

Building and Operating a System to Promote Regional Competitive Industries Through Cross-Sectoral Collaborations: Findings From the Experience in Germany

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ABSTRACT

Initiated by regional governments, economic associations, etc., many regions are trying to promote competitive industries through cross-sectoral collaboration. The purpose of this study is to consider management approaches to build and operate a regional system for facilitating a self-organizing process of cross-sectoral collaborations. First, related literatures are reviewed. Then, the concept of constructing regional advantage is introduced. Then, a platform policy through building a Regional Innovation System based on the Triple-Helix model is examined. In the case study, the experiences of three states in Germany are examined by focusing on the medical technology industry. In these states, to promote regional industries, regional systems to facilitate cross-sectoral collaborations are structured. The main focus is how the systems were built and operated through the involvement of regional stakeholders. Last, the results of the case study are comparatively analyzed and the implications for the management are discussed.

KEYWORDS

Constructing Regional Advantage, Cross-Sectoral Collaborations, Management Approach, Platform Policy, Regional Industries, Regional Innovation System, Self-Organization Process, Triple-Helix Model

INTRODUCTION

Region is a key component for economic and industrial development. Today, through restructuring and reorganizing relationship between industry, university, government, and even civil society, promotions of new and competitive regional industries are undertaken in many areas in the world. The purpose of this study is to examine the management approach to consider how regional systems can be built and operated to facilitate self-organization process of cross-sectoral inter-organizational collaborations for promoting regional competitive industries. In the literature review, firstly, the concept of “Constructing Regional Advantage (CRA)” is introduced and discuss platform policy for CRA which aims to promote regional competitive industries by facilitating self-organization process of cross-sectoral collaborations. Then, structure and functions of regional innovation system (RIS) which is based on Triple-Helix Model for implementing the policy are examined and consider how the system should be built/operated and how the support by the public sector should be implemented. Based on the literature, three states in Germany (North Rhine-Westphalia, Bavaria, and Baden-Wuerttemberg), where competitive regional industries are promoted through cross-sectoral collaborations between public sector, industry, and research institutions etc., are studied and analyzed. Here, the process to

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construct the structure and functions of the system are examined by focusing on the effort to promote medical technology industry. Then, the three regions are compared and examined the common and the difference.

REVIEW OF RELATED LITERATURE

Why Regions?

Region is conceptually regarded under the level of *country* but above the local or municipal level (Cooke and Leydesdorff, 2006, p.6). Today, region is increasingly recognized as a key component for economic development (Pessoa, 2013, p.101; Kitson et al., 2004, p.991), a locus for process and patterns of innovation, and competitiveness in the globalization (Fiore, et al., 2011, p.1400). This is because regions, as is stated by European Commission (1995), “the best level for contacting enterprises and providing them with the necessary support for the external skills they need (resources in terms of manpower, technology, management, and finance). It is also the basic level at which there is natural solidarity and where relations are easily forged (p.45)”. In this trend, Cooke et al. (2006, p.29) also indicates region is strategically important for constructing its advantage, however at the same time, since regional innovation systems are open, socially constructed and linked to global, national and other regional systems of innovation, it is necessary to employ multi-level approach to innovation and governance.

Concerning competitive advantage of regions, Cellini and Soci (2002) show regional competitiveness is more than the potential ability to export or trade surplus and “include different economic elements, demographic and social aspects (p.90)” and says the concept is complex and elusive. It is also indicated that there is no unanimous agreement concerning the definition and the framework to consider regional competitiveness (Borsekova et al., 2012). On the other hand, Pessoa (2013) proposes to recognize regional competitive advantage in the dynamics in “i) sales of local products in contested external markets, ii) use of local assets (people and other endogenous resources) in an efficient way, iii) adding value to its firms and workers which means to maintain or increase employment (p.107)”. Moreover, with reference to Porter (1998)’s argument about clusters, Pessoa (2013) concludes the improvement of continual innovation capability through productive use of inputs is essential for regional competitive advantage. Therefore, here the fundamental question is “how can the innovation capability be improved in a regional context (p.108)”.

How to Promote Regional Competitive Industries?

Cooke and Leydesdorff (2006) define Constructed Advantage as “both a means of understanding the noted metamorphosis in economic growth activity and a strategic policy perspective of practical use to business firms, associations, academics, and policymakers (p.10)”. Cooke et al. (2006) recognize Constructed Advantage “as the next evolutionary step in regional economic development (p.12)” and discuss some key elements for Constructing Regional Advantage (CRA) as follows.

Firstly, understanding the initial conditions of a region is necessary to consider policy options which are often limited by the historical trajectory of a region. Here they indicate regional endowments such as historical and geographical background and economic, socio-institutional and political conditions should be taken for consideration. More concretely, as initial conditions to be considered, it introduces typology of regions, as well as individual factors such as an access to natural resources, the degree of centrality and connectivity with respect to its geographical location, the size of its population, the quality of regional communication infrastructures, the knowledge base strengths of the region, and evolutionary processes based on path-dependent technological trajectories. Here, it is presumed that “true regional innovation system connectivity is not complete in most regions (p. 33)”. Regarding the methodology to analyze the initial condition, Borsekova et al. (2012) propose to conduct SWOT analysis which clarifies internal environment (strengths and weaknesses) and the

external environment (opportunities and threats). This is to identify unique or potential competitive advantages of the region in order to consider strategies for CRA.

Secondly, Cooke et al. (2006) propose the following basic approaches for creating CRA:

1. Own solutions for a particular region or regional firms' needs have to be provided (p. 30) because each region has different economic and socio-institutional environments (p. 32). In this point, Asheim et al. (2011, p. 894) also indicate that one-size-fits-all regional policy models do not work.
2. They call to change firms' behavior being more innovative and taking a more dynamic role by the public sector (p. 19). It also suggests promotion of public-private partnership, policy intervention for reducing interaction or connectivity deficit, co-occurring of business interactions and knowledge flows need to be encouraged (p. 31). On this point, Cooke and Leydesdorff (2006, p.10) propose that CRA need to embrace new dynamics of innovation and the capacity to exploit them, so it requires interfacing developments in various directions such as economy, governance, knowledge infrastructure, and community and culture.
3. Lastly, they indicate the regional policy has to be considered in a mosaic and need to be built with pieces which are not pre-determined (p. 13). Therefore, as key importance, they stress the recognition of institutional and governance capabilities in regions (p. 33), which enable to take variations of key elements into account, then, to find own solutions. Based on the idea, three key dimensions; related variety, differentiated knowledge bases, distributed knowledge networks, are proposed as requirements for policy model of CRA (Cooke et al., 2006; Asheim, 2011).

Platform Policy for CRA: Building “Regional Innovation System (RIS)” Based on “Triple-Helix Model”

Platform Policy for Promoting CRA

As a policy for promoting CRA which is based on the dimensions above, cross-sectoral platform policy is proposed. Asheim et al. (2011) explain the essence of a platform policy “represents a strategy based on related variety, which is defined on the basis of shared and complementary knowledge bases and competences. Moreover, this approach also clearly illustrates that knowledge is distributed across traditionally defined sectors in distributed knowledge networks (p.901).” Cooke et al. (2006, p.21) also indicate the effectiveness of platform policy for learning to aim for behavioral value-added such as the role of knowledge creation, absorption, and diffusion under well-structured local and global knowledge flows. They (p.16~17) explain platform policies create more scope and flexibility, while needs connectivity and the creation of systems, therefore, have to include various actors, agencies and structures for strengthening territorial competence bases which include people, business climates, regional knowledge infrastructures, SME and entrepreneurship policies, and governance dimensions of upgrading and building regional innovation systems as creative knowledge environments. Based on the recognition, they propose “the need for more platform and system oriented as well as more pro-active innovation-based regional policy in order to construct regional advantage (p.69)”.

“Regional Innovation System (RIS)” Based on “Triple-Helix Model”

Concerning how to promote CRA through platform policy, Cooke et al. (2006, p. 17) show the concept of Triple-Helix where university, industry, and government collaborate and poses the key question how the collaboration is organized externally and how knowledge creation and innovation-oriented work are organized internally among different parties. Triple-Helix is the model proposed by Etzkowitz, and Leydesdorff (1997) as an innovative dynamic model which is to capture multiple reciprocal linkages at different stages of the capitalization of the knowledge (p. 1)” through technology transfer, collaboration, and conflict moderation among the three actors. Ivanova (2014) explains “these three sub-dynamics... exchange among themselves functions of knowledge production, wealth creation, and

normative control (p. 359)". Ranga and Etzkowitz (2013, p. 238) explain the "functions" described as processes taking place in "Triple-Helix spaces" where knowledge, innovation, and consensus are performed. As an evolution of Triple-Helix model, Yawson (2009) proposes the concept of Quadruple-Helix which includes public as forth helix. European Union (2016) indicates public is equivalent to "Citizens or users" in Arnkil et al. (2010) and "media-based and culture-based public" and "civil society" in Carayannis and Campbell (2012). Here, they explain "civil society not only uses and applies knowledge, and demand for innovation, but also becomes an active part of the innovation system in terms of knowledge, inventiveness, and creativity (p. 7, 18)". Arnkil et al. (2010) indicate while Triple-Helix is a systematic way of pursuing research/technology-driven innovations, Quadruple-Helix is a systematic way of pursuing demand or user-oriented innovation. Therefore, Quadruple-Helix perspective enables territories to follow non-traditional innovation paths such as non-technological improvements, service creation and creativity exploitation (European Union, 2016, p.14, 18) and secure better conditions to commercialize R&D efforts (European Commission, 2012, p. 37).

Regarding the system to implement the policy, Cooke et al. (2006) propose the importance of building and promoting regional innovation system (RIS), which is considered as the institutional infrastructure supporting innovation within the production structure of a region (Ashheim and Coenen, 2005, p. 1175), for strengthening territorial competence bases. Firstly, Asheim and Coenen explain the underlying idea of RIS, for considering innovation-based learning economy, is understood as an interactive learning process. They also explain territorial agglomeration gives the best context because knowledge is sticky and grounded in social interaction (with interactive learning processes) at a localized level. Secondly, concerning the relationship with clusters, Asheim, and Coenen explain clusters are sector specific and RIS is more generic sector orientation in a policy context, and since both concepts are closely related, clusters and RIS can and often do co-exist in the same territory. Thirdly, Cooke and Leydesdorff (2006) explain paradigm of RIS sees regions with a systems perspective, which is generated by the recombination of the economic dynamics of the market, the dynamics of knowledge-based innovation, and governance. They also see the trajectory of a region can be the subject of evolution. Lastly, Cooke et al. (2006), sum up the element for creating RIS are as follows:

1. understanding initial conditions
2. increasing the territorial competence bases of the region in terms of human resources and knowledge infrastructure
3. developing, attracting, and retaining talented and creative people
4. promoting 'learning to innovate framework' for SME as well as providing scarce resources
5. building social capital for increased cooperation and interaction

Concerning the relationship between Triple-Helix and RIS, Kerry and Danson (2016) indicate RIS often involve organizations from differing backgrounds working together to enhance innovation efforts and the prominent theory that depicts the interaction is the Triple-Helix model (p.69). They also indicate (p.68) both Triple-Helix stream and RIS stream are rooted in open innovation thinking which is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation (Chesbrough, 2006)."

Building RIS for Platform Policy

In order to promote regional competitive industries, the arguments above suggest each region is required to seek its own solution with consideration of initial conditions and interfacing of various directions. Here the public sector is expected to play a dynamic role and firms to behave in more innovative ways. A platform policy should be deployed by building RIS based on Triple (Quadruple)-Helix model. In this section, firstly, actors who compose RIS and their role for building and operating RIS are clarified. Then, the process for building RIS is considered.

Actors of RIS and Their Role

Concerning the components to build RIS, firstly, Cooke et al. (2006) propose the importance of promoting public-private partnership (p.31) and explains RIS has two subsystems of actors which are systematically engaged in interactive learning. These subsystems are: (1) The regional production structure or knowledge exploitation subsystem. This is mainly composed of firms, often displaying clustering tendencies. (2) The regional supportive infrastructure or knowledge generation subsystem. This is composed of public and private research laboratories, universities and colleges, technology transfer agencies, vocational training organizations, etc. (p.79).

Secondly, regarding the role of private-sector entrepreneurship, Feldman et al. (2005) explore how innovative clusters take hold and transform regional economies. They explain, in the genesis process of industrial clusters, which is path dependent and idiosyncratic, entrepreneurs play as economic-change agents (p.130) who shape local environments and build institutions through adaptive, self-organizing behavior as well as shaped by the environment.

Role of The Government

Regarding the role of the government to build RIS, firstly, Kerry and Danson (2016, p. 69) stress the importance of public policies which aims to ensure the full deployment of RIS development factors. These factors are the crucial factors for the emergence and sustenance of competitive RIS (Fiore et al., 2011, p. 1401):

- The presence of high-tech industries, potentially oriented towards international markets
- Relationships between firms and university system
- A specialized labor market and labor force, with readily available, highly skilled human capital
- Local traditions of cooperation and entrepreneurial approaches
- Supporting agencies and organizations (Asheim & Isaksen, 2002)
- The presence of social capital: shared norms, values and trust, which facilitate relationships and mutual understanding and learning (Lorenzen, 1998; Landry et al., 2002)
- Financial capacity

Charles et al. (2004, p. 14) also show three key roles are attributed to regional governments:

- setting regional priorities for research on the basis of small units of excellence not necessarily recognized at the national scale
- negotiating with central actors to shape central policies for the benefits of their regions
- building linkages from all elements of the regional science system into innovation, commercialization, and technology transfer

Koschatzky and Kroll (2009) introduce the concept of catalytic approach and propose “the role of a (regional) government should be confined to the setting of a favorable legal and institutional environment, and should stimulate but not govern processes (p. 49)”. They also point out (p.50) a high degree of experimentalism in policy making is required “due to different approaches and the non-linearity of policy input and the intended output (p. 50).”

Management Approach to Build RIS

Based on the arguments, it is inferred that in the process to build and operate RIS, the business environment is created through involving actors which include the two subsystems above and feed-backed by the environment for further development. These cycles occur as a self-organization process. On the other hand, public policies by the government are implemented in order to create a regional environment for facilitating these cycles. These should be implemented as “more platform and system

oriented as well as more pro-active innovation-based regional policy” (Cooke et al., 2006, p. 69). Therefore, the process seems to be promoted through interaction between top-down public and bottom-up creative forces where the former provides a policy to facilitate the latter’s self-organization process.

This view is supported by several arguments. Firstly, Asheim and Coenen (2005, p. 1179-1181) propose “regionally networked innovation system”, characterized by planned involvement of public-private cooperation by policy intervention, is the most ideal types of RIS. The system allows firms and organizations to deploy localized interactive learning while being supported by the region’s institutional infrastructure. The infrastructure is composed of regionally based R&D institutes, vocational training organizations and other local organizations which are involved in firms’ innovation process. They also explain the cluster is market driven, and firms gain access to wider pools of both analytical and synthetic knowledge and avoid technological and cognitive ‘lock-ins.’

Secondly, the argument by Stewart and Ayres (2001) also gives a supportable and useful view. They propose that public policies should be viewed as interventions into self-organizing social systems and the aim of a policy intervention should not be to reach a pre-determined goal, but to enable the capacity of the target system to enhance its self-steering capacity. With reference to Stewart and Ayres (2001), Morcol (2014, p.5-6) explains self-organizational, emergent, and coevolutionary processes within and among complex governance networks arise under the increase of complex and dynamic social problems where no governmental or private actor can solve, and governance networks become to be multi-centered. Here, it is proposed that a variety of autonomous individuals and organizations are involved in policy making, however at the same time, they need to be directed, controlled, and coordinated.

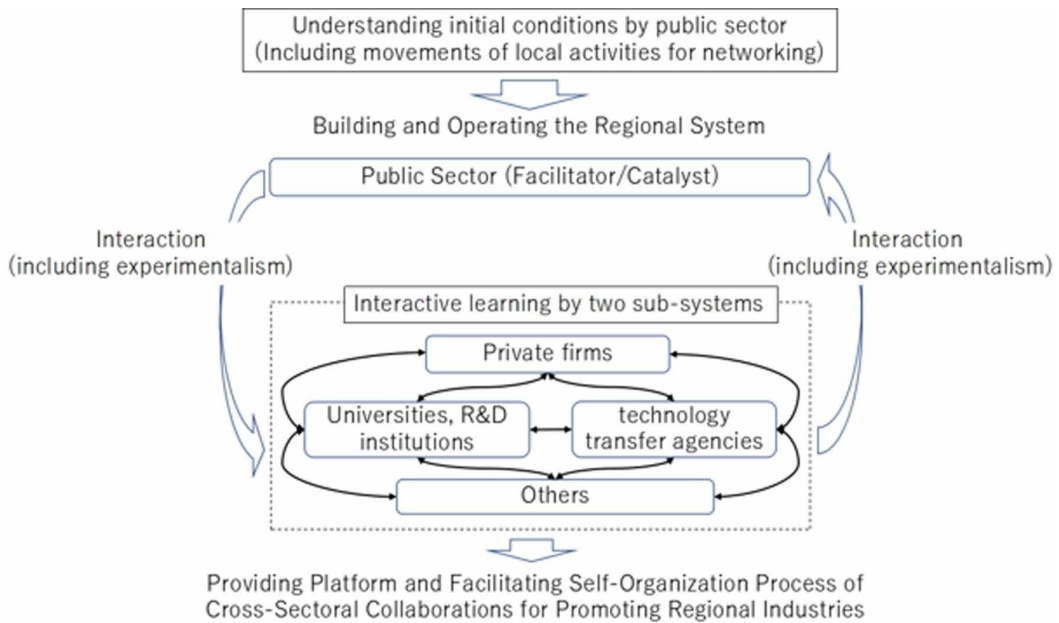
Perspective Regarding the Management Approach to Build and Operate the System for Promoting Regional Competitive Industries

From the review of literature, the research theme to examine “management approaches to build and operate a regional system for facilitating self-organization process of cross-sectoral collaborations which aim to promote regional competitive industries,” can be described as a conceptual model (Figure 1). Firstly, initial conditions, which includes the movement of local actions toward networking for industrial promotion, should be understood by policymakers in the public sector. Then, in addition to the decision making about which sector to promote, policymakers also have to approach and involve the local stakeholders through interaction in order to seek its own solution for implementing ‘Platform Policy’ through building RIS based on triple (quadruple)-helix model. The goal of the regional system is to create the structure (or the environment) where the former provides a policy to facilitate the latter’s self-organization process toward cross-sectoral collaborations. Moreover, the regional system is built and operated through interaction between top-down public force, which is composed of the public sector, and bottom-up creative forces, which is composed of firms and R&D institutions, etc. The building process also seems to include experimentalism for evolution.

RESEARCH DESIGN

The case study focuses on the experiences of the following three states in Germany; North Rhine-Westphalia, Bavaria, and Baden-Wuerttemberg. The state governments of these regions have been working on building and operating regional systems for promoting regional industries through cross-sectoral collaborations. Here, the experiences of building and operating the regional system are explored by focusing on movements in the field of medical technology as well as overall movements in the state. Since the programs are promoted through interaction between the state government and regional stakeholders such as industry, universities, etc. and intended to facilitate the self-organization process of the latter, the cases are appropriate for this study to consider management approaches for building and operating a regional system for facilitating the self-organization process of cross-sectoral collaborations which aims to promote regional competitive industries.

Figure 1. Conceptual model: management approach to build and operate a regional system for promoting regional competitive industries through cross-sectoral collaborations. Source: Drawn up by the author.



Since this study explores the process how the regional systems are built and operated, following Yin (2003), it is appropriate to clarify the process by conducting a case study that evaluates the interactions between the entities concerned as an analysis unit.

Data Gathering and Analysis Method

The data used for this case study was collected from secondary sources as well as from interviews of concerned parties. In this regard, secondary sources include magazine columns, information on the internet. Interviews were conducted with the following persons:

1. North Rhine-Westphalia: a project manager of InnovativeMedizin NRW (interview conducted in November 2017 and November 2018), a project manager of MedEcon Ruhr (interview conducted in November 2017), and a project manager of Health Region Cologne/Bonn (interview conducted in November 2017). InnovativeMedizin NRW is the statewide cluster organization in the field of medical technology (In this study, the term 'cluster organization' refers to an association or a company which provides services, i.e. matching service, to industry and academia, etc., in order to promote a certain industry through cross-sectoral collaborations.). The latter two are the local cluster organization in the same field. In the field of medical technology, since the system was restructured and a new system was launched in January 2019, the case study describes movement before the period.
2. Bavaria: an official of Bavarian Ministry of Economic Affairs, Energy and Technology who is responsible for cluster policy in Bavaria (interview conducted in November 2018). CEO and a member of the Executive Board of Bayern Innovative which is an affiliated organization of the state government of Bavaria for supporting activities of cluster organizations (interview conducted in December 2018). CEO of Forum MedTech Pharma which is a cluster organization in the field of medical technology (Interview conducted in December 2018).

3. Baden-Wuerttemberg: a project manager of Cluster Agency BW which is an affiliated organization of the state government of Baden-Wuerttemberg to support activities of cluster organizations (interview conducted in January 2019). An official of Baden-Wuerttemberg International which is an affiliated organization of the state government for promoting the internationalization of industries in the state and collaborates with Cluster Agency BW.

Regarding the analysis method, this study performs a qualitative analysis of three cases in order to elucidate the management approach of building and operating the regional system for industrial promotion through cross-sectoral collaborations. Thus, on each case, the events are chronologically tracked to explore the cause-and-effect relationships, ranging from the situations that the parties were facing at the time of the interactions began to build the regional system to the present day. Then, the three cases are compared and analyzed.

CASE STUDY

Overview

Facing the stagnation in the 1990s, several reforms were implemented in Germany and one of the main policy is to strengthen innovation capability and increase the competitiveness of industry through promoting cross-sectoral collaborations. The policy was called ‘cluster program’ and studies about excellent precedents, such as Silicon Valley, and survey about the economic/industry of their own region were conducted by the state governments. Based on the study and survey, they did not imitate but pursued their own solution to build and operate the regional system by targeting prospective industries. Medical technology, which increases its market size (30.6 billion Euro, 4.8% increase in 2017) and displays high export ratio (64%, 2.5% increase in 2017), was one of them (Germany Trade and Invest).

The case study focuses on the experiences of the following three states in Germany; North Rhine-Westphalia (hereafter ‘NRW’), Bavaria, and Baden-Wuerttemberg (hereafter ‘BW’). Firstly, the background and process to build the state-wide regional system of the three states are examined. Then, focusing on the field of medical technology, more specifically, how the system is built through interaction between industry/academia/government and how the system is operated through the interaction between the state government and the cluster organizations are explored. Lastly, based on the literature above, the case study is analyzed and interpreted to consider management approach for building and operating the regional system by focusing on how public sector support to strengthen self-organization process of regional stakeholders for promoting regional industries through cross-sectoral collaborations.

Background, Movement toward Building, and the Features of Present Regional System

In the following, economic and industry background, the movement toward the building, and the features of the present regional system are summarized in the paragraph. The details are described in Tables 1-3.

Economic and Industry Background

Economic and industry background before the three states started full-fledged cluster program is described based on the SWOT framework in Table 1. Regarding strength, all states had a large number of firms (including SMEs) and R&D institutions and universities which were essential for innovation through cross-sectoral collaborations. Although all states had weakness caused by the problem concerning the traditional sectors, NRW faced the most apparent problem by the declining of leading industries (mining, metal, and steel) accompanied with serious job loss (600,000 from

Table 1. Movements toward building regional system: economic and industry background

	NRW	Barvaria	BW
Economic /Industry Background (SWOT)	S Heavy industry: mechanical, chemical, metal) Many Research Insititutions: universities, Fraunhofer etc. Thousands of excellent SMEs (many hidden champions)	S Manufacturing (machinery, ectorical engineering, automobile, medical instrument etc.) Research institutions : universities, Fraunhofer etc. Many large companies and suppliers (SMEs: hidden champions)	S Manufacturing, high tech engineering, light industries SMEs: especially middle sized (for innovation and export) Highest amount for R&D, 30.2% of German patent applications Educational and research infrastructure: universities, Fraunhofer etc.
	W Old linkage in mining and steel sector and lack of absorptive capacity as a barrier to innovation Lower R&D expenditure (compared with National Average) Decline of core (metal and steel) industries and job loss	W High production cost (job losses by outsourcing in traditional industries) Lack of raw materials (no heavy industry)	W Lack of raw materials (no heavy industry) Traditional cross-industry linkage and inertia of established production structures, unequally distributed R&D (to core industries) Weak in new areas (e.g. IT, Bio)
	O Largest population (17.9 million) and GDP (20% in Germany) and large market in the surrounding areas Economic integration in EU, globalization (locational advantage)	O Large population (second in Germany: about 12.7 million), large market in surrounding areas Economic integration in EU, globalization (locational advantage)	O Large population (third in Germany: about 10,5 million), large market in surrounding areas Economic integration in EU, globalization, high export ratio
	T Downturn of metal and steel industry (core industry) but the region still highly specialized in it after 2000 Competition with US, other EU and Japan Competitive pressure from emerging countries (including East Europe; low cost & qualified labor)	T Competition with US, other EU and Japan Competitive pressure from emerging countries (including East Europe; low cost & qualified labor)	T Competition with US, other EU and Japan Competitive pressure from emerging countries (including East Europe; low cost & qualified labor)

Source: Drawn up by the author

1964 to 1992) (Ache, 2002). The three states had similarity in opportunities with large population/ market inside/outside the states and threat from outside.

Movement before Launching the Present Regional System

The point of origin to work on CRA was declining of traditional industries and needs to develop a new area of industries. All the states recognized the concept of ‘cluster’ in the 1990s and consider/ promote its own solution toward building present regional system either by experiencing precedent program (e.g. Objective 2 in NRW) or gradually introducing the policies. These processes were accompanied by a survey, the interaction between regional stakeholders from industries, universities, local governments, etc., and experimentalism which allowed them to pursue their own solutions.

Present Regional System

As is described in Table 3, the three regions had their own way to launch and to build the structure. The present system in NRW launched by the agreement of several ministries in 2007 and each of these ministries supervise some of the cluster organizations. The structure in Bavaria was established in 2006 after the survey of the regional industries and study about industrial networks in the region. The performance and the target clusters to support are reviewed between the different stages of the program. In Bavaria, the Ministry of Economic Affairs, Energy and Technology supervise the cluster program and Bayern Innovative GmbH provides support to cluster organizations. In BW, after launching a cluster program, the structure is built step by step. The structure is supervised by the Ministry of Economic Affairs, Labor and Housing and a program for supporting to strengthen management capability of cluster organizations is provided by Cluster Agency BW. Another notable difference is also found in the number of cluster organizations to support. In NRW and Bavaria, a relatively small number of clusters were targeted. On the other hand, in BW, a large number of (about 120) clusters were listed. The structure of the regional system of the three states is depicted in Figure 2.

Concerning the goal of the system, for all states, the final goal is to increase innovation capability and promote competitive industries through promoting cross-sectoral collaborations. The notable point

Table 2. Movements toward building regional system: movements before launching the present regional system

	NRW	Barvaria	BW
Direction of CRA: Historical Background and Process toward Building Present Regional System	<p>Situation: decline of major industries (coal mining and steel), political awareness and made industrial policy a top priority</p> <p>Goal: Change in economic structure, create new/competitive industries, compensating for the loss of employment, renewal of the regional firm base</p> <p>Key concepts: field of competence, innovation core (technology and labor market policies), public-private partnership</p> <p>Policy (2000–2006): Objective 2 programme: cohesion policy programmes for regional competitiveness by Ministry of Economics and Business, Energy and Transport of NRW (co-financed by the European Regional Development Fund)</p> <p>Criticism/Reflection: not enough to interrelate/complement between the state and local initiatives, uncoordinated between project targeting and network formation, not enough in evaluation and its reflection, too many activities and not structuralized as a whole</p>	<p>Situation: recognition of cluster policy by the state government (Ministry for Economics, Transport and Technology) in 1990s</p> <p>Goal: modernize economic structure, attracting firms, higher-order production activities, creating new jobs</p> <p>Key concepts: Strengthening the local strength and self-initiative, supporting networking</p> <p>Policy (1995–2007):</p> <ul style="list-style-type: none"> – Started financial support to industrial network – 1994 “Offensive Zukunft Bayern (Future Bavaria Initiative)” – 1995 Foundation of Bayern Innovative GmbH (limited company): founded jointly by politics, business and science (A unit responsible for Bayern Innovative in the ministry, Budeget: financed by the state government, project fund from EU, service fee etc.) – Survey and grasping industrial network in the state, financial and founding support to individual industrial network (with Trial and Error) 	<p>Situation: economic downturn in 1990s and recognition of failing to stake out a greater share in new areas of industries</p> <p>Goal: the diversification and systematic development of a new range of products and services</p> <p>Key concepts: Bottom-up, promoting innovation, development of entrepreneurship, cooperation between science research centers and private sector</p> <p>Policy (1990s–2006):</p> <ul style="list-style-type: none"> – Bottom up movements for establishing industrial network in sub-regional areas – 1990: Society for International Economic Cooperation BW (founded by Ministry of Economic Affairs) – 2000: “Strategies for the Baden-Württemberg Research Policy”: A 100 page report of the state government about analysis of strengths and weaknesses of the research sector in BW and identification of the most important areas of action for the state.

is supporting to strengthen the management capability of cluster organizations is strongly stressed in BW. This is due to the fact that the average scale of cluster organizations in BW is smaller (therefore smaller number of supporting staff) than those of other regions.

Movements in Medical Technology Field

Industrial Background

Industrial background of medical technology in the three states around the period when they started the cluster program are described based on the SWOT framework in Table 4. All of the states have many medical related institutions such as hospitals and rehabilitation facilities etc., research institutions, and SMEs which are essential for promoting innovations in the medical technology field. The three states commonly had problems of lack of coordination between different sectors (e.g. research and industry, industry and hospitals) which prevented innovations through collaborations. Moreover, among the three states, NRW does not have traditional strength and does not have notable large companies in the field which result in the lower opportunities of the spin-off. Regarding the opportunities, since the industry is growing inside/outside of the area and they have many medical related institutions, all of the states have growth potential both inside and outside markets. Moreover, they also have a number of potential entrants to the industries because there are thousands of supplier firms. Lastly, the three states have a common threat of competition from outside and regulatory reform. In BW, it is also recognized as a threat that they faced severe competition in medical devices, such as surgical instruments, which are their traditional strength.

Features of Medical Technology Cluster

Each of the states built its own structure for promoting medical technology industry (Table 5). In NRW, InnovativeMedizin NRW, which covered state, national, and international activities, was established in 2011. With the support of the state government, InnovativeMedizin NRW was founded by the three local cluster organizations of the medical technology field which focus on their own region (e.g. Koln and Bonn in the state). It received financial support for the operating cost and follow the mandate from the state government for their scope of activities. In Bavaria, Cluster MedizinTechnik was launched in 2006, as a project organization and it is operated by Forum MedTech Pharma e. V. and The Medical Valley EMN e.V. The former focuses on state, national, international level activities, and the latter focuses on local activities and the two cooperate each other. Bayern Innovative GmbH supports the activities of the clusters (e.g. providing facilities, coordinating cross-cluster cooperation, etc.). The cluster organizations receive financial support from the state government for the operating cost. Lastly, in BW, six clusters, which operate in the different areas in the state, are listed in the Cluster Portal BW. They are relatively smaller scale compared to those of NRW and Bavaria and do not receive financial support from the government for operating cost.

Concerning the supporting service to the members, networking and matching opportunities for the collaborations, support for the application for competitive funds, consulting for project and training are commonly provided by the cluster organizations. As a notable service, lobbying activities to the governmental organizations are provided by Medical Mountain AG in BW.

Process to Build and Direction by the State Government to Operate

The paths of building a statewide structure to support the medical technology field were varied between the three states. However, it is commonly observed that the state governments (or the affiliated organizations for supporting cluster organizations) supported the bottom up movement of industry-academia (and some of the cases include local authority) to build the networks in the phase of foundation or in the phase to structure as cluster organizations of the states (Table 6). In NRW, before being structured as an organization for state-wide activities, associations aimed to promote cross-sectoral collaborations in medical technology field were built initiated by industry, university,

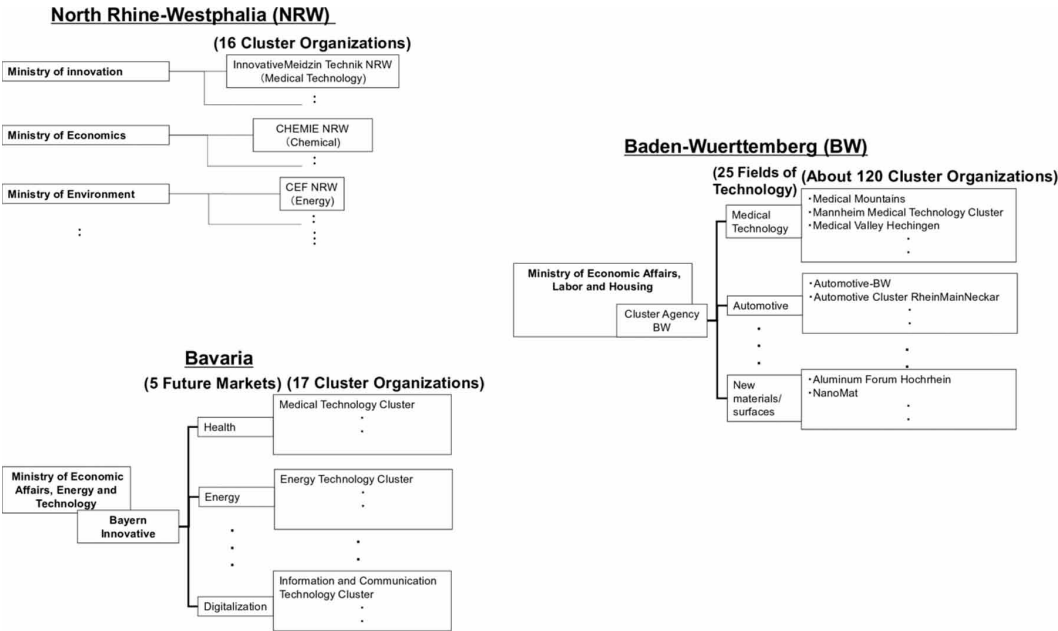
Table 3. Movements toward building regional system: present regional system

	NRW	Barvaria	BW
Present Regional System	<p>Process of policy making:</p> <ul style="list-style-type: none"> – Basic principle for cluster policy is approved by in a Cabinet meeting in March 2007 (through dialogue between Ministries of Economics, Ministry of Innovation, Ministry of Environment, Ministry of Health, and Cabinet) <p>Goal: Supporting leading (Leitmarkt) market with high potential</p> <ul style="list-style-type: none"> – strengthening the strength, enhancing competitiveness, innovation, and sustainability, promotion of SMEs – Creating ideal environment for innovation, building competence center capable of adapting demand by global economy/society – Generating innovation and sustainable development through NRW wide networking & collaboration between firms, research institutions, universities, and public sector <p>Structure (Figure 2):</p> <ul style="list-style-type: none"> – 8 leading markets and 16 clusters are designed – Each of the ministry (above) supervises some clusters among 16. – Officials of the ministry are responsible for each cluster. – Cluster organization: managed by a cluster manager who is veteran in the field. Professional staffs are employed for project management and administration – Financial support by the state government only for operating cost of cluster organizations – Source of (competitive) fund for R&D from the state government, the federal government, and EU 	<p>Process of policy making:</p> <ul style="list-style-type: none"> – Survey on economic, industry, industrial distribution and network. Study about Silicon Valley (before 2006): Determined target industries/cluster and to establish its own model. Defining “a cluster is a network of companies and research institutions in a particular field managed by a cluster organization”. – Launched ‘Cluster Offensive Bayern (Bayern Cluster Initiative)’ in 2006: 1st stage (2006–2011), 2nd stage (2012–2015), 3rd stage (2016–2019) <p>Goal: Building an ecosystem with dynamic networks for accelerating innovation process</p> <ul style="list-style-type: none"> – Identifying development opportunities close to the market and gaining cooperation partners for innovations across all technologies and sectors (with knowledge/technology transfer) – Utilizing local strength, building network, supporting R&D of SMEs (not interfere activities of each cluster organization) <p>Structure (Figure 2):</p> <ul style="list-style-type: none"> – 5 future markets and 17 clusters – Specialized unit/officials for each cluster in the state government (Ministry of Economic Affairs, Energy and Technology) – Selection of cluster spokesman is initiated by the state government. – Cluster MD is selected by the cluster spokesman – the cluster board is a group of businessman and scientists (regularly to check the strategy, the targets, and progress) – Staffs are recruited by the cluster MD (up to around 10). – Financial support by the state government only for operating cost of cluster organizations – Source of (competitive) fund for R&D from the state government, the federal government, and EU 	<p>Process of policy making:</p> <ul style="list-style-type: none"> – Understand Clusters (2006~) : Cluster Dialogue (2006) – Identify Clusters (2008~) : Start of cluster funding (2008), Regional Cluster Atlas (2008), Cluster Data Base (2010), Cluster Portal BW (2013) – Cluster Excellence (2011~) : Quality Label BW (2012) – Develop Clusters (2013~) : Establishment of Cluster Agency BW (2014) <p>Goal: targeting professionalization of cluster/network management, increasing innovation and competitiveness</p> <ul style="list-style-type: none"> – Bottom-up & needs-based services: policies are developed together with the cluster stakeholders from different regions (cluster dialogue etc.) – Promoting cooperative projects, internationalization, SMEs, training for cluster management (strategic development, demand analysis, service for members etc.), qualification offers etc. <p>Structure (Figure 2):</p> <ul style="list-style-type: none"> – 25 fields of technology and 120 clusters – Supervised by Ministry of Economic Affairs, Labour and Housing – Cluster Agency BW as service provider affiliated to the ministry – Top manager of Cluster Agency BW is appointed by the ministry and the staff is dispatched from partner organizations (VDI/VDE Innovation + Technik GmbH, the Steinbeis-Beratungszentrum GmbH, BW International GmbH) – Cluster Agency BW is co-financed by the European Regional Development Fund (ERDF) – No financial support by the state government for operating cost of cluster organizations – Source of (competitive) fund for R&D from the state government, the federal government, and EU

Source: Drawn up by the author

and city government, etc., in several different areas in the state. Then the associations of three areas interacted and agreed to build a state-wide structure and the state government supported it. In Bavaria, the movement of industry-academia to establish an association in the medical technology field was supported by Bayern Innovative. Then in 2006 when the state’s cluster program was launched, it was

Figure 2. Present regional system in NRW, Bavaria, BW Source: Drawn up by the author



structured as an organization for state-wide activities. In BW, some of the six cluster organizations listed in Cluster Portal BW were already established as industrial network before 2006 when the state's cluster program was launched. Then, during the period from 2009 to 2012, these clusters were established or reorganized as associations or as limited companies with the initiative of local industry, university, and authority, etc. Through investigation of the state government or approach of cluster organizations to Cluster Agency BW for requesting supporting service, they are recognized by the state government and listed in Cluster Portal BW as clusters of the state.

Concerning the direction by the state governments, the measures are different between the three states. In NRW, direction and field to focus are discussed by the committee in the state government, then within the scope of the field, InnovativeMedizin NRW formulates projects. Moreover, the two continually communicate every two weeks and draft a protocol for the next step, then, the protocol is shared with the three local cluster organizations. In Bavaria, annual monitoring is conducted by the state government based on the performance of activities of each cluster. Moreover, evaluation is conducted at the end of each stage by inviting the third party and the continuity of the support by the state government is considered. Moreover, close communication between the state government, Bayern Innovative, and each cluster organization are kept in operations. Lastly, in BW, 'Quality Label' is implemented by the state government. This is a certification system to appraise and to guarantee the management performance of cluster organizations which apply for it, therefore if they are certificated, it is beneficial for them in terms of gaining popularity, collecting members and expanding their activities, etc. Moreover, list up of cluster organizations in Cluster Portal BW, which is the requirement to apply for competitive funds for projects and to apply for Quality Label, is re-examined every 2 years by the state government. Cluster organizations also have opportunities to voice and share their directions with the state government in Cluster Dialogue etc. (see Table 3).

Table 4. Movements in the medical technology field in NRW, Bavaria, and BW: industrial background

	NRW	Barvaria	BW
Industrial Background of Medical Technology (SWOT)	S Large number of medial/health institutions (20% in Germany) Patents and R&D projects in medical technology About 400 SMEs in medical technology (many “hidden champions”) High export ratio (65%)	S Centre for the medical technology (1/3 of output in Germany) Large companies (Siemens Healthcare, GE Healthcare etc.) About 1000 SMEs in medical technology (many “hidden champions”) Medical related universities (supply of engineers) High export ratio (70%)	S 29.1% of production in Germany: surgical instrument etc. SMEs (more than 800, many middle-sized companies as global-players) Research institutions and universities, and related program High export ratio (65%)
	W Lack of coordination between different sectors (e.g. research and industry, industry and hospitals) Not having traditional strength (compared to BW and Bavaria) Few large companies (therefore fewer spin-off) compared to Bavaria and BW	W Lack of coordination between different sectors (e.g. research and industry, industry and hospitals)	W Lack of coordination between different sectors (e.g. research and industry, industry and hospitals)
	O Large internal/external growth market (largest in healthcare spending, number of medical institutes, high export rate) High growth in export Supplier industries (as potential entrants) for metal/plastic processing	O Large internal/external growth market (high export rate), number of medical related institutions Supplier industries (as potential entrants)	O Large internal/external growth market (high export rate), number of medical related institutions Supplier industries (as potential entrants) Potentiality to collaborate with large IT companies located in BW (SAP etc.)
	T Competition from overseas, change of the certification process	T Competition from overseas, change of the certification process	T Competition from overseas, change of the certification process Competition from cheaper production sites around the world in traditional BW medical device (surgical instrument etc.)

Source: Drawn up by the author

ANALYSIS AND INTERPRETATION

The case study about the three states shows the difference in paths to build the regional systems and their structures between the states. However, it is found that, in all cases, the self-organization process for cross-sectoral collaborations are initiated by industry and academia, then, the cluster organizations support the process by providing the platform and services. Then, the public sector (in this case, the state government) support the cluster organizations through understanding initial conditions, building/strengthening the regional system, and directing operations of cluster organizations. More specifically, common movements are as follows.

Understanding Initial Conditions and Exploring Own Solutions

All the state governments recognized the concept of ‘cluster’ in the 1990s and pursued to strengthen innovation capability and increase the competitiveness of regional industry through facilitating cross-sectoral collaborations. They considered their own policy not only by conducting a survey but also by learning through interaction between the state government and regional stakeholders, either by experiencing precedent program (NRW) or by gradually/experimentally implementing policies

Table 5. Movements in the medical technology field in NRW, Bavaria, and BW: features of medical technology clusters

	NRW	Bavaria	BW
Features of Medical Technology Clusters	<p>Overview of InnovativeMedizin NRW: founded in 2011, more than 300 members</p> <p>Service: creating network between industry, government, academia and users/ promoting innovations/supporting young companies and research associations for transferring innovations to the market/offering a wide range of events for transferring knowledge and exchanging expertise.</p> <p>Structure:</p> <ul style="list-style-type: none"> – Founded by local cluster organizations for promoting medical technology (Health Region Cologne/Bonn, MedEcon Ruhr and MedLife) as an association (GBR) The 3 organizations are employer and decide employment of InnovativeMedizin NRW – Scope of activities is mandated by the state government. – Budget: the fund from the state government for operating cost. – Number of staff: 5 (full time equivalent) and 3 (part-time) 	<p>Overview of Cluster Medizintechnik: founded in 2006, operated by Forum MedTech Pharma e.V. (600 members) and The Medical Valley EMN e.V. (185 members)</p> <p>Service: cross-linking of industry & clusters/ providing platform (workshops and events)/ consulting and matching support, access to expert networks/ advice on funding programs/ providing training</p> <p>Structure:</p> <ul style="list-style-type: none"> – Operated by Forum MedTech Pharma and Medical Valley – The two organizations are independent but closely cooperate (the former focus on state/federal/interantional activities, the latter focus on local activities. Cooperation for holding conference, trade fair etc.) – Management and facility support by Bayern Innovative – Budget: the fund from the state government for operating cost. – Number of staff: 10 in Forum MedTech Pharma and 11 in Medical Valley (full time equivalent) 	<p>Overview of Medical Technology Clusters: six clusters are enrolled in Cluster Portal BW in medical technology field. Entitled to apply for the public fund and Quality label (explained below).</p> <ul style="list-style-type: none"> • Mannheim Medical Technology Cluster (Member: 100, founded in 2011) • Medical Valley Hechingen eV (Member: 40, founded in 2009) • Medical Mountain AG (Member: 260, founded in 2011) • Medical Technology Neckar-Alb (Member: 70, founded in 2009) • Medi_NETZ (Member: 60, founded in 2009) • MedTecForum Heilbronn (Member: NA, founded in 2012) <p>Service (e.g. Medical Mountain AG): lobbying activities/ innovation and technology development by networking and initiating R&D projects etc./ providing education/ promoting internationalization/ funding advice/ marketing (fairs) etc.</p> <p>Structure:</p> <ul style="list-style-type: none"> – the six cluster are independent and operate in different area in BW – No financial support by the state government for oeperating cost. – Number of staff: 0.2~7 (full time equivalent)

Source: Drawn up by the author

(Bavaria, BW). In other words, the process for understanding initial conditions and exploring own solution was not only played by the government but also by the involvement of regional stakeholders in industry and academia, etc. (the two subsystems).

In NRW, the reflection and learning from the precedent experience of Objective 2 program seems to be the basis for launching the cluster program in 2007. Turning to the movement of medical technology, the survey was conducted by the state government with the participation of the local cluster organizations, then, building and operating state-wide structure were considered through the interaction among them. In Bavaria, after the foundation of Bayern Innovative in 1995, policies were implemented gradually with try & error and learning through dialogue with regional stakeholders (including learning about activities of the industrial network in the state). Moreover, a study/survey was conducted for considering how their own cluster program should be in the state, then, a full-fledged cluster program was launched in 2006. In BW, a survey on the strength and weakness of the state was conducted by the state government and the cluster program was launched in 2006. Reflecting the dispersed structure of industrial distribution in the state, the policy was started from recognizing the clusters in the region and measures were gradually introduced through interaction between the state government and regional stakeholders. Then, the present structure is established with the foundation of Cluster Agency BW in 2014.

Table 6. Movements in the medical technology field in NRW, Bavaria, and BW: process to build and direction by the state government

	NRW	Barvaria	BW
Process to Build and Control by the State Government on Operation	<p>Process to build state wide structure to promote medical technology field:</p> <ul style="list-style-type: none"> – Bottom-up movements to form associations for promoting medical technology in several local areas. (Example 1) MedEcon Ruhr : several informal associations for business creation focusing on medical technology etc. were integrated in 2007 initiated by the city government with participation of business associations, universities and hospitals. (Example 2) Health Region Cologne/Bonn : established in 2009 with a bottom up initiative of clinics, hospitals and medical technology companies etc. to establish a platform for area wide interaction for collaborative business. – Members of the local associations knew each other through interaction at a trade fair etc. and agreed to build a state wide network. Then, three local associations requested to the state government for support. – Survey on the situation and potentiality of medical technology industry in NRW by the state government – Contract between the state government and the three local associations for promoting state wide promotion of medical technology. – Foundation of InnovativeMedizin NRW by the three local association with the budget from the state government in 2011 <p>Direction by the state government:</p> <ul style="list-style-type: none"> – Linkage between the direction by the committee in the state government, determination of the fields of innovation to focus (e.g. digitalization) and formation/implementation of projects. – Regular exchange between the state government and InnovativeMedizin NRW for every two weeks. Then, mandated protocol is shared between the latter and the local associations. 	<p>Process to build state wide structure to promote medical technology field:</p> <ul style="list-style-type: none"> – Financial and founding support to industrial networks – Before 1998: medical technology was already regarded as important field by the state government and a survey was conducted by the state government – The state government concluded to support more for technological transfer/innovation and determined to establish an association. – In 1998, Forum MedTech Pharma was founded with support of Bayern Innovative (participation of 55 members: companies, universities, hospitals and insurance companies etc.). – Facing the closure of Siemens, a center (former body of Medical Valley) was established by the city government, universities and local companies for promoting start up in 2003 – Launching Cluster Offensive Bayern in 2006 and Cluster Medizin Technik was established – Medical Valley was reorganized as an association in 2007 with funding support by the state government <p>Direction by the state government:</p> <ul style="list-style-type: none"> – Not interfere with activities of the two organizations (Entrusting to experts of cluster organization who are close to the industry and stay contact with companies), however, keep close communication with cluster MD (by phone, email, meetings twice a year) – Annual monitoring: evaluating the progress and consider/share the next step with reference to: networking activities, general services, acquisition of funds, number and scale of R&D project, etc. – Evaluation: total evaluation in the end of each stage (see Table 3) by external experts and submit the result to the parliament to consider continuity of the support 	<p>Process to build state wide structure to promote medical technology field:</p> <ul style="list-style-type: none"> – Industrial networks were established to promote medical technology field in several areas (e.g. establishment of 'the competence network Medical Valley Hechingen' in 2003) – The six clusters were established/reorganized as associations or as limited companies with the initiative of local industry, university, and authority etc. (2009~2012) – Recognized by the state government through investigation of industrial network by the government or approach of cluster organizations to Cluster Agency BW for requesting supporting service, then, listed in Cluster Portal BW as clusters of the state. <p>Direction by the state government:</p> <ul style="list-style-type: none"> – Quality Label is implemented by the state government (Ministry of Economics, Labor and Housing) for systematic development and quality improvement of cluster initiatives, providing incentives for satisfying quality standards, reviewing activities and management services, and playing as an effective tool for acquiring new cluster partners (valid for 2 years, assessed by 34 quality indicators in the categories of structures, processes, activities and strategies) – Re-examination of the list in Cluster Portal BW based on performance of each cluster (every 2 years) – Interaction and information sharing (including request from clusters) through Cluster Dialogue, Cluster Manager Meeting, and Cluster Forum

Source: Drawn up by the author

Supporting and Facilitating Self-Organization Process

Building and Strengthening the System (Self-Organization Process for Setting up Platform)

Although the path to building the regional system is different between the states, the regional systems were built for creating an ideal environment to strengthen innovation capability and increase the competitiveness of industry through cross-sectoral collaborations. These are realized, as is described above, either by experiencing precedent program or gradually introducing and experimentally implement policies through interaction and learning between the state government and regional stakeholders. Moreover, turning to the movement toward building the system in the medical technology field, it is found the state governments supported for self-organization process of regional stakeholders to finding cluster organizations which aim to provide a platform for promoting cross-sectoral collaborations. The state governments also support to strengthen the capability of these organizations. Therefore, it is concluded that the regional systems are built (including foundation and strengthening cluster organizations) through interaction between public sectors and regional stakeholders.

In NRW, the local cluster organizations reached an agreement to found a statewide cluster organization through interaction. Then, in response to the request from these local cluster organizations, the state government support the foundation of the state-wide cluster organization (InnovativeMedizin NRW). Moreover, the state government also support to strengthen their capability by funding for operating costs. In Bavaria, the movements of companies, universities, hospitals, and insurance companies, etc. were coordinated by Bayern Innovative, then, Forum Medtech Pharma was founded. Medical Valley was also reorganized to be an association with funding support by the state government. The two cluster organizations also obtain fund and management support from the state government and Bayern Innovative to strengthen their capability. In BW, the state government and Cluster Agency BW provide the support to strengthen management capability of cluster organizations.

Direction to the Operation of Cluster Organizations (Supporting to Facilitate Self-Organization Process of Cross-Sectoral Collaborations)

The main goal of cluster organizations is to facilitate the self-organization process of cross-sectoral collaborations by industry-academia for promoting industries through developing innovative products and services. The state governments in the three states, do not directly intervene in the self-organization process but, through influencing on cluster organizations, try to direct and enhance their self-steering capacity for achieving the regional priorities.

In NRW, InnovativeMedizin NRW try to form and support cross-sectoral collaborations in the scope of field directed by the state government and progress management between the two are implemented. In Bavaria, annual monitoring and evaluation are implemented based on performance indicators. Moreover, business communications between the state government, Bayern Innovative, and cluster organizations are sustained. In BW, a re-examination of the list in Cluster Portal BW is conducted for every two years for all cluster organizations. A certification system called 'Quality Label' is implemented for verifying the excellence of management capability of cluster organizations. Moreover, the interaction between the state government and cluster organizations are sustained through 'Cluster Dialogue' etc.

CONCLUSION

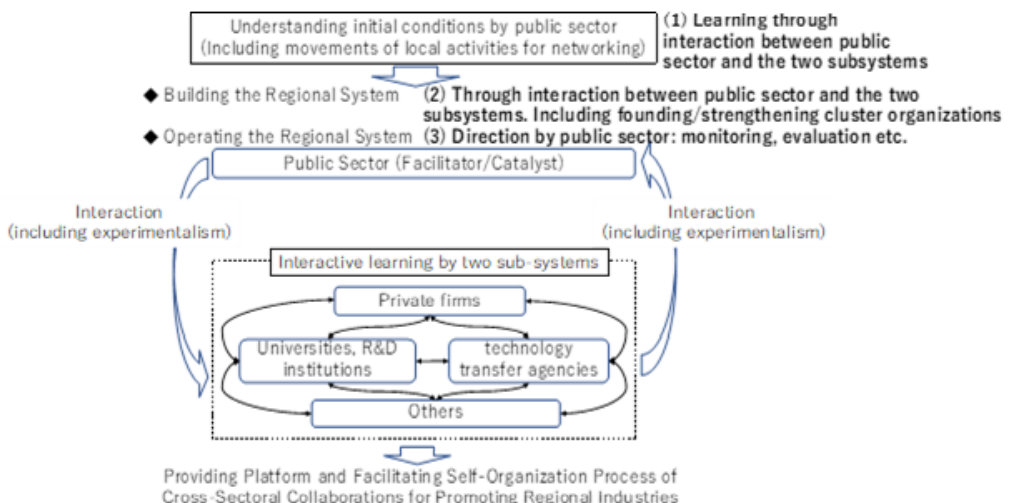
In this study, in order to consider the management approach to build and operate the system for promoting regional competitive industries through cross-sectoral collaborations, firstly, 'why regions' is considered. Then, based on the concept of 'Constructed Advantage', approaches and key dimensions of 'Constructing Regional Advantage (CRA)' are discussed. Here, with an understanding of the initial

conditions, it is required to seek own solutions for a region through public-private partnership and to 'create institutional and governance capabilities of regions which enable to take the variation of key elements into account (Cooke et al., 2006)'. In order to pursue the goal, 'Platform Policy' is introduced and 'Regional Innovation System (RIS)' based on 'Triple-Helix (or Quadruple-Helix) model' is proposed to build and operate the regional system. This is 'more platform and system oriented as well as more pro-active innovation-based regional policy (Cooke et al., 2006)' which is implemented through cross-sectoral collaborations for promoting regional competitive industries. Based on the argument, a management approach to build and operate the regional system is considered. Firstly, it is shown that there are knowledge generation subsystems, which is composed of university and R&D institutions, etc., and knowledge exploiting subsystem, which is composed of firms. Secondly, regarding the public sector, it is required to play as a facilitator or catalyst by directing, facilitating cross-sectoral linkage, and creating a regional environment.

Through the case study, it is found that the paths to building the regional systems and their structures are different between the states. Regarding similarities, first, while the three states set the concept of 'cluster' for their goal, all of them understood initial conditions and pursued their own solutions to build and operate the regional system. Second, regarding building the regional system, experimentalism is observed in terms of the interaction between the state government and regional stakeholders with try and error, either by experiencing precedent program or by gradually implementing policies. Moreover, the state governments support the self-organization process of industry-academia to establish cluster organizations which aim to provide the platform for cross-sectoral collaborations. Third, it is found, through influencing on activities of cluster organizations, the state governments try to direct the self-organization process of cross-sectoral collaborations toward regional priorities. These findings from the case study show a certain validity of the conceptual model. Figure 3 depicts the conceptual model with some additional findings, which are described from (1) to (3), from the case study.

The aim of this study is to consider management approaches to build and operate a regional system for facilitating the self-organization process of cross-sectoral collaborations which aims to promote

Figure 3. Conceptual model (with findings): management approach to build and operate a regional system for promoting regional competitive industries through cross-sectoral collaborations. Source: Drawn up by the author.



regional competitive industries. Through the case study, a certain result could be achieved by extracting some findings of the management approaches. Moreover, the study also provides practical insights for policy maker, such as officials of the regional government, who consider promoting industries through cross-sectoral collaborations. However, since the scope of this case study is confined to certain regions and industry, the result has limitations to obtain sufficient views on theory building and on management. In order to increase the significance of the study, with the theoretical framework introduced in this study, it is required to continue the case study by expanding the scope of regions (including other countries) of different backgrounds and industries of different fields.

Regarding how the result of this study can be used for the future research, as the findings from the case study, the literature about CRA, RIS, and Triple (Quadruple)-Helix help us to consider the management approach. On the other hand, as is shown by Cooke et al. (2006), the key question for realizing the goal is how the collaboration is organized externally and how knowledge creation and innovation-oriented work are organized internally among different parties. However, with reference to Doloreux and Parto (2004), Kerry and Danson (2016, p. 75) indicate the concept of RIS needs to be further developed. Moreover, Razak and White (2015) introduce criticisms of Triple-Helix model on its theoretical validity because “no studies have holistically examined the overall barriers and enablers when implementing and attempting to operationalize the Triple Helix model (p. 279)”. Cooke et al. (2006) also indicate the perspective “does not give much guidance concerning how a Triple Helix-based collaboration could be functional, operational and implemented in concrete policy settings (p. 88)”. In response, based on the result of this study, the key questions above should be discussed and deepened further by exploring further studies concerning cross-sectoral collaborations. This requires examining the studies such as network organization and its governance, complexity, and self-organization, field, intervention, and change management, which seem to help us to find clues for elaborating theoretical framework by focusing on meso/micro-level mechanisms. Combining the result of this study which explains the macro level mechanism and the further study, the comprehensive framework, which explains how to manage for facilitating cross-sectoral collaborations in the context of a regional system aiming to promote regional competitive industries, can be considered.

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