연구실적요약문

Easi-Clouds - Patterns of Innovation in SaaS Networks

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연구과제명: Easi-Clouds - Extensible Architecture and Service Infrastructure for Cloud-aware Software

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1. Research Background & Goal

The IT technology advancement and the demand for new business models, which attract users to innovate, motivate software vendors to provide their software as a service (SaaS). SaaS is based on an old paradigm, in which users can run software installed on a remote computer via the Internet. SaaS is again spotlighted since the emergence of cloud computing in a variety of areas, ranging from office applications to computer resources (Campbell-Kelly, 2009). SaaS is provided to users not only as a final good but also as a resource, which users can reuse for creating new services under the service-oriented architecture (SOA). SOA defines the interface, through which users can utilize the functions of the service for their innovation (Haines and Rothenberger, 2010). For example, a user can develop a composite service by adding her value on an existing service or combining several existing services. This requires that all services are provided with open application programming interfaces (APIs).

This new trend of innovation, in which each service is reused by other services, invites researchers to analyse the structure and the evolution of the environment of SaaS as a platform for “open innovation” from the perspective of networks (Chesbrough, 2003). The existing innovation studies on SaaS networks (Hwang et al., 2009; Kim et al., 2011) follow two research designs of innovation studies from the networks perspective: one investigates the structure and evolutionary pattern of networks (Newman, 2001; Valverde and Solé, 2007; Wagner and Leydesdorff, 2005), and the other correlates the network characteristics with innovation performance (Granovetter, 1973; Grewal et al., 2006; Krackhardt and Stern, 1980). These studies regard the network characteristics static and the effect of networks on innovation invariant. They lack the consideration of positional change of a node in the evolving network.

For example, in the model of Barabási and Albert (1999), a hub keeps its status in the static topology once it occupies the position in the evolution. However, the change of the innovation leader and the innovation trend is normal in real innovation systems.

To investigate this in the context of SaaS, we investigate the position of five representative software services in a SaaS network and discuss the patterns of changing positions of the five software services in the evolving SaaS network within this paper. A SaaS network is a network, in which a node represents a software service and a link the use of two combined software services. The SaaS network that we consider is formed based on the empirical data surveyed from the Web site www.programmableweb.com, a public board listing information on software services with open APIs and on composite services that are built on top of other software services. We choose the following five software services as representative software services, as they have been used the most during the study period: Google Maps, Flickr, Twitter, YouTube and Facebook. For this SaaS network, we measure the normalized degree centrality, normalized eigenvector centrality, and the normalized betweenness centrality of the representative software services for each month of the study period.

2. Research Outcome

Our main results lead to three propositions. First, the degree centrality and the eigenvector centrality of the representative software services show the typical life cycle of goods (i.e., the growth after birth, the prosperity, and the following decline). Second, as the innovation trend shifts from image services to social networking services, the betweenness centrality together with the other two centralities shows that the network structure includes hubs. Finally, the network structure transformation involves two types of competition between the major software services: competition for getting into a hub position in the network, and competition for getting into a core position in several clusters. Our findings redirect the focus of innovation network studies from analyzing the invariant network topology and position to analyzing the incessant change of network position in invariant topologies. This shift of focus is expected to help understanding the innovation trend and identifying the strategy of software vendors for their software services.

Our findings cast important implications both to academia and industry. On the one hand, academic research on innovation (e.g., Grewal et al. (2006) and Kim et al. (2011)) should also consider the evolving patterns of a network and the position of nodes in those evolving networks. The static network characteristics that influence innovation are not the only factors, if the position of a node in the network can change as we demonstrated with our research. From the entrepreneurial perspective, on the other hand, our analysis results show that each software service emerges and declines as suggested in prior research on diffusion (Bass, 1969). These changes over time have been missed in prior research on networks of information systems. Prior research of network analysis described only the network structure and the evolutionary rule of a network (Hwang et al., 2009; Valverde and Sol?, 2007). Therefore, our results suggest that our analysis method can be applied to the analysis of innovation trends of information systems.