14 KNOWLEDGE TRANSFER UNDER COOPETITION

Claudia Loebbecke
Copenhagen Business School
Denmark

Paul C. van Fenema
Rotterdam School of Management
The Netherlands

Philip Powell
Goldsmiths College, University of London
United Kingdom

Abstract

Recent business trends have given rise to coopetition: simultaneous cooperation and competition between firms. Coopetition entails the sharing of knowledge which may be a key source of competitive advantage. Under coopetition there is a paradox that the knowledge shared for cooperation may also be used for competition. While the existence of this problem is known, there is little investigation of how it may be modelled and, thus, managed.

This paper begins by discussing the problem situation and its underlying theory. It then introduces a game-theoretic framework for analyzing interorganizational knowledge sharing in the context of coopetition. This allows the value of knowledge shared to be investigated and reveals that a crucial aspect will be the firm's ability to manage the process. Thus, based on the framework, the paper explores management guidelines predicated on co-ordination and control theory for the most challenging of four contingencies identified. The paper concludes with an agenda for future theoretical and empirical research.

Keywords: Coopetition, knowledge sharing, knowledge transfer, game-theory, coordination and control, interorganizational knowledge management systems.

Introduction

The current business environment, advances in information and communication technologies, and the resultant development of network and virtual organizations have led firms to cooperate and compete simultaneously (Preiss, Goldman, and Nagel 1996). Brandenburger and Nalebuff (1996) refer to this phenomenon as coopetition. Underlying coopetition are internal knowledge management and information systems (IS) and procedures, and interorganizational systems. Indeed, coopetition may involve cooperation in the development of such systems but sufficient internal competencies to use both the knowledge derived and the systems themselves for competition.

Knowledge (or often just information) is a source of competitive advantage (Drucker 1992; Simon 1992), and cooperation, in the form of interorganizational knowledge sharing (IOKS), has the potential to increase each partner's knowledge base and, thus, competitiveness (Lorange 1996). However, even if cooperation increases the total value for the partners and enlarges the "overall pie," for an individual firm, what ultimately counts is its share of the new pie and, perhaps, what other new pies may be produced by the knowledge. In other words, firms would rather *not* share (or transfer) knowledge if they feel that what they gain from cooperation is outweighed by losses from relinquishing their monopoly over the knowledge (Appleyard 1996). The problem is, thus, how to manage IOKS under coopetition. That is, to determine *how much* and *what* knowledge should be shared, *when*, *with whom*, and *under what conditions*.

Literature on organizational knowledge sharing is concerned mainly with the creation, transfer, and integration of knowledge within organizations (Grant 1996; Nonaka 1995; Grant 1996; Walz, Elam, and Curtis 1993) or with the determination of organizational boundaries (e.g. Bakos and Brynolfsson, 1996; Madhok 1997). There is also some work on the strategic problems of sharing knowledge (e.g. Hamel, Doz, and Prahalad 1989; Appleyard 1996). This paper seeks to build on and extend the strategic and interorganizational perspectives by focusing on the value of knowledge transfer. After a detailed discussion of the problem situation and its theoretical background, the paper introduces a game-theoretic framework to analyze four basic scenarios of IOKS under coopetition. These reveal the need to assess the value of knowledge shared and the necessity to give proactive consideration to the management of the process. Thus, the paper uses the insights gained from the game-theoretic model to develop a preliminary set of management guidelines based on coordination and control theory for the most challenging of the four contingencies analyzed. The paper concludes with a research agenda for empirical investigation and suggests information, communication, and media technologies developments for supporting the management of interorganizational coopetive knowledge transfer.

Problem Situation and Theoretical Background

The problem is whether to use knowledge internally or to share it. Thus, IOKS is a facet of the "markets and hierarchies" debate (Buckley and Casson 1976; Coase 1937; Williamson 1975, 1991). Interorganizational knowledge sharing, by definition, only

becomes relevant in the case of the "market," although there is a question to be determined by the "hierarchy"—*if* knowledge is to be shared.

There are two main streams to the markets and hierarchies debate: Williamson's transaction cost economics (TCE) approach and the internalization perspective (Buckley and Casson 1976; Rugman, 1980). The latter focuses on knowledge, while TCE is concerned with micro-level transaction characteristics such as asset specificity (Teece 1986). Chandler (1992) distinguishes these on the basis of the unit of analysis: "I am convinced that the unit of analysis must be the firm, rather than the transaction or contractual relations entered into by the firm" (p. 99). "If the firm is the unit of analysis, instead of the transaction, then the specific nature of the firm's facilities and skills becomes the most significant factor in determining what will be done by the firm in what market" (p. 86).

From the TCE perspective, asset specificity is a principal dimension governing exchange (Williamson 1985). Asset specificity is the extent to which partners involved in exchange must invest in assets that have limited value beyond the exchange. TCE argues that if transactions are accompanied by investments in transaction-specific assets, opportunistic behavior might be triggered (Williamson 1975).

From the internalization perspective, an organization possesses value-adding advantage, in the form of knowledge (Madhok 1997). This follows the widely accepted notion that firms compete primarily on the basis of capabilities (Cantwell 1991; Prahalad and Hamel 1990). Capability accumulation is a dynamic process where knowledge management attributes, i.e. the firm's ability to acquire, evaluate, assimilate, integrate, diffuse, deploy, and exploit knowledge, are critical (Madhok 1997). Further, cooperation, and more specifically knowledge sharing, develops a firm's capabilities (Hamel 1991; Kogut 1988; Mody 1993).

This perspective broadens the focus from minimizing transaction costs involved in the organization of an activity to assessing the value, including its erosion and its development, inherent in a firm's knowledge base (Madhok 1997). A balance between knowledge exploitation and development is essential (Hedlund and Rolander 1990; March 1991) and this requires organizational capabilities for managing the creation, maintenance, and exploitation of knowledge. Hence, skills in managing interorganizational knowledge flows through a network become the ultimate source of advantage (Dunning 1988; Goshal 1987). More generally, in line with the notion of firms as repositories of productive knowledge (Demsetz 1988), where knowledge resources are the primary concern, managing cooperative relationships is frequently a process of managing knowledge flows (Badaracco 1991).

As to the question of *what* to share, both TCE and the internalization perspective predict that tacitness of knowledge leads to internalization (Madhok 1997), i.e., to limited sharing. More tacit knowledge leads to less cooperation. Badaracco argues that knowledge management capabilities are what makes firms "repositories of embedded knowledge" (p. 129). Thus, better knowledge management capabilities increase tacit knowledge and ultimately lead to less IOKS. Madhok (1997) takes this further by stating that the embeddedness of the underlying processes limits transferability (or voluntary sharing) and imitability (involuntary sharing).

The issue of *how* to share is the one least addressed. The market for knowledge, under the assumption of opportunistic behavior and bounded rationality, is characterized by imperfections which create complications in pricing and transfer, and consequently increase costs of transacting (Buckley and Casson 1976; Teece 1986).

One reason that market mechanisms fail for the transfer of knowledge, under the assumption of opportunism, is the tacit nature of much knowledge (Madhok 1997).

Given a potential buyer who is uncertain about the true value, revealing the knowledge to convince the buyer of its worth paradoxically reduces its value since he then would possess it without paying for it (Buckley and Casson 1976).

Contractual arrangements for knowledge sharing are problematic due to the nature of the "product'," although they are exhibited in things such as patents. Economic contract theory differentiates between complete and incomplete contracts. In many instances, the nature of cooperation cannot be fully captured in a contract (Williamson 1975).[1] As exchanges between organizations are, to some extent, uncertain, specification of reciprocal performance by organizations will be, by definition, incomplete (Williamson 1985). Uncertainty and incompleteness of contracts increase the potential for opportunistic behavior (Hart 1991). In essence, incomplete contracts theory stresses the freedom of the parties to decide what to do with accessible, but not contracted, knowledge: they may share it or keep it, and they may benefit from it as much as they can (Williamson 1979).

According to incomplete contract theory, all rights to the asset not expressly assigned accrue to the owner (Grossman and Hart, 1986). Brynjolfsson (1994) states that the allocation of such residual rights of control has an important effect on the bargaining position after partners have invested in their relationship (ex-post bargaining positions). These rights provide opportunities for actually taking advantage of the asset concerned, i.e., for using accessible knowledge to one's own advantage.

In such a context, the traditionally negative connotation of "opportunism" as developed by Williamson (1985) may have to be reconsidered. If partners apply the rules of the market (competition, entrepreneurship, etc.) within a legally accepted framework or mutually accepted (incomplete) contract, the outcome may be beneficial. Further, from an "opponent's" point of view a strong partner may be better than a wounded one (Brandenburger and Nalebuff, 1996).

To summarize: this paper builds on the markets and hierarchies debate, but considers only the market situation that potentially allows for interorganizational knowledge sharing. It favors the internalization perspective that points at market activities taking place when firms compete on the basis of their strategic resources with knowledge being an increasingly important one. Consequently, knowledge sharing activities need be assessed not only in light of transaction costs arguments, but more in terms of their value.

The paper now investigates under what conditions these value-based capabilities can be leveraged or are reduced through cooperation. It is the almost omnipresent simultaneous occurrence of cooperation and competition, i.e., coopetition, that makes the issue of *what to share with whom, when* ,and *under what conditions* paramount in a firm's effort to achieve a sustainable competitive advantage. Aiming to capture this complexity, the following provides a game-theoretic framework of IOKS under coopetition.

---

[1]The traditional focus of economic contract theory is on non-human assets like machines, factories, etc., which are "alienable," i.e., can change ownership (Grossman and Hart 1986; Hart and Moore 1989). Recent literature (e.g., Brynjolfsson 1994; Bakos and Brynjolfsson 1996) extends the analysis to knowledge as an asset which is basically considered to be not (fully) contractable.

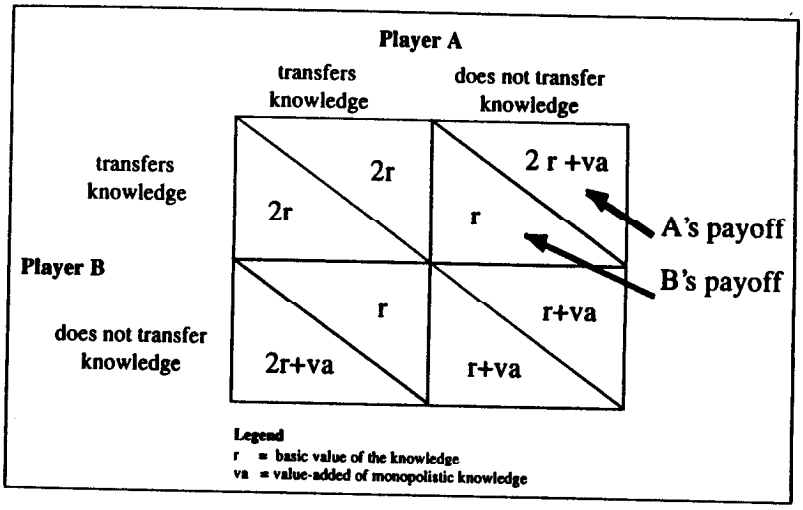

Figure 1. Game-theoretic Framework of Knowledge Transfer (After Schrader 1990)

A Game-theoretic Approach

Von Hippel (1994) and Schrader (1990) analyze knowledge exchange among competitors using the prisoners' dilemma paradigm (Axelrod 1984). Schrader assumes two players who both have knowledge that the other does not have (with both pieces having equal value). The value consists of two parts, the basic value "r" and the "value-added" ("va"). The value-added reflects the advantage that results from having knowledge of which the other is not aware. This is lost by knowledge sharing.

Applying these assumptions to the basic structure of the prisoner's dilemma (Figure 1) shows that IOKS is beneficial if the knowledge has a high basic value and a low value-added, i.e., when $2r > (r+va)$. Competitive behavior, on the other hand, is increased in the case of low basic values and high value-added, i.e., when $2r < (r+va)$. Further, Schrader concludes that cooperation only takes place based on a long term perspective and with an appropriate level of trust between players.

Three Dimensions of Knowledge Transfer under Coopetition

The research framework here extends the analysis of the game-theoretic model by introducing three additional dimensions of IOKS: synergy, leverageability, and negative reverse-impact (Loebbecke and van Fenema 1998). These dimensions are elaborated below. Although the dimensions will have actual values, at this stage the framework only considers low or high values. Two things are crucial to the firm's decision as to

whether to share knowledge. The first is the extent of the three additional dimensions explored here. The second is the ability of the firm to manage the process of knowledge sharing. The latter is discussed in the following section.

(1) *Synergy* (or more precisely synergetic value) of knowledge transfer is defined as the extent to which cooperation yields additional value from interdependent knowledge sharing beyond the sum of the parties' individual knowledge. In other words, cooperation yields knowledge in excess of the exchange of individual knowledge.

The concept of synergy is closely related to the interdependencies identified by Thompson (1967) and Van de Ven, Delbecq, and Koenig (1976). Here, interdependence is interpreted as synergy: the higher the interdependence, the more organizations cooperate to reap additional synergy benefits. The introduction of synergy stresses the potential for firms to improve their competitive position by cooperating. Synergetic value only exists if both players exchange knowledge.

(2) The *leverageability* of knowledge gained from cooperation is closely related to the concept of asset specificity as it captures the inverse situation. Leverageability refers to the potential of the knowledge receiving party to increase its value from knowledge sharing by exploiting the shared knowledge on its own beyond the cooperation. Hence, additional value may result from *leverage* whenever one party "receives" knowledge. Here, leverageability is not related to opportunism that, from a TCE point of view, has a negative connotation (Williamson 1985). Under coopetition, it is accepted business behavior to pursue self-interest beyond fulfilling cooperative agreements, which is more in line with incomplete contracts theory (Hart 1991). It is also important to stress the reciprocal dimension of opportunism: access to the other's knowledge enables both parties to benefit from additional opportunities by leverage (Brandenburger and Nalebuff 1996).

(3) A particular situation arises if a party's use of received knowledge has a *negative reverse-impact* on the sender. Negative reverse-impact describes the extent to which a receiver's use of knowledge acquired during cooperation may lower the sender's original value of the knowledge. In the case of firms operating in highly overlapping markets, for instance, the use of knowledge to improve competing products and processes is likely.

Negative reverse-impact does not necessarily imply negative behavior that, per se, needs to be avoided; it may—but does not have to—result from parties' opportunistic behavior ,as earlier described. During coopetition, firms may well aim at a bigger piece of the enlarged overall pie as long as they operate within the (incomplete) agreements (contracts) that govern the cooperation.

Extended Game-theoretic Framework of Knowledge Transfer in the Context of Coopetition

Building synergy, leverageability, and negative reverse-impact into the game-theoretic framework of knowledge transfer outlined above leads to Figure 2.

Integrating the three dimensions into the basic game-theoretic model of knowledge transfer reveals that mutual knowledge sharing is beneficial under the conditions of coopetition if $2r+s+l-nci > (r+va)$. Secretive behavior, on the other hand, is appropriate when $2r+s+l-nci < (r+va)$. Further, the extended game-theoretic model shows that

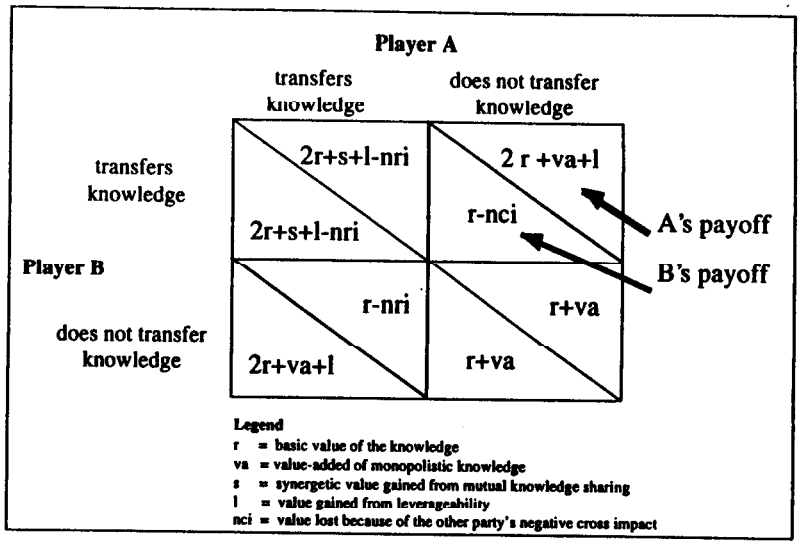

Figure 2. Game-theoretic Framework of Knowledge Transfer under Coopetition

introducing additional dimensions widens the value gap between the two players if only one player actually transfers knowledge.

Coopetition and the Transfer of Knowledge

This section elaborates on the situation in which both A and B share knowledge (upper left cell) by analyzing different scenarios based on high/low values for the three dimensions.

Synergy and Leverageability

Rather than providing values for the dimensions in order to decide whether to share knowledge, two matrices of IOKS under coopetition are discussed: first, synergy and leverageability are covered (Figure 3).

In the case of low leverageability and low synergy (cell I), from the sender's perspective there is not much to gain nor much to lose. An example is cooperation, which involves simply exchanging knowledge specific to the transaction; use of the party's knowledge beyond the cooperation does not yield additional value. A conceptually similar situation arises when high synergy and high leverageability intersect (cell IV). The expected synergy, which offers an incentive to cooperate, is (partly) offset by the expectation that the other party may gain additional value. In both

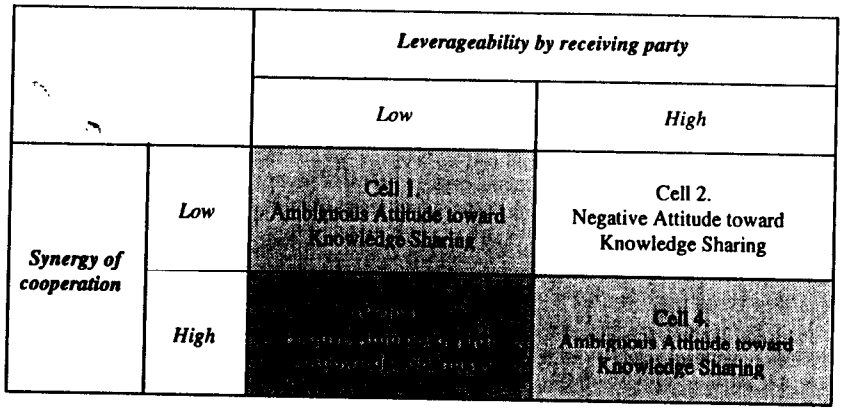

Figure 3. Effects of Synergy and Leverageability on Knowledge Sharing During Coopetition

situations, firms will be ambivalent in their decision whether to share knowledge. Where there is a low chance of synergy but a high risk that the receiving side may leverage the knowledge (cell II), a party's interest in IOKS is low. In addition to the absence of synergetic value, the other firm can use the knowledge for additional gains. Finally, cell III describes a situation in which a firm would be eager to share knowledge in spite of the overall coopetitive environment. Simply, there is more to gain from synergy than the other party might derive from leverageability.

Extending the Analysis: Effects of Negative Reverse-impact

The paper now illustrates that only (the risk of) *high* negative reverse-impact may change a firm's decision derived from just analyzing synergy and leverageability (Figure 4). From a sender's perspective, high negative reverse-impact lowers his interest in IOKS. In cell II, the decision against sharing is simply reinforced. In situations I and IV, the previous ambivalent attitude will become negative as the risk of value loss increases. The previously positive attitude in favor of IOKS (cell III) becomes ambivalent as the firm takes account of the risk of negative reverse-impact.

Managing Interorganizational Knowledge Transfer

The prisoners' dilemma modeling reveals that introducing the additional dimensions makes firms, probably at best, ambivalent in their desire to share knowledge. The extent to which this ambivalence can be overcome is dependent on the firms' ability to manage the knowledge sharing process. Thus, it is crucial to investigate the steps organizations may take to reduce the risks and garner the benefits.

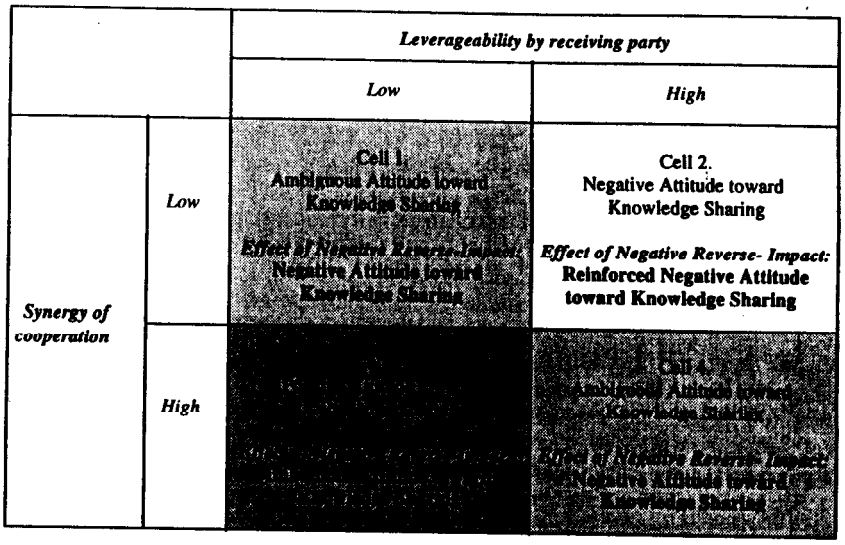

Figure 4. Effects of Negative Reverse-Impact on Knowledge Transfer under Coopetition

Further investigating the most interesting specific situation of cell 3 in Figure 4 (the case of high synergy, low leverageability and given negative reverse-impact), assume that *both* parties can translate the knowledge into adjacent business capabilities and, hence, can exploit additional opportunities beyond the cooperation. This suggests partially diverging interests between partners (typical for coopetition), and necessitates the development of a strategic perspective on managing IOKS.

In terms of management pragmatics, as contracts cannot specify everything, control strategies will need to focus on managing the dynamics of IOKS. This includes, for example, installing gatekeepers and instructing employees to maintain awareness in social situations in any task force. More specifically, it suggests different measures for managing IOKS of explicit and tacit knowledge (van Fenema and Loebbecke 1998). The management of explicit knowledge may require

- contractually defined *quid pro quo* knowledge exchange contents and procedure,
- interorganizational coordination by mutual adjustment, and
- intraorganizational planning and control procedures.

With regard to tacit knowledge, transfer management should include

- close interaction in interorganizational collaborative teams,
- managing dual commitment by rotating members of interorganizational teams, and
- structuring intraorganizational knowledge flows.

Clearly, measures aimed at IOKS need to include intraorganizational coordination and control procedures in order to prepare a firm for coopetition. These are discussed in detail in the next section.

Managing IOKS of Explicit Knowledge

Presence in, and knowledge of, local markets often differs between firms with comparable R&D and marketing competencies. In order to enable both firms to leverage their competencies, exchange of such complementary local knowledge is often a viable strategy. This may trigger a process of exchanging, for example, marketing and sales information, and knowledge of local business opportunities and economic developments. The explicitness of knowledge allows comprehensive contracts that specify the contents and procedures of IOKS. Internally, explicit guidelines and task partitioning define organizational expectations for collecting and formatting the transferable know-how.

Mutual knowledge sharing provides for a feature that has been referred to as the *quid pro quo* problem (Hamel, Doz, and Prahalad 1989). *Quid pro quo* suggests interdependence between the work flows and, thus, exacerbates the needs for coordination (Crowston 1997). Contracts will, therefore, contain stipulations defining how IOKS is to be undertaken and mutually dependent planning of intermediate deliveries. In practice, mutual dependence necessitates frequent meetings between firm representatives to provide feedback and to adjust corporate performances (Van de Ven, Delbecq, and Koenig 1976).

Cooperation agreements stress the mutuality and equivalence of firms' expected performance. However, in practice, each partner may be tempted to unilaterally enhance its added value from the cooperation. This comprises strategies aimed at decreasing the volume and value of the information that an organization shares. From a recipient's point of view, it also suggests attempts to increase the volume and value of incoming flows. For example, a firm may ask for clarification and additional contextual information beyond the IOKS covered by the formalized agreement.

Internally, contractual clauses are complemented by, and translated into, bureaucratic guidelines (Jaeger and Baliga 1985). For example, standard operating procedures are implemented to clarify and ensure intraorganizational compliance to the contract and alignment to corporate interests. On an operational level, firms will need to screen carefully their partner's performance and adjust accordingly.

Managing Interorganizational Transfer of Tacit Knowledge

Procedure for managing tacit knowledge are more problematic. In high technology industries that thrive on rapid R&D, IOKS is crucial to competitiveness. Examples include the semiconductor industry in which knowledge transfer is prominent (Appleyard 1996). In conjunction with the pace of technological progress, such industries often require considerable investments in R&D. This often motivates external cooperation to mutually benefit from complementary know-how (Powell 1996).

Attempts to foster knowledge transfer in high technology industries include oft-described examples of Japanese and U.S. firms, like NEC and Honeywell, GM and Toyota (Hamel, Doz, and Prahalad 1989). The strategic dynamics of tacit IOKS concern the equality of knowledge flows. The assumption of intensive collaboration implies that firms participate equally in, and contribute to, cooperative agreements with respect to quality and added value of know-how. However, the leverageability of knowledge being shared and the partially conflicting interests may tempt organizations to deviate from the initial agreement. Examples

are strategies to deliver inaccurate information, combined with enhancing the reception of valuable knowledge.

Managing these dynamics is hampered by tacitness and reciprocity of knowledge exchange. The former impedes *ex ante* specification of the content and procedure for transferring. Implications of the latter are more complicated.

Reciprocity of workflows necessitates intensive interdependence and interaction between professionals from both firms. To sustain these increased information processing needs, the literature proposes various group modes for work coordination (Van de Ven, Delbecq, and Koenig 1976). For instance, partners may organize interorganizational task forces or project teams to foster synergetic knowledge creation and exchange. In order to make such teams work effectively, socialization and interpersonal contacts are required (Katzenbach and Smith 1993). These should yield feelings of collegiality and commitment to the group (McGrath 1994). The firm may view things differently, however. As Hamel, Doz, and Prahalad indicate, "Collegiality is a prerequisite for collaborative success. But too much collegiality should set off warning bells to senior managers." In other words, team-centered commitments may conflict with the interests of the firm. There are similarities in professional (e.g., medical) and pseudo-professional (e.g., software developers) situations in which employees feel more bound to their profession rather than to their employers.

Firms need to provide corporate knowledge to members of interorganizational teams. At the same time, organizational knowledge expands during team work, yet project members spend less time in their own organization to absorb these novel competencies. However, even if project members had access to the latest corporate knowledge, the organization would be reluctant to share it with them: the tacit character and team commitment of project members limits the firm's capacity to control actual knowledge sharing in the project team. Yet in contrast, firms need to tap the knowledge available in the team and disseminate it within.

This configuration provides for complicated coordination and control. Formalized contractual agreements cannot comprehensively capture the mutual contingencies introduced by task interdependence (McCann and Galbraith 1981). Hence, inevitably incomplete contractual statements and internal bureaucratic procedures need to be complemented with people-based strategies. Examples include fostering frequent contacts between firm personnel and project participants (Hamel, Doz, Prahalad 1989). Alternatively, the organization can rotate its project members on a regular basis (Edström and Galbraith 1977). Such strategies balance project participants' commitment to both team and firm. Moreover, transfers of novel insights and results from the project to the organization are facilitated. Finally, project members re-entering the organization transfer and disseminate the knowledge acquired. This will have to be balanced with the learning time required for new team members to become acquainted with the project and presupposes that the firm has a sufficient supply of interchangeable potential project members.

Conclusions and Research Agenda

This paper has considered the problem of interorganizational knowledge sharing and offered both a theoretical model and developed a set of management actions. Managing interorganizational knowledge and information processes will play an increasing role in achieving sustainable competitive advantage.

The research here takes into account the ultimate goal of firms to increase their profits. The question is, to what extent cooperation, i.e., knowledge sharing, can be beneficial for an individual firm. Although sharing knowledge during coopetition involves a risk for the competitive game, Brandenburger and Nalebuff (1996, p. 38) point out that, "What matters is not whether others win—it's a fact of life that they sometimes will—but whether you win.... Sometimes the best way to succeed is to let others do well, including your competitors."

The extended game-theoretic analysis developed here provides a rich structure for modeling complex arrangements in which players' fortunes are interdependent, e.g., for modeling knowledge sharing in the context of coopetition. By focusing on strategic aspects, it leads toward a framework for further extending the understanding of issues involved in IOKS under coopetition. Development of this and other dynamic frameworks is enabled and sustained by cross-fertilizing insights from information systems literature, strategic management theory, economics, organization theory, and knowledge management (Spender 1996).

The proposed configurations of IOKS offer a contribution to both practitioners and academics. For practice, they provide professionals involved in business processes or projects crossing their organization's boundaries with insights and guidelines to manage knowledge transfer and to anticipate opportunities and pitfalls. They might further consider how to make their organizations receptive to the knowledge gained from exchange as well as flexible and responsive enough to gain competitive advantage if this is ephemeral. It may be that knowledge is bundled with other physical assets and that there are prerequisites for using the knowledge fully. In some cases, there will be power disparities between the cooperating parties (customer and supplier, small business and large) which may dictate the extent of knowledge shared.

For researchers, this paper provides the basis of a theory of managing interorganizational knowledge sharing under coopetition. A research agenda encompasses the following: First, the game-theoretic framework needs further refinement, extension, and integration with related theories. Such extensions might include the transactions costs of knowledge exchange, mechanisms and uncertainties in the value of knowledge exchanged, minimization of the costs of leverage or exploitation, and the time value of knowledge. Economic theories and recent developments in organization theory like complexity theory may be a fruitful start. More specifically, introducing "time" as additional dimension (simulations with more than one decision point per party, impact delays) or designing and analyzing the impact of adequate incentive structures for mutually beneficial IOKS during coopetition would be apposite. Further, the paper does not elaborate on situations in which benefits from cooperation are positive yet unequally distributed for the organizations involved. In parallel, empirical research needs to investigate hypotheses based on the framework and the management measures outlined here. However, empirical research is hampered by the difficulty of measurement (Madhok 1997) and issues of confidentiality.

Finally, the true source of competitive advantage arises not from embodied and visible elements of knowledge but from the supporting infrastructure and complementary organizational capabilities around it (including and depending on IS) that enable exploitation of this advantage (Dunning 1988; Teece 1986). Here it will be the challenge for interorganizational information systems developers to design and implement appropriate infrastructures and applications to support value-orientated IOKS in the context of coopetition.

References

Appleyard, M. "How Does Knowledge Flow? Interfirm Patterns in the Semiconductor Industry," *Strategic Management Journal* (17), Winter, 1996, pp. 137-154.

Axelrod, R. *The Evolution of Cooperation*, Basic Books, New York 1984.

Badaracco, J. L. *The Knowledge Link*, Harvard Business School Press, Boston, M, 1991.

Bakos, Y., and Brynjolfsson, E. "Organizational Partnerships and the Virtual Organization," personal communication to the authors, 1996.

Buckley, P. J., and Casson, M. *The Future of the Multinational Enterprise*, Holmes & Meier, New York., 1976.

Brandenburger, A. M., and Nalebuff, B. J. *Coopetition*, Doubleday, New York 1996.

Brynjolfsson, E. "Information Assets, Technology and Organization," *Management Science* (40:12), 1994, pp. 1645-1662.

Cantwell, J. "The Theory of Technological Competence and its Application to International Production," in *Foreign Investment, Technology and Economic Growth*, D. McFertridge (ed.), University of Calgary Press, Calgary, Alberta, Canada, 1991, pp. 33-67.

Chandler, A. D. "Organizational Capabilities and the Economic History of the Multinational Enterprise," *Journal of Economic Perspectives* (6:3), 1992, pp. 79-100.

Coase, R. "The Nature of the Firm," *Economica* (4), 1937, pp. 386-405

Crowston, K. "A Coordination Theory Approach to Organizational Process Design," *Organization Science* (8:2), 1997, pp. 157-175.

Demsetz, H. "The Theory of the Firm Revisited.," *Journal of Law, Economics and Organization* (4:1), 1988, pp. 141-161.

Dunning, J. H. *Explaining International Production*, Unwin Hyman, London, 1988.

Drucker P. "The New Society of the Organizations," *Harvard Business Review* (70), September-October 1992, pp. 95-104.

Edström, A., and Galbraith, J. R. "Transfer of Managers as a Coordination and Control Strategy," *Administrative Science Quarterly* (22), June 1977, pp. 248-263.

Goshal, S. "Global Strategy: An Organizing Framework," *Strategic Management Journal* (8:5), 1987, pp. 425-440.

Grant, R. M. "Prospering in Dynamically-competitive Environments: Organizational Capability as Knowledge Integration," *Organization Science* (7:4), 1996, pp. 375-387.

Grossman, S., and Hart, O. "The Costs and Benefits of Ownership: A theory of Vertical and Lateral Integration," *Journal of Political Economy* (24:4), 1986, pp. 691-719.

Hamel, G. "Competition for Competence and Interpartner Learning within International Strategic Alliances," *Strategic Management Journal* (12), Winter Special Issue, 1991, pp. 83-103.

Hamel, G.; Doz, Y. ;and Prahalad. C. K. "Collaborate with Your Competitors—and Win," *Harvard Business Review* (67), January-February 1989, pp. 133-139.

Hart, O. D. "Incomplete Contracts and the Theory of the Firm," in *The Nature of the Firm: Origins. Evolution, and Development*, O. E. Williamson and S. G. Winter (eds.), Oxford University Press, New York, 1991.

Hart, O., and Moore, J. "Property Rights and the Nature of the Firm," *Journal of Political Economy* (98:4), 1991, pp. 1119-1158.

Hedlund, G., and Rolander, D. "Action in Heterarchies: New Approaches to Managing the MNC," in *Managing the Global Firm*, C. A. Bartlett, Y. Doz and G. Hedlund (eds.), Routledge, London, 1990, pp. 15-46.

Jaeger, A. M., and Baliga, B. R. "Control Systems and Strategic Adaption: Lessons from the Japanese Experience," *Strategic Management Journal* (6), 1985, pp. 115-134.

Katzenbach, J. R., and Smith, D. K. *The Wisdom of Teams: Creating the High-Performance Organization*, Harvard Business School Press, Boston, MA, 1993..

Kogut, B. "Joint Ventures: Theoretical and Empirical Perspectives," *Strategic Management Journal* (9:4), 1988, pp. 139-332.

Loebbecke, C., and van Fenema, P. C. "Towards a Theory of Interorganizational Knowledge Sharing during Coopetition," in *Proceedings of European Conference on Information Systems*, Aix-en-Provence, France, 1998, pp. 1632-1639.

Lorange, P. "Strategy at the Leading Edge–Interactive Strategy–Alliances and Partnership," *Long Range Planning* (29:4), 1996, pp. 581-584.

Madhok, A. "Cost, Value and Foreign Market Entry Mode: The Transaction and the Firm," *Strategic Management Journal* (18), 1997, pp. 39-61.

March, J. G. "Exploration and Exploitation in Organizational Learning," *Organization Science* (2), 1991, pp. 71-87.

McCann, J. E., and Galbraith, J. R. "Interdepartmental Relations," in *Handbook of Organizational Design*, P. C. Nystrom and W. H. Starbuck (eds.), Oxford University Press, New York, 1981.

McGrath, J. E. *Groups: Interaction and Performance*. Prentice-Hall, Englewood Cliffs, NJ, 1994.

Mody, A. "Learning Through Alliances," *Journal of Economic Behavior and Organization* (20), 1993, pp. 151-170.

Nonaka, I., and Takeuchi, H. *The Knowledge-Creating Company*, Oxford University Press., New York, 1995.

Powell, W. W. "Trust-Based Forms of Governance," in *Trust in Organizations: Frontiers of Theory and Research*, . R. M. Kramer and T. R. Tyler (eds.), Sage, Thousand Oaks, CA, 1996.

Prahalad, C. K., and Hamel, G. "The Core Competence of the Corporation," *Harvard Business Review* (68), May-June 1990, pp. 79-91.

Preiss, K.; Goldman, S. L.; and Nagel, R. N. *Cooperate to Compete*, van Nostrand Reinhold, New York, 1996.

Rugman, A. M. "Internationalization as a General Theory of Foreign Direct Investment: A Reappraisal of the Literature," *Weltwirtschaftliches Archiv* (116), 1980, pp. 365-379.

Schrader, S. *Zwischenbetrieblicher Informationstransfer. Eine empirische Analyse kooperativen Verhaltens*, Dunker & Humbolt, Berlin, 1990.

Spender, J. C. "Making Knowledge the Basis of a Dynamic Theory of the Firm," *Strategic Management Journal* (17), Winter 1996, pp. 77-91.

Simon H. A. *Models of Bounded Rationality: Behavioral Economics and Business Organization*, The MIT Press, Cambridge, MA, 1992.

Teece, D. J. "Transaction Cost Economics and the Multinational Enterprise: An Assessment," *Journal of Economic Behavior and Organization* (7), 1986, pp. 21-45.

Thompson, J. D. *Organizations in Action*, McGraw-Hill, New York, 1967.

Van de Ven, A. H.; Delbecq, A. L. ; and Koenig Jr., R. "Determinants of Coordination Modes Within Organizations," *American Sociological Review* (41), April 1976, pp. 322-338.

van Fenema, P. C., and Loebbecke, C. "Strategic Coordination and Control of Interorganizational Knowledge Sharing," Working Paper, Erasmus University Rotterdam, The Netherlands, 1998.

von Hippel, E. "'Sticky Information' and the Locus of Problem Solving: Implications for Innovation," *Management Science* (40:4), 1994, pp. 429-439.

Walz, D. B.; Elam, J. J. ; and Curtis, B. "Inside a Software Design Team: Knowledge Acquisition, Sharing, and Integration," *Communications of the ACM* (36:10), 1993, pp. 62-77.

Williamson, O. E. *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York, 1975.

Williamson, O. E. "Transaction-Cost Economics: The Governance of Contractual Relations," *Journal of Law and Economics* (22), 1979, pp. 233-261.

Williamson, O. E. *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, Free Press, New York, 1985.

Williamson, O. E. "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives," *Administrative Science Quarterly* (36), 1991, pp. 269-296.

About the Authors

Claudia Loebbecke holds the KRAK Chair in Electronic Commerce at Copenhagen Business School. She received her MBA at Indiana University and her Ph.D. at the University of Cologne. She has worked at McKinsey & Co., INSEAD, HKUST, University of New South Wales, and Erasmus University. She is associate editor of *Information Systems Journal* and on the editorial board of three international journals. E-mail: Loebbecke@cbs.dk

Paul C. van Fenema is a Ph.D. student at Rotterdam School of Management. He studies the impact of global distributedness on the coordination and control of IS development projects. He conducted research with Ford Motor Company, and graduated cum laude in Law and Economics from Utrecht University (The Netherlands). E-mail: pfenema@fac.fbk.eur.nl

Philip Powell is Professor of Information Systems at Goldsmiths College, University of London. He is the author of four books on information systems and financial modeling and has published widely in international journals. He is managing editor of *Information Systems Journal* and associate editor of *Journal of Strategic Information Systems* and *OR Insight*. E-mail: orspp@wbs.warwick.ac.uk