Chapter 2.27
Structure Evolution of B2B Enterprise Networks

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ABSTRACT

This chapter analyzes the structural dynamics of multilateral business-to-business (B2B) relationships based on game theoretical approach. It focuses on the evolution of network structures initiated by three major forces: a neutral intermediary, a dominant supply chain partner, and an industry consortium. We show the typical enterprise network structures, identify the conditions that cause structure reconfiguration, and demonstrate the change of social welfare in the evolution process. Web-based technologies have changed the landscape of enterprise networks, and the proposed framework will provide an analytical understanding of the endogenous formation and dynamics of enterprise networks in the information era.

INTRODUCTION

Due to the vast benefits of web-enabled networks, they have become increasingly popular in information-intensive industries. Firms realize that business-to-business relationships often have impacts beyond the bilateral exchanges between the firm and its business partner. For example, the

well-known bullwhip effect (Lee, Padmanabhan & Whang, 1997) refers to the distortion of demand when the number of intermediaries increases in a supply chain. Thus when the manufacturer evaluates its relationship with a wholesaler, it has to take into account the retailers that the wholesaler serves. Even competing firms are forming horizontal marketplaces, such as the consortia (for example, Covisint, Transora), composed of multiple buyers and sellers to improve purchasing efficiency and facilitate collaboration. Evidently, thanks to information technology, the cost of integrating another firm in the value web continues to decrease. As a result, the formation and evolution of value webs have become highly dynamic.

The benefits of such web-enabled networks are well understood in the industry. They encourage information sharing, thus leading to better coordination among partners in activities such as demand forecasting and new product development. And the formation and evolution of such enterprise networks (EN) have yet to attract attention from researchers. Existing literature in related fields such as economics and management have mostly focused on characteristics of specific network structures that are exogenously given. However little research studies how EN form endogenously and evolve (Tomak & Xia, 2002).

In this chapter we study the formation and evolution of EN. In our setting, each firm is regarded as a rational entity and will create and sever its relationships with others in order to maximize its own payoff. The structure will evolve as firms respond to market changes that will affect their payoff. We analyze three types of EN, which are prevalent in the e-business area. They are: e-Market, EN enabled by a neutral intermediary; e-Hub, EN enabled by information sharing across a dominant supply chain partner; and industry consortia, EN enabled by a buyer-based consortium.

The remainder of the chapter is organized as follows. The next section gives an overview of EN and reviews related literature on network eco-

nomics; the section on model settings presents the general model of EN; the next sections separately discuss the evolution of the three types of EN; and the final section concludes with a summary of our findings and some future research directions.

ECONOMICS OF ENTERPRISE NETWORK

Definition: An Enterprise Network (EN) is a network formed among multiple enterprises to realize certain functions.

EN facilitates business transactions among trading partners. The relationships among them can be general and broad, from arm-length relationships to strategic alliances to even market-based relationships. Supply chain networks and spot markets for particular products are examples of EN. To fulfill critical business imperatives, self-interested firms are always seeking efficient connections with their trading partners. While some general trends are well known[1], it is not clear which network structures are more likely to form and which ones are more stable. More importantly, knowing the conditions of obtaining stable networks before and after the changes, we can gain insights into the critical factors leading to new stable networks, properties of new EN, and the resultant change in social welfare.

To answer these questions, we use non-cooperative network games to simulate the network formation and evolution process. Economists have used the game theoretical approach to model network formation for some time (Aumann & Myerson, 1988; Myerson, 1991). Their findings can be grouped into three categories: (1) The importance of network relationships in determining the outcome of economic interactions (Jackson, 2003); (2) Some dominant and stable network structures under various circumstances (Bala & Goyal, 2000); (3) Relationship between stability and efficiency of networks (Jackson, 2001). Our

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