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An Organizational Strategic Analysis for Dynamics of Generating Firms' Alliance Networks

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***Abstract*—**This paper proposes an analytical method for the dynamics of generating firms' alliance networks along with business phases. Dynamics in network developments have previously been discussed in the research areas of organizational strategy rather than in the areas of regional cluster, where the static properties of the networks are often discussed. The analytical method introduces the concept of business phases into innovation processes and uses relationships called prior experiences; this idea was developed in organizational strategy to investigate the state of networks from the viewpoints of tradeoffs between link stabilization and node exploration. This paper also discusses the results of the analytical method using five cases of the network developments of firms. The idea of Embeddedness helps interpret the backgrounds of the analytical results. The analytical method is useful for policymakers of regional clusters to establish concrete evaluation targets and a viewpoint for comparisons of policy programs.

***Keywords*—**Regional Clusters, Alliance Networks, Innovation Processes, Prior Experiences, Embeddedness.

I. Introduction

RECENTLY, regional clusters are drawing increased attention from both academic and political societies as a mechanism for generating innovation in a region [1]-[5]. "Regional clusters" refers to related firms in a specific area and related institutions that compete and create synergies while also cooperating within a region [2]. To develop regional clusters, national and local governments support the development of firms' alliance networks, which are a sort of business infrastructure toward innovations.

The policymakers of regional clusters must determine the types of business projects to support and the best kinds of policy programs for them. For example, policymakers must determine whether R&D or sales phase projects are better to provide alliance network construction programs. Illuminating the innovation processes in which alliance networks are developed is an important way to build effective and systematic methods for managing policy programs. From this viewpoint, we research the dynamics of generating firms' alliance networks.

Some analytical approaches in economics have been researched to explain the agglomeration economies of affiliated industries and population [6]. Classifications of agglomeration effects have also been researched [7]. However, these researches do not have a strong interest in the alliance networks of business projects. On the other hand, Sakata et al. quantified network structures to compare firm's networks in regions [8], and Nishiguchi used qualitative properties to illustrate the advantages of potential networks [9]. Since these researches statically operate alliance networks, they do not provide knowledge for the dynamics of generating and dissolving networks during the progress of business projects.

The research areas of organizational strategy have concerned with the dynamics of generating and dissolving networks. Types of resources which bring the competitive edge have been discussed [10] and ways to generating the types of resources have been illustrated [11]. As a result, some important ideas such as Knowledge Creation [12] and Learning Organization [13] were established where alliances and networks play a key role as resources of the competitive edge [14]-[17].

To present an analytical method for the dynamics of generating firms' alliance networks, we investigated the progress of business alliances involving research and development. There are several phases by which a new business alliance gets an economical outcome: finding new business ideas, developing new basic technology for realizing the ideas, manufacturing the idea by trials, selling products or services, and so on. In this way, developing a new business alliance is regarded as a process of developing something new. We call such steps "business phases" and have developed an analytical method for alliance network generation in each business phase. This paper aims to (1) present an analytical method for the dynamics of generating firms' alliance networks along with business phases and (2) to show findings derived by the method using five actual cases of business alliances. In this paper, network structure terms are defined as in previous researches [8]. A network consists of nodes and links, where nodes are the minimum elements that join the network and links are the connections between nodes. For example, nodes represent firms or institutions and links represent their alliances. In the proposed method, the alteration of nodes and links from moment to moment is investigated and the process of generating alliance networks is described.

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The rest of this paper is organized as follows. Section II describes the analytical method's basic idea and shows its procedure. Section III introduces five actual cases of business alliances and describes the findings derived from the proposed method. Section IV summarizes our conclusion.

II. Analytical Method

This section introduces the basic ideas of the proposed method. A hypothetical model called a multi-layer network model is introduced to classify the network links into three types: fundamental, potential, and active. The idea of business phases is also introduced to investigate the network during each phase. This section also introduces network intentions to explain the motivation for altering network structures. Network intentions are the consensual intentions of the key persons in the network and consist of two types: link stabilization and node exploration. The procedures of the proposed method are based on these concepts and ideas.

A. Multi-layer Network Models

Fig. 1 shows the concept of multi-layer network models in which network links are classified into three layers: fundamental, potential, and active links. Active links are the relationships for current alliances, and fundamental links are all relationships that might become active links. Potential links are relationships that used to be active and will likely be active links again (other than fundamental links). The number of potential links in a region shows the potential of generating new business alliances within it.

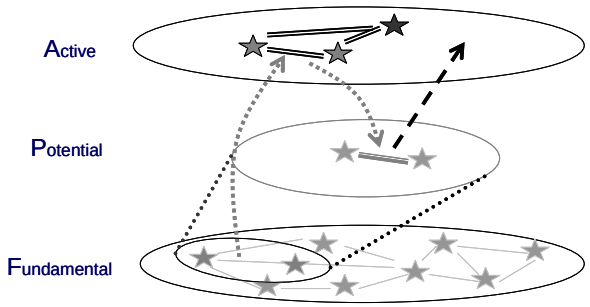

Fig. 1 Concept of Multi-Layer Network Model

Three layers in the models give the viewpoints for the roles of links in terms of the situation of the alliance network. For example, fundamental links are preferred for the network when new nodes are guaranteed to acquire new functions in the network, while potential links are preferred when usual nodes are guaranteed to maintain stable and comfortable situations. Statistical investigations into the contributions of fundamental and potential links for making new alliance networks are useful for policymakers because they can use the link type for managing policy programs such as business matching programs.

B. Business Phases

We use the idea of business phases shown below to grasp the series of the density of the potential links of network developments.

Phase 1 (idea): A basic idea is flashed for a new business.
Phase 2 (feasibility study): Related information is surveyed to consider its possibility.
Phase 3 (research): The technology for the products or services is refined.
Phase 4 (development): It is prototyped through trial and error processes.
Phase 5 (sales): It is manufactured and its product or services are sold.

Not every new business goes through all these phases. For example, Phase 4 may be skipped when the new business is a service business. Interviews with key persons in networks are important to get comprehension and explain business phases. The idea of business phases enables us to describe the network states for each business phase and give a viewpoint of their series.

C. Network Intentions

The idea of strong/weak ties [18][19] is often used for analyzing the qualitative and quantitative properties of network structures. Strong ties are relationships between nodes that frequently contact the others and share a sense of worth. On the other hand, weak ties are relationships between nodes without frequent contact with the others. The idea of strong/weak ties is useful for analyzing network structures but options for measuring the strength of the relationships are insufficient; e.g., they are often measured as the frequency of contacts.

Since it is sufficient to analyze network developments only from the viewpoint of contact frequency, we introduce a distinction between fundamental and potential links to add another viewpoint for a deep investigation of network development. With multi-layer network models, each network link is distinguished by whether it belongs to the fundamental or potential links. This viewpoint is useful for analyzing valuable types of links for business purposes and phases in network developments.

Kogut argued that prior experiences for collaborations contribute to alliance stability; namely, the network is not broken down [20]. Based on this idea, we define the degree of stabilization in a network as the ratio of the number of potential links to the number of all links of the network. In this way, the proposed method analyzes network stabilization by (1) distinguishing potential links from fundamental links and (2) investigating the ratio of the number of potential links in the network. The method's procedure is shown below:

1. The number of nodes and links is counted as the basic information of alliance networks. By counting it during each business phase, the series of numbers quantitatively shows the alternation dynamics of network structures.

2. The ratio of potential links, which is calculated by the number of all links in the network, is called the density of potential links and indicates the degree of stabilization in the network. The density averages of the set of networks are useful for understanding the properties of network sets.

As an indicator of network stabilization, the density of potential links can also be regarded as an indicator of the degree of the network's openness/closedness. A network is closed when its density is 100% because it is identical to the previous alliance team. On the other hand, the network becomes more open when the value of density decreases because it has been constructed without previous collaboration experiences.

In principle, the network's key persons entreat link stabilization, but the important factors for getting an economical outcome from the alliance are not only stabilization. A decline in the need for stabilization refers to a shift of intention to another target, which may be node exploration. Not only potential links but also fundamental links with new nodes are guaranteed when open networks are preferred for acquiring new business functions. Based on the idea, we investigate the states of networks from the viewpoint of tradeoff between link stabilization and node exploration.

III. Case Study

This section shows the findings derived from the proposed method with five actual cases of business alliances that are mainly doing business in the Kansai region of Japan.

A. Method

Five cases were chosen based on the following conditions: (1) alliances had to be made with different firms, and (2) developing products had to be finished. It was not guaranteed to start sales. Businesses categories included three in information technology, one in chemistry, and one in fine processing technology. The company cases also contained a wide range of sizes and number of years in business.

We directly interviewed the key persons in the alliance networks for about an hour for each case and obtained the following: (1) abstract descriptions of the entire business of the alliances and (2) detailed information of each business phase. The second step addressed several themes: (a) business targets for each phase, (b) persons directly connected with the project, and (c) the roles in the project of persons in (b), when they joined, and whether they had prior experience with the other project members. When a person joined the alliance networks with prior experience with another person in the network, their link is regarded as a potential link. On the other hand, when a person joined the network without prior experience but only a mere acquaintance with another person in the networks, their link is regarded as a fundamental link. Alliance networks are illustrated as mentioned above. Since a key person represents persons in the same firms or institutions, in the network, a node denotes a firm or an institution and a link denotes fundamental and potential links between key persons representing them.

B. Results

Table I shows the number of links for each case. The numerator shows the number of potential links, and the denominator shows the total number of links in the network. Fig. 2 shows the averages per case of the density of the potential links as a series of each business phase.

TABLE I
Number of Links: Numerator Shows Potential Links, and Denominator Shows all Links in Network

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Case 1	0	1/1	10/10	10/12	10/15
Case 2	1/3	3/5	3/5	3/3	4/4
Case 3	1/2	1/2	3/4	3/3	2/3
Case 4	1/2	0	2/2	2/2	2/2
Case 5	1/1	2/2	2/2	4/4	4/5
Total	4/8	7/10	20/23	22/24	22/29

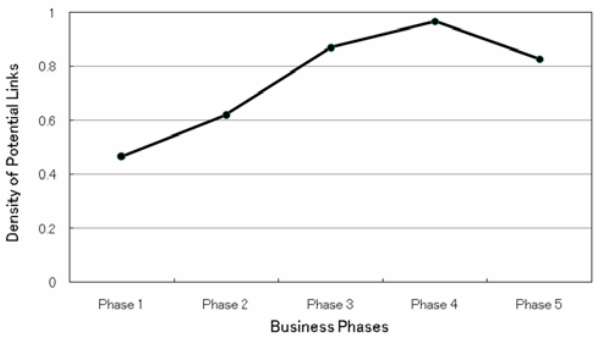

Fig. 2 Average Density of Potential Links for Each Business Phase

As shown in Table I, the number of links increases for all cases during the business phase, although the number of links is different in each case. We can quantitatively see network development as a series of densities for each business phase.

As shown in Fig. 2, density is comparatively high in phases 3 and 4 and lower in phase 5. The tendency of the density represents the network's intention of stabilization, which does not become stronger monotonously but becomes stronger in phases 3 and 4 and smaller in phase 5. In case 4, however, the density remains unchanged. Therefore, we cannot insist that network's openness will increase in phase 5 for all alliance networks. However, from comments acquired during interviews, all key persons in the networks believe openness is an important factor in the sales phase. Such comments support the increase of openness in phase 5.

We introduce two comments about the signals for network changes. The first was acquired from a firm that changed business partners during the manufacturing phase because the new partner not only had manufacturing systems but also circulation of commodity. The new business function of sales was proved decisive for determining the direction of network development. The second was mainly acquired from interviewees about changing opportunities for drawing up a business plan to claim the subsidy. All persons in the network loosely participated in the business project in the early stages,

but earnestly participated after the business plan was started. In this phase, some persons in the network dropped out to promote network closedness.

Based on the results shown in Fig. 2 and the comments acquired from interviews, we derived the following three hypotheses for network dynamics:

- In phases 1 and 2, the key persons of alliance networks seek different business partners as a new business function that can connect a new business idea to economical output. As a result, the network becomes comparatively open.
- In phases 3 and 4, the key persons prefer business partners with whom they have prior experiences to concentrate on the core of the business model. In other words, link stabilization is preferred to node exploration. As a result, the network becomes comparative closed.
- In phase 5, the key persons again seek new business partners to acquire business sales functions. So the network becomes comparatively open once again.

By using the above proposed method, the series of the density of potential links is calculated, investigated, and are regarded as the indicators of the dynamical change of the openness/closedness of a network. They indicate the network intentions of the key persons in the network as link stabilization and node exploration. The viewpoint of the tradeoff between link stabilization and node exploration provides a new principle for network development.

IV. Conclusion

This paper presented an analytical method for the dynamics of generating firms' alliance networks along with business phases and showed findings derived from the method with five actual cases of business alliances.

The proposed method introduces three ideas as a basis of the proposed method: multi-layer network models, business phases, and network intentions. These ideas enable investigation of the state of networks and explanations for the dynamics of firms' alliance networks from a viewpoint of the tradeoff between link stabilization and node exploration.

The results of the proposed method were applied to five cases and show that intention for link stabilization declines during the initial and final business phases. Based on the results, the following three hypotheses were derived for alliance network development: (1) In the initial phase of network development, the key persons of alliance networks seek new business partners and prefer node exploration. As a result, the network becomes comparatively open. (2) In the middle phase, the key persons prefer business partners with whom they have prior experience. In other words, link stabilization is preferred over node exploration. As a result, the network becomes comparatively closed. (3) In the final phase, the key persons again seek new business partners to acquire business functions of sales and prefer node exploration. As a result, the network becomes comparatively open again. These hypotheses are supported by comments acquired from interviews. In addition, from the viewpoint of Embeddedness, incentives might exist for node exploration when new business functions are guaranteed.

In this paper, five cases were used to show the availability of the proposed method. For future work, bigger cases and more diversified categories of industry must be investigated to derive general knowledge of dynamics.

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