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To cite this article: Sam Youl Lee, Meansun Noh & Ji Yung Seul (2017): Government-led regional innovation: a case of 'Pangyo' IT cluster of South Korea, European Planning Studies, DOI: [10.1080/09654313.2017.1282084](https://doi.org/10.1080/09654313.2017.1282084)

To link to this article: <http://dx.doi.org/10.1080/09654313.2017.1282084>



Published online: 30 Jan 2017.



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## Government-led regional innovation: a case of 'Pangyo' IT cluster of South Korea

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### ABSTRACT

This paper investigates the effective formulation and implementation of 'Pangyo Techno Valley' (*PTV*), a regional innovation cluster led by Gyeonggi province in Korea. It emphasizes the historical, institutional and regional contexts to understand the concept of regional innovation cluster by using the framework of indicators of regional innovation. Especially this paper investigates *PTV* in terms of open innovation in supply chains. The development of *PTV* is theoretically interesting since the local government played an active role in providing with various incentives including physical space next to Seoul. This paper investigates the success factors for establishing *PTV* in the context of RIS and how a local government-led RIS can overcome the existing limits shown in other development policies the Korean government had pursued so far. This paper argues that the strategic investment and administrative support by Gyeonggi province and the location of *PTV* have played a critical role for the success of *PTV* by attracting abundant numbers of IT companies and competent talents. The finding is expected to provide an ample policy reference for other developing countries as they are eager to emulate the success of 'Silicon Valley' but have kept failing.

### KEYWORDS

Regional innovation system; innovation cluster; government-led; 'Pangyo Techno Valley'; Gyeonggi province

## 1. Introduction

The 'Pangyo Techno Valley' (*PTV* hereafter) as one of the regional innovation systems (RIS) in Republic of Korea is an insightful case on the creation and growth of government-led RIS. Korean central government had been successful in building a series of clusters in various sectors including shipbuilding, steel, electronics and petrochemical industries since 1970s. However, there have been little success stories regarding local government-led cluster policy in Korea. *PTV* is considered as a unique case of a proactively planned and implemented regional innovation cluster by Gyeonggi province, a local government. Gyeonggi province strategically utilized the geographical advantage of the *PTV* which is high accessibility to Seoul, the capital city of Korea. Only after the initial success of *PTV*, the central government hopped in to join with Gyeonggi in expanding and promoting the *PTV*.

This paper explains the specific kinds of policy measures that Gyeonggi province adopted to work effectively in the forming of IT cluster in the context of RIS suggested by Cooke (2002). The importance of geographic location is discussed in the context of RIS. Also, this paper examines the underlying incentive mechanism which enabled the clustering of innovative companies in *PTV*. Repeated interaction among the firms, academia and research institutes of the regional innovation cluster tends to result in innovation and regional competitiveness (Feldman & Audretsch, 1999; Von Hippel, 1986).

The case of the *PTV* supports that the local government in building the RIS plays an important role and the *PTV* can be referred as a successful policy case to other developing countries.

The remainder of the paper is organized as follows. Section 2 provides the theoretical background for the paper and its framework for further analysis. Section 2 leans on RIS theory and cluster studies. In this section, this paper emphasizes the importance of understanding the role of institutional groups such as the central government, local government as well as innovative players in the dynamics of a regional cluster. Then in Section 3, this paper introduces Korea's RIS and the institutional, historical and regional contexts surrounding *PTV*. Also Section 3 analyses the life course of *PTV* as an example of the government-led regional innovation cluster in Korea. Then, Section 4 examines the five characteristics of the new economy innovation system (NEIS) (Cooke, 2012) such as agglomeration economies, institutional learning, associative governance, proximity capital and interactive innovation as factors contributing to the success of *PTV*. Section 4 contains conclusions, policy implications and limits of the study.

## 2. Theoretical background

Innovation used in this paper has its roots in economics and can be defined as 'commercialization of knowledge', which has been developed within RIS studies (Edquist, 1997; Lundvall, 1992; Nelson, 1993). Schumpeter (1934, 1954) suggests that innovation is a change in the production function, and the result of a contingent phenomenon – inherently dependent on context and circumstances.

The concept of RIS is popular among policy-makers and researchers of the globalized economy since keys to understand a regional innovation process have important implications for the regional economic development and welfare of people in a region. Along with RIS, the concept of cluster can be one explanation regarding why economic activities generally seem to be localized and agglomerated (Breschi & Malerba, 1997; Porter, 1998). Oganisjana (2015) also points out the cooperation between SMEs and higher education institutions as one of the critical channels of regional innovation. Florida (1995) argues that a region should become a learning region by appreciating the importance of knowledge and that public policy should not only target short-term economic competitiveness, but also the long-term sustainable advantage of regions. In short, the cluster concept, which was originally concerned with the competitiveness of nation-states, is trying to answer why some regions at the subnational level prosper, whereas others do not.

Therefore, it is no surprise that politicians who are interested in regional economy are enthusiastically embracing the implementation of agglomeration factors of regional innovation cluster (Porter, 1990, 1998, 2000). Cluster-based policies along with the model of 'Open Innovations' (Chesbrough, 2003) and the 'Triple Helix of University–Industry–

Government Relations' (Etzkowitz & Leydesdorff, 1995, 2000) have been largely adopted by nations, starting from the UK to European Commission, North American nations and other nations in OECD (DTI, 1998; European Commission, 2002). Most of the cluster policies include support policy, typically in the form of R&D assistance, training and learning process, venture capital and initiatives that attempt to stimulate a culture of innovation and learning (Raines, 2002).

Especially, in researching the mechanism of innovation cluster policy, Grabher (1994) advocated 'institutional thickness', which is the key factor of a dense set of institutions that build up networks and trust between different economic and production actors in the region's development. Also, the gradual transformation of a political economy into a knowledge-based economy can be expected to depend on the reflective capacities of this knowledge-based system (Leydesdorff & Ivanova, 2016). These ideas eventually fostered the importance of learning in modern regional development studies. Moreover, Cooke and Morgan (1998) promoted the concept of 'associational economy' to emphasize the importance of the role of active learning and negotiating regional governments.

By adopting the concept from Cooke and Morgan (1998), this paper identifies the roles of three important acting groups in regional innovation cluster. First is the public group, which includes central, local governments and provincial administration. Second is the semi-public group, which includes university and government research institutes or public enterprises. Third is the private group such as industry and professional associations, venture capitals, incubator, labour unions and training organizations. Whether these three groups can provide a positive effect to regional innovation cluster depends on their capacity and networks (Ahedo, 2004). Not only the strategy itself used in a regional innovation cluster is important, but also the overall fitness between socio-economic institutions and dynamics of the cluster is critical in order to stimulate regional potential (Begg & Mayes, 2000).

Despite a growing literature on RIS and cluster policy, the case studies on context-dependent adaptation of cluster heavily lean on European and US regions. Especially, not many academics had put effort for the proper analysis of the impact of the government-led regional innovation cluster policy. For example, Zhang, Cooke, and Wu (2011) showed that the development of China's biotechnology had been led by the Chinese government. By applying the typology of entrepreneurial, partnership and development states, the paper concluded that the model for China's biotechnology is a hybrid one, a mixture of multiple types. Much like China has been experiencing, the state holds a significant role in developing high-technology parks and strategy formulation and is dominant in funding science and technology programmes. Also, Korea shares traits with China with a weak link between university and industry, and lacks of a horizontal link between industries. Even though it is not fair to fit Korea perfectly into China's hybrid innovation model in its biotechnology sector, one is not mistaken to put Korea and its National Innovation System as a typical example of the developmental state model (Table 1).

Asheim and Gertler (2004) categorize RIS into three groups: territorially embedded RIS, regionally networked innovation system and regionalized national innovation system. According to their definition, *PTV* can be categorized as a regionally networked innovation system. Cooke (2001) suggests a comparison between a rather traditional

RIS and a NEIS as shown in Table 2. *PTV* clearly shows the typical aspect of NEIS, which will be explained in detail in Section 3.

Cooke (2002) lists, based on various literatures, five main characteristics of regional cluster: agglomeration economies, institutional learning, associative governance, proximity capital and interactive innovation. The concept of agglomeration economies is closely related to lower transaction cost in the process. Institutional learning refers to sets of rules and routines, and according to this concept, competitiveness of a firm depends upon whether an organization is open to ideas and practices from another organization. The unit can be expanded from a single firm to a group of firms and a region. Associative governance refers to the interactivity and inclusiveness of governing agencies in a region. Since the forming of a cluster heavily depends on the cooperation among various government agencies and private organizations, associative governance is critical for the sustainability of a region. Proximity capital has double meanings: hard and soft. Geographic proximity matters for active cooperation among innovators, and proximity to venture capitals is also important for the growth of ventures, which explains the agglomeration of innovators in Silicon Valley and other places. Interactive innovation refers to the interactive nature of innovation and a firm or a region differs in terms of interactivity among main players including universities, accelerator, venture capital, testing agencies, etc.

This paper applies five characteristics of an innovation cluster to *PTV* in the context of NEIS suggested by Cooke (2001, 2002), developmental state model (Zhang et al., 2011) and regionally networked innovation system by Asheim and Gertler (2004).

### 3. The institutional context of RISs in Korea

#### 3.1. *PTV as a rare success case of regional innovation cluster*

Korea introduced a RIS for the first time in 1995. Since the 1960s, Korea had enjoyed a strong and effective central government, with a robust and capable bureaucracy system in the regional governments. Also, as Korea has the single-member electorate system, the political elites of Korea always had great interest over regional economic development for their re-election outcome. As a result, Korean central government has always dominantly held initiatives to implement the RIS in terms of technological innovation.

Even though seven major metropolises have already been industrialized under the development state since the 1970s, there are still significant differences in the degrees of economic development among the regions in Korea. In fact, Korean government has pushed forward with regional demand-driven policy as well as technology-targeting support programmes to create specific government-led innovation clusters in specific

**Table 1.** Theoretical typology of innovation model.

Model	Entrepreneurial model	Partnership model	Developmental state model
Theoretical description	<ul style="list-style-type: none"> <li>– Dominance of the liberal market</li> <li>– Flexible labour market</li> <li>– Private ownership</li> <li>– Outsourcing and subcontracting</li> </ul>	<ul style="list-style-type: none"> <li>– Regulated market</li> <li>– Business association and chamber of commerce</li> <li>– Risk sharing</li> <li>– Cooperation between universities and PRIs</li> </ul>	<ul style="list-style-type: none"> <li>– Planning rationale</li> <li>– State bank support and greater state influence in the capital market</li> <li>– State-controlled ownership</li> </ul>

Source: Zhang et al. (2011, p. 591).

**Table 2.** Comparison of the main aspects between a RIS and an NEIS.

RIS	NEIS
R&D driven	Venture capital driven
User–producer relations	Serial start-ups
Technology-focused	Market-focused
Incremental innovation	Incremental and disruptive
Bank borrowing	Initial public offering
External supply-chain networks	Internal EcoNets
Science parks	Incubators

Source: Cooke (2001, p. 970).

regions. However, the result was limited to the traditional industrial complex based on tradition industries. As mentioned above, Korea has shown a fairly typical case of government-driven innovation clusters.

In order to address regional inequality among provinces of Korea, through so-called ‘Innocity’ policy, new innovation cities have been established from 2007. In designing ‘innocities’, policy-makers benchmarked the famous success stories from Silicon Valley and other innovation clusters. As of June 2016, 139 public institutions (90%) have moved to total 10 ‘innocities’. Including the total 40,000 employees of relocated public institutions, 3.1 million (76%) employees have migrated formal residence, of which 29.4% have moved with their family members. Due to this huge relocation, the local tax revenue of ‘innocities’ has steadily increased to 212.7 billion KRW by 2014 and 744.2 billion KRW by 2015 (Korea Research Institute for Local Administration [KRILA], 2012). Therefore, increase in local tax revenue and local recruitment can be distinguished roughly as two achievements of ‘innocities’ so far.

Despite Korean government’s effort to establish ‘innocities’ in regions, almost all of them failed to show any significant concentration of innovative firms. As Saxenian (1996) pointed out in Silicon Valley’s case, regional institutions, such as good academic universities, start-ups and other business infrastructures, strengthen technical, financial and networking services that firms usually cannot afford individually and allow these firms to continue to innovate (Saxenian, 2000). ‘Innocities’ in Korea suffered heavily from the lack or non-existence of proper regional institutions and as a result, most of them turned into real estate development projects.

However, there are three major limitations in ‘innocities’ (KRILA, 2012). Firstly, there are various types of inefficiency regarding long business trips and retirement due to the relocations. Secondly, the actual settlement of family migration to ‘innocities’ seems still insufficient. Lastly, ‘innocities’ are unsatisfactory in the formation of industry–academia cluster to promote sustainable innovation. ‘Innocities’ were designed for solving inequality in regional economy, but it is now evaluated as a policy failure since the programme has failed to attract enough innovation players such as residents and companies required to operate self-sufficient RIS. To fully meet the purpose of ‘innocities’, firms should first be located, and then universities and research institutes should be linked sufficiently with other innovation players of the cluster.

Compared to ‘innocities’, *PTV* has shown a stark difference. *PTV* was not an ‘innocity’ but was initially designed to be an IT cluster. Still *PTV* successfully has encouraged innovative firms to concentrate in ‘Pangyo’ area and has started to function as an IT cluster, surpassing other competing regional clusters. How does *PTV* become a successful

innovation cluster while other innovation cities failed miserably? What are the significant factors that contributed to the success of *PTV*? This paper argues that the well-designed plans and careful implementation by Gyeonggi province played a crucial role for *PTV* to reach the agglomeration stage initially. Also, this paper emphasizes the geographical location of *PTV* as one of the success factors that the ‘innocities’ and other competing clusters had lacked.

### 3.2. Institutional context: Gyeonggi province in RIS

Compared to other innovation cities in Korea, Gyeonggi province holds a peculiar geographical position since it is very closely located near Seoul, which provides various advantages to the residents. This geographic proximity and accessibility of *PTV* has increased its embeddedness in the ‘Pangyo’ region economy and attracted innovation players.

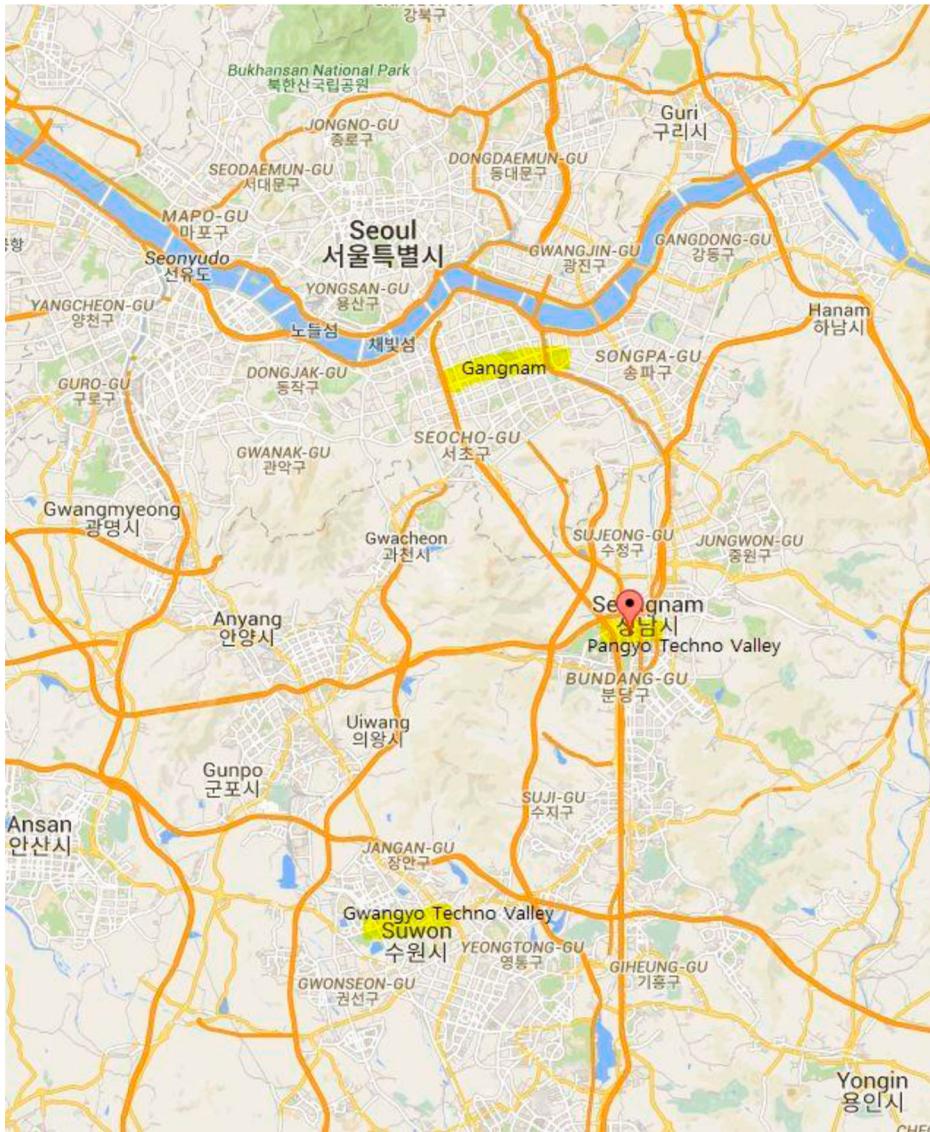
During the early stages of the RIS, from late 1990s and early 2000s, Gyeonggi province and its local governments such as ‘Seongnam City, Gwacheon City, Ansan City and Suwon City’ welcomed the central government’s targeted R&D industry policy. It was a huge opportunity for the local government to expand tax base and to make impression on voters for politicians. Korea has already experienced this kind of intensive development policy and targeted regional projects throughout 1970s and 1980s which brought prosperity to the national economy. So it was not impossible tasks for Gyeonggi province to cultivate the government-driven innovation clusters during the past two decades. There are currently three major innovation clusters functioning in Gyeonggi province: *PTV*, ‘Gwanggyo Techno Valley’ and ‘Ansan Science Valley’. Among the three innovation clusters, *PTV* is the most active and successful one (Figure 1).

From the late 1990s to the early 2000s, not only Gyeonggi province has focused on regional innovation development, but also other regions of Korea have been developed. Regional innovation clusters were implemented by central government in ‘Gyeongbuk, Gyeongnam, Jeonnam, Jeonbuk, Chungbuk and Chungnam’ provinces, but none of them have evolved into a form of NEIS over years and stagnated as traditional clusters (Figure 2).

The role of three groups in a regional innovation cluster is critical for it to function well. First is the public group, which means mainly central government, provincial administration and local governments in the Korean case. Secondly, for the semi-public groups, there are universities in the region and public research institutes (PRIs), government research institutes (GRIs) and public enterprises. Lastly, for the third actor, there are private groups of market players, such as local firms, firms from other regions, startups, venture capitals and entrepreneurship incubators.

Historically, the role of central government and local government has been emphasized in coordinating innovation activities in each regional innovation cluster. Yet, at the front line of innovation activities, GRIs, PRIs, firms and universities have all done great deeds to establish and operate innovation clusters. In spite of some overlapping, they are placed differently in the innovation process and make significant contributions to enhance regional and also national technological competitiveness.

Semi-public groups in Gyeonggi province have been strengthened over years. In 1995, there were only 42 PRIs in Gyeonggi province and about two decades later, the number increased to 68 PRIs in the same area. Also, the number of universities in Gyeonggi



**Figure 1.** The proximity of PTV to Seoul. Source: Google Map edited by Authors (2016) <https://www.google.co.kr/maps/@37.5651,126.98955,11z?hl=ko>.

province also has increased nearly twofold in 2014 compared to that of universities in 1995 (Figure 3).

Private groups have increased as shown in the increase in the number of R&D-related firms in Gyeonggi province. There were only 685 firms operating in Gyeonggi province in 1995, but in 2014, there were 10,467 R&D-related firms running in the same province. However, public enterprises in Gyeonggi have decreased from nine in 1995 to six in 2014 due to the relocation plan by the central government, which means that the role of the central government has relatively weakened for the economic vitality in Gyeonggi province (Figure 4).

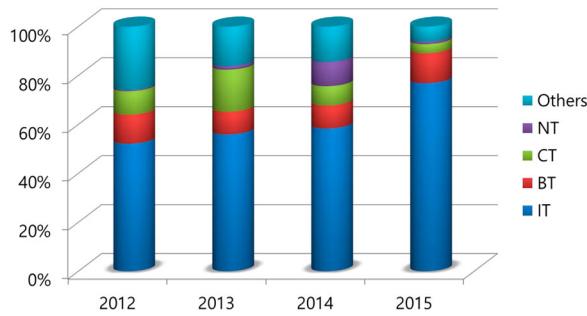
Gyeonggi Province				
Year/number of institutions	Public Research Institutes	Universities	Public Enterprises	R&D related firms
1995	42	40	9	686
1996	34	46	7	727
1997	40	48	9	755
1998	37	52	10	666
1999	27	51	12	700
2000	32	58	15	1112
2001	37	52	9	1652
2002	33	54	9	1821
2003	42	61	12	1982
2004	41	59	8	2067
2005	42	54	9	2372
2006	41	55	8	2967
2007	44	67	11	3450
2008	47	65	10	3982
2009	56	72	9	4820
2010	57	70	9	5350
2011	55	73	7	6840
2012	58	71	10	8237
2013	64	76	9	9020
2014	68	75	6	10467

**Figure 2.** The agglomeration of players of a RIS in Gyeonggi province (1995~2014). Source: Statistics from National Science & Technology Information Service (2016) <http://www.ntis.go.kr/en/GplIndex.do>.

R&D expenditure by Gyeonggi has always exceeded that of Seoul except in 2000. In fact, the scale of R&D expenditure in Gyeonggi province has been similar to the whole sum of R&D expenditure in regions other than Seoul and Gyeonggi (Figure 5).

The number of full-time employees (FTEs) working in the R&D sector in Gyeonggi has started to slightly exceed that of Seoul since 2003 and has clearly surpassed that of Seoul since 2008 (Figure 6).

Moreover, the number of R&D organizations including GRIs, PRIs, firms, universities as well as public enterprises regarding R&D has continuously increased since 1995. In 1999, Gyeonggi province only had less than 5% of the nation's R&D organizations, but in 2014 the province had over 30% of the total number of R&D organizations.

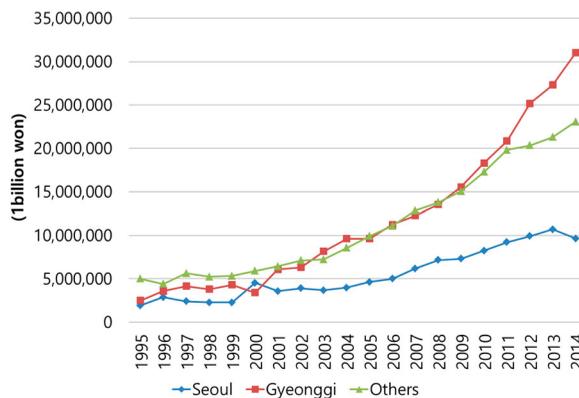


**Figure 3.** PTV resident companies share by the industry sector (2012–2015). Source: Pangyo Techno Valley Management Planning Team, Public Website of PTV (2016) [http://www.Pangyotechnovalley.org/html/tenant/company\\_statistic.asp](http://www.Pangyotechnovalley.org/html/tenant/company_statistic.asp).

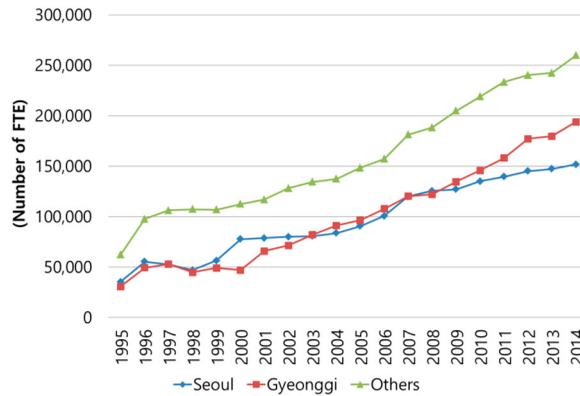
While Seoul has been losing its share of total number of R&D organizations since 2001, the absolute number of R&D organizations in Gyeonggi province has surpassed that of Seoul in 2006 and has maintained its lead since then. In fact, Gyeonggi province has the highest number of R&D organizations concentrated among provinces in Korea (Figure 7).

To manage R&D performances, PRIs need research staffs such as research scientists, visiting scientists, fellows and trainees, and foreign scientists involved in basic research in various fields of science and technology. In 2014, both Gyeonggi and Seoul have approximately 10,000 FTEs related to R&D activities of PRIs. Simultaneously, the R&D expenditure by PRIs in Gyeonggi and Seoul region tops nearly 1 trillion KRW, which has nearly increased fourfold compared to that of 1995. In 1995, there were only about 2500 personnel working for PRIs’ R&D activities in Gyeonggi and Seoul (Figure 8).

Unlike other R&D organizations such as PRIs and firms, Gyeonggi still lacks absolute number of universities in the region compared to that of Seoul. In other words, Seoul holds an absolute advantage with attracting higher education compared to any other



**Figure 4.** Expense for research and development by regions in Korea (1995~2014). Source: Statistics from National Science & Technology Information Service (2016) <http://sts.ntis.go.kr/ntisStats.jsp#>.

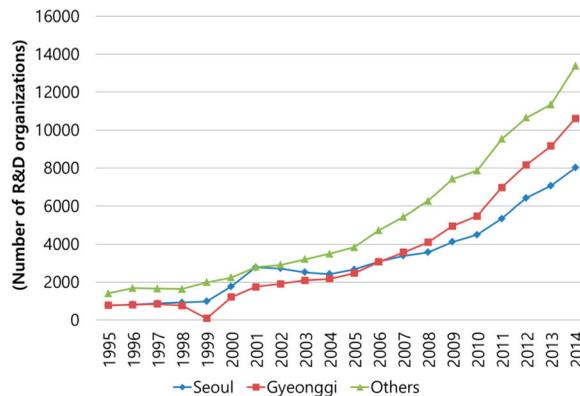


**Figure 5.** Number of FTEs in the research and development sector by regions in Korea (1995~2014). Source: Statistics from National Science & Technology Information Service (2016) <http://sts.ntis.go.kr/ntisStats.jsp#>.

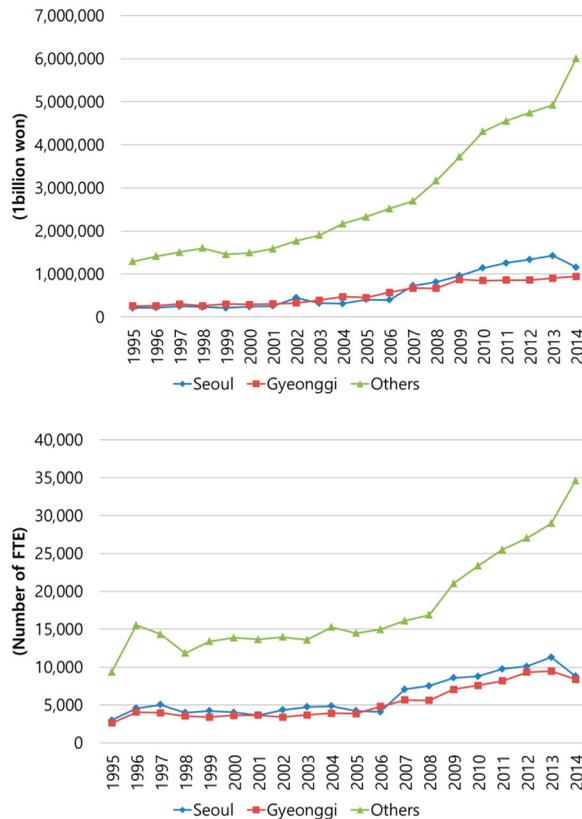
regions in Korea. In 2014, the size of university R&D expenditure in Seoul surpassed threefold of that in Gyeonggi province. However, since Gyeonggi province and Seoul are an integrated labour market and geographically attached, Gyeonggi province has little difficulty in tapping into the R&D capabilities of universities located in Seoul (Figure 9).

Except the wobbling stage from 2007 to 2010, Korea has briefly regained its original pace in the number of patent registration very recently. After taking a low point in 2009, the number of patent registration in Gyeonggi province has been gradually increasing, whereas that of Seoul is slightly decreasing again since 2013.

In sum, compared to other provinces, Gyeonggi province has been well positioned to establish and operate new economy innovation cluster in terms of R&D talents, organizations and expenditure. Other provinces paid more attention to traditional industry cluster such as automobile, steel, shipbuilding and petrochemical industries.



**Figure 6.** Number of R&D organizations by regions in Korea (1995~2014). Source: Statistics from National Science & Technology Information Service (2016) <http://sts.ntis.go.kr/ntisStats.jsp#>.



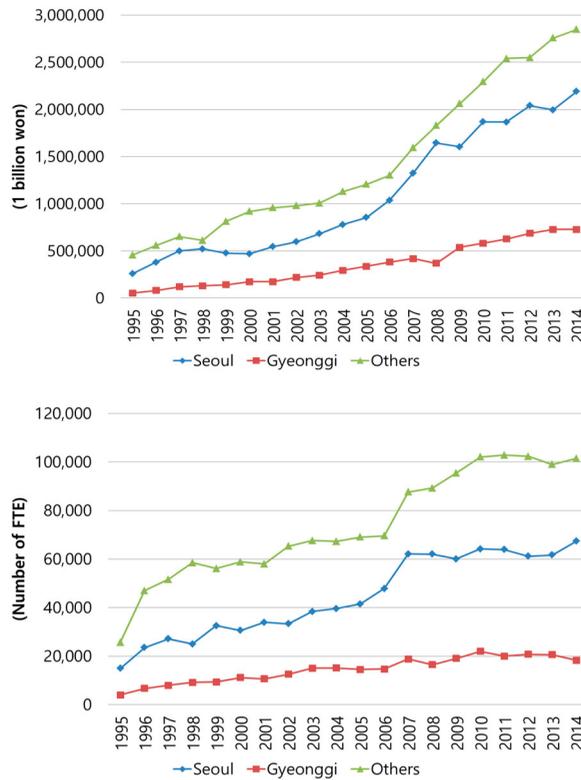
**Figure 7.** R&D expenditure and number of R&D-related employees of PRIs by regions in Korea (1995~2014). Source: Statistics from National Science & Technology Information Service (2016) <http://sts.ntis.go.kr/ntisStats.jsp#>.

### 3.3. Strong demand for IT cluster in Gyeonggi province

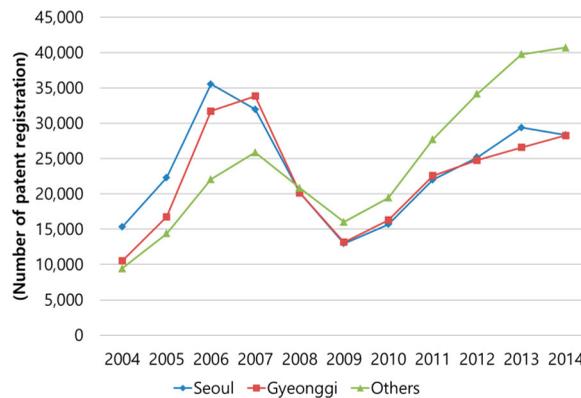
On the surface, it seems that the strong commitment of the central government to build a regional innovation cluster is one of the major reasons for the success of *PTV*, since there are various national and public institutions set up by the central government. However, as mentioned before, the start of *PTV* had been orchestrated by Gyeonggi provincial government.

On one hand, *PTV* and Silicon Valley share similarities since they are both ICT-based. But on the other hand, they are quite different. Silicon Valley is a voluntarily networked regional innovation cluster, whereas *PTV* is a strictly government-driven innovation cluster, where a regional government plays an important role instead of the central government.

*PTV* is a R&D complex located in ‘Pangyo-Gu, Seongnam City’. ‘Pangyo-Gu New City’ was a new town designed based on a national-level development plan to expand the supply of housing to the capital area. ‘Pangyo’ area was once covered with forest and rice pads and had been protected as green space by the so-called Green Belt Law. Since ‘Pangyo’ was the only available space near the south of Seoul, there has been a strong demand for the development of the area.



**Figure 8.** R&D expenditure and number of R&D-related employees of universities by regions in Korea (1995~2014). Source: Statistics from National Science & Technology Information Service (2016) <http://sts.ntis.go.kr/ntisStats.jsp#>.



**Figure 9.** Number of patent registration by regions in Korea (2004~2014). Source: Statistics from National Science & Technology Information Service (2016) <http://sts.ntis.go.kr/ntisStats.jsp#>.

Gyeonggi province decided to develop the area in 2005 and to build an IT cluster as she has urged for vibrant economic development in the region. Although Samsung Electronics is located near ‘Suwon City’, Gyeonggi province has never grown as a thriving IT cluster.

'Suwon City' has been dominated by a single company, Samsung Electronics, which has grown based on R&D and manufacturing. A self-sustaining ecosystem for IT-based innovations, which gave birth to dazzling innovation players such as Google, Apple, Uber and Amazon in the Silicon Valley, failed to happen in Suwon city against the initial hope since Suwon city is solely dependent up on Samsung Electronics. Rather, many innovation clusters such as 'Gasam Digital Complex', 'Guro Digital Complex' and 'Tehran Valley' had emerged in Seoul Metropolitan City.

Therefore, Gyeonggi province longed for a regional innovation cluster which can be the kindling to start fire for a new industrial platform based on IT and convergence technologies. By these reasons, *PTV* became the major project for the provincial government in the 'Pangyo New Town City' Plan. Gyeonggi province had huge anticipation for *PTV* and set the vision to create Korean Silicon Valley by establishing an R&D hub of IT convergence field. This *PTV* project was promoted as the foundation work for the future knowledge ecosystem in Gyeonggi province from the start.

### 3.4. Leapfrogging to the stage of an emerging cluster

According to Audretsch and Feldman (1996), the life cycle of an innovation cluster consists of four stages: pre-cluster, emerging cluster, expanding cluster and restructuring cluster. Firstly, pre-cluster is a stage where only few firms exist with very limited links among themselves. In this stage, there is only little economic impact shown and also only few anchor companies emerge in a region. Secondly, at the emerging cluster stage, the firms in the region create linkages among themselves to form industry associations and alliances. Next, in the expanding cluster stage, the growing linkages can be noticed in the region and the agglomeration of firms becomes a critical mass which shifts the business paradigm of the region. As more firms voluntarily join the cluster, the economic impact expands. Moreover, the networking process among players in the regional innovation cluster becomes more spontaneous compared to the previous stages. Lastly, in the restructuring cluster stage, the linkages among firms, academia, GRIs, local government and central government become very frequent on a daily basis. Hence the regional innovation cluster spawns new small clusters and also begins to adapt to market changes.

Since *PTV* is carefully planned by Gyeonggi province, it skipped the pre-cluster stage and jumped to the emerging cluster. Before the construction of *PTV* was finished, Gyeonggi province had screened the tenants for *PTV* and selected only IT and bio-related companies, which indicated that most of the tenants were already decided before the completion of *PTV*. Why did companies want to move to *PTV* even before the completion of *PTV*? Firstly, Gyeonggi province supplied office space at a much lower price than market price. Since 'Pangyo' is located near Seoul, the price of office space was expected to be high. However, Gyeonggi province decided to set the price of office space lower than the market price, which worked as a strong incentive for small and medium-sized companies to purchase their own buildings and office spaces. Most of them regarded the move to *PTV* as an investment in real estate for the worst case.<sup>1</sup>

*PTV* started as an emerging cluster after skipping the stage of pre-cluster since *PTV* chose most of the tenants before the construction was even finished, which was possible by the effort of Gyeonggi province and the geographical advantage of the 'Pangyo' region.

Due to the strong demand, *PTV* was able to select IT-related companies, which led to the agglomeration of IT companies.

#### 4. Factors that contributed to the success of *PTV*

As mentioned above, Cooke (2002) lists five main characteristics of a regional cluster: agglomeration economies, institutional learning, associative governance, proximity capital and interactive innovation. This paper analyses *PTV* in terms of five main characteristics. Also, the main actors for each characteristic will be identified as suggested by Cooke and Morgan (1998).

##### 4.1. Agglomeration economies

*PTV* successfully accomplished the agglomeration of IT companies, which is the most difficult task that other ‘innocities’ or clusters in Korea could not fully accomplish. Most of the planned ‘innocities’ in Korea often failed to make companies concentrate on designated areas, whereas *PTV* succeeded to gather around. The number of tenant companies in *PTV* surpassed 1000 in the last 5 years. According to the ‘2015 *Pangyo Techno Valley* Tenants Survey Report’ by Gyeonggi province and Gyeonggi Institute of Science and Technology Evaluation and Planning (GISTEP), the number of resident companies in *PTV* has increased from 83 in 2011 to 1002 in 2015; 86% (857 companies) of resident companies in *PTV* are small businesses. Also, 99 of the resident companies are mid-sized businesses, which exceed the standard of small businesses but are not yet designated as non-mutual investment conglomerate business groups. Only 37 of the resident companies in *PTV* are large enterprises associated with business conglomerates.

This dramatic agglomeration of business not only interested various sizes of enterprises, but also attracted many talents from diverse fields to *PTV*. The number of resident FTEs in *PTV* has dramatically increased from 30,802 in 2012 to 72,820 in 2015. In 2015, 18.2% of the total workforce in *PTV* was researchers as the fair share of FTEs. In addition, approximately 76% of the total FTEs in *PTV* are in their twenties and thirties.

Hence, the total sales of resident companies in *PTV* also rose from about 54 billion KRW in 2013 to over 70 billion KRW in 2015. In fact, the total sales in *PTV* have increased fourteen times compared to 5 million KRW in 2011. The numbers show that *PTV* became a dynamic, energetic and growing regional innovation cluster.

##### 4.2. Associate governance

As mentioned above, Gyeonggi province played a crucial role in developing *PTV*. However, it would not have been possible without close cooperation with other public institutions. Gyeonggi province is located in the capital area which includes Seoul Metropolitan City and ‘Incheon Metropolitan City’.

Since the current ‘Park Geun-hye’ government adopted and set up the concept of ‘creative economy’ as the vision for major policies, innovation clusters became very important for the central government. Howkins (2001) initially developed the concept of ‘creative economy’ to describe economic systems where value is based on novel imaginative qualities rather than the traditional resources of land, labour and capital. The ‘Park’

administration twisted the original concept and defined ‘creative economy’ as a kind of growth strategy that creates new opportunity of market, industry and employment through the convergence of ideas. By advocating the blueprint of ‘creative economy’, Korean central government began to put much effort for the utilization of ICT to create a new market and employment.

Therefore, the regional innovation cluster such as *PTV* was supported mainly by the central government to accomplish the goals. In addition, there was another strong incentive for the central government to cooperate with Gyeonggi province for the success of *PTV*. Although ‘creative economy’ was set as a motto for the *Park* administration, it is almost impossible for the central government to produce meaningful results within five years (Korean presidency is five years and a single term). Therefore, the central government had a strong motivation to select and support already succeeding clusters to prosper.

As a way to support *PTV*, the central government set up Center for Creative Economy & Innovation in Gyeonggi at *PTV* and arranged KT Corporation (2nd largest mobile business operator in Korea) to be responsible for supporting and operating the centre. Also in the Global R&D Center constructed in 2012, Software Policy & Research Institute (SPRI) and branches from Korean Electronic Technology Institute (KETI) and Electronics and Communications Research Institute (ETRI) are located to work with companies in *PTV*.

Also, local public institutions in Gyeonggi province such as Gyeonggi Urban Innovation Corporation, Gyeonggi Content Agency and GISTEP have been closely located together and have collaborated with the Gyeonggi provincial government to operate *PTV*.

### 4.3. Institutional learning

The institutional learning in *PTV* is not activated up to the level of the expanding stage. *PTV* forum was established in 2012 and since then it has functioned as an institutional hub for exchanging information and learning experience. The *PTV* forum has developed joint research topics eight times to facilitate the interaction among the firms located in *PTV*. Also, various business services and spaces were provided for cooperation among the firms. For example, the Global R&D Center was constructed and the Startup Campus was established each in 2012 and 2015 to promote interactions among firms in *PTV* and to provide with business services, meeting places and space for start-ups.

Although there are various opportunities such as cultural activities, joint research opportunities and business consulting, it would be fair to conclude that institutional learning among the *PTV* firms is not active up to the level it was initially desired to be. The strength of *PTV* as a cluster could be judged by this measure in upcoming years since institutional learning is one of the main advantages that firms can benefit from an innovation cluster. Learning is the core concept in the discussion of RISs after all (Lundvall, 2007).

### 4.4. Proximity capital

Proximity in *PTV* can be interpreted in a geographical sense. Since ‘Pangyo’ is located just next to ‘Gangnam-Gu’, the central business district of Seoul Metropolitan City, it enjoys

particular advantages compared to other ‘innocities’ or clusters. The advantages are multi-fold. Firstly, there is the availability of ample labour supply in IT industries. Since *PTV* is conveniently located in terms of transportation, it enjoys a tremendous advantage over other regions. Due to the reason that *PTV* is 15 minutes away from ‘Gangnam’ district by subway and located just outside of ‘Pangyo’ exit on ‘Gyeongbu Expressway’, the main expressway in Korea, *PTV* can easily tap into the labour pool in Seoul of 10 million population.

Secondly, *PTV* benefits from proximity to global players in the IT industry. *PTV* is located near the R&D centres of Samsung Electronics and LG Electronics (only takes 10~15 minutes by car) and such proximity tends to promote interactions between global companies in Seoul and small and medium-sized companies in *PTV*. Thirdly, proximity to ‘Gangnam’ district indicates an easy access to investments from Seoul. It provides with more chances to interact with venture capitals since venture capital firms are gathered in ‘Gangnam’ district. Fourthly, since numerous universities, especially leading universities, are located in the capital area of Korea, firms in *PTV* can enjoy collaboration with laboratories in excellent universities.

#### 4.5. Interactive innovation

As explained before, *PTV* favoured support from the central government which intended to promote the ‘creative economy’ policy led by the ‘Park’ administration. As a result, institutions such as Center for Creative Economy & Innovation at Gyeonggi and SPRI were set up in *PTV*. Also, there has been a good mixture of big companies as well as small and medium-sized companies for cooperation.

From the point of view of the so-called triple helix, universities are missing in *PTV*. However, since the major universities in Seoul are located within an hour’s distance, it will be safe to conclude that *PTV* does not have any geographical limitation in access to R&D capacities and talents in universities in Seoul. There is little strong evidence to support that interactive innovation is happening in *PTV* yet. But since there is solid infrastructure in place for interactive innovation, more active interactive innovation is expected to be realized in the future.

#### 4.6. Second *PTV* is planned already

Deeply impressed by the success of *PTV*, Gyeonggi province and the central government decided to build a second *PTV* next to the original *PTV* in 2014. The area of the second *PTV* will be 460,000 m<sup>2</sup> and will be jointly financed by Gyeonggi province and the central government. Gyeonggi province is expected to attract 600 firms and create 43,000 jobs by focusing on IT and nanotechnology industries.

The original *PTV* is suffering from the lack of possibility of expansion since the *PTV* was planned as a part of new town plan. Although there had been strong demands for more spaces, common facilities and business services, it had been impossible to expand *PTV* since there is no space for expansion.

The second *PTV* was designed to meet such demands and is expected to fill the geographical gap among the R&D facilities of Samsung, LG and *PTV*. Once the second *PTV*

is completed, numerous R&D facilities and firms would be networked. This would result in a huge regional cluster interconnecting Gyeonggi province and Seoul Metropolitan City.

## 5. Conclusion

This paper investigates the effective formulation and implementation of *PTV*, a regional innovation cluster led by Gyeonggi province in Korea. It emphasizes the historical, institutional and regional contexts to understand the concept of regional innovation cluster by using the framework of indicators of regional innovation (Cooke, 2003). Especially this paper investigates *PTV* in terms of open innovation in supply chains. Since most of the Korean IT firms have vertical relationships with big firms such as Samsung and LG, all IT clusters in Korea can be categorized as a RIS in a traditional sense (Cooke, 2001). *PTV* is different from other IT clusters because it shows main aspects of NEIS and takes an open innovation approach instead of in-house R&D and vertical division of labour.

The paper argues that the success of *PTV* has been dependent upon its strategic location, clear division of labour between the private and the public, and also active policy coordination among diverse ministries and agencies within the government. Once *PTV* was located within the capital area, the regional cluster benefited from 'national-level innovation competence', which exceeds the regional-level innovation competence of Gyeonggi province. In addition, once sizable groups of IT companies had concentrated on, *PTV* has evolved as the destination of government support programmes for entrepreneurship and new technologies.

The success of *PTV* in the future is heavily dependent upon a smooth transition from a government-initiated programme to a privately running cluster or the NEIS (Cooke, 2001), which will be another interesting case to be investigated in coming studies. The finding is expected to provide with policy examples for other developing countries to refer to since they are eager to emulate the success of 'Silicon Valley', yet keep failing.

However, there are limits with the research. Since this paper deals with a single case of *PTV*, the conclusion from this paper cannot be applied to other cases without more rigorous studies, although *PTV* is a rare successful case out of IT clusters planned and implemented by the Korean government. Also, since *PTV* is in the process of expansion, it might be too early to evaluate its success as a regional cluster. Further studies on *PTV* will draw a sounder conclusion and provide with more constructive policy implications.

## Note

1. The authors interviewed various owners for the relocation to *PTV* in the early stage. Most of them answered that it was a good investment decision even if *PTV* would not succeed. They expected that the real estate price would increase over years even if they could not benefit from the cluster.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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