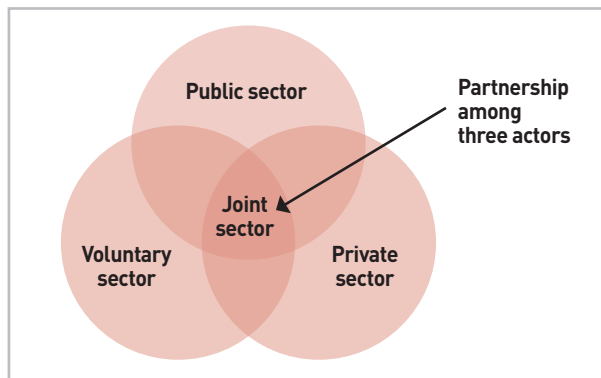


Fig. 1. Area of governance based on actor's character

interacting on a relatively equal basis in the process of governance. This is what we refer to as shared participant governance. At the other extreme, the network may be highly centralized, governed by and through a lead organization that is a network member.

While shared, participant governance may involve many or all network members, there are many situations that may not be conducive to such decentralized, collective self-governance. In particular, the inefficiencies of shared governance may mean that a more centralized approach is preferred. At the extreme, network governance can occur through what we refer to as a "lead organization." In lead organization governance, all major network-level activities and key decisions are coordinated through and by a single participating member who act as a lead organization.

Thirdly, main tasks in governance as a process are related with what is the most effective and efficient way of doing things. Mutual coordination through active discussions and communications between actors is considered the key in this governance and a steering committee is a necessary organization for this. The process of the governance should be designed elaborately and managed democratically to minimize tensions and conflicts from diverse participants' value and institution and to achieve common goals with effective motivation.

Finally, it is necessary to build a cognitive base to promote mutual interchange and collaboration rather than competition and conflict for the participants who have diverse goals, expectations and habits in one hand and to make an effort to alter social structure to secure public value to stabilize conditions surrounding governance in the context of governance.

Table 1. Main components of governance

Components	Contents	Functions
Actors	- Sharing experiences and interests through communication	Opinion formation
	- Handling common issues& public opinion	Sharing suggestions
Organization & institution	- Area of formal institution <ul style="list-style-type: none"> <li>• Principle of response, responsibility and efficiency</li> <li>• Process in institutionalization and exercising authority</li> </ul>	Policy formation
	- Area of informal institution <ul style="list-style-type: none"> <li>• Principle of spontaneous participation and cooperation</li> <li>• Process in exercising influence and deriving mutual agreement</li> </ul>	Opinion formation
Process	- Designed and operated to minimized stress and conflict from diverse participants	Exchanging opinions
	- Introducing democratic working system to achieve common goals effectively	Collecting opinions
Context	- Preparing base for promotion of mutual interchange and cooperation <ul style="list-style-type: none"> <li>• conquering dichotomy of autonomy and responsibility in governmental and civil society</li> </ul>	Building cognitive base
	- Maintaining institutional order and balance <ul style="list-style-type: none"> <li>• Establishing conditions for link and collaboration between actors</li> </ul>	Building institutions

Source: Ministry of Environment (2004): Restructuring <Table 3-5> from page 45.

### 3. CONTENT ANALYSIS ON THE GOVERNANCE STRUCTURE FOR COLLABORATION

#### 3.1 Science and Technology Park

##### 3.1.1 Introduction

Science and technology parks are the places in which many facilities for R&D, start-ups and incubation, training, supporting function are located to conduct joint R&D projects and technology transfer for universities, public research institutes and private research labs to support high-tech industries and to accelerate regional economic development

A science park is an organization managed by specialized professionals, whose main aim is to increase the wealth of the community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions (World Bank and European Investment Bank, 2010). To enable these goals to be met, the science park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets. It facilitates the creation and growth of innovation-based companies through incubation and spin-off pro-

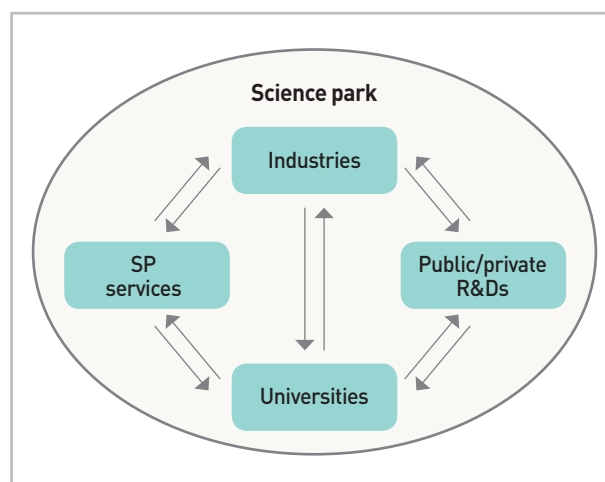


Fig. 2. Main actors and their relationships in the science park

cesses; and provides other value-added services together with high quality space and facilities.

Science parks are always directly or indirectly associated with the education sector through universities (the primary

source of trained human and intellectual capital) or through public or private research institutes. They share common objectives such as providing a training ground for entrepreneurs and supporting technology-led entrepreneurship based on university or laboratory research results. In fact, universities and R&D institutions play an important role in science parks as drivers of education, new knowledge, and trained manpower. In particular, university students and faculty may collaborate with companies located in the science park through student internship programs and part-time jobs, company created by faculties, and research partnerships.

The physical facilities and the services offered are expected to enhance the competitiveness of tenants (researchers, firms, start-ups) located in the science park.

#### **Industry-specific specialized infrastructure**

Depending on the technological or industrial scope of the science park, the technical infrastructures may include advanced telecommunication systems, prototype and pilot production, testing facilities, tool development laboratories, calibration laboratories, and environmental testing. To attract leading players, the planned infrastructure should incorporate the most recent technological advances in the industry. The decision about the range and quality of this kind of investment will affect the overall attractiveness of the science and technology parks.

#### **Key support services**

Science park clients include technology-intensive small and medium sized enterprises (SMEs), as well as large corporations, all of which require a range of services. The range, quality, and cost effectiveness of services are a key positioning tool vis-a-vis prospective tenants. Support and advisory services are expected to include marketing, contractual, and legal issues related to technology management and collaborative projects such as below (World Bank and European Investment Bank, 2010).

- Screening of new business opportunities, technology trends and foresight
- Management of collaborative projects, patenting and IPR
- Market development (business plans, road shows, international missions)
- Match-making between tenants and clients
- Easy access to project finance (grants, loans, equity financing)
- Training, seminars and workshops for capability building
- Facilitated recruitment from universities
- Networking events

### **3.1.2 Contents of activities in science parks**

#### **(1) Technology commercialization**

Technology commercialization is defined by the incorporation of research results by private firms. It includes activities such as utilization of research results, development of new products and technologies, and transfer of technology. It also includes all the cooperative activities among universities, public and private research institutes that leads to technology commercialization. Technology commercialization is the most critical function of science and technology parks, and it plays a primary role in the “value chain” that connects innovation to markets.

By transferring and expanding research results through R&D activities and collaborative researches, regional innovation, economic development and technology commercialization can occur. Universities and research institutes continuously provide necessary research results and human resources to science parks. Public research institutes, which are funded by the government, conduct R&D activities to promote the development of strategic industries with a long-term vision. Private research institutes, managed by private firms, conduct mid & short range vision strategic research projects for specific technologies in order to promote industrialization.

Universities and research institutes promote technology commercialization through collaborative researches. They contribute to the success of science parks through the innovation of technology, and the industrial growth and economic development of the region. Occupants of science and technology parks are firms, universities, public research institutes, and private research institutes.

#### **(2) R&D activities**

R&D in science and technology parks includes collaborative research among universities and private & public research institutes. The major contents of R&D in each kind of institute are such as below:

Universities (HEI) educate human resources capable of scientific research and conduct R&D activities with private & public research institutes. Public R&D institutes accelerate technology innovation and build R&D infrastructure through government led R&D activities. They also support private R&D activities of private firms with long-term vision (Kang, 2004).

Private R&D institutes or research institutes affiliated to firms conduct research in specific fields and put more focus on application of research results, manufacturing of new products. Collaborative research increases innovative capacities of

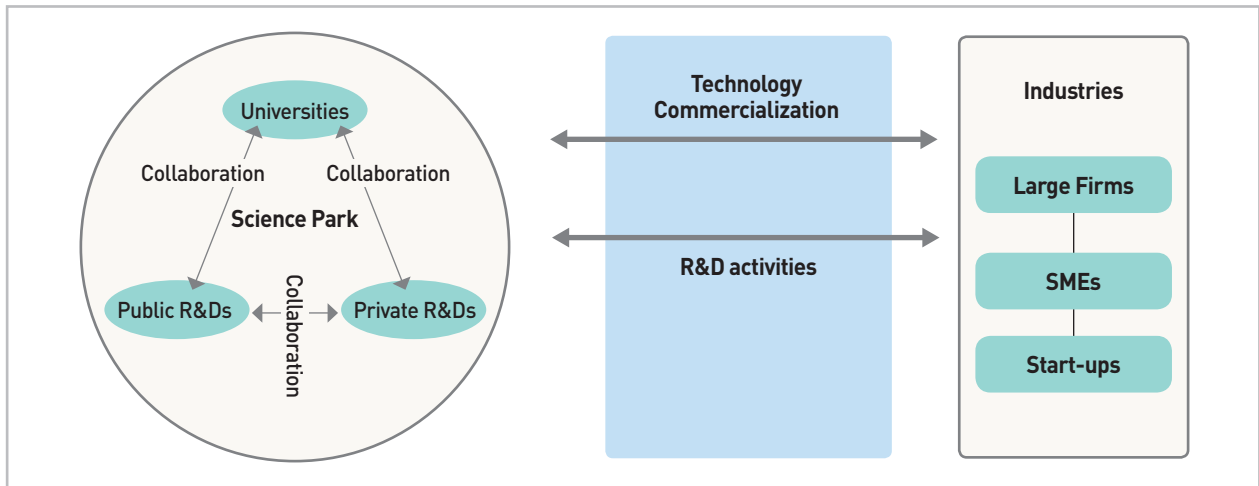


Fig. 3. Major activity links in the science park

science parks through partnerships among firms, universities, and private and public research institutes. Collaborative research is a key method to develop and expand technologies through the close collaboration among various organizations.

### 3.2 Higher Education Institutions (HEIs)

#### 3.2.1 Introduction

Universities (HEIs) are the source of knowledge. They produce human resources capable of research and conduct various research such as elementary research, research funded by firms, and collaborative research among institutes. There are government affiliated research institutes and research centers for industry-university collaboration research in universities. These organizations conduct research focused on technology commercialization.

Universities perform diverse roles to the community and the region in which they located. Basic roles of universities are provision of education and accumulation of scientific discoveries, but many other roles such as providing updated technical knowledge and skills in the workforce and making spin-offs successful are also included. There is a complementary role in which universities undertake joint research, consultancy, or contract work with industry to help address various technological problems. This interaction with industry allows universities to learn about needs from industries (Narasimhalu, 2015).

#### 3.2.2 Contents of activities in HEIs

##### (1) R&D activities

Universities conduct research through government sup-

ported R&D projects, R&D projects entrusted by private firms, and collaborative R&D projects from industry-university collaborations. By carrying out these R&D activities, universities can train high quality human resources and acquire funds. Universities and graduate schools conduct R&D activities in basic and applied fields. University affiliated research institute, research center for industry-university collaboration conduct industry-university collaborative research projects. University affiliated research institutes, public and private research institutes, large firms and venture firms build industry-university partnerships by conducting R&D projects together.

Private R&D projects are entrusted to universities from private firms through legal contracts. Public R&D projects are given to universities by public organizations such as central and local governments. Various R&D projects are also offered to universities by the ministries of central government in Korea (e.g. Brain Korea 21, NURI (New University for Regional Innovation)), CK (Creative Korea) etc.).

Universities hold R&D capacity by securing funds from patents, technology transfer, and technology transactions. Universities build a sustainable R&D circulation structure, which provides professional human resources capable of R&D activities.

##### (2) Collaborative Research

International competitiveness in technology is grown up through collaborative research projects. Thus, more countries are focusing on collaborative R&Ds for the expansion and development of specific industries. There are many collaborative R&D programs such as VLSI in Japan, MCC, SEMATECH and

VHSIC in the U.S.A. and, EURECA and ESPRIT in Europe.

Collaborative researches in science and technology parks are conducted by the cooperation between universities, firms, and research institutes to generate knowledge and technology. Mutual dependency and trust between research bodies are necessary factors. Collaborative research contributes to enhancing the overall innovative capacity of the nation by generating valuable and practical research results. Collaborative researches are conducted through the collaboration centers built by HEIs or governments.

#### **Collaboration center built by universities, research institutes or government (Korean case)**

International or domestic collaborative research projects are conducted by “Advanced Research Centers,” which, in Korea, were designated by the Department of Science and Technology. ERC (Engineering Research Center) is an institute built to accelerate cooperation between universities and industries by supporting research projects related to basic technologies and industrial development. SRC (Science Research Center) is an institute built to increase the standards of research in Korea to a world-class level by supporting elaborate and creative research projects in basic science (Oh and Kang, 2002).

Other organization such as, “The Supporting center for technology in university-industries,” or “The Center for collaborative researches among universities, research institutes, and firms,” is located in universities to promote collaborative researches. Partnerships are built between research institutes affiliated to firms and universities for collaborative research. Collaborative research projects can be accelerated through the exchange of human resources among universities, research institutes, and private firms.

Functions of collaboration center in Korea are listed below (Oh and Kang, 2002):

- Initiating government led joint research projects (basic research & applied research).
- Providing technology support to enhance competitiveness of regional industries.
- Initiating development programs targeting local resources.
- Providing workshops to increase technological capacities of local human resources, etc.
- Establishing research centers in local universities by the government for R&D (ERC, SRC, etc.).
- Establishing regional research centers to promote cooperation among regional institutes (RRC: Regional Research

Center).

- Holding consortiums related to collaborative research among local venture firms and universities.
- Supporting locally specialized R&D programs based on the “matching fund concept”.
- Initiating construction projects to build centers for technology development, centers for business development, and technology parks.

#### **(3) Technology commercialization**

Technologies are commercialized by a few actors such as universities, government contributed research institutes, and venture firms. Subjects that perform technology commercialization are divided into two groups such as general subjects and specific subjects. General subjects are universities or research institutes, where technologies are created or invented. Specific subjects are technology-researching individuals (researchers, professors, students, and etc.), organizations that perform technology commercialization (technology transfer centers in universities, research institutes, etc.), and agencies that intervene in technology transaction (Korea Technology Transaction Institute, etc.)

Technology commercialization occurs through technology transfers, creation of venture firms by technology inventors, or techno-marts, where technologies are sold directly to technology consumers.

Technologies are commercialized through two routes. Firstly, technologies are commercialized through licensing technology, building and operating center for technology transfer, etc. Secondly, technologies are commercialized through the creation of venture firms by technology inventors, building and operating support centers for venture firms, etc. Centers for technology transfer and support centers for venture firms provide various types of support services and professional consulting services in Korea.

## **4. GOVERNANCE STRUCTURE FOR THE COLLABORATION OF HEIS WITH SCIENCE AND TECHNO PARKS**

### **4.1 Characteristics and Contents of Collaboration Governance**

It is nearly impossible to create a standardized governance model that could be applied to HEIs with science and techno

parks collaboration, because various elements are combined together in composition and management of this kind of governance (Janine and Wanna, 2008).

Governance plays an important role in the science and technology park and will often be based on an association of all the actors and the observance of general governance principles. Such an association must be given clear coordination tasks. Management team must match the needs and expectations of the public and private stakeholders and an agreement between the association, the developer, the planning contractor, and the partners should link the various aspects of the science park projects (Eppel, 2013). There should be consultation procedures and coordination bodies, to promote the development of mutual trust, and an arbitration body, to settle disagreements between partners. A board of directors should be set up, which groups the founding partners, including their elected representatives, into various bodies. Economic and financial players, and researchers and academics, should also be grouped into relevant bodies.

Stakeholders in the science and technology park include public authorities in charge of land development or responsible of the land on which the facilities will be built. They also include higher education and research institutes looking to create value from their resources. Such resources need not be located within the science park, but they should be related to the facilities or activities being developed within it.

## 4.2 Governance Model

### Conceptual governance model of collaboration

Figure 4 below shows activities among three actors such as a science park, university, public and private research institutes. The organization for the collaboration is in charge of acceleration of R&D, management of collaborative research, execution of technology transfer and commercialization, communication and exchange between actors, operation of financial programs, etc.

### Form of governance structure

There are a few forms in governance structure such as hierarchies, networks, communities but each governance structure has a different effective working area based on the spatial and timing considerations. Three governance models such as a basic governance model for the collaboration of HEIs with the science and techno parks and two forms of governance structure such as hierarchy model and community model will be suggested in this presentation.

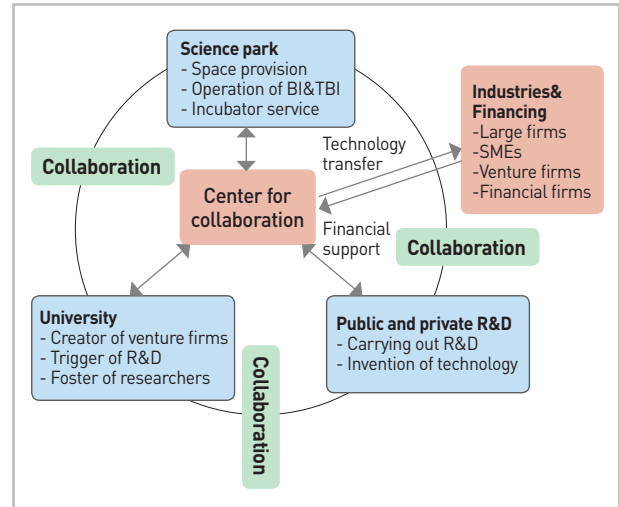


Fig. 4. Concept of governance for collaboration

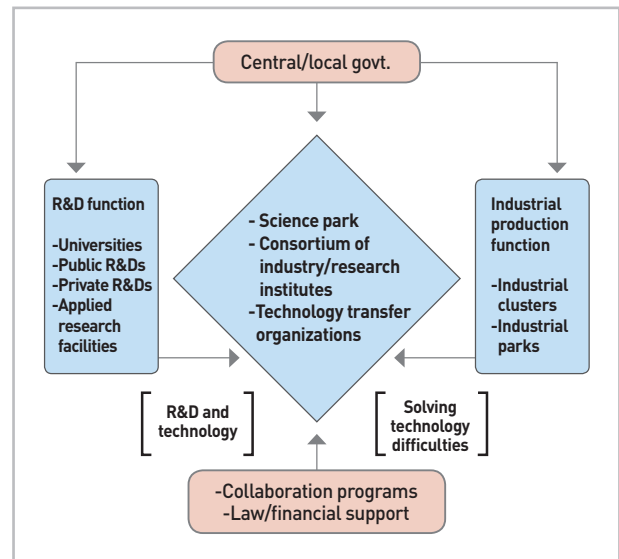


Fig. 5. Basic governance model for the collaboration of HEIs with the science park

The first form of governance for the collaboration of HEIs with the science park is a basic governance structure that links all the stakeholders together.

The focus of an efficient governance structure should be put how to achieve a rapid technology innovation by appropriately combining limited resources available in the region and technological adaptability and capacity of development existing in the region. Basic governance model for the collabora-



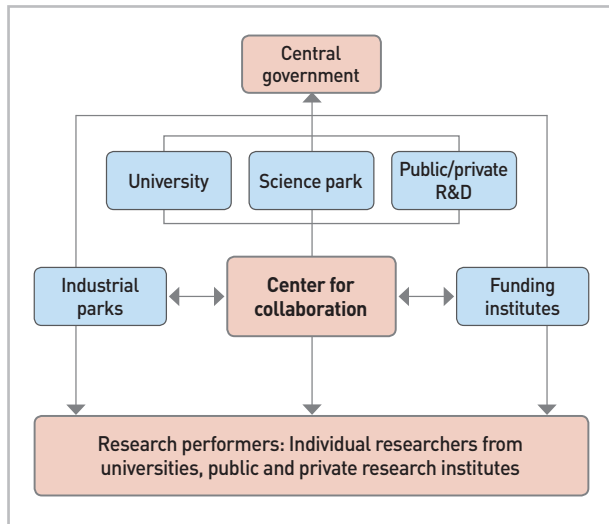


Fig. 6. Four layers hierarchy collaboration governance structure

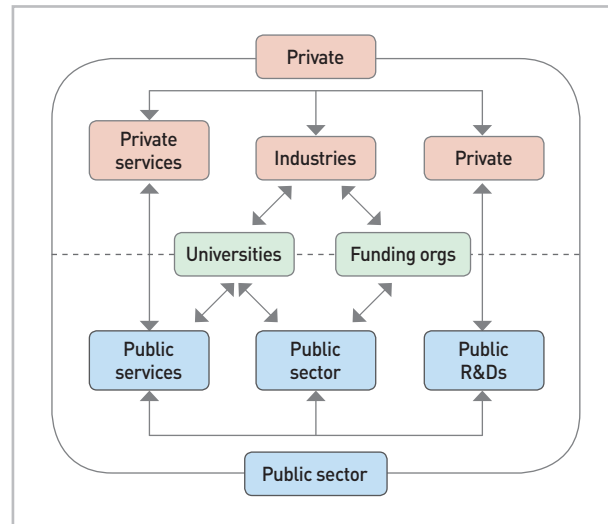


Fig. 7. Network governance structure for collaboration

tion of HEIs with the science park is a governance structure that links R&D system such as universities, public research institutes and private research institutes with industrial production system such as a group of company and industrial parks. Science parks, consortiums of industry, university and research institute are linking organizations. It is required that linking organizations should develop and expand collaboration program and policy tool to build an organic and harmonious governance structure, and should make a harmonious supply and demand system to circulate R&D and technologies among suppliers and demanders.

The second form of governance for the collaboration of HEIs with the science park is a governance structure that has four layers of hierarchy. This hierarchical governance model is composed of four levels of organizations such as central government, three actors, one center for collaboration and many individual research performers.

According to Arnold (2003), in governance structure that is composed of four layers of organizations, the most important layer for policy design and overall strategy formulation lie at the level of governments, departments and, to varying degrees, advisory bodies. The degree to which the central government (Cabinet and head of state) are involved in deciding overall coordination and strategy formulation in innovation differs enormously, but nonetheless can have great impact. The composition of these bodies and their links with key decision makers determines their importance

Each country has an important “middle level” consisting of

research funders (typically research councils, funding institutes and dedicated agencies) that allocate funding to research performers (universities, think tanks and labs, or companies). The level of independence in this middle layer shows large variations in their policy design roles and decisions on fund allocation.

The third form of governance for the collaboration of HEIs with the science park is a governance structure that networks all the stakeholders horizontally (Garvey, 1993).

Under this structure, governance is conducted by the network members with no separate and unique governance entity. Therefore, there is no center for collaboration as a leading organization like in other model. Network participants are themselves responsible for managing internal network relationships and operations as well as external relations with such groups as funders, government, and customers. There is no distinct, formal administrative entity, although some administrative and coordination activities may be performed by a subset of the full network (Lindquist, 2004).

## 5. CONCLUSION

This article has attempted to develop a model about governance for collaboration between HEIs and science and technology parks, and to stimulate fresh thinking about how governance structure might be build. A study on governance

structure for the collaboration between HEIs and science and technology parks has special meaning because unlike hotel and restaurant chains, which could be planned with similar formats in different regions or countries, there is no fixed global standard that can be applied to every case of collaboration between HEIs and science parks.

There is a high correlation between the quality of governance and per capita income. And statistical analysis has proven that good governance enhances economic performance rather than vice-versa. Singapore is one of the least corrupt places in the world and has transformed to advanced economy with good governance.

The focus of governance for collaboration between HEIs and science and technology parks is mutual relationships among collaboration actors rather than the priorities, strategies and outcomes of collaboration (Gursel, 2014). Main actors in governance structure for the collaboration of science parks with HEIs are science parks, universities and public/private research institutes.

It was identified that major activities for the collaboration between science parks and HEIs are R&D activities, collaborative researches, technology transfer, space provision for BIs and TBIs which located in the science parks, provision of technical, legal and financial services for start-ups and venture firms.

Understanding the governance structure require to operate effectively. No single university, research institutes, science parks or government can solve the critical issues facing society today. As organizations open themselves to stakeholders and communities, they tend to specialize and develop relationships with other organizations that complement and extend their core expertise. Two forms of governance structure such as hierarchical governance structure and network governance structure were analyzed in this research.

Hierarchical governance structure should only be chosen if good reasons exist to do so. When there is a high degree of uncertainty, hierarchical governance structure is more effective than any other form of governance. Hierarchical governance is the preferred sourcing mode during the growth phase, when task complexity is high. The more complex and frequent the transaction, the more efficient the hierarchical governance structure. Under this circumstance, network governance structure is more reasonable for the collaboration between science parks and HEIs because tasks of governance are not that much complex here.

Lead organization-governed network structure is recom-

mended in this study. A lead organization provides administration for the network and/or facilitates the activities of member organizations in their efforts to achieve network goals, which may be closely aligned with the goals of the lead organization. The lead organization may underwrite the cost of network administration on its own, receive resource contributions from network members, or seek and control access to external funding through grants or government funding. The role of lead organization may emerge from the members themselves, based on what seems to be most efficient and effective, or it may be mandated, often by an external funding source.

Center for collaboration could act like a lead organization in network based governance structure. As was introduced in Korean case, two categories of collaboration center such as a center built by the government and a center built by university and research institutes could be a lead organization. Collaboration center plays a critical role like conducting government led joint researches, providing technical support to enhance competitiveness of local industries, holding workshops to enhance technological capacities of local human resources, establishing consortiums related to collaborative research among local venture firms and universities.

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