Happy together?
Insights and implications of viewing managed supply chains as a social dilemma

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Abstract

Supply chains are beginning to displace firms as the competitive entity in the global marketplace. Managed supply chains offer the promise of added value through proactive cooperative efforts among participating firms. However, as a strategic alliance, managed supply chains represent a form of social dilemma: supply chain alliances may fail because participating firms fear opportunistic behavior on the part of other alliance participants, and as a consequence underinvest their information and resources into the alliance. The interdependence structure of the alliance may contribute to this problem. Viewing managed supply chains as a form of social dilemma also identifies solutions that may be implemented unilaterally by individual firms or jointly by the alliance to maintain the “indispensable virtue” of high trust that allows supply chains to effectively create added value.

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1. Introduction

In recent years, supply chain management has been displacing firm-to-firm competition as the focus in the global marketplace. A major reason for this displacement is the bottom-line benefits promised to supply chain alliance members, e.g., increase in shareholder value, increase in profits, and lower costs in the short and long run (e.g., Hendricks and Singhal, 2003). However, despite the compelling benefits supply chain management offers, many supply chain alliances fail to realize such benefits (Boddy et al., 1998), and experience failures such as inaccurate forecasts or quality and production problems (e.g., Fawcett and Magnan, 2001).

One reason supply chain alliances may fail to realize exceptional value is because of “inter-firm rivalry” (Park and Ungson, 2001) or misalignments in allying firms’ efforts to cooperate, including reluctance to share information, skills and processes, and opportunistic behavior (e.g., Dyer and Nobeoka, 2000; Fawcett and Magnan, 2001). Supply chain alliance failures brought on by inter-firm rivalry have significant monetary implications for alliances because such failures lead to performance “glitches” or an inability to supply customer demands (Hendricks and Singhal, 2003, 2005). For example, Hendricks and Singhal’s (2005) longitudinal study of 885 supply-chain glitches of publicly-traded firms from 1992 to 1999 found that firms experiencing glitches reported “on average 6.92% lower
sales growth, 10.66% higher growth in cost, and 13.88% higher growth in inventories” (p. 695). Thus, a better understanding of the underlying mechanisms causing supply chain alliance failure may prove insightful to supply chain scholars and helpful to managers.

This paper argues that a primary reason that inter-firm rivalry may abound in supply chain alliances is that a supply chain alliance represents a social dilemma. A social dilemma exists when (1) individuals must choose between doing what is in their own best interest or the group’s best interest, and (2) everyone choosing to do what is in their own best interest leads to an outcome that does not provide benefits for anyone (Dawes, 1980).

We begin our arguments with the idea that managed supply chains are a form of strategic alliance, and that all strategic alliances represent a social dilemma. We then consider how viewing supply chains as a social dilemma implicates trust as a key factor in supply chain success, and how different forms of interdependence structures within the supply chain might differentially influence the presence or growth of trust. Finally, we consider how viewing supply chains as a social dilemma suggests ways alliance partners can enhance the probability of supply chain cooperation. We conclude with several suggestions for future research.

2. Managed supply chains as alliances

A supply chain is in place whether it is managed or not (Mentzer et al., 2001). For example, several apple farmers can supply apples to an applesauce maker, who in turn supplies the applesauce to a local distributor, who then supplies several grocery stores, who finally sells the applesauce to the end customer. In this instance, all of the parties participate as members of a supply chain; however, the parties are not necessarily overtly involved in collaborative activities and behaviors to manage the supply chain and create added value.

In contrast, the apple farmers, the applesauce maker, the distributor, and the grocery stores could all cooperate to coordinate their actions so that the apples are picked and processed a certain way to be delivered with shorter lead times at lower costs. By working together to coordinate their actions, the supply chain participants become partners in an alliance (Monczka et al., 1998) to manage their supply chain. Alliance is a broad term referring to collaborative arrangements in which participants explicitly agree to work together in the belief that, by doing so, they are more likely to succeed than by working alone (Zeng and Chen, 2003). In a supply chain, such an alliance suggests three or more business entities collaborating on the upstream and downstream flow of resources (Mentzer et al., 2001). The coordination of effort implied when an alliance is formed among supply chain participants – for example, sharing resources and/or jointly coordinating initiatives – offers the promise of added value through proactive management of the supply chain interdependencies (Danese et al., 2004). This paper focuses on managed supply chains, where supply chain participants collaborate strategically to create added value (Fawcett and Magnan, 2001; Mentzer et al., 2001). The notion that supply chain partners willingly choose to collaborate does not necessarily assure that they will do so successfully. As we argue later, the effectiveness of collaboration and resource sharing among alliance participants may vary in relation to the alliance interdependence structure and degree of trust among partners.

Several characteristics define a managed supply chain as a particular form of strategic alliance. First, although past research on strategic alliances mainly focuses on horizontal forms of relationships (e.g., Nault and Tyagi, 2001; but see Rindfleisch, 2000, for an exception), the focus in supply chains always includes vertical relationships (Mentzer et al., 2001) and the additional vulnerability that vertical interdependencies implies. Second, these relationships are often not symmetrical in regards to channel power and alliance involvement, but instead often feature asymmetric distributions of power and influence (e.g., a single applesauce maker working with many apple farmers) (Maloni and Benton, 2000). Third, the vertical independencies inherent in supply chains can mean that the success of an alliance is not only a function of direct relationships among participants but also indirect relationships. For example, in the applesauce supply chain described above, the success of the distributor–retailer relationship is dependent on the success of the apple farmers and the applesauce maker relationship, to which neither the distributor nor the retailers are direct participants. Such additional complexities – as will be discussed shortly – create additional opportunities for inter-firm rivalry that can lead to alliance failure.

2.1. Alliances represent a form of social dilemma

Several scholars suggest that conceptualizing strategic alliances as social dilemmas helps to understand how cooperation in strategic alliances can be achieved and sustained over time (Zeng and Chen, 2003). The dictionary defines a dilemma (Merriam-Webster, 1974) as a choice between undesirable alternatives. In the case of a social dilemma, that choice is between a
cooperative course of action and a non-cooperative course of action in a group.

A classic social dilemma is illustrated by Hardin’s (1968) “tragedy of the commons.” In this dilemma, the herders represent a strategic alliance: they have pooled their resources to be able to enjoy a benefit – the commons – that none of them could afford individually. However, the herders must restrict their individual usage of the commons for the land to remain viable for each herder’s animals to graze. The dilemma here is that it is in the interest of any individual herder for all of the other herders to restrict their use of the common grazing land – to contribute to the maintenance of the collective good – while that individual herder does not (called “defecting”). If each individual herder relies on all of the other herders to voluntarily restrict their use of the commons while not restricting their own usage, the commons grass becomes overgrazed, the value of the commons is lost, and everyone’s herd suffers. The dilemma occurs because defecting seems like the rational choice if no one else is defecting, but everyone loses if everyone makes this individually rational choice to defect. Strategic alliances – in this instance a supply chain alliance – can be characterized as two different types of social dilemmas: Prisoners’ Dilemma Game and Assurance Game.

2.1.1. Prisoners’ Dilemma Game

Transaction cost economics (TCE) (Williamson, 1975) concerns itself with the possibility of “exchange hazards” (Silverman, 2002) such as opportunism that occurs in social dilemmas if the other side does not act cooperatively. TCE focuses on exchanges that fit the Prisoners’ Dilemma Game (Parkhe, 1993), in which it is always beneficial to not act cooperatively if the other side does not act cooperatively. As a consequence, TCE concludes that the imposition of some form of governance structure (such as vertical integration) is required to appropriately manage the probability of an exchange hazard. A simplified example of a two-person Prisoners’ Dilemma Game is represented in Fig. 1a. Both partners make a dichotomous choice between either contributing or not contributing (defecting) toward the creation or maintenance of a public good (e.g., a better method for making and delivering applesauce that decreases costs). In a Prisoners’ Dilemma, it is in the best interest of each partner to not cooperate, and thus exploit the other side, if they believe the other side will cooperate.

2.1.2. Assurance Game

Some social dilemmas represent more of an “Assurance Game” than a Prisoners’ Dilemma (Celly et al., 1999; Kollock, 1998). In contrast to a Prisoners’ Dilemma, it is logical in the Assurance Game to act cooperatively if the other side is going to act cooperatively – and thereby share the extra value created by cooperating – and it only makes sense to not act cooperatively if the other side is not going to act cooperatively either. The implication of an Assurance Game structure is that contributions by alliance participants are to some extent non-redundant (Cortazar, 1997). Non-redundancy means that the most value can be realized only when all alliance participants contribute. Thus, the dilemma in an Assurance Game derives not from the possibility of exploiting the contributions of others (since extraordinary value cannot be created unless everyone contributes), but instead from the possibility of not risking one’s own contribution if it looks like extraordinary value will not be created (e.g., because someone else fails to contribute). While defection in a Prisoners’ Dilemma occurs because of the possibility of opportunism (stemming from the belief that others will cooperate), defection in an Assurance Game occurs out of fear that extraordinary value will not be created (stemming from the belief that others will defect). A simplified example of a two-person Assurance Game is represented in Fig. 1b.

In summary, whether an alliance is more of a Prisoners’ Dilemma or an Assurance Game is a function of the extent to which non-contribution offers the opportunity to exploit others. The greater the extent to which the contributions are redundant, such that extraordinary value can be created without all alliance participants contributing, the greater the opportunity to exploit the contributions of others by not contributing. The greater the extent to which contributions are non-redundant, such that the creation of extraordinary value suffers in the face of any non-contribution, the less opportunity exists to exploit alliance partners through non-contribution.
2.2. Supply chain as a social dilemma

Participation in a managed supply chain represents a social dilemma. Referring back to the applesauce supply chain, it is in the best interest of any member who is party to the alliance to let all the other members do all the work (e.g., gather information and provide resources to design new processes for picking the apples, and processing and distributing the applesauce downstream to the end consumer). Not doing one’s fair share of work in the alliance allows that member to reap the benefits of whatever the alliance produces while not incurring the costs of creating those benefits. However, if all or enough of the members adopt this strategy, the “value-added” benefits of the alliance disappear because no information about customers is collected and no resources are contributed to the alliance.

The example of the applesauce supply chain alliance characterizes a particular kind of social dilemma: a public goods dilemma. Public goods are resources from which all members of a collective may benefit regardless of whether they incur the cost of providing the good (Kollock, 1998). For example, a firm participating in a strategic alliance may be able to glean important information or enjoy the benefits of new products or services developed by an alliance without contributing any insight. Whether any benefits can be enjoyed without contributing depends on the redundancy of alliance partners’ contributions. The more that value creation depends on the (non-redundant) contributions of all alliance partners, the less the opportunity for any partner to exploit other partners’ contributions. In that case, a supply chain alliance represents an Assurance Game. The less that value creation depend upon the (redundant) contributions of all alliance partners, the greater the opportunity for any partner to exploit other partners’ contributions. In this case, a supply chain alliance represents a Prisoners’ Dilemma.

3. Trust in social dilemmas

Trust is an important determinant of behavior in social dilemmas (e.g., de Cremer et al., 2001). Although trust has been defined in multiple ways (e.g., Lewicki et al., 1998), Malhotra and Murnighan (2002, p. 535) assert that there are two dispositions that are central for trust to be present among people and organizations: (1) a mutual willingness to be vulnerable to each other based on (2) a mutual “expectation of cooperation (or benevolence)” from each other. Trust is herein defined as:

A psychological state where a party is willingly vulnerable to the behavior of another party because of expected cooperation or benevolence from that other party.

In this paper, we use the term “behavior” specifically to mean a supply chain participant’s decisions and actions, in particular contributions and non-contributions to alliance value-creation attempts. “Expected cooperation or benevolence” refers to a supply chain participant’s anticipation that others will do what is good for the alliance (i.e., will make appropriate contributions to the creation of extraordinary value).

An individual’s willingness to contribute time, money, or other resources to a public good can be a function of how much that individual trusts that others will also contribute and not exploit his/her contributions (de Cremer, 1999). If members of a collective trust one another – i.e., are confident that other members of the collective will also cooperate if they cooperate – then there should be less of a social dilemma because everyone knows that everyone will benefit when everyone contributes to the collective good.

3.1. Trust in supply chain alliances

Trust has also been identified as a critical factor for effective collaboration within a supply chain alliance (e.g., Monczka et al., 1998). However, the presence of trust among alliance partners does not guarantee trust will be maintained, nor that opportunistic behavior will not arise (Arino and Abramov, 1997). Thus, even though the formation of a strategic alliance implies the existence of some trust among allying firms, it does not suggest the absence of opportunistic temptations among those firms (Das and Teng, 1998; Williamson, 1975).

When trust is high among supply chain managers, products, services, ideas, and information can flow freely to help design, implement, and manage initiatives that create added value. When trust is low, an alliance can still exist (Das and Teng, 1998), but that alliance’s effectiveness will likely be hindered (Kwon and Suh, 2004; Lewicki et al., 1998), i.e., in the case of a supply chain alliance, collaboration and coordination of resources and information among participants will be negatively affected.

4. Three types of supply chain defection

Defection is a general term referring to any form of non-cooperative behavior by participants in a social
Three types of defection seem particularly relevant to the management of supply chains: (1) free riding (e.g., Dyer and Nobeoka, 2000), (2) hold-ups (e.g., Gilbert and Cvsa, 2003), and (3) leakages (e.g., Zhang, 2002).

4.1. Free-riding problem

“Free riding” occurs when an alliance partner attempts to gain the benefits of the alliance without contributing to their creation (Olson, 1965). For example, imagine that a garbage truck company, a waste-management supplier/provider, and several body and chassis suppliers enter into a supply chain alliance because a new garbage truck design would be more efficient for the garbage truck company. Such an alliance would result in added value for all parties (better service by the garbage collection company, sales of new trucks by the garbage truck suppliers). To cooperate, the participating firms must invest time, money, and knowledge. However, it could occur to a participating firm to invest very little in the alliance in the hopes of still realizing the benefits of the new design without the cost of contributing. If every firm in the alliance adopts this strategy to “free ride” then there are no resources to create added value so the benefits of the new body and process will never be designed and the alliance benefit will never be realized.

4.2. Hold-up problem

A second form of defection in supply chains is a “hold-up” (e.g., Gilbert and Cvsa, 2003). In the hold-up problem, defection occurs not in the form of not contributing to the creation of value, but in the attempt to claim an unfair share of the value that is created. In the example above, once the new garbage trucks have been designed, the garbage truck provider may try to hold-up the garbage collectors (e.g., charge more for the new trucks than previously agreed upon) because the garbage collectors already have too much invested in the redesign of the truck to walk away from the investment.

4.3. Leakage problem

A third type of defection that might occur in supply chain alliances is called “leakage” (e.g., Zhang, 2002). The leakage problem occurs when an alliance partner attempts to use the resources of the alliance to create value outside of the alliance. Going back to our garbage truck example, the discovery of value-added benefits by the supply chain alliance may be predicated on the supply participants sharing sensitive (proprietary) information, such as demand, lead time, and production costs. Doing so allows better coordination and potentially lower costs. However, doing so makes the supply chain partners vulnerable to that sensitive information being “leaked out” of the alliance to competitors, or at least used for other purposes outside the supply chain alliance. For example, the truck manufacturer might “leak” contributions to the alliance by trying to supply the new-and-improved trucks to waste management firms not part of the alliance (i.e., competitors of the alliance partners).

5. Trust and defection

In all three forms of defection noted above, an alliance partner may defect as a strategy for exploiting other supply chain members. However, in all three forms of defection, low trust may also lead to the fear of exploitative behaviors by other members of the supply chain alliance, and that fear of exploitation in turn may lead alliance partners to underinvest information and resources in the alliance (e.g., Schnake, 1991)—a major cause of alliance failure. Without information and resources to create value, the supply chain alliance will fail to create value (Zeng and Chen, 2003).

In sum, the purpose of a supply chain alliance is the management of the supply chain to create added value—specifically, the sharing of information and other resources to enhance effective supply chain coordination. However, in the absence of trust, fear of opportunistic behaviors (defection, namely hold-ups, free riding, and leakages) by other alliance participants may lead firms to underinvest in the alliance, and the alliance fails. These relationships are captured in Fig. 2 and are discussed in the following two sections.

6. Characteristics of supply chains that predict trust

A key factor in predicting the level of trust in groups (e.g., strategic alliances) is the interdependence structure among the involved parties (e.g., Yilmaz et al., 2005). Since alliance partners in a managed supply chain depend upon one another to varying degrees, the interdependence structure of the alliance can help determine the level of trust in the supply chain. In turn this may lead to a better understanding of how structural interdependence of alliance partners can result in underinvestment in the alliance, leading to alliance failure.
6.1. Interdependence theory

Interdependence theory suggests that organizations form strategic alliances to manage pressures from exogenous uncertainties in their common environment (Gulati and Gargiulo, 1999). For example, to reduce the uncertainty of procuring resources, organizations form “voluntary cooperative interorganizational ties” (Gulati and Gargiulo, 1999, p. 1443). A strategic alliance – for example, a managed supply chain – is a form of voluntary cooperative interorganizational tie formed “to cope with the uncertainty created by environmental forces beyond their direct control” (Gulati and Gargiulo, 1999, p. 1441).

We examine three types of structural interdependence among supply chain partners and consider how that interdependence affects the uncertainty about exchange hazards among the alliance parties. We propose that the level of uncertainty affects the level of trust among chain partners, which in turn influences partners’ willingness to invest information and resources in the alliance. The three interdependence structures – displayed in Fig. 3 – are asymmetrical interdependence, extended interdependence, and constellation interdependence.

6.1.1. Asymmetrical interdependence

Asymmetrical interdependence occurs when there is an uneven distribution of benefits and burdens among parties (Wade-Benzoni et al., 1996). Going back to the garbage truck example, if multiple chassis and body suppliers decided to invest a lot of time and money into the alliance to meet the unique and individual needs of one particular truck company, then the chassis and body suppliers would have greater dependence on the truck company because switching costs are very high (hold-up problem). This greater dependence creates two potential exchange hazards for the less powerful party: (1) the more powerful party may attempt to hold-up the less powerful parties or (2) another of the less powerful parties may attempt to free ride. This asymmetry can be magnified even further if the truck company is a monopsony (the only buyer of garbage truck body and chassis parts), or if the supplier(s) represent a monopoly or oligopoly (the only supplier(s) of truck body and chassis parts).

The asymmetry of the interdependence fosters greater likelihood of the more dependent party being uncertain of being held-up by the less dependent party and the less dependent party being “short changed” by the more dependent party. Both parties may therefore be more tempted to withhold their resources from the alliance. Thus:

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Fig. 2. A conceptual model of supply chains as a social dilemma.

Fig. 3. Three types of interdependence in supply chains.
Proposition 1. Fear of opportunistic behavior by supply chain alliance participants increases as the asymmetry among supply chain alliance partners increases.

6.1.2. Extended interdependence

Managed supply chains tend to consist of more than three entities and extend into the second and third tier of the value chain (Fawcett and Magnan, 2002). The more tiers up and down the value chain participating in the supply chain, the larger the alliance group, and the more extended the interdependence of the supply chain (Mentzer et al., 2001). Many studies have demonstrated that the greater the group’s size in public good dilemmas the smaller the probability of effective cooperation (see Franzen, 1994, for a review). By group size we mean the number of firms vertically linked in the supply chain alliance. There are two reasons for the deleterious effects of group size in supply chain management: (1) “deindividuation,” where “the identity or accountability of the individuals is submerged by the group” (Hamburger et al., 1975, p. 520), and (2) free riding from “diffusion of responsibility” (Stroebe and Frey, 1982).

More partners in a supply chain alliance provide more opportunities for any individual firm to “free ride” on the contributions of other alliance members, and more opportunities for resources to be “leaked out” to competitors and other projects not associated with the alliance. Thus, partner firms may be more fearful that others will: (1) free ride off their contribution or (2) leak out their private information to other firms as the number of firms increase across tiers.

Proposition 2. Fear of opportunistic behavior by supply chain alliance participants increases as the length of the supply chain (number of links) increases.

6.1.3. Constellational interdependence

In social dilemmas, it is often the case that participants belong to many different groups simultaneously (Polzer et al., 1999), just as organizations can be members of multiple supply chains simultaneously (Lincoln et al., 1992). In the garbage truck example, the truck company may also supply other kinds of trucks in other supply chains. Thus, the garbage truck company is a member of multiple supply chains and could thus be a partner in multiple supply chain alliances simultaneously. In such cases, the garbage truck company may no longer be a party to one social dilemma but rather a party to several social dilemmas simultaneously. Being a member of multiple groups simultaneously may lead to conflicting interests for that member (e.g., Wit and Kerr, 2002).

An alliance constellation is a group or network of alliances a firm enters into (Das and Teng, 2002). Jones et al. (1998) argue that in alliance constellations a tension exists between a firm’s competing allegiances. Studies of social dilemmas (e.g., de Cremer and Van Vugt, 1999) have suggested that the more an individual strongly identifies with a particular alliance, the more likely the individual will do what is in the best interest for that alliance (Wit and Kerr, 2002). The more alliances the firm becomes involved in, the more uncertain it becomes for partnering firms to know whether that firm will do what is best for their partnership. This is because the firm’s interests may no longer rest with only that alliance, but with other alliances. Thus:

Proposition 3. Fear of opportunistic behavior by supply chain alliance partners increases as the number of supply chain alliances those partner firms are engaged in increases.

6.2. Fear, trust, and underinvestment

Pruitt and Kimmel (1977, p. 375) suggest that the desire to cooperate is insufficient to elicit cooperation, and that such a desire must be accompanied by “an expectation that the other will cooperate.” Such an expectation is a function of the level of trust people have in each others’ willingness to cooperate (Yamagishi, 1988), and the level of trust among members in public good dilemmas affects the level of cooperation (e.g., Parks and Hulbert, 1995). In the above three types of supply chain interdependence, the structure of the supply chain may lead alliance partners to fear opportunistic behavior by the other partners. The greater the fear of opportunism by partners, the lower the level of trust in the alliance (e.g., Yamagishi et al., 1998). Thus, cooperation will be less likely in managed supply chains where the alliance participants cannot trust other alliance participants to contribute appropriately to the creation of value (de Cremer and Oosterwegel, 1999).

Proposition 4. A managed supply chain firm’s willingness to invest information and resources in a supply chain alliance will decrease when fear of opportunistic behavior is high and trust of supply chain partners is consequently low.

7. Implications for effective supply chain management

Researchers have volunteered several taxonomies of solutions to social dilemmas (e.g., Foddy et al., 1999;
Kollock, 1998; Messick and Brewer, 1983). Here we draw upon the dichotomy offered by Messick and Brewer (1983) which divides possible interventions into those which can be unilaterally implemented by any single party versus those which require joint action by all or most partners in the alliance. As suggested in Fig. 2, these solutions typically operate by disrupting the effects of supply chain alliance structural interdependence on trust.

7.1. Partner selection

A key unilateral action available in supply chain management is deciding “with whom should a firm partner” (e.g., Choi and Hartley, 1996). In the context of social dilemma research, this is called “selective play” where players may choose other players in contrast to “forced play” where individuals must play with parties whose selection they had no control over (Hayashi and Yamagishi, 1998). Experimental findings show that selective play fosters greater cooperation in public good dilemmas (e.g., Vanberg and Congleton, 1992). Selective play results in greater cooperation because cooperative parties should, over time, refuse to interact (play) with non-cooperative parties and begin only to associate (play) with other cooperative parties—a strategy called “Out-for-Tat” (Hayashi and Yamagishi, 1998).

7.1.1. Social networks and partner selection

Organizations are embedded in a variety of inter-organizational networks—called social networks (Gulati and Gargiulo, 1999). Participation in social networks provides firms with access to timely information about (referrals to) other firms with whom potential alliances could form (e.g., Gulati, 1995). One way organizations may use social networks is to choose partners based on the potential partner’s reputation. An organization’s reputation is a function of its past alliances with others (Gulati, 1995), i.e., a particular firm’s willingness to cooperate in one alliance affects that firm’s reputation regarding how likely they will be to cooperate in other (future) alliances. For example, a buyer wanting to form alliances with suppliers can find out from a network of buyers how cooperative particular suppliers have been. This knowledge of the cooperative tendencies of prospective partners then influences with which suppliers the buyer chooses to ally (Kogut et al., 1992).

The number of connections or linkages among firms (such as past alliances, mutual ties, trade associations, etc.) is a characteristic of social networks (Peteraf and Shanley, 1997). Connections refer to the frequency and pattern of interactions among network members. As a firm’s linkages to other firms in a network increases, more information is available through those linkages—including information about other firms’ reputations for behaving opportunistically or cooperatively. This allows highly connected network firms to make more informed alliance partner selections. By making more informed alliance partner selections, a firm should be less uncertain and thus less fearful of opportunistic behavior on the part of its selected partner. Thus:

**Proposition 5a.** The probability of a firm’s investment in supply chain alliances increases as the number of the firm’s social network connections increases.

7.1.2. Selection for partner non-redundancy

Although more members in a supply chain means greater opportunities for an individual firm to “free ride” off the contributions of other alliance members, some social dilemma research has found that large group size does not always lead to collective failure (e.g., Yamagishi and Cook, 1993). An important consideration in the effects of supply chain size may be the redundancy of each partner (Cortazar, 1997). Redundancy can be thought of in terms of the substitutability of partners. If a large distributor allies with several suppliers, any one supplier may be redundant to creating value in the supply chain—any supplier’s contributions can be substituted for the contributions of other (defecting) suppliers. This may create a sense of security for the distributor, knowing that defection by any one supplier would not be fatal. Social dilemma theory suggests that this sense of security may be false, however. Redundant suppliers may feel their contributions are unnecessary, creating the opportunity to “free ride.” Moreover, redundant suppliers may defensively defect in fear that the supply chain’s asymmetry exposes them to the possibility of a “hold up” by the distributor (e.g., Ellingsen and Johannesson, 2004). Paradoxically, while allying with redundant partners may seem desirable from the viewpoint of insulating a firm from the ravages of defection that disrupt cooperation in an alliance (Sheffi and Rice, 2005), in fact creating redundancy in an alliance may foster defection.

Non-redundancy, on the other hand, provides all participants the mutual assurance of non-defection created by reciprocal interdependency: if value cannot be created unless everyone contributes, everyone has equal power over everyone else. This is consistent with research demonstrating that cooperation in a social dilemma can be a function of perceived impact (Kerr, 1992). The more an alliance partner considers their contributions to be critical to creating value (i.e., non-redundant), the less fear they have of...
opportunism by others and the more cooperative they are likely to be (Chen et al., 1996). This line of thought suggests that it is not so much keeping the number of partners in a supply chain alliance to a minimum (Goffin et al., 1997) that reduces the incentive to free ride. What may matter more is how redundant those partners are. The key here is that what produces a stable supply chain alliance – one in which there are no defectors – is the trust by all alliance partners that no other firm in the alliance has an incentive to defect, and no one has an incentive to defect if everyone’s contributions are critical. Thus:

**Proposition 5b.** The probability of a firm’s investment in supply chain alliances increases as the number of redundant partners at each tier in the supply chain decreases.

### 7.2. Communication

Communication is also a unilateral action available to partner firms that can increase the likelihood of supply chain alliance success. Many social dilemma studies have shown that increased communication among individuals increases the frequency of cooperation (e.g., Bouas and Komorita, 1996). Communication may increase the likelihood of alliance success because it offers the opportunity to provide (or elicit) promises to cooperate. Unfortunately, experimental research findings have been mixed regarding whether making promises affects cooperation rates (e.g., Dawes et al., 1977; Orbell et al., 1990). The effects of promises may be dependent upon tangible commitments by parties (Chen and Komorita, 1994).

Perhaps more to the point, communication offers the opportunity to strengthen group identity of the alliance. For example, communication provides the opportunity to heighten the salience of inter-alliance competitors (Bornstein and Gilula, 2003) such as rival supply chains, thus creating a stronger alliance identity via the identification of a common enemy. Partners feeling a sense of common fate facing a common enemy are more likely to cooperate (Hamel, 1991). Thus:

**Proposition 6a.** The probability of a firm’s investment in supply chain alliances increases as the frequency of communication among supply chain alliance participants increases.

#### 7.2.1. Virtual communication

The form of communication among alliance participants also may play a role here. Virtual communication is less efficient than face-to-face communication (Hightower and Sayeed, 1995). Virtual groups exchange less social–emotional information, slowing the development of relational links (Chidambaram, 1996). Deceptive behavior (such as lying about one’s intentions) may also be easier when communication is not face-to-face (Riegelsberger et al., 2003; Rockmann and Northcraft, 2006), perhaps because people are more willing to cheat corporations than individuals (Tenbrunsel et al., 2003). Frequency of face-to-face interaction also influences liking (Zajonc, 1974). Face-to-face communication puts a personal face on an otherwise potentially impersonal inter-firm transaction, which may prove more reassuring concerning fears of defection. As a result, greater reliance on technology-mediated communication rather than face-to-face contact may lead to greater uncertainty about the behavior of others, which in turn leads to lower trust and hence less investment in the supply chain alliance. This does not suggest that technology-mediated communication does not increase the ability to collaborate and cooperate (Constant et al., 1994), but rather suggests that reliance on non-face-to-face communication may decrease the value of communication. Thus:

**Proposition 6b.** The probability of a firm’s investment in supply chain alliances increases as the frequency of face-to-face communication among supply chain alliance participants increases.

#### 7.2.2. Communication and proximity

Significantly, these last two propositions also reinforce the importance of forming alliances with geographically proximal partners. Geographic proximity has been found to foster more frequent interaction and information exchange among firms (e.g., Teece, 1994). Further, managers from local firms are more likely to encounter one another face-to-face in social settings and know one another personally (Peteraf and Shanley, 1997), thus increasing familiarity and decreasing fear. Thus:

**Proposition 6c.** The probability of investment in a supply chain alliance increases as the geographic distance among partners in the alliance decreases.

### 7.3. Agreement time horizons

Beyond unilateral actions to reduce the problems of social dilemmas in supply chain alliances are remedies that require joint action by alliance partners. Axelrod (1984) coined the term “shadow of the future” to refer to the role that the duration or time horizon of an alliance agreement has on the cooperative behaviors of its
participants. Axelrod noted that the probability of continued future interaction was a key requirement for the emergence of cooperation, and this contention has been confirmed by field studies. For example, Heide and Miner (1992) surveyed purchasing agents and suppliers and found that the “shadow of the future” promoted buyer-seller cooperation. Parkhe (1993) similarly found that in a survey of senior execs involved in joint ventures, long time horizons reduced opportunistic behaviors.

Longer-term cooperative agreements may enhance cooperation because they create longer-term opportunities to reciprocate the behaviors of other participants—both cooperative and non-cooperative. Knowing that non-cooperative behavior can (and will) be reciprocated decreases any short-term incentive to act opportunistically, and in turn provides all players reassurance that no one has an incentive to defect in the short-term. Significantly, social dilemma theory thus may present a paradox when it comes to the time horizons of cooperative alliance agreements. Firms may be tempted to stick with short-term time horizons to minimize their exposure to opportunism, but in doing so may create the very “end-game” (Heide and Miner, 1992) possibilities for opportunism that will cause alliance participants to defect. Thus:

**Proposition 7.** The probability of investment in a supply chain alliance increases as the time horizon of the cooperative agreement increases.

### 7.4. Rewards and sanctions

The joint creation of rewards and punishments by an alliance also provide opportunities to decrease the impact of structural interdependence on the perception that alliance partners will behave opportunistically. Rewards and punishments act as countervailing forces against the short-term benefits of defection (Dawes, 1980; Kollock, 1998), and thereby may provide reassurance for alliance members that other alliance members are less likely to defect. Some have suggested that using private goods as rewards for contributing to public goods holds promise to solving public good dilemmas (e.g., Olson, 1965). A recent case study by Ogden and McCarter (2004) shows how a truck company – to initiate cooperation and collaboration among its suppliers – conducts semi-annual surveys to evaluate supplier performance. Suppliers are ranked accordingly by survey score and the suppliers who perform the best in the partnership are given private rewards. These rewards are made visible to the other suppliers, who are then encouraged to “catch up” to the other suppliers receiving the rewards. Using private rewards for cooperation should provide reassurances that other partners in the supply chain alliance have an incentive to not defect and thus can be trusted not to.

On the other side of this coin, parallel arguments can be made for the impact of sanctions (or punishment) for defection. Social dilemma research has shown that individuals are more likely to cooperate if group members can punish defectors (e.g., Fehr and Gächter, 2000). Supply chain firms can sanction each other by either direct sanctions (e.g., termination of alliance partnership, contractual fines for defection behaviors) or indirect sanctions (e.g., bad reputation within social networks) which in turn (again) should provide reassurances that all alliance partners have an incentive to not defect and therefore can be trusted not to.

**Proposition 8.** The probability of a firm’s investment in supply chain alliances increases in the presence of rewards for alliance cooperation and punishments for alliance defection.

Unfortunately, reward systems themselves represent a secondary social dilemma (Kollock, 1998). Additional resources are required (which partner firms must contribute) to reward cooperative partners in an alliance, including a monitoring system to keep track of which alliance partners are appropriately contributing and which are not. Further, Tenbrunsel and Messick (1999) warn that weak sanctions against defection may actually exacerbate the dilemma by changing the decision to collaborate from an issue of trust to a business decision about the likelihood of getting caught.

### 8. Conclusions: Uncharted territory in supply chains as social dilemmas

Modeling supply chain alliances in the framework of social dilemmas can prove insightful in several ways. First, casting supply chain alliances as social dilemmas highlights the importance of perceptions – and the management of perceptions – in supply chain management success. The propositions we have offered focus on non-contribution as a defensive behavior, meaning that alliance partners do not defect to exploit others so much as to prevent being exploited themselves. Significantly, fears of exploitation are perceptions, and these fears need not be well-founded to have their effects. Perceptions can also have to do with the distinction between a Prisoners’ Dilemma Game (where partners can be exploited via non-contribution) versus an Assurance Game (where non-contribution does not offer the opportunity to exploit others). In psychological
studies, this pay-off structure is typically the starting point—a given. In the real world, the ability to exploit is a function of the redundancy of contributions—the ability of the alliance to create value in the absence of complete contributions from all partners. Redundancy of contributions is a perception as well, and again one that need not be accurate to affect alliance success. These critical roles for perception again highlight the importance of communication—and face-to-face contact and geographic proximity—in managing the perceptions that will help make a supply chain alliance successful.

Second, some have suggested that supply chain management may not guarantee long-term competitiveness in markets where firms have similar cost and revenue structures (Boyaci and Gallego, 2004). The argument here may be that if every supply chain is being managed, supply chain management cannot offer any advantage. Of course, this argument presupposes that the decision to manage a supply chain puts a supply chain on equal footing with all other managed supply chains. Casting supply chain alliances as social dilemmas instead suggests that the decision to form an alliance is only the first step down a long road toward the successful management of a supply chain. Social dilemma theory identifies some of the significant potholes on that road that supply chain alliances are likely to encounter, and in doing so provides some insight into navigating those potholes more successfully to avoid inter-firm rivalry effects.

In addition to these insights, the particular context of supply chains also challenges the limits of social dilemma research. For example, most past (game theoretic) research on public goods dilemmas has explicitly made the simplifying assumption that mutual contribution alone determines the return on joint investment (e.g., more efficient processing and delivery of applesauce, a better garbage truck design). However, in the real world—for instance, in supply chain alliances—the synergistic potential of collaboration cannot be known a priori. As suggested by van Dijk et al. (2004), alliance members may not be certain about the extent to which collaboration with their alliance partners can further the collective interest. For example, just because several firms form a supply chain alliance for the purpose of generating value-added processes and goods (e.g., logistics systems, inventory reductions, and quality products) does not mean the initiative will yield high returns on investments, even if everyone does their part. Thus, in many real-world public goods dilemmas, making appropriate contributions—investing in the alliance— is only a beginning, not an end.

Past public goods studies have addressed the question of what factors determine whether everyone plays their part when the value of collaboration is known (van Dijk et al., 2004). Additional work is needed to ascertain the impact of uncertainty about the value of effective collaboration on collaborative behavior. One might speculate that uncertainty about the value of collaboration would increase the fear that someone would defect, i.e., not collaborate. In doing so this might then increase the probability that others would defect so as not to be played as suckers. This reminds us that the social dilemma framework suggests that the critical issue in alliance success may be defensiveness. The issue is not just whether potentially reluctant contributors can be convinced to invest resources into the alliance public goods—it is also a matter of convincing even enthusiastic contributors that their contributions will produce a good return on their investment, particularly to the extent that reluctant contributors may fail to contribute (Kollock, 1998). Defensive behaviors (e.g., short-term alliance agreements, structural redundancies) intended to insulate alliance partners from the ravages of defection may create self-fulfilling prophecies (e.g., Rosenthal and Jacobson, 1968) that encourage the very defection behaviors they are intended to defend against.

Another issue raised by supply chain alliances that traditional social dilemma research has not fully addressed has to do with the tangibility of alliance contributions. Again, most past (game theoretic) research on public goods dilemmas has simplified the problem by defining alliance contributions concretely (e.g., Pillutla and Chen, 1999) or even just assuming that the choice to collaborate alone is sufficient to create value. Contributions of physical resources to a supply chain alliance—such as money, machines, people, or even time—fit this assumption well. However, much of what can be contributed to real-world alliances—and in some cases the most important resources than can be contributed—may not be concrete at all. In particular, while alliance partners may be able to tell how much money or people or equipment each firm has contributed to the collaboration, measuring information (how much available has been shared) or effort (for example, how hard each side tried to think about the problem) is another matter altogether. Within social psychological research, the subtle distinction between defection and social loafing (Latane et al., 1979) focuses on the measurability of contributions: defectors are those who do not contribute their fair share, while social loafers are those who pretend to (Robbins, 1995). Often, it is hard to tell the difference. And while contributions of money and machines and people can
The issue of measurability of partner contributions may be critical to supply chain alliance success for several reasons. Measurability may influence partners’ perceptions of the probable success of the collaboration. Where contributions can be feigned, this again may result in fear of non-contribution, which in turn would fuel defensive defection. Measurability of contributions also highlights the importance of the type of solution used to motivate collaborative intent. Using extrinsic motivators (such as rewards and punishments) to foster contributions to an alliance would fuel defensive defection. Measurability of partner contributions (to some extent) be retracted and reclaimed, information and effort cannot.

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