

論文の要旨

題目 Analyzing the Co-evolution Impacts of Interconnected Relationship Strategies on the Behaviors and Structures of Supply Networks
(サプライネットワークの挙動と構造に関する相互関係方策の共進効果の解析)

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A supply network (SN) inherently has two challenges for decision makers to deal with. Firstly, as a consequence of its “network” nature, it is complex. In SN environments, not only firms that interconnected through relationships, but also the relationships themselves are interconnected and not independent or isolated from others (Ritter, 2000). The quantity of relationships among firms inside SN dictates the complexity level of the network. Secondly, SN is not static. At any time, firms could leave or enter the network, regularly firms make some decision to reconfigure their relationship portfolio to adapt to business environment changes or to respond to partners and rivals actions. As a result, SN structures and behaviors are evolved.

Inter-firms relationships had been investigated for decades, especially in the 1990s (Ritter & Gemünden, 2003) emphasizing on dyad or triad relationship. However, the theory of relationships among firms, especially in the context of broad network is still emerging. The dyad and triad level of SN analysis comes from reductionism methodologies positing that an entire system mechanism under investigation can be fathomed by studying its parts. However, most systems, especially those that are composed of live beings or man-made i.e., network of social/economic systems, behave in a more complex manner than the sum of their components (Choi, Dooley, & Rungtusanatham, 2001). Such systems comprise many loosely coupled entities whose individual interactions are based on local information, but collectively this arrangement would lead to complex emerging behavior.

Although bottom-up and evolutionary-approach modeling methodologies of complex adaptive systems (CAS) which are more suitable for overcoming the dynamic and complex issues have existed for decades in the fields of biology and physics, researchers have only recently employed CAS perspective to intensively investigate SN (Nair, Narasimhan, & Choi, 2009; Pathak, Day, Nair, Sawaya, & Kristal, 2007; Pathak & Dilts, 2009). CAS methodology explain how phenomena or features of a

complex system emerge from co-evolution of local interactions among all components of the complex system.

A CAS theory perspective for SN was initially proposed by Choi et al., (2001) in their seminal work. They popularized this approach under the name of complex adaptive supply networks (CASN). From a CASN perspective, firms in SNs can be regarded as a part of an interconnected live being that exhibits co-evolution, self-organizing and recursion. To investigate SNs, a researcher can develop an SN model while emphasizing the three fundamental foci of CAS, namely the internal mechanisms, the environment and co-evolution (Choi et al., 2001).

Using CASN perspective, Nair et al., (2009) developed a CAS framework using cellular automata (CA) model to investigate the co-evolution of relationship strategy decisions among firms at the SN level. Their experiments successfully showed how relationship strategy co-evolution inside SNs causes the emergence of complex interconnected relationship behaviors of cooperation and defection. In accordance with Nair et al., (2009) frameworks, Li, Gu, & Song (2013) investigated the impacts of SN topologies on the co-evolution of a cooperation and defection strategy inside SN. They concluded that heterogeneous network structures are helpful for promoting cooperation. Nonetheless, both papers still focus on co-evolution between cooperation and defection. In fact, there are other archetypes of relationship strategies that exist and that might have a significant influence on co-evolution of relationship strategy inside SNs, i.e., competition and co-opetition (Choi, Wu, Ellram, & Koka, 2002).

A cooperation relationship between firms is motivated by a common goal (e.g., to solve problems, to improve products and streamline processes, etc.) (Choi et al., 2002) and/or a resource dependency (Ritter, 2000; Lee & Leu, 2010). This type of relationship builds upon teamwork by sharing information and resources. Conversely, a defection relationship between firms is provoked by short-term opportunistic behavior (e.g., being lured by better terms of a contract from other firms) (Nair et al., 2009).

A competition relationship between firms is based on the logic of economic risks (e.g., appropriation risk, technology diffusion risk, forward integration by suppliers and/or backward integration by buyers, etc.) that can introduce threats to the core competence of a firm (Choi et al.,

2002). Conversely, co-opetition is a strategy employed by firms that simultaneously mixes competitive actions with co-operative activities (Gnyawali & Madhavan, 2001). The motivation for engaging in co-opetition between rival firms in SN varies; namely, companies may choose co-opetition to pursue the advantages by pooling resources and competences (accessing new channels and/or markets, developing new products, learning new processes or technologies) (Bengtsson, Eriksson, & Wincent, 2010) or because of obligations to buyers, government regulations or other third-party firms ((Gnyawali & Madhavan, 2001; Z. Wu & Choi, 2005).

All the archetypes of relationship strategies should be considered in the construction of co-evolution models of interconnected relationship strategies. Considering only cooperation and defection in a model will mean that the model represents only interaction among firms with dissimilar resources. At the same time, interactions among firms that have a high resource similarity, where competition or co-opetition relationships could naturally emerge, have been neglected. Changing its relationship strategy toward other firms is part of the natural adaptability behavior of a firm. For example, one type of relationship strategy (e.g., cooperation) can be affected by other relationship strategies and can transform into other types of strategies (e.g., defection) (Nair et al., 2009). Two types of strategies (i.e., cooperation and competition) can operate simultaneously in the form of co-opetition (Wu & Choi, 2005). Therefore, to reproduce more comprehensive behavior of interconnected relationship strategies inside SN, we need to extend the research framework of Nair et al., (2009) by means of accommodating not only cooperation and defection but also co-opetition and competition relationship strategies into the model.

In this study, I have two stages of research. At the first stage, I developed a research framework and conducted several experiments to investigate the co-evolution of interconnected relationship strategies of CASN using CA (Sofitra, Takahashi, & Morikawa, 2012a, 2012b, 2013a). I aimed to address the following research questions: how and under what conditions does co-opetition in CASN co-evolve simultaneously with competition, cooperation and defection? What kind of interconnected relationships behavior will emerge as a result of this co-evolution?

If I could successfully identify and understand the emergence of collective behavior of SN firms as

the result of the interconnected relationship strategies among them, then it is also important to investigate the impacts deriving by this emergent behavior which is emphasized in the second stage of my study. The first impact is on firms' survivability. Investigation on the first impact is very important because any relationship strategy which engages firms with each other, mainly intends to achieve a firm's goals. One crucial goal of firms is to prolong its survival in the market.

The second impact of this emergent behavior is on the network structure of SN. Many researchers have investigated how local interaction of components of particular CAS can affect its network structure (Biely, Dragosits, & Thurner, 2007; Gross & Blasius, 2008; Poncela, Gómez-Gardeñes, Traulsen, & Moreno, 2009; Zimmermann & Eguíluz, 2005). Among CASN features, understanding of the underlying structure of CASN is very important. CASN structures play crucial roles in affecting the functionality and behavior of the complex system represented by it such as power, learning, innovation, or flow of resources (Wang, 2002), (Estrada, 2011).

To sum up, at the second stage of my study, I investigated the impact of the emergence of macro behavior of interconnected relationships co-evolution of CASN to its firms' survivability (Sofitra, Takahashi, & Morikawa, 2013b) and to its network structure (Sofitra, Takahashi, & Morikawa, 2014). I question how and under what conditions the survivability of firms inside the SN is affected by the co-evolution of interconnected relationship strategies among them? And whether this co-evolution of interconnected relationship strategies emerges efficient SN structures?

Why is the co-evolved behavior of interconnected relationship strategies inside CASN a fascinating issue? As managers realize that their firms are not actually isolated entities but are integrated parts of a network, they will become interested in learning how the network should be controlled and the potential effects on the network and on their firm (Hakansson & Ford, 2002). Therefore, the objective of this study is to gain better understanding of the coevolution impact of interconnected relationships strategy to SN behavior and structure. The conceptual figure of the study can be seen in **Error! Reference source not found..**

After this introductory chapter, I structured this dissertation as follows:

- The second chapter

Since my research utilized some theories coming from quite a wide field of study, I need to provide literature reviews on several background knowledge that may be needed by readers to have a complete depiction of how I drive my hypothesis and conclusion.

- The third chapter

In this chapter, I describe all of my novel methodologies that had been used in this study.

- The fourth chapter

This chapter provides the result of my first stage study dedicating in the investigation on the behaviors that emerge as a result of the co-evolution of interconnected relationship strategies.

- The fifth chapter

This chapter provides the result of my second stage study mainly on the co-evolution impacts of the interconnected relationship strategies on firms' survivability.

- The sixth chapter

This chapter provides the result of my second stage study on the impact of the co-evolution of interconnected relationship strategies on the structure of SN.

- The seventh chapter

The seventh chapter compiles the conclusion from all the study results and gives the direction for further work.