Towards a Theory of Co-opetition of Supply Networks


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Towards a Theory of Co-opetition of Supply Networks

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Towards a Structural View of Co-opetition in Supply Networks

Abstract

Co-opetition, or simultaneous competition and cooperation, in the supply chain management literature has been treated as a dyadic relational phenomenon where the buyer’s strategy is considered to be the primary driver. In this paper, we move beyond the dyadic view and propose a theory of co-opetition in supply networks. We argue that as firms within a supply network interact over time to access, share, and transform resources, new ties between firms are formed and existing ties dissolve, giving rise to co-opetition dynamics at the network level. Taking a configurational approach, we employ the inter-related dimensions of ties between firm, firm-level task, network-level objective, and governance to specify four practical supply network archetypes that cover a wide range of economic activities. We then explain how co-competitive relationships may evolve in these supply network archetypes. Specifically, we discuss how relationships form or dissolve in these archetypes and how local structural changes lead to co-opetition dynamics at the network level. We also discuss the implications of such dynamics from a managerial perspective.

Keywords: Co-opetition, Tertius Iungens, Tertius Gaudens, Supply Networks, Structural Holes, Archetypes

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1. Introduction

Co-opetition, or simultaneous competition and cooperation is ubiquitous in supply networks. Co-opetition between buyers and suppliers has been observed and analyzed in industries including semiconductors (Browning et al., 1995), steel (Gnyawali, He and Madhavan, 2006) and pharmaceuticals (Quintana-García and Benavides-Velasco, 2004). At its very core, co-opetition is a phenomenon of dynamic inter-firm relationships. Over the past three decades, scholars have built a rich body of literature explaining such inter-firm relationships (Grandori and Soda, 1995; Holm et al., 1999; Tsai, 2002; Wu and Choi, 2005). Among them, strategy scholars have carried out extensive studies of co-opetition to understand the relational strategies of peer firms in an industry (Gulati, 1995; Gnyawali, Madhavan and He, 2006). Researchers have also taken a game theoretic perspective of firms’ relational strategies to highlight the dilemma and challenges of managing collaboration among competitors in an industry (Brandenburger and Nalebuff, 1997; Lado, Boyd and Hanlon, 1997; Ramon and Yoffie, 2007). In contrast, there is little study of co-opetition taking place in supply networks. Co-opetitive dynamics in supply networks are different—firms are bounded by contracts and linked operationally across multiple tiers in a network to fulfil a common set of tasks. Specifically, operational links in a supply network lead to relational strategies that differ from those of peer firms; a firm’s position in the supply network affects how it relates and responds to other firms in that production and service network (Kim et al., 2011).

Operations management (OM) scholars began to explore co-opetition in supply chains, but only within the context of dyadic buyer-supplier or supplier-supplier relationships (Nair et al., 2011; Ramon and Yoffie, 2007; Wu and Choi, 2005). There are limited studies that have looked beyond the dyad and examined co-opetition in broad supply networks (Choi et al., 2001; Choi and Hong, 2002; Kim et al., 2011). A network perspective of supply chains offers two important insights to theory and practice. First, co-opetitive tension between a buyer and a supplier is influenced by the multiple and overlapping relational linkages in the larger network in which the firms are embedded (Choi and Wu, 2009; Dyer and Nobeoka, 2000; Wilhelm, 2011). Second, supply network structure changes relational dynamics and influences firms’ sourcing and relationship strategies (Kim et al., 2011). Thus, understanding co-opetition
in a supply network requires consideration of both the structural characteristics of the network and the behavior of individual firms (Choi et al., 2001; Lejeune and Yakova, 2005; Li et al., 2011; Nair et al., 2011; Wu and Choi, 2005). Thus a theory of co-opetition of supply network will describe both their behavior and their overall pattern of complex relationships.

In this study, we take the first step to theorize supply network co-opetition. We begin by taking a configurational approach (Boyer, Bozarth, and McDermott, 2000) and specify four practical supply network archetypes, presenting them as building blocks to describe co-opetition across a broad range of economic activities and business operations. To theorize on co-opetitive dynamics within and across these archetypes, we adapt the micro-process proposed by Obstfeld (2005) to describe network evolution. We apply this micro-process to discuss how relational changes among individual firms may lead to structural changes in the network, altering the co-opetitive dynamics within each archetype and eventually causing the archetypes to evolve.

2. Theoretical background

To examine co-opetition in supply networks, we draw upon two different research streams. First we briefly discuss previous research on co-opetition and multi-firm relational dynamics. Second, we present existing research on a structural view of supply networks.

2.1 Co-opetition among organizations

The concept of co-opetition originated from the game theory literature (Axelrod, 1984; Lado, et al., 1997; Luce and Raiffa, 1957; Rapoport and Chammah, 1965; Von Neumann and Morgenstern, 1944). Brandenburger and Nalebuff (1997) popularized the concept within the general business community. Game theorists have focused on understanding the strategic behavior of firms as they engage in co-opetition to maximize their individual utility functions. Specifically, Dagnino and Padula (2002) describe co-opetition between firms as a variable sum game where cooperation is a positive sum game and competition is a zero sum game.

Strategy scholars view co-opetition as syncretic rent-seeking behavior of individual firms combining cooperation and competition to attain an optimal performance outcome (Gnyawali, Madhavan, and He,
Co-opetition in strategy research takes place within lateral business networks (Luo, 2004; Soekijad and van Wendel De Joode, 2009), where firms are competitors. Researchers have identified two enablers of co-opetitive behavior. First, competitors have complementarity in technology, market and capabilities (Gimeno and Woo, 1999). Second, competitors are able to engage in competition and cooperation sequentially—they cooperate in developing the market and then compete to divide up the market (Bengtsson and Kock, 2000; Luo et al., 2006). Researchers in both game theory and strategy disciplines have primarily focussed on firms embedded in lateral relations, and there is limited discussion of co-opetitive relational dynamics in tiered and vertical supply chains.

Co-opetitive relationships in the supply chain management literature are discussed in the context of a buyers’ parallel sourcing practice, where two competing suppliers collaborate or are forced to collaborate (Richardson and Roumasset, 1995; Wu and Choi, 2005). Here the relational context is a triad; and the buyer plays an active role in initiating and cultivating such co-opetitive dynamics. Supply chain scholars have argued that, while a dyad can show how the behavior of a node in the network affects another node, it fails to consider how a tie between nodes affects other ties in the network (Choi and Wu, 2009). Unfortunately, little has been done to address the question of how the triadic view relates to a larger supply network. As a result, there is limited understanding of how co-opetitive dynamics plays out in extended supply networks and how firms manage it.

2.2 Supply networks and co-opetition

Scholars have conceived a supply chain as a network in an effort to understand the structural characteristics of relationships and answer practical questions including innovation, collaboration and power distribution among firms (Borgatti and Li, 2009; Bozarth et al., 2009; Nair et al., 2011). Pathak et al. (2007b) is one of the first studies to systematically examine the structural arrangements of supply networks. They include flat and self-organized production networks in which firms coordinate and collaborate with minimal formal control, as well as hierarchical networks orchestrated by one end buyer as seen in a typical modern manufacturing environment. Such a structural view of supply networks
considers complex relational patterns beyond the purview of a single firm where the relationships are
governed by formal contracts as well as informal social ties (Choi and Dooley, 2009).

Choi and Hong (2002, pg. 469) define a supply network as a “network of firms engaged in
manufacturing and assembly of parts to create a finished product.” Particularly, they highlight that supply
networks are not static systems; instead they are complex adaptive systems that display dynamism.
Supply networks adapt, as firms collectively attempt to fulfill demand through individual firm-level
actions while responding to changes in both the environment and actions of other firms in the network
(Choi et al., 2001; Pathak et al., 2007a). The interaction between firms in a supply network can be
competitive or cooperative in nature. Competition and cooperation in these supply networks may take
place for a number of reasons. Buyers and suppliers could engage in competition on technology,
information, access to resources, and face the threat of vertical integration or acquisition. On the other
hand, buyers and suppliers may cooperate to coordinate production, access new technology, information,
or other resources (Smith, Carol, and Ashford, 1995). While the discussion above highlights the
competitive and cooperative behaviors of firms it does not shed light on how competition and cooperation
manifest structurally in a supply network.

As we examine co-opetition in supply networks, the first question we need to answer is: “from a
structural perspective, how do we conceptualize cooperative and competitive relationships?” In this study,
we posit that a cooperative relationship between two companies refers to a direct link between two firms.
The tie indicates direct communication and interaction between the two firms related to the delivery of a
product or service. On the other hand, we specify that the absence of a link between two firms suggests
competition when at least one of the following three conditions is met. One: the two firms can supply a
product of equivalent functionality. Two: the firms require similar scarce resources or input. Three: the
two firms have overlapping and complementary technology such that it is possible for one company to
engage in learning and value appropriation. Any of these three conditions necessitates operational
coordination and an absence of a direct link suggests a relational tension between two firms leading to
competition (Choi et al 2002; Wu and Choi 2005). Thus, as firms in a supply network take actions to
manage their position in the supply network, it affects the structure and in turn, the level of competition
and cooperation in the network.

2.3 Understanding co-opetition as a dynamic phenomenon

Triads are the smallest unit of a network (Choi and Wu, 2009; Wasserman and Faust, 1994; Simmel,
1950). To understand the co-opetitive dynamics of supply networks, we first need to discuss relational
actions taking place in triads and how such actions set off relational changes beyond given triads. Simmel
(1950) was the first to extensively discuss triads in the context of sociology research. Later, Burt (1992)
drew on Simmel’s triadic research to explain relational behavior of nodes in a social network. Researchers
describe two distinct behaviors to explain the relational strategy of a node and the consequent effect on
the presence or absence of ties within and beyond the triad.

Structurally two nodes in a triad may have no direct links except through a common third node. This
common node plays the role of a broker and such an arrangement is referred to as a structural hole (Burt,
1992). In such a triadic block, the disconnected nodes may be aware of each other, but do not directly
tend to the activity of the other node (Burt, 1997, Choi and Wu, 2009, Madhavan et al., 2004). Within
such a triadic block, two basic types of strategic behaviors may take place. First is the strategy of “tertius
gaudens,” meaning “the third who profits” as introduced by Simmel (1950). By executing a “tertius
gaudens” strategy, the broker develops control over the disconnected firms by actively separating the two
nodes, and maintaining the structural hole. The broker separates the two nodes by playing them against
each other and benefits from information or resource asymmetry between the two disconnected nodes
(Burt, 1992; Simmel 1950).

A structural hole embeds tension (Burt 1992, pg 32), implying “no tension no tertius.” Here, the
absence of a direct link leads to competitive tensions between the disconnected nodes within the triad.
Baker and Obstfeld (1999) refer to the tertius gaudens as a strategy that is focussed on “disunion”
between two disconnected nodes in a triad. Simmel (1950) also suggested a second behavior: tertius
iungens, or “the third who joins.” It focusses on the “union” of the two disconnected nodes by a non-
partisan third node in the triad. Obstfeld (2005) investigated the tertius iungens relational strategy. In this
case, the broker joins the disconnected firms to enable direct interaction between them. The broker relinquishes its power and control in exchange for synergy and self-coordination in the triad (Obstfeld, 2005). As a result of a firm enacting the tertius iungens strategy, the connectivity within the triad increases and so does the level of cooperation.

A firm in a supply network may play the role of a broker to block a potential link or be a matchmaker to connect two otherwise disconnected firms, which generates new ties that change the existing relational dynamics. Obstfeld (2005) presents a sequence of recursive steps based on the tertius gaudens and tertius iungens strategies to explain how relationships evolve in a social network. In Section 4, we will present our adaptation of Obstfeld’s micro-process (2005) to explore how cooperation and competition dynamics change in supply networks. Supply networks encompass different economic activities including simple village-based agricultural production, capital-intensive modern manufacturing and virtual knowledge-based service operations and product development (Harland et al., 2001; Miles and Snow, 2007; Pathak et al., 2007b). A robust theory of co-opetition, therefore, must hold for many industrial settings and economic activities. In Section 3, we specify four supply network archetypes to capture such broad range of economic activities.

3. Supply network archetypes

We take a configurational approach to specifying supply network archetypes (Bailey, 1994; Boyer et al., 2000). Bozarth and McDermott (1998, p.427) define a configurations-based model as “multidimensional profiles used for describing organizational strategy or processes.” Archetypes are a “set of structures and systems that reflects a single interpretive scheme” where interpretive schemes relate to a set of attributes or elements that is embodied commonly across the multiple profiles of the system under consideration (Greenwood and Hinings 1993). Meyer, Tsui, and Hining (1993, pg 1175) suggest that elements ranging from environment and industry structure to processes and organizational practices can be grouped together to describe archetypes. Therefore, the first step to specify archetypes is to identify such elements of the archetypes (Bailey, 1994). To define these elements for our study, we turn to the supply networks literature.
Choi and Krause (2006) describe a supply network as a collection of connected firms that are engaged in value added activities or tasks. Key firms in the network coordinate and control the activities in the network and ensure that the final objective of satisfying the customer demand is met. Combining Choi and Hong’s (2002) definition of a supply network presented earlier, and Choi and Krause’s (2006) view of how a supply network operates, we posit that there are four interrelated elements that are common to supply networks: firm level tasks, ties between firms, network level objectives, and governance. Firm-level tasks in supply networks refer to typical operational tasks such as product development, procurement, production and distribution. Borgatti and Li (2009) refer to the relations between firms as they engage in their respective tasks as ties in a supply networks. As discussed earlier we consider relational ties as indicators of cooperation between firms, whereas absence of ties indicates competition. While the individual firms in a supply network engage with other firms to complete myriad operational tasks, they collectively deliver a product or service and achieve the network level objective (Choi and Hong, 2002).

Network governance is a set of mechanisms used for monitoring and controlling the behavior of one or a group of organizations in order to protect the interest of shareholders and community members associated with the system (Provan and Kennis, 2008). There are three basic forms of governance: “shared,” “lead,” and “network administered” (see Provan and Kenis, 2008, for details). Shared governance is administered by member firms in the network. A network can also be governed by a lead organization that manages the network through formal contracts. Lastly, network administered governance (NAO, for network administered organization) involves a separate administrative entity that governs the member firms in the network. Different forms of governance are deployed to manage different tasks and network level objectives (Kilduff and Tsai, 2003).

Based on these four components of network, we specify four supply network archetypes: Community, Federation, Consortium and Hierarchy. Next, we provide a conceptual definition and then illustrate the relational dynamics inherent in each archetype using examples from published studies. For each archetype, we begin with the definition and the nature of the ties in the archetype. We illustrate the firm-
level tasks through the examples and highlight the network level objective and governance type. In Table 1, we summarize the key characteristics of these archetypes.

- Table 1 about here-

3.1 Supply network archetypes descriptions

3.1.1 Community Supply Network.

A community supply network is defined as a group of companies within a specific geographical region that produce products and services associated with those regions. They interact, exchange information and reciprocate assistance to create a common marketplace. Typically, a community supply network provides a local aggregation point, where customers and producers meet. Buyers come to the market for one-stop shopping; they expect to compare the prices of similar and complementary offerings to meet their needs. Communities often comprise small businesses and provide network externality to participating companies (Grängsjö and Gummesson, 2006). Because of geographical proximity, community members may have ties through social interactions or occasional commercial transactions. Ties in these networks are primarily between multiple end buyers and a relatively small number of providers. Sometimes, two providers can form complementary ties creating additional tiers in the supply network. Figure 1 illustrates a community supply network.

-Figure 1 about here-

The New Zealand Farmers’ Market exemplifies such a community supply network (Lawson et al., 2008). Farmers are suppliers in this network and buyers include consumers as well as institutional purchasers such as restaurants and food service companies. In this market, farmers pay a fee to third party organization such as the city’s Park and Recreation Services to manage the event. This farmers' market creates a physical food hub, where growers and farmers convene to sell produce, vegetables, flowers and meats. Buyers are attracted to the variety of fresh products as well as the friendly shopping experience. Interactions at the market allow the farmers to exchange information. For example, knowing the selection and prices at neighboring stands helps farmers to determine what to grow in the next season. Farmers also try to stagger planting and harvest time to avoid excess supply. In this network, structural holes are minimal and lack of direct ties among farmers typically does not hold competitive tension. Specifically, a
large producer may have supply relations with a dairy farmer as well as a florist. Yet, absence of such ties does not mean they are competitors.

The Swedish winter sport destination, Åre Village, is another example of a community supply network (Grängsjö, 2003). This network involves such entities as hotels, restaurants, taxi services, hospitals, ski lifts and city tourist promotion offices among others. These companies are mostly small family businesses and entrepreneurs. They often refer business to one another and participate in joint promotions. While they view themselves as independent product and service providers, tourists see them as providing an integrated service experience -- ski vacation packages often include lifts, restaurants and other entertainment venues. While the service providers coordinate marketing efforts to offer a seamless vacation experience, operational coordination is minimal. Direct cooperation is spontaneous and marketing and promotional efforts are facilitated through the local Chamber of Commerce. Here also, similar to the farmer’s market example, resource contention is rare and competitive tensions do not build up even if many entities are disconnected.

In sum, a community supply network has many individual firms that are independent of each other with few direct operational linkages. Direct competition among community members is low as communities form to create markets. Their primary network-level objective is to effectively signal to the market and attract customers. Business transactions between members are temporary and change over time. The intensity of both competition and cooperation is low in a community supply network. As was evident from the two examples above, the minimal governance in community supply networks is usually through a non-partisan third party that facilitates events as needed.

3.1.2 Federation Supply Networks

A federation refers to a group of autonomous firms who operate under the direct supervision of a central governing body consisting of members from the different firms. Firms in the federation maintain collaborative ties and exchange information. Member firms interact through training programs and trade shows. Demand from the end customer creates competitive tension as members of the federation compete for contracts. Here, both cooperation and competition are higher compared with that in a community
network. Absence of a direct tie in a federation (presence of a structural hole) holds competitive tension. Competition and cooperation are often sequential in federated supply networks. Competition intensifies when members bid on a contract. Cooperation arises when members coordinate as subcontractors to fulfill the contract obligations. These exchanges dissolve at the end of the transaction. Figure 2 illustrates a federation supply network.

*Figure 2 about here*

Virfebras in Brazil (Vallejos et al., 2007) and the Organic Valley Cooperative (Lyson et al., 2008) are examples of federation supply networks. Virfebras, founded in 1999, represents about 10% of the mold and die makers in the Caxias do Sol region of Brazil to support the Brazilian automobile industry. Federal and regional governments and banks sponsored this group in order to build the competency of the small and medium-sized mold and die producers. Twelve out of two hundred firms were selected to participate. In this network, companies compete to secure orders from external customers; absence of ties at this stage drives competition. Once a company secures an order, it takes the lead as a general contractor, organizes production and subcontracts the business to other members (cooperation through tie formation). Virfebras also bids on projects as a group and then elects a project leader when the bid is awarded.

Complementarity is a salient characteristic of this federation. Companies affiliated with Virfebras may have similar production equipment; yet they often have different niches of expertise. Further, they complement each other on production capacity. As a result, contract timing and delivery requirements organize companies into coordinated production partnerships. The president and managers for the governing body of Virfebras are elected from member companies. They create operating procedures and ethical codes, which assure a fair environment for members. The companies collaborate and form ties to solve common problems and access new technologies.

Many large-scale agricultural co-operatives are federations, with suppliers located across several regions (Cook, 1995). United States Department of Agriculture (USDA) reports indicate that agricultural cooperatives have become a major business sector in United States of America, with over 2000 cooperatives reported in 2012 with a combined business volume of over 200 billion dollars. Organic
Valley, the largest organic milk and vegetable co-op in the U.S., is an example (Lyson et al., 2008). Its members represent more than 1800 small farm families in 22 states. This member-owned cooperative is managed by a national Board of Directors and regional executive committees. Like Virfebras, members of the Organic Valley co-op combine complementary assets and capabilities and coordinate otherwise unconnected operations to attain economy of scale. Customer demands are communicated to regional growers, whose products are pulled through distribution centers and processing facilities, some of which are owned by members. Growers participate in the cooperative-wide forum and lateral information sharing takes place on an ad hoc basis. Competition may occur among unconnected growers as they compete for common resources (e.g. milk processing facilities) and on quality (Cook and Iliopoulos, 2001).

Governance of a federation is usually shared between members. Firms a federation share responsibilities through collaborative ties and manage network functions, carrying out coordinated and complementary tasks such as marketing, lobbying, training, and capacity sharing. While their production and service activities are independent, the operations of these firms are in fact coupled; coordination among the members is higher than that of a community supply network. Market demand compels the competing firms to band together and set a network-level objective of resource pooling in order to “expand the pie.”

3.1.3 Consortium Supply Networks

A consortium supply network is a collection of firms made up of buyers, tier one and even tertiary suppliers that already belong to multiple competing supply chains within an industry. These firms form a coalition and pool strategic and tactical resources to achieve a common goal. Consortium members nominate a governing body that establishes the charter of the consortium and takes charge of its daily operations. The objectives of a consortium are to confront common challenges (e.g., external threats) and to build competency through capability advancement. Firms in a consortium create ties through exchange of information and engage in joint tasks such as R&D and establishing technology standards. While these collaborations occur in the consortium, the firms continue to fulfil their roles and compete against each
other in their respective business supply chains. A consortium is unique in the sense that it is a knowledge-based supply network built on top of existing product and service supply networks. As shown in Figure 3, not all suppliers are linked with each other in a consortium. Competition is a natural state between disconnected partners and coordination through collaborative ties has to be enforced by the governing body.

Sematech is an extensively studied consortium supply network (Browning et al., 1995). It started as a government initiative to rejuvenate the recovery of the US semiconductor industry when it was losing ground to Japanese competition. Founded in 1987 with a mandate to develop open standards, manufacturing competency and a technology platform, the consortium consisted of fourteen major U.S. semiconductor companies including manufacturers and equipment makers. The board of directors was selected from senior executives of the member firms. They established policies and hired executives to address various strategic, technical and competitive challenges facing the member companies.

Initially, managers and researchers from member companies co-located at the Sematech site and worked independently from their companies. Over the next five years, Sematech evolved from its disorganized beginnings and rivalry among members to become an entity that developed collaborative relationships and accomplished its major objectives. The transformation was enabled by the leading firms and consortium administrator creating an open and inclusive work environment that worked towards advancement of semiconductor technologies.

Another consortium supply network is the Textile Dyeing Technologies (3T) in Turkey. It was founded in 2000 as an industry-wide R&D collaboration to prepare Turkish companies for rising foreign competition (Cetindamar et al., 2005). 3T initially consisted of six technology providers and ten dyeing and finishing companies, each having a one-sixteenth share in the organization. The dyeing and finishing companies are medium- and large-sized companies while the participating suppliers are mainly small firms. 3T develops and implements integrated automation systems from feasibility studies to after-sales services. Member firms meet on a regular basis and collaborate on technology development and
knowledge dissemination. 3T matches customer needs and fashion trends with supplier capabilities to
develop new products. 3T also instigates competition among their members instead of shielding them
from external technological advancement. While 3T attempts to use its members’ products first, it resorts
to outside resources when members cannot supply them. This compels the members to develop new
hardware and software to meet requirements and develop new processes and methods to enhance their
productivity.

While both federations and consortiums have a flat structure with an administrative body overseeing
the members, members’ relational behaviors are different in these two archetypes. In a federation,
competing companies pool resources and seek out collaboration to create business opportunity.
Relationship coordination is less complex because members are engaged in relatively discrete “modular”
operations with clear interfaces and boundaries. In a consortium, however, members by nature are fierce
competitors. They join a consortium in response to a common threat and with an overall network
objective of knowledge or skills development. Cooperation here is oriented towards defending their
common “territory”. Companies are aware that when the external threat abates, rivalry among them will
intensify. Thus, in order to overcome distrust and the competitive disposition, governance through strong
leadership with dedicated management resources and an effective administrative organization are critical
to meaningful interactions.

3.1.4 Hierarchy Supply Networks

A hierarchal supply network is defined as a set of buyers and suppliers that are organized to carry out
a design, production or service for an end customer. OM scholars are most familiar with this type of
supply network as it represents a typical supply chain with tiers of upstream suppliers, transforming
material and information into finished products. The tiered structure of the network influences how firms
interact. Specifically, material and information flows governed by contractual relationships enforced by
the primary end buyer strongly influence the relationships between firms (Borgatti and Li, 2009; Provan
and Kennis, 2008).
It is necessary to delimit the boundary of a hierarchical supply network to bring focus to meaningful structural characteristics and relationships of the network. In a supply network of a passenger vehicle, for instance, conceptualizing windshield manufacturers and engine part suppliers in one supply network will hardly identify meaningful relationships between suppliers making unrelated modules. Instead, it makes more sense to consider a supply network that includes firms making a single complex assembly or module. Choi and Hong (2002) took this approach for identifying a supply network for the central console of a passenger vehicle. We will take the same approach and discuss hierarchical supply networks in the context of a product assembly.

We use the Honda and Daimler Chrysler’s center console supply networks discussed in Choi and Hong (2002) and depicted in Kim et al (2011) to illustrate such hierarchy supply networks. As shown in Figure 4, both networks have multiple tiers with many structural holes present. Understanding co-opetition in large supply networks begins with an analysis of co-opetition in triads embedded in these networks. There are three prominent triadic arrangements embedded in these supply networks, namely, buyer-supplier-supplier (BSS), buyer-intermediary-supplier (BIS) and buyer-buyer-supplier (BBS). These three typical triadic arrangements are examined in various studies (Bonel and Rocco, 2007; Chirgui, 2005; Lazzarini, Claro and Mesquita, 2008; Rossetti and Choi, 2005). In Honda’s supply network, Honda, CVT and JFC form a BSS triad, where the first tier suppliers CVT and JFC cooperate on operations tasks. On the other hand, competition may exist between the second-tier suppliers GE Plastics and C&C Tech, as they supply similar products to JFC. Daimler’s network contains more structural holes. While firms such as Textron and Leon may collaborate to achieve cost savings for Daimler, there are no lateral ties between suppliers in the same tier.

In a hierarchy supply network, a certain level of cooperation is pre-wired through contractual obligations and material flows among firms. Competition is persistent as well because structural holes are present in many of the triads that make up the larger hierarchy. There is a constant tension as some firms attempt to close the structural holes while others try to maintain them, depending on their positions in a
given triad. The overall network-level objective is to satisfy customer demand at the right time, place, and appropriate quality levels. Governance in hierarchy networks is managed by buyers through contracts.

Co-opetition is inherent at different intensity levels within each of the supply network archetypes discussed in this section. So far we have provided a static description of competition and cooperation in these archetypes to capture the basic characteristics of these salient supply networks. In the next section, we focus on understanding how individual decisions of firms to create or dissolve ties in the network could lead to structural changes of the supply network.

4. Co-opetition dynamics in supply networks

4.1 Micro-process of tertius iungens and dynamics of coopetition in supply networks

We apply Obstfeld’s micro-process (2005) to describe how coopetition manifests as a network level phenomenon due to individual firms’ relational decisions. In his analysis of the tertius iungens strategy, Obstfeld (2005, p. 122) postulated that when one node in a network begins to connect two otherwise disconnected nodes, new structural holes are generated in the network. The broker’s action of connecting these nodes often elicits reciprocal responses from these two nodes leading to bridging of some of the new structural holes over time and creation of new ties in the network. Figure 5 is an adaptation of Obstfeld’s pictorial depiction of the structural evolution of a network in three phases.

- Figure 5 about here-

Initial state ($T_1$): The first graph in Figure 5 can be considered as a stylized supply network where firms are linked by contracts and material flow. The network consists of a buyer firm, A, that has two first tier suppliers, B and C. Firm B has two of its own suppliers D and E, while Firm C has two suppliers F and G. In this arrangement, Firm A acts as a broker connecting B and C. The triadic relationship as depicted among A, B, and C is observed in a parallel sourcing arrangement (Asanuma, 1985; Richardson, 1993; Wu and Choi 2005), where a structural hole and competitive tension exists between B and C. There are other structural holes in this network. For example, B also acts as a broker in between D and E. Next, we illustrate how this network may evolve as certain key nodes enact the tertius iungens strategy.
At time $T_2$, firm A may trade the control in exchange for better coordination between B and C. Firm A enacts the *tertius iungens* strategy and connects B and C. This new tie is illustrated by a solid line between B and C. An example of such a strategy is described by Choi and Hong (2002), where Honda actively requires two of its first tier suppliers, CVT and JFC, to coordinate their activities in product design as well as other production operations.

The introduction of the tie between B and C has a secondary effect according to Obstfeld (2005). Specifically, the linking of B and C increases the “awareness” within the supply network – now that B and C are connected, they become brokers of new structural holes in the network. Specifically, B now brokers the relationship between D and C. Similarly, C acts as a broker between B and F.

B, benefiting from being connected to C by A, may reciprocate A’s action by connecting A with its own supplier E. Thus B’s enactment of the *iungen* strategy adds ties in the network. As other nodes begin to reciprocate by introducing new ties firms that may not be directly linked may get connected due to the overlapping nature of the triads. Ultimately, a firm’s position is affected by rewiring of ties beyond its own control. As a result of the rewiring through tie formations, the overall network becomes more cohesive and cooperative (Garguilo and Benassi, 2001). Understandably, if the broker senses a negative consequence of linking two disconnected nodes, it would refrain from introducing the two disconnected nodes. For example, a firm may never introduce two other firms if it sees a dis-intermediation risk thus halting the reciprocation process. Therefore, a cooperative environment is essential to facilitate and sustain the creation of more ties. Ultimately, the enactment of the *tertius gaudens vs. the tertius iungens* strategy by individual nodes affects the level of co-opetition in a supply network.

4.2 Measures of co-opetition in supply networks

In order to theorize about the overall patterns of co-opetition at the network level and the implications for individual firms, we next discuss how competition and cooperation of a supply network can be measured. This will gives us a language to describe coopetition at the network level.

We consider a total count of the structural holes in a network as a measure of competition. A bridge represented by a third party broker in a triad connects two otherwise disconnected firms. Thus, one
potential bridge equates to one structural hole (Burt, 1992; Burt et al., 2000), and a bridge-count provides a direct measure of the number of structural holes in a network. We need to bear in mind that presence of structural hole (or absence of ties between two nodes in a triad) does not necessarily equate to competitive tension between the disconnected nodes. Assessment of the competitive tension associated with a given structural hole must consider the three conditions explicated in Section 2.2. As discussed previously “no tension, no tertius,” and a structural hole that does not have any competitive tension would not be meaningful from a co-opetition standpoint. The definition of a bridge-count can be extended where structural holes can be labeled as meaningful or not based on the three conditions identified in section 2.2.

We consider network cohesion as measure of cooperation in supply networks. There are various measures of network cohesion including density, transitivity and reciprocity, among others (Wasserman and Faust, 1994). A low level of density suggests sparseness of connections and presence of structural holes in the network whereas highly connected dense networks reflect cohesion. Yet, density does not reflect whether the ties are bidirectional or not, making it unsuitable for empirically measuring cohesion in the network. Transitivity measures the speed of information flow in the network (Borgatti and Li, 2009) and hence it does not directly capture the relational cohesion of the network. Reciprocity, on the other hand, occurs if firms engage in bidirectional exchanges. We argue that among the measures of cohesion, reciprocity best captures the cooperation among firms in a supply network. Reciprocity considers symmetric or bidirectional exchange of both material and tacit information (Xu and Beamon, 2006). A typical measure of reciprocity involves the ratio of symmetric and bidirectional links to the total number of links in a network. Higher the reciprocity of information, material or knowledge in a network, the higher the total number of bidirectional linkages between firms in the network.

5. Evolution of co-opetition in supply networks

To recapitulate, co-opetition is inherent across supply networks. Co-opetition across different supply network archetypes manifests through the individual decision of firms to form or dissolve ties in the network. Based on the two relational strategies described by Simmel (1950), Burt (1992, 1997) and the recursive micro-process by Obstfeld (2005), we describe brokering decisions by firms that lead to
formation or dissolution of ties and eventual evolution of the network. In this section, we turn to analyzing prominent patterns of evolution by applying the micro-process to describe how co-opetition unfolds in different supply network archetypes. In line with Giddens (1986), individual firm activities aggregate, leading to larger structural changes. Consistent with how complex adaptive supply networks operate, the structural changes of a network are contingent on the decisions of other firms and one cannot predict the exact structure of the emergent network (Choi et al., 2001; Pathak et al., 2007a). For each archetype therefore, we propose how a broker’s decision to enact the *tertius iungens vs. the tertius gaudens* strategy within its local triad has a spillover effect on other relationships in the supply network leading to changes in the co-opetitive dynamics and possibly a transition to another archetype.

5.1 Co-opetitive dynamics of community and federation

A community network, as shown in Figure 6 (a), begins with low levels of competition and cooperation. Other than combining their resources to signal to a potential market, there is no real need for formal cooperation nor are there serious competitive tensions. Members of the community may form ties with each other to explore sporadic and mutually beneficial partnerships. For example, a wholesaler selling produce to local restaurants may source from two different farms for the same produce. Sustained competition is limited between the farms and the two farms may occasionally collaborate and share equipment or coordinate deliveries to satisfy the wholesaler’s demand. Such coordination, however, is ad hoc and there is little desire to formalize the supply situation by either seller or buyer. Thus,

*Proposition 1a: In the absence of sustained competitive tension, there are minimal opportunities for brokerage in a community supply network and the overall co-opetitive intensity is restrained.*

Over time, as demand for products from a community network grows, the needs for supplier coordination in production, marketing and logistics will inevitably rise. As shown in Figure 6 (b), the increased interactions lead to the emergence of triadic relationships in the supply network. The broker firms such as the wholesaler in a community network (shown as gray nodes in Figure 6), play a pivotal role in influencing the structuring of community supply network.

*Figure 6 (a, b, c, d) here*
If brokers choose to act in self-interest and employ the *tertius gaudens* strategy, they will not induce new relationships in the network. For example, as the wholesaler dual-sources in order to satisfy the increased demand for local produce of its own customers it can instigate a price war between the two suppliers. Consequently, competitive tension develops within the triad and the two suppliers are unlikely to introduce any of their own contacts to the wholesaler or to the other firm. As a result, the competitive tension becomes dominant and the buyers and suppliers fail to develop collaborative ties in the wider community network. Eventually, such partitioning of the buyer supplier relationships in the community leads to small and disconnected hierarchies and the community network would cease to exist. Thus,

*Proposition 1b: As competitive tension increases in a community supply network, enactment of the tertius gaudens strategy by brokers leads to the fragmentation of the community into hierarchies.*

Alternatively, brokers may decide to become a match-maker by enacting the *tertius iungens* strategy and introduce disconnected firms in the network. For example, the wholesaler may introduce the two produce suppliers to each other. The newly connected suppliers may then reciprocate by introducing the wholesalers to other producers setting off the micro-process described earlier. As shown in Figure 6 (c), new ties are formed and cohesion in the network increases. While competitive tension may exist in pockets, the community network now becomes more cooperative. Thus,

*Proposition 1c: Enactment of the tertius iungens strategy by brokers increases cooperation and leads to sustained coopetition in a community supply network.*

Over time as this community network develops a reputation amongst its clientele, the demand may scale up, pushing the community beyond its small market. Consequently, to serve this increasing demand, increased coordination in farming, food processing, and marketing becomes inevitable (Barham, 2012). Business growth and associated increase in task complexity will not only attract new members to join the community but also push it to transform into a federation (see Figure 6(d)). The rapid growth of Organic Valley highlights how the organization started as a small community of seven farmers that has now grown to 1834 providers in 22 states within the United States as demand for organic product has taken off since the 1990s (Hansen, 2010).
Such a transition from community to federation does not happen on its own. Broker firms need to take a lead and coordinate among the members to establish fair contracts, formalize processes and establish cultural norms to nurture trust and reciprocal ties in the network. Meanwhile stronger governance that has equal representation from all members is required to coordinate interactions in the federation. More formal governance, specifying membership rights, obligations and organizational policies becomes necessary to manage tasks and relationships. Thus,

Proposition 1d: Growth in a community requires a broker-led transition to a federation with an equitable governance structure.

As firms tackle increasingly complex tasks in a federation, a few of them can develop unique skills or operational capabilities. When such firms in a federation resort to enacting the tertius gaudens strategy they end up creating their own clique of firms. For instance, a firm can become a general contractor or assembler in the network and subcontract specific tasks to other members. As a result, this firm now brokers relationships between subcontracting firms. Over time, such behavior may be replicated by the subcontracting firms and members of the federation may begin to specialize in niche areas with varying levels of task complexities and a pulled production process emerges (Schilling and Steensma, 2001; Wu and Choi, 2005). As the coordinating company issues contracts and orchestrates production, the lead position in the network is no longer shared between multiple firms. One or more lead buyer emerges, the supply relationships are rewired, tiers appear in the network, and the federation transforms into a hierarchy. The shared governance between the members of the federation is replaced with contracts, and resource pooling ceases to be the network level objective. Thus,

Proposition 1e: Task specialization among members in a federation acts as an incentive for firms to enact the tertius gaudens strategy, triggering a transformation of the federation to a hierarchy.

5.2 Co-opetitive dynamics of consortium

In a consortium archetype, fierce competitors and their hierarchies of suppliers overcome their natural instinct to compete and agree to cooperate in the face of game-changing market, technology and operating risks. As shown in Figure 7 (a), to overcome the natural instinct to compete, an external non-partisan third party organization is needed that can enact the tertius iungens strategy, connect at least a key set of
players in the industry, and set up governance across the network of firms. For example, in order to form the Sematech consortium, an independent networked administered organization (NAO) was formed. It was the NAO that brought fourteen key players from the semiconductor industry together and set up a collaborative work environment where these firms could safely exchange information and create new knowledge. Subsequently, these key players brought other critical suppliers from their respective supply networks onboard and as shown in Figure 7(b), enacted the tertius iungens strategy to create reciprocal ties with other member firms in the network. Thus,

Proposition 2a: A non-partisan third party enacting the tertius iungens strategy among key players in an industry drives the emergence of a critical mass of connected firms to establish a consortium.

A consortium exists and thrives when members engage in intense co-opetition, i.e., they cooperate to overcome the technology or knowledge barrier by engaging in learning and capability development while maintaining their competitive engagements outside the consortium in the regular business world. If this separation is not maintained, a consortium can easily fall prey to the “tragedy of the commons” (Ostrom, 1990). A system suffers from the “commons” problem when individual entities in the system attempt to optimize their own performance selfishly, often depleting a common resource, without taking the global interest into account (Ostrom, 1990). Competitors in a consortium may try to gain advantages such as patent rights over each other or learn through free-riding (Das and Teng, 2002; Duhigg and Lohr, 2012). However, when opportunistic behavior or free-ridership is detected by opponents, information flow stalls as companies become more cautious to prevent inadvertent sharing of proprietary technology and know-how. As a result, cooperative ties dissolve and structural holes appear in the network (see Figure 7(c)). These holes are almost always meaningful. As other firms perceive asymmetrical gains from the consortium—and especially if they are unable to advance their own interests—competition among members may accelerate at the larger network level through the formation of multiple meaningful structural holes as shown in Figure 7(d), and the consortium fractures. Thus, we propose that:

Proposition 2b: Free riding or opportunistic behavior in a consortium leads to asymmetric learning and increases competitive tension leading to its eventual dissolution.
A relevant managerial question is how can the destruction of a consortium be prevented? Feedback from external environment or other firms in complex adaptive systems plays a critical role in the evolution of the system and may provide the answer to this question (Choi et al., 2001). In theory, behavior of individual firms can be controlled through feedback from an external entity, preventing the system from evolving in an undesirable fashion. A strong Network Administered Organization (NAO) provides such control in a consortium (Provan and Kenis, 2008). The NAO in the Sematech case helped the larger firms introduce other members (Browning et al., 1995, pg 119). As the cohesion in the consortium increased, the NAO continued monitoring and controlling the behavior of members by enforcing transparent and fair policies. An NAO therefore can prevent free ridership and stoppage in learning by monitoring the behavior of the member firms and intervening before opportunistic behavior sets in. As a result of such monitoring, the NAO ensures that cohesion is maintained by resolving sources of competitive tension before they can take root. Therefore, we propose that,

Proposition 2c: An NAO enforces sharing of proprietary information and resources in a consortium, thereby, preventing formation of structural holes and an increase in competitive tension.

5.3 Co-opetitive dynamics of hierarchy

Co-opetitive dynamics in a hierarchical supply network is driven by local action within various triads (BSS, BBS, and BIS, see Figure 4). Consider a hypothetical supply network as shown in Figure 8(a). The buyer initially places an order to two suppliers (S1 and S2), triggering the emergence of a supply network based on material flow and division of tasks. Numerous structural holes are present in this network. Such a network may exhibit competitive behavior as key players broker the relationships among many suppliers, especially those with similar technologies, making some of the structural holes meaningful.

-Insert Figure 8(a, b, c, d) here-

The closure of a meaningful structural hole within a BSS triad triggers a network-wide reaction. Specifically, the closure of the structural hole occurs when the buyer introduces S1 and S2 and encourages them to coordinate their actions. Wu and Choi (2005) describe an example of such an introduction between Coach, a luxury leather goods manufacturer and two suppliers. Coach encouraged
two if its suppliers to work together to share capacity through close collaborative ties. As described earlier in section 4, once the tie between S1 and S2 is formed, many structural holes appear in the network. We indicate two such structural holes in Figure 8(b). The first is between the buyer, S1, and S4. The second is between S1, S2, and S4. Firm S1 plays the role of a broker in both cases. As the buyer links with S4, and S2 also links with S4, production efficiencies are gained due to sharing of resources and information. As shown in Figure 8(c), the two new ties (S4-Buyer, and S2-S4) gives rise to new structural holes and the micro-process continues to unfold over time leading to many more new ties in the network. Eventually, as shown in Figure 8(d) the overall supply network becomes more cohesive and cooperative. Choi and Hong (2002) allude to this effect in the Honda Accord supply network, where Honda introduced two top tier suppliers (CVT and JFC). In turn, CVT and JFC adopted similar practices with their top tier suppliers.

Therefore, we propose that in a hierarchy supply network with structural holes,

*Proposition 3a*: Enactment of the tertius iungens strategy by the buyer within a BSS triad leads to increased cohesion and cooperation in the overall network.

A mere enactment of the tertius iungens strategy by the buyer does not guarantee that S1 and S2 will reciprocate the buyer’s action and introduce them to other suppliers in the network. If S1 or S2, for example, perceive a threat from upstream suppliers in the form of asymmetric learning, disintermediation, or resource conflicts due to sharing upstream suppliers, the cohesive evolution of the network may never happen. Therefore, a hierarchy supply network may not become cohesive just because of the initial enactment of the tertius iungens strategy by the buyer. In the Honda supply network case study, Choi and Hong (2002) highlight how Honda manages the relationships in the supply network beyond CVT and JFC (first tiers) all the way up to second and third tier suppliers through formal (contractual) and informal relationships. The primary buyer’s active management of the upstream supply base beyond the first-tier prevents upstream suppliers from creating competitive tension through enactment of the tertius gaudens strategy. Therefore,

*Proposition 3b*: Active management of suppliers by the primary buyer beyond the first-tier facilitates iungens introductions and prevents build-up of competitive tension among upstream suppliers.
Co-opetition is a temporal phenomenon in which the intensity of cooperation and competition is affected due to changes in the business environment. Consider the cohesive network shown in Figure 9(a). This network can become highly competitive over time due to dissolution of ties. Li and Choi (2009), discuss the issue of tie dissolution in supply networks. The loss of a relationship can occur due to resource contention or disintermediation. In the case of resource contention, S4 as shown in Figure 9(a), can take advantage of its shared supplier position and play S1 and S2 against each other with respect to availability of its resources. Over time, this may strain the relationship between S1 and S2 and eventually lead to a break in the relationship (see Figure 9(b)). The dissolution of the tie between S1 and S2 may lead to other relationship losses, especially between S1 and S2’s suppliers (or vice versa). Eventually, as shown in Figure 9(c) the cohesive ties are replaced by meaningful structural holes. Thus,

**Proposition 3c:** Enactment of the tertius gaudens strategy by an upstream supplier in a BBS triad can trigger a cascading set of tie dissolutions leading to structural holes and increased competition in the overall network.

Alternatively, a hierarchy as shown in Figure 10(a) can see heightened competition if S1 and S2 are disintermediated in the BIS triad. Specifically, if the second-tier supplier, S4, develops capabilities and is able to directly supply to the primary buyer, enactment of the tertius gaudens strategy becomes a choice for the buyer. If the primary buyer enacts that strategy and sources from all three suppliers, meaningful structural holes will develop as shown in Figure 10(b). The competitive tension in the first-tier of the network can spill over to the second tier suppliers. For example, S3 may stop supplying to S2, and S5 may only supply to S2 (see Figure 10(c)). Thus, a single decision of the buyer to accept S4 as a direct tier 1 supplier leads to a cascading set of dissolutions of ties and as shown in Figure 10(d), the overall network transforms from a cohesive network with minimal structural holes to a network with heightened competitive tension. Thus,

**Proposition 3d:** Enactment of the tertius gaudens strategy by a buyer through disintermediation of a first-tier supplier in a BIS triad leads to increased competition in the overall network.
From suppliers S1 and S2’s perspective, pre-emptively enacting a *tertius iungens* strategy and introducing S4 to the buyer and controlling the relationship through contractual agreements can prevent the formation of meaningful structural holes in the network. Choi and Hong (2002), discuss such an arrangement in Daimler’s supply network for the Grand Cherokee’s central console unit. Textron which is the equivalent of S1 in Figure 10 (a) is in a disintermediated BIS triad with Leon Plastic being the second–tier supplier (equivalent of S4 in Figure 10 (a)). Textron negotiated a contract with Daimler, where the demand was split in a 70%/30% ratio between Textron and Leon. In return, Textron closely collaborated with Leon to ensure high quality of the products. Thus,

*Proposition 3e: Enactment of the tertius iungens strategy by an intermediate supplier in a BIS triad can prevent complete disintermediation and the resulting increase of competitive tension in the overall network.*

5.4 Managerial Insights

These propositions lead to three high level insights. First, local brokerage choices can trigger broad structural changes in the supply network. Second, co-opetition of a supply network is not a simple aggregation of dyadic co-opetitive relationships between firms. The relational action in the form of the *tertius iungens* and *tertius gaudens* strategy and the reaction from member firms coalesce to form or dissolve ties in the larger network. Such changes in the network structure predicate the co-opetition dynamics. As explicated through the propositions, depending on the underlying archetype a firm is embedded in, the choice of enacting a *tertius gaudens* vs. *tertius iungens* strategy can have very different outcomes. For example, a firm in the position of a broker in a community has to carefully think whether it should enact the gauden strategy. Recall that enactment of the gauden strategy in a community can lead to fragmented hierarchies. If the hierarchy formed as a result of the broker enacting the *tertius gaudens* strategy cannot collectively deliver on the end customer demand then it would be detrimental to the broker firm to follow this path. Thus, a manager in a firm needs to understand the direction in which the network will evolve based on their brokerage choice and evaluate whether the outcome would be a desirable one or not.
Lastly, co-opetition of the network by nature exists in a dynamic balance between two opposing forces. Managers must invest resources and energy to maintain or transform a network structure. For example, in a community, brokers have to expend energy to ensure coordination such that localized hierarchies do not form. Similarly, brokers in a federation endeavor to ensure equitable growth such that the federation does not dissolve into a fragmented hierarchy. In a consortium, an NAO must maintain transparency and reciprocal transfer of knowledge to prevent dissolution while in a hierarchy firms must prevent the closure of structural holes or decide whether it is cost-effective to nurture direct relationships between its suppliers.

6. Summary and future work

In this study, we take the first step to articulate a theory of co-opetition in supply networks. Moving beyond the dyadic consideration of co-opetition in OM literature and management research in general, we argue that co-opetition is a network-level phenomenon. This perspective allows researchers and managers to assess the overall relational dynamics of a supply network through the network’s structural characteristics. Specifically, we contribute to the nascent literature on supply networks and co-opetition in three ways. First, we conceptualize competition and cooperation in a supply network as the presence and absence of ties. Based on this conceptualization, we introduce a micro-process based network evolution framework (Obstfeld, 2005) and adapt it to explain co-opetition between firms in supply networks. While Wu and Choi (2009) had suggested that Obstfeld’s work could be used for studying supply network dynamics, to the best of our knowledge, we are among the first few researchers to formally propose a “tertius” approach to explain how competition and cooperation evolves in a wide range of complex supply networks.

Second, by taking a configurational approach (Boyer et al. 2000) we propose four dimensions of firm-level task, firm-level tie, network level objective, and governance as the “interpretive scheme” (based on Greenwood and Hining, 1995) for defining supply network archetypes. Based on published empirical evidence, we specify four practical supply network archetypes covering a wide range of economic activities. Specifically, using co-opetition as the underlying theme we expand the discussion on supply
network to include networks with knowledge flows along with material flows. Lastly, we analyze the competitive dynamics in the four archetypes by applying the micro-process based evolution framework. Specifically, we highlight how individual decisions of key players in a supply network can trigger intended or unintended consequences at the network level, leading to evolution of one archetype into another.

We also enrich the literature on complex adaptive supply networks. In the past scholars have suggested that individual decisions of firms can have network-wide effects and that managers need to control parts of the network while letting the rest of the network emerge (Choi et al., 2001; Pathak et al., 2007a). Our application of the micro-process at the triadic level, building it up to the larger network, provides initial insight into the relationships and tasks a manager should control. Finally, we also partially respond to the call for research on including a temporal element in analyzing supply network dynamics (Pathak et al., 2007a) by focussing our propositions on the co-evolution of individual firm behavior and network structure.

We chose a core set of dimensions that could explain a wide variety of practical supply networks, yet list is not exhaustive. Meyer, Tsui, and Hinings (1993) as well as Boyer et al. (2000) discuss this in the special issue on the configurational approach to theory development, and suggest that the focus of the configurational approach is not to be exhaustive, but to be generative. In that spirit, this paper opens up opportunities for future research in the area of co-petition and supply networks. For example, while we consider many practical supply networks to suggest archetypes, new supply networks are emerging quickly. One such supply network is humanitarian disaster relief systems where organizations tend to cooperate but can be presumed to compete for governmental or other relief resources. Not much is published or known about these networks but it seems to have a more complex temporal element that should be investigated. As more information becomes available on such networks, our dimensions and analysis framework can serve as a foundation for future research.

Another interesting area to study in the contexts of public policy and natural resources (Rowley, 1997) would be supply networks encompassing resource suppliers in sustainable development. Such
“commons” are associated with free-willed agents (e.g. firms, government agencies) operating in nested systems and sharing joint tangible physical assets, resources and intangible intellectual property. The Social-Ecological Systems (SES) framework pioneered by Ostrom (2009) can be employed to explore how firms co-adapt within the supply network and the associated institutional framework (Giddens, 1986). That framework requires cooperation among competing entities to achieve economic, environmental or social goals. Future supply network management will inevitably tackle such sustainability challenges and managing a supply network will necessarily involve managing co-opetition in the “commons.”

Future work should definitely validate the proposed theory. Grounded case studies and agent-based simulations could test and refine the theory. Researchers should investigate how co-opetitive dynamics change as firms allocate resources and respond to environmental changes and the actions of other firms over time. By taking a longitudinal view and understanding the conditions and events associated with the evolutionary process, researchers can understand critical thresholds that are common in complex adaptive systems (Choi et al., 2001; Kauffman, 1995). Network structure and co-opetitive dynamics emerge from the interactions of a multitude of relationships, punctuated by drastic shifts in dynamics as the network reaches these critical thresholds. How a supply network sustains a steady state versus how it changes to a different co-opetitive state remains to be explored. Such understanding will further expand the evolutionary view introduced in this paper and enrich our understanding of co-opetition in supply networks.

Reference


Table 1: Brief description of supply network archetypes

<table>
<thead>
<tr>
<th>Network Archetype</th>
<th>Firm Level Tasks</th>
<th>Ties</th>
<th>Network Level Objective</th>
<th>Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>Sell produce or services to end-buyer Occasionally collaborate or procure material from another supplier</td>
<td>Cooperative activities (presence of ties): Firms may partner temporarily to pursue joint activities such as promotion or logistics Competitive activities (absence of ties): Firms try to attract the attention of the customer for similar goods and services short of direct price competition</td>
<td>Signalling: Aggregate fragmented suppliers under common banner to supply the demand of a local community</td>
<td>Shared values, minimal network administered organization or third party</td>
</tr>
<tr>
<td>Federation</td>
<td>Manufacture parts or develop technology solutions</td>
<td>Firms jointly satisfy a common customer’s demand. Firms cooperate by sharing resources Firms may compete on price, development of superior capabilities, and being lead firm for any given customer</td>
<td>Resource Pooling: Suppliers coordinate to satisfy customer demand. Firms may subcontract within the federation once a lead firm has been selected</td>
<td>Formally elected board represented by members from each federation partner</td>
</tr>
<tr>
<td>Consortium</td>
<td>Perform R&amp;D and develop new knowledge</td>
<td>Jointly work to tackle threats from new market entrants. Knowledge is shared to achieve a common purpose or solve a common problem Firm’s individual brands compete head to head. Firms compete to leverage the learning from the consortium</td>
<td>Knowledge development: Buyer as well as supplier firms collaborate to develop new technology or standards</td>
<td>Network administered organization that acts independent of individual members and has legal rights to enforce contracts</td>
</tr>
<tr>
<td>Hierarchy</td>
<td>Manufacture parts or develop technology Different suppliers perform tasks of varying complexity and function depending on their position in the hierarchy</td>
<td>Buyer and suppliers cooperate to fulfill customer orders. Cooperation may extend to operational activities such as logistics and distribution and new product development Firms compete to secure control over supply chain. Specifically, firms may compete on access to common resources, or on issues such as price, volume, delivery lead times or quality</td>
<td>Contractual production: Fulfill orders for end customers by transforming raw material into finished products</td>
<td>Individual buyer or supplier firm acts as the lead organization. Governance is primarily through contracts</td>
</tr>
</tbody>
</table>
New Zealand Farmers Market
Swedish Winter Sport Destination – Åre Village

Legend:
NAO  Network administered governance
⬤   Size of the circles illustrate size of firm
○   End buyers

Figure 1: Community archetype

Organic Valley Cooperative
Italian Opera Houses
Brazilian Die and Mold Industry

Legend:
NAO  Network administered governance
⬤   Size of the circles illustrate size of firm
○   End buyers

Figure 2: Federation archetype

Sematech
Turkish Textile Industry- 3T

Legend:
NAO  Network administered governance
⬤   Size of the circles illustrate size of firm
○   End buyers

Figure 3: Consortium archetype
Figure 4: Hierarchical supply networks (courtesy of Choi and Hong, 2002; Kim et al., 2011)
Initial State:
A *brokers* B and C

B and C can have competitive tension due to factors such as pricing, parallel sourcing, competing technologies etc.

**Tertius iungens Introduction:**
A *connects* B and C

A fosters a collaborative relationship between B and C

**New Structural Holes Created:**
New brokerage relations are developed as shown by the dotted gray lines

**Second Reciprocal Tertius iungens:**
B can formally introduce A and E to improve the coordination in the supply network.

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Figure 5: Tertius iungens mechanism of co-opetition in supply networks

Legend:
A: Primary buyer
B,C: First tier supplier
D,E,F,G: Second tier supplier
Figure 6: Coopetitive dynamics in community and federation archetype

Figure 7: Coopetitive dynamics in consortium archetype
Figure 8: Enactment of tertius iungens strategy in a BSS triad and increase of cohesion in a hierarchy supply network

Figure 9: Enactment of tertius gaudens strategy in a BBS triad and increase of competitive tension in a hierarchy supply network
Figure 10: Enactment of tertius gaudens strategy in a BIS triad and increase of competitive tension in a hierarchy supply network