Change on Patterns of Technology Diffusion through a Collaborative Network

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Abstract. This study focuses on inter-organizational collaboration in the diffusion of technology innovation. An ecosystems approach on innovation explains that relationships among organizations for collaborative innovation are continuously changed and evolved. In this respect, this study aims to investigate structural changes on interaction patterns among organizations involved in the use of technology innovation. An empirical study on a collaborative network for distributing technology standardization was performed to demonstrate structural dynamics of collaborative innovation.

Keywords: Technology Innovation, Ecosystems, Inter-organizational Collaboration, Value Co-creation, Structural Equivalence

1 Introduction; Collaborative Innovation

Innovation can be achieved only when economic value is generated from new knowledge. In this respect, research on innovation has traditionally centered on innovation process from the development of new knowledge to its dissemination and use. Studies mostly emphasize inter-organizational collaboration in implementing innovation process. These studies can be divided into two theoretical approaches including innovation systems and innovation ecosystems. Studies on innovation systems explain that innovation process is performed through arrangements among institutional organizations [1-3]. They deal with collaborative innovation as institutionally static relationships. Whereas innovation ecosystems approach explains that relationships among organizations involved in innovation process are continuously changed [4]. Innovation ecosystems concept is characterized by structural dynamics in which inter-organizational relationships evolve according to the technological development, market demands, and social contexts that affect diffusion of technology innovation. In other words, technology innovation is disseminated through dynamic changes of interactions among organizations involved in innovation process. The organizations collaborate to develop new knowledge, generate economic value, and control on resource exchange with each other [5].

Although some theoretical frameworks have been developed to explain dynamics of collaborative innovation, there are less empirical studies that examine longitudinally structural changes of a collaboration network [6]. In this regard, this
study aims to investigate structural changes on interaction patterns among organizations around technology innovation.

2 Literature Review on Dynamics of Collaborative Networks

2.1 Resource Dependency Theory and S-D Logic

An inter-organizational network is described by resource dependency theory. The resource dependency theory explains that all organizations should collaborate with other organizations to gratify lack of resources since any organization cannot have all resources by themselves [7]. This perspective is related to Service-dominant (S-D) logic that is an emerging theory introduced by [8] in order to explain dynamic changes of service-driven market. In S-D logic, service is defined as the application of resources including technologies, functions, and even products. Customers obtain value through service embedded in products. Hence, value of service offerings depends on how customers use the resources.

S-D logic describes a social economy system as a stakeholder network for service exchange. Vargo and Akaka [9] explain that a social economy system is self-organized through the integration of shared resources. A service-driven inter-organizational network is conceptualized as a service ecosystem [9]. All organizations involved in a service ecosystem collaborate to generate value of the whole system through service exchange. In a collaborative network, value is co-created through service exchange. The organizations co-create customers’ value by integrating others’ resources into their own products or services.

Accordingly, an inter-organizational network for collaborative innovation can be regarded as a collaborative network for application of resources. This network is re-organized by adjustment of governance rules for controlling resource exchange [9].

2.2 Research on Structures of Inter-organizational Networks

An inter-organizational network can be represented as a network system consisting of nodes and links [10]. Studies on structures of inter-organizational networks mainly focus on structural positions of organizations. Borgatti and Everett [11] explained the structure of an inter-organizational network by structural equivalence analysis in terms of position. The interaction pattern among the organizations would be rearranged when the position of an organization is changed over time. Therefore, the structural dynamics of an inter-organizational network can be explained by examining the changes of positions of the organizations within the network.
3 A Case of a Network for Resource Exchange

This study analyzed changes on interaction patterns among organizations in a collaborative network for using technology innovation. The investigation was performed on the digital living network alliance (DLNA). The DLNA is an alliance network of consumer electronic (CE) manufacturers to develop technology guidelines for sharing digital contents among multimedia devices. The DLNA products can be used as mutual complements in a home-network. Consumers would perceive greater value when using together more different DLNA products. Therefore, it can be said that all the organizations involved in the DLNA network co-create customers’ value through the application of the DLNA technologies. They are interrelated by service exchange through technological complementation among their DLNA products. The DLNA network is a loose network in which organizations are indirectly connected with each other through the DLNA products.

The DLNA network has been evolved along with the improvement of the technology guidelines since the DLNA certification program was introduced in 2006. Accordingly, the interaction patterns among the organizations could be assumed to have been changed by the diffusion of technology innovation. Accordingly, this study investigated longitudinally the changes on the interaction patterns of the DLNA network for the last decade.

4 Network Analysis and Results

We abstracted the DLNA network as a network structure of nodes inter-linked through the application of complementary resources. The network structure is represented as a relational data that consists of organizations in rows and complementary product types in columns. Over 20,000 certificates on the DLNA-compatible products were analyzed to calculate weights on each organization’s capability for providing complementary resources. According to an approach on two-mode structural equivalence [12], we constructed block model of the organizations by comparing correlation Euclidean distance.

The analysis result indicates that the interaction patterns among organizations have been changed as the technology innovation has been diffused in the industry. We found policy implications for diffusion of technology innovation, by comparing these different patterns. Innovation policies and strategies should focus on building a successful industrial network for use of technology innovation in terms of technology commercialization. The collaborative network should be continuously re-organized by controlling the scope of technology use in order to keep up diffusion of technology innovation.
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References