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Decision Support

Strategizing niceness in co-opetition: The case of knowledge exchange in supply chain innovation projects

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ABSTRACT

In this paper, we take a novel approach to address the dilemma of innovation sharing versus protection among supply chain partners. The paper conducts an exploratory study that introduces factors affecting a firm's optimum supply chain innovation strategy. We go beyond the conventional Prisoners' Dilemma, with its limiting assumptions of players' preferences and symmetry, to explore a larger pool of 2×2 games that may effectively model the problem. After classifying firm types according to collaboration motive and relative power, we use simulation to explore the effects of firm type, opponent type, and payoff structure on repeated innovation interactions (or, equivalently, long-term relations) and optimality of 'niceness'. Surprisingly, we find that opponent type is essentially irrelevant in long-term innovation interactions, and focal firm type is only conditionally relevant. The paper contributes further by introducing reciprocation of strategy type (nice versus mean), showing that reciprocation is recommended, while identifying and explaining the exceptions to this conclusion.

1. Introduction

Inter-firm knowledge sharing[1] is now an integral part of organizational strategy. Firms pursue opportunities to increase their stock of corporate knowledge (Samaddar & Kadiyala, 2006) while sharing the costs and risks of knowledge creation (Tether, 2002). Nevertheless, the threat that unintended knowledge spillovers will diminish competitive advantage still persists (Ding & Huang, 2010). In particular, when "fine-grained tacit knowledge" is to be shared, the increasing preference for informal, as opposed to legal, safeguards elevates this risk (Lee & Johnson, 2010; Nair, Narasimhan, & Bendoly, 2011). We take the case of supply chain knowledge sharing between the participative members as a particular case to further discuss this dilemma.

As supply chain knowledge exchanges have become increasingly indispensible (Eng, Chew, & Lee, 2014), a firm's decision to share part of its internal knowledge with other members of the chain may be encouraged, but nonetheless partners must be trusted not to leak the shared knowledge to the competition. Thus, the risk of horizontal leakage of knowledge (to competition) is inherent in vertical sharing (with supply chain partners). In this context, the unintended knowledge spillover problem becomes each firm's *deliberate* choice whether or not to leak its partner's knowledge to that partner's competition (e.g., a shared supplier may pass a manufacturer's development plans to competing manufacturers). Because the outcome depends on the decisions of all parties, this multi-decision-maker problem can be effectively modeled as a game (Nagarajan & Sošić, 2008). We, therefore, adopt a game-theoretic perspective in an exploratory study of supply chain knowledge exchanges, to address whether a firm should:

(1) readily share its knowledge with a partner; and/or
(2) use partner's knowledge in other linkages.

For the most part, the literature on knowledge sharing has dichotomized this challenge as the choice to be a "good partner" or not (Hamel, 1991), or, more pointedly, as the choice to cooperate or defect (Nair, Narasimhan, & Choi, 2009). This knowledge-sharing dilemma is also known as the "boundary paradox" (Quintas, Lefrere, & Jones, 1997).

We focus on a knowledge-sharing problem involving two firms (or players) in a supply chain. In our model, the firms have shared knowledge (e.g., innovation projects such as new product development), and each has the option of sharing it without the partner's consent or keeping it within the partnership. Because each player must choose one of two alternatives, the relationship between the two players can be modeled as a 2×2 game, in which each player chooses (simultaneously) whether to cooperate or defect. The best known of these games is Prisoners' Dilemma, but there are many

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[1] Knowledge sharing and knowledge exchange are used interchangeably.

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others in which the players' values are different (Kilgour & Fraser, 1988; Rapoport & Guyer, 1978; Robinson & Goforth, 2005). In our view, the assumption of symmetric player motivations inherent in the Prisoners' Dilemma payoff structure limits the applicability of the model, and does not facilitate an understanding of the relationship of partners' preferences and actions.

Our aim in this paper is to highlight a broader class of symmetric and asymmetric 2×2 games that can model the knowledge-sharing dilemma among supply chain partners, in the context of joint innovation projects. Firms strive to involve supply chain partners in innovation activities in multiple ways including strategic commitment to price (Gilbert & Cvsa, 2003), subsidies provision (Kim, 2000), or direct exchanges of knowledge. We here focus on the latter to study decisions regarding incoming and outgoing knowledge flows, shedding light on how the different types of players (firms) interact by relaxing several of the assumptions of Prisoners' Dilemma. For this purpose, we consider the six player types suggested by Perlo-Freeman (2006, p. 5). *Cooperate-Defect (CD) Games* are 2×2 games in which

> *"... for each player X, there exists a strategy of the other player, which we call 'Co-operate', such that for each strategy for player X, he prefers the other player to choose Co-operate. We call the other strategy for each player 'Defect'."*

In other words, whatever X chooses, he/she prefers that partner Cooperate. Restricting attention to CD games enables us to classify firms along two dimensions:

(1) Collaboration motive: What is the firm's most preferred outcome?
(2) Relative power: Which outcome does the firm strive to avoid the most?

The answers to these questions determine the player type. For example, a prisoner is a firm that prefers to defect (while partner cooperates, of course) and least prefers to cooperate (while partner defects). Thus we think of a prisoner as an aggressively exploitative firm that most prefers to defect and least prefers to be suckered. The interaction of two prisoners is a Prisoners' Dilemma. The other five types are fully opportunistic, fearfully exploitative, fair, good and moral.

We see CD games as particularly relevant to the supply chain knowledge-sharing dilemma in the short term, as each firm always prefers that its partner cooperate (maintain secrecy) rather than defect (expose secrets). We build on Perlo-Freeman's definitions to characterize firms of different types and study their behaviors in one-time joint innovation projects.

To address long-term relationships, we investigate the effect of repetition of the game on firms' choices and outcomes using MATLAB simulation. We adopt Axelrod's (1984) classification of long-term strategies as 'nice' or 'mean' according to their approach to supply chain relations, trustful or distrustful. A 'nice' firm never defects, except when provoked (defected against), whereas a 'mean' firm may defect without provocation. In particular, we are interested in conditions when sequences of cooperation might occur, and when they are vulnerable to unprovoked defection.

The issue of provoked versus unprovoked defection carries a particular relevance to the supply chain, where communicating a policy of defection only when provoked would seem to signal fairness and trustworthiness, while the threat of unprovoked defection signals untrustworthiness. Managers tend to consider inter-firm relationships as polar opposites, either entirely cooperative or entirely competitive (Klein, Rai, & Straub, 2007). In this study, we explore the conditions under which being trustful (nice) versus distrustful (mean) is advisable (see Rousseau, Sitkin, Burt, & Camerer (1998) for a review of inter-firm trust).

This paper provides a relevant and timely expansion of the horizon of supply chain innovation games beyond Prisoners' Dilemma. We introduce a pool of possible knowledge interactions by firms showing how they could be strategized in a supply chain. We also build on Axelrod's (1984) findings on direct reciprocation (the famous TIT FOR TAT strategy) by introducing reciprocation of *strategy type*. One interesting finding is that the superiority of TIT FOR TAT is not universal, but depends on the relative gain from changing the opponent's action versus the cost of changing one's own. We identify seven payoff categories that help us explore the effect of different motivations – gaining the greatest reward versus avoiding the worst punishment in exchange of knowledge between two firms in a supply chain.

2. Background/literature review

2.1. The joint innovation dilemma

The joint innovation process (e.g., in supply chain) is a collaborative relationship in which organizations collectively implement a knowledge creation endeavor, sharing the expenses and the benefits of the newly created knowledge according to a mutually agreed rule (Samaddar & Kadiyala, 2006). In this process, participating firms contribute useful knowledge to this pool, building up a "knowledge repository" retrievable by all members (Cress & Martin, 2006). For the endeavor to succeed, participating firms must allocate and share adequate resources (Samaddar & Kadiyala, 2006).

The conventional wisdom regarding collaborative knowledge creation generally directs firms to be "good partners" by being open and contributing knowledge to the shared pool. Hamel (1991) was the first to question this advice, suggesting that inter-firm collaboration can develop into a "race to learn", in which a firm intends to "acquire" its partner's skills as opposed to merely accessing them. The idea was that "good partners" with high transparency and collaborative intent tend to be exploited by opportunistic partners with lower transparency and competitive intent (Hamel, 1991). Larsson, Bengtsson, Henriksson, and Sparks (1998) build on this analysis using a game-theoretic perspective, by developing a collective learning framework that explains both negative and positive learning processes. The authors highlight the distributive dimension and its effect on the appropriation of joint learning by individual organizations.

Consequently, there is a trade-off between the integrative and distributive dimensions of collaborative knowledge creation (Larsson et al., 1998). Quintas et al. (1997) referred to this problem as "the boundary paradox"; where borders must be open for knowledge to flow, but core strategic knowledge, upon which survival depends, must be preserved. On similar grounds, Das and Teng (1998) define relational risk in terms of the probability that a partner does not cooperate, instead acting opportunistically and misusing the acquired knowledge.

Given the existence of both collaborative and competitive dimensions, joint innovation projects have often evolved into "mixed-motive" relations (Parkhe, 1993). In some cases, abundance of access to a firm's knowledge has *created* new competitors (Arruñada & Vázquez, 2006). In others, leakage effects allowed the imitators to profit *more* from innovations than the original commercializers (Teece, 1986). Once a firm shares valuable and strategic knowledge externally, its ability to control access to this knowledge is severely compromised (Anand & Goyal, 2009). There is an obvious imperative to manage organizational knowledge strategically in order to optimize its flow.

The literature suggests few ways to deal with the tension between sharing and protecting knowledge. Trust is one of the most significant ways of reducing partners' opportunistic behavior (Das & Teng, 1998; Norman, 2004; Zaheer, McEvily, & Perrone, 1998). Empirically, it has been shown that when firms build relational capital in conjunction with an integrative approach to managing conflict, they are able to simultaneously learn and protect (Kale & Singh, 2000). Other protection mechanisms include: (1) making company personnel aware of