McMaster University
MICHAEL G. DEGROOTE SCHOOL OF BUSINESS

RESEARCH AND WORKING PAPER SERIES

KNOWLEDGE MANAGEMENT IN NETWORK ORGANIZATIONS

By

Norm Archer and **Shan Wang**

Michael G. DeGroote School of Business
McMaster University
Hamilton, Ontario

Working Paper # 456

July, 2002

Table of Contents

1. Introduction

As competition in the global marketplace strengthens and technological change makes available better communication infrastructures and means to collaborate through eBusiness technologies, firms are increasingly moving towards cooperative ventures that take advantage of the complementary expertise of multiple firms to compete effectively. Due to the close relationships employed by such arrangements, they are known as network organizations. Strategically, a network organization is a long-term arrangement among distinct but related organizations that support the included organizations in gaining or sustaining competitive advantage (Jarillo 1988). Partnerships among network organizations rely on synergy, where collaborating organizations can profit more by pooling complementary resources (e.g. through outsourcing, supply chain arrangements, partnerships with organizations that have complementary expertise, etc.) than through independent operations.

Network organizations (often referred to as strategic alliances) come in a variety of forms and structures: joint ventures, minority equity alliances, joint R&D, joint production, co-marketing, licensing, long-term supply agreements, consortia, and so on. These forms differ primarily in the nature and closeness of their inter-organizational linkages, in turn determined by the strategic objectives of the participating firms. There has been a phenomenal growth in applications of network organizations during the last decade (Gulati and Gargiulo 1999), with the number of U.S. business alliances increasing at the rate of 25% per year during much of the 1990s (Harbison and Pekar 1998). For example, network organizations now underlie the productive power of the automobile, electronics, pharmaceutical, biotechnology, and apparel industries. A side effect of this trend has been a consolidation and reduction in the number of independent firms (Phillips 2000).

Some of the principal motivations for creating inter-organizational alliances have been identified as (Faulkner 1995) (Barringer and Harrison 2000): resource dependencies (e.g. in supply chains), spreading risk (e.g. joint development), speed to market (e.g. leveraging specialized expertise and knowledge of partner firms), cost reduction (e.g. in business process or IT outsourcing arrangements), flexibility (ability to form or terminate relationships quickly without major investments), learning (e.g. acquiring expertise through reciprocal arrangements),

neutralizing or blocking competition, and creating effective competitive forces through organized partnerships. One demonstration of the impact of network organizations is the diffusion of lean production practices (better labour productivity and inventory reductions) through network organizations, credited for the ability of Japanese auto makers to outpace North American firms prior to the late 1980s (Lieberman and Asaba 1997). Toyota's performance is often used as a benchmark to illustrate effective knowledge sharing in network organizations (Dyer and Nobeoka 2000).

Overlaying network organization structures are patterns of social relationships among sets of people, positions, groups, or organizations. These patterns can leverage the application of knowledge by providing a path for its distribution. Knowledge transfer and application is a critical determinant of network organization effectiveness, involving the sharing of customer, operational, and product information among the various network components (Passiante and Andriani 2000). However, network organizations have certain characteristics that may impede the transfer of knowledge and information, reducing their effectiveness and defeating the purposes for which such organizations are often created. We believe that the likelihood that a network organization will succeed is linked to the proper management, flow, and exploitation of knowledge resources among the component organizations. The purpose of this paper is to explore knowledge applications in network organizations, and to propose and demonstrate a framework for measuring the effectiveness of knowledge management in these organizations.

2. Knowledge Management

There are a large number of definitions of knowledge, particularly as it relates to information and wisdom. For our purposes, we will use the definition "familiarity, awareness, or understanding gained through experience or study". This will differentiate knowledge from information for which one definition is "arrangement of data into meaningful patterns." Although certain kinds of knowledge and information often make use of similar communications paths, the distinction between them is important in considering how to manage knowledge. In turn, we will define knowledge management as "the way that organizations create, capture and reuse knowledge to achieve organizational objectives."

"Knowledge, particularly as manifested in the creation of new products and services, has become a prominent source of wealth creation and sustainable competitive advantage" (Cole 1998). Factors that have increased interest in knowledge management include: a) growing speed of change, b) staff attrition, c) growth in organizational scope, d) geographical dispersion associated with market globalization, e) new structures, including network organizations, f) growing knowledge intensity of goods and services, and g) revolution in information technology.

An organizational survey (Khalifa, Lam et al. 2001) determined the relevant components of corporate knowledge management structures that impact knowledge management effectiveness. These were, in declining order of importance: strategy, technology fit, leadership, and culture. This indicates that knowledge management is more than the technical exercise of installing and implementing intranets, data warehousing, developing expert systems, and refining organizational routines. A survey of over 400 U.S. and European firms estimates that this represents only 25% of desirable knowledge management activities (Ruggles 1998). 50% of the activities are oriented to people, such as: establishing new roles to leverage knowledge, enabling knowledge (training and education), and making knowledge visible to the organization, and 25% to process: mapping sources of internal expertise, and creating networks of knowledge workers. A common mistake in implementing knowledge management projects is to assume that these activities can be treated separately. They must be approached in an integrated manner, in order to extract and utilize knowledge embedded within the organization effectively.

3. The Nature of Knowledge

A knowledge resource can be viewed both as a thing to be stored and manipulated and as a process of knowing and acting, or applying expertise. It can be tacit or explicit. Tacit knowledge or "know-how" is subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversations and shared experiences. Consequently, tacit knowledge may be difficult to transfer to other people or organizations, unless they have the cultural experience and background that enables them to receive the knowledge. Some tacit knowledge may be next to impossible to articulate and transfer, especially if it is know-how acquired through observation and experience. Tacit knowledge is part of an organization's core competency. As intellectual property it may be

embedded in collective work practice and thus easy to protect, but at the same time difficult to spread, coordinate, benchmark, or change (Lam 1997).

Explicit knowledge can be precisely and formally articulated (e.g. training manuals, textbooks, computer software, patents, formulas, etc.). It can be stored, retrieved, manipulated, and transferred more easily than tacit knowledge, but consequently is more difficult to protect as intellectual property. Tacit knowledge is more strategic than explicit resources, because it is more difficult to transfer and imitate. Tacit knowledge may often be transformed to explicit knowledge and thus made more readily available to others without direct interaction with the knowledge source itself (e.g. through expert systems).

Knowledge may range from the general to the specific (Grant 1996). General knowledge is broad, often publicly available, and independent of particular events. Because the context of general knowledge is commonly shared, organizations can more easily and meaningfully codify and exchange it - especially among different knowledge or practice communities. Specific knowledge is context-specific. Codifying specific knowledge so that it is meaningful requires that its context be given along with the focal knowledge. This requires explicitly defining contextual categories and relationships that are meaningful across knowledge communities, including provisions for cultural or natural language differences.

While tacit versus explicit knowledge refers to a particular knowledge dimension, there are two other dimensions relevant to knowledge resources in network organizations: specificity and complexity (Parise and Henderson 2001). Specificity refers to the potential redeployment of investments in knowledge resources. Resources with high specificity are specialized to particular needs (e.g. software development for one specific application), while a non-exclusive license in this case implies low specificity. Complexity or degree of partner interdependence also applies to knowledge transfer characteristics in network organizations. For example, a network partnership with a moderate degree of interdependence typically involves a sequential transfer of knowledge such as intellectual property licenses. A high degree of interdependence or high complexity involves simultaneous exchange of knowledge and other resources such as through a research and development agreement. The various levels of organizational interdependence are described in more detail in Appendix I.

4. Knowledge Applications in Network Organizations

There is a wide variety of knowledge applications in network organizations, and some are listed in Table 1. These provide the motivation for knowledge enablers, also summarized in Table 1. We have classified the applications as upstream, operational, and downstream. Although there are applications in each sector, the most prominent are in the upstream and operations sectors, normally a primary focus for knowledge management in network organizations.

Upstream

In the upstream sector, knowledge applications tend to be strategic, and are oriented to planning, designing, and developing new products or services. Generating, identifying, and propagating new ideas and best practices is promoted by inter-organizational learning (Dyer and Nobeoka 2000) (Powell 1998), including knowledge transfer through social exchange in distributed organizations (Hall 2001). Ideas for new or revised products are frequently garnered by suppliers through market research with lead users in customer firms (von Hippel 1988), and from knowledge gathered by the manufacturer as customer firms gain experience with existing products (Ritchie and Marshall 2002).

Firms are reluctant to share intellectual property and core competencies without prior legal agreements relating to trade secrets, patents and copyright (Dyer and Nobeoka 2000), and arrangements for reciprocal exchanges (Parise and Henderson 2001). These agreements can cover processes as well as products and other intellectual property.

Virtual collaboration through synchronous and asynchronous communications among and within network organizations is often used to overcome distance obstacles. Its role in knowledge transfer can be improved through (Qureshi and Zigurs 2001): management motivation, explicitly stating collaborative roles, collaborating on beneficial tasks (knowledge sharing, structure, and detailed teamwork), improving value by increasing cultural diversity of team members, appropriate training, and work practices. As an example of improving collaboration and competitive advantage by sharing ideas and designs, Bremer et al (Bremer, Mundim et al. 1999)

have developed an online system that supports knowledge interactions among SMEs in a network organization.

Table 1. Knowledge Applications in Network Organizations

Sector	Application	Enablers	References
Upstream	Generate, identify, propagate new ideas, best practices	Inter-organizational learning; B2B market research	(Dyer and Nobeoka 2000) (Powell 1998) (Hall 2001) (O'Dell and Grayson 1998) (Ritchie and Marshall 2002) (von Hippel 1988)
	Transfer/share intellectual property	Copyright, patent, trade secret agreements	(Dyer and Nobeoka 2000) (Parise and Henderson 2001)
	Collaborative design and product management	Virtual teams and collaboration systems	(Bremer, Mundim et al. 1999; Qureshi and Zigurs 2001)
	Time to market reduction	Outsource design, development, and/or manufacturing	(Phillips 2000) (Cullen and Hickman 2001) (Quinn 1999; Camuffo, Romano et al. 2001)
Operations	Inventory reduction	E.g. pull-type logistics (JIT)	(Lieberman and Asaba 1997) (Dyer and Nobeoka 2000) (Trethewey, Wood et al. 1998)
	Labour productivity improvement	Coordinate division of labour; Workflow, task management	(Lieberman and Asaba 1997) (Dyer and Nobeoka 2000) (Tillet 2001)
	Supply chain management and automation	Inter-organizational information systems; Work flow management	(Camuffo, Romano et al. 2001) (Lamming, Caldwell et al. 2001)
	Outsourcing	Inter-organizational information systems; Off-site technical expertise	(Lee 2001) (Currie 2000)
Downstream	Customer relationship management	Customer interaction databases, call centres; Mfr – distributor – customer links, online support; Data mining.	(Davenport and Klahr 1998) (Nasukawa and Nagano 2001) (Ritchie and Marshall 2002)

As the business environment becomes more competitive, one effective response is to reduce the time to market for new products and services. This is often accomplished by outsourcing to other firms one or more of the steps in the product cycle (Phillips 2000). This may be a particularly good choice for startup firms, allowing them to bypass the need to acquire and organize manufacturing and distribution facilities, reducing upfront investment, and shortening time to market. This may also be a particularly good way to acquire and to share knowledge with other organizations (Quinn 1999). Other reasons for outsourcing include reducing the cost of managing manufacturing infrastructure and under-utilized capacity, improving agility and flexibility, and the desire to invest in areas other than development and manufacturing, such as new product design, marketing and brand awareness. The nature of the contracts entered into is very important in achieving the expected efficiencies from these operations (Cullen and Hickman 2001). Also, some firms find that the resulting loss of control is not necessarily in their best interests, so that the use of such network organizations tends to evolve over time, (Camuffo, Romano et al. 2001) depending upon economic and competitive factors.

Operations

Inventory reduction and labour productivity improvement can be accomplished through pull-type production operations such as JIT (Just-In-Time), and workflow management systems that automate more routine operations and support employees in more productive tasks. Appropriate division and scheduling of labour among organizations in the network is critical to productivity gains (Dyer and Nobeoka 2000) (Lieberman and Asaba 1997). Automation of interactions between dissimilar systems has been supported through the development of standards for business processes by an industry consortium (Tillet 2001). Lamming et al (Lamming, Caldwell et al. 2001) advocate a transparency approach in exchanging knowledge among organizations linked in a supply chain. This permits the development of mutual understanding in order to achieve the most effective operations. Outsourcing service operations in order to reduce costs and to take advantage of the expertise of supplier firms has become standard for many organizations, particularly for IT services (Currie 2000) (Lee 2001).

Downstream

Downstream operations include marketing, sales, distribution, and service support although, of course, marketing input has a strong impact on upstream development choices as well. Network organizations can result, for example, from an arrangement where a firm markets its products and a partner firm agrees to distribute and service these products in an exclusive agreement that gives the distributor access to detailed knowledge about the products. Also, online support by manufacturers can provide product and service knowledge direct to customers, bypassing and supporting the other organizations in the supply chain. This approach can provide service-based product differentiation to customers (Davenport and Klahr 1998). Current business customers can be accessed to gather knowledge relevant to potential new or revised products (von Hippel 1988). Accumulations of information gathered through customer sales and support interactions can also be mined for knowledge relevant to customer needs and product strengths and weaknesses (Ritchie and Marshall 2002) (Nasukawa and Nagano 2001), feeding back to upstream development choices.

5. Knowledge Sharing and Transfer

There are several ways for a firm to acquire needed knowledge, expertise, or other resources quickly, aside from building or expanding its own internal organization. It can do so either by acquiring or merging with a firm with the desired knowledge and/or resources, or by forming a network organization with that firm. Even if implicit knowledge sharing and transfer is not the main motivation for such relationships, as is normally the case with supply chain networks, knowledge that contributes to the success of the relationship can be contributed by all the organizations involved. For example, inventory reduction in a supply chain is assisted by sharing detailed customer firm production schedules and other explicit production knowledge with supplier firms.

The nature of knowledge has an important impact on the knowledge transfer process (Bresman, Birkinshaw et al. 1999). If the relevant knowledge is tacit, and thus not readily communicated in written or symbolic form, it follows that its transfer across organizational boundaries will not be a trivial process. Such transfers can be facilitated by intense interaction between the two parties, and by the gradual creation of a single organization with a single social

community. In contrast, explicit knowledge such as that found in documented information (e.g. patents) is more easily transferred, because it relies more on legal agreements and less on social bonds between parties.

For some network organizations (see, e.g. (Chen 1999)), effective knowledge management and transfer may be crucial to their existence. Although there has been no organized empirical work to analyze how organizational knowledge creation and sharing can be improved, suggestions that are adaptable to network organizations include: incentive systems, mentoring programs, executive management declarations concerning expectations of trust and openness, training programs, and social events (von Krogh 1998). Transfer of tacit knowledge by debriefing after significant events such as conferences or seminars, important client, vendor, or regulator meetings, shortly after promotion or transfer, and just before leaving the company (Geisler 1999) are also adaptable to network organizations.

Other techniques for overcoming knowledge transfer barriers in network organizations include: a) appointing process champions who are committed to the knowledge sharing process, b) seeding component organizations with highly regarded and knowledgeable members from other organizations, c) using low risk, high payoff demonstration projects, d) arranging face-to-face meetings among participants regularly, e) providing systems specifically for project knowledge management, and f) using a variety of communication formats for both tacit and explicit knowledge. All of these activities require the leadership of committed champions of knowledge sharing, using these tools to improve trust and understanding among participants, as well as to open new avenues for sharing and communication.

5.1 The Learning Organization

There is some belief that the key role of the organization is creating, storing, and applying knowledge effectively (Dyer and Nobeoka 2000) (Seely Brown and Duguid 1998). The network organization amplifies this role (Kogut 2000), since it provides for: a) specialization and variety in markets and networks, b) ability to access additional knowledge, c) coordination guided by principles of network organization, d) availability as a knowledge repository, and e) competitive advantage through access to intellectual property rights. Inter-organizational social networks

play a significant role in the knowledge transfer process, where teamwork can assist in diffusing best practice and benchmarking (O'Dell and Grayson 1998).

The learning organization is a concept that builds on the role of an organization as a knowledge manager, by utilizing a regular pattern of interactions among individuals to permit transfer, recombination, or creation of specialized knowledge. This facilitates knowledge transfer across both internal and external organizational boundaries. Tacit knowledge may be communicated via regular meetings, and by having members of each organization share work assignments. Because extended communities (e.g. professional associations with similar practices, languages, and backgrounds) often cross organizational boundaries, it may be easier to move knowledge across such boundaries than among heterogeneous groups within an organization. Barriers to success in knowledge transfer include: lack of a legitimate language that all team members understand, stories of failures, and habits that team members share, formal procedures, and company paradigms (von Krogh 1998). Others include expertise highly regarded while mentoring and assisting others is not, inequality in status (e.g. doctor/nurse), distance (physical and time separation), and working group preference for a particular mode of communication (Leonard and Sensiper 1998). Dixon (Dixon 2000) suggests that the knowledge transfer process to be selected depends on the intended receiver, the nature of the task, and the type of knowledge being transferred, and proposes five models for knowledge transfer based on these three elements: serial, near, far, strategic, and expert transfer.

The Toyota network organization is often used as an example to demonstrate knowledge sharing (Dyer and Nobeoka 2000). Toyota takes the view that the key role of the organization is creating, storing, and applying knowledge rather than simply reducing transaction costs. It uses organizational learning to achieve sustainable competitive advantage through continually learning, adapting, and upgrading the capabilities of itself and its partners. Innovation-intensive fields such as biotechnology and pharmaceuticals also rely extensively on collaboration through network organizations. Their key challenge is to develop organizational routines for learning and transferring knowledge that are robust, flexible, and durable (Powell 1998). As mentioned below, an alternative approach is to learn through acquisitions (Vermeulen and Barkema 2001).

5.2 Mergers and Acquisitions Compared with Network Organizations

It is worthwhile to compare the advantages, disadvantages, and similarities between merger and acquisitions (M&As) and network organization approaches. First, the knowledge transfer process becomes permanent through M&As, and reciprocity between organizations under the same ownership is usually not a concern. Second, the new organization is hierarchical in nature, and this reduces the need to negotiate sharing and control over resources and knowledge. Third, hierarchical controls are superior for task coordination. Nonetheless, undertaking successful M&As requires due diligence, taking into account the relative cultures of the two organizations and the potential for achieving full value in the newly formed organization (Fretty 2001). Careful investigation and planning that includes a review of the compatibility of the economic, social, and systems views of the organizations in the network, of the type often undertaken prior to mergers and acquisitions (Ambrosio 2000) (Archer and Yuan 2000), is no less important as a pre-requisite to effective knowledge management in a network organization.

Organizing and managing relationships in a network organization is more difficult. Formal authority structure is lacking, and there is concurrent conflict and cooperation among participating organizations. This results in significant uncertainty and a need for mutual adaptation and adjustment (Barringer and Harrison 2000). These problems can worsen as the number of firms in the network increases. The difficulty in transferring tacit R&D know-how among organizations adds to the problem of controlling and assessing the value of such transfers. However, there are advantages to a network organization, since it is a temporary arrangement, and can be disbanded when it is no longer useful. There is also likely to be less initial investment and less at risk by the organizations involved. Network organizations accomplish conflict resolution by reciprocity considerations and the benefits of recurring contracts. Network relationships, although not permanent, are typically long-term, flexible, and built on a high degree of trust (Powell 1990) (Van Alstyne 1997).

6. Organizational Factors Affecting Knowledge Management in Network Organizations

There is a considerable literature on knowledge management in network organizations. In this section, we will attempt to characterize and summarize this literature in agreement with

certain factors we have identified. Van Alstyne (Van Alstyne 1997) suggests taking three general views of network organizations: economic, social, and information processing (systems). These views are useful in categorizing the factors in our discussion. Table 2 summarizes in these three categories (we have expanded the "economic" category to include strategic considerations) the factors we have found in the literature that are likely to affect knowledge applications in network organizations, along with literature references discussed in the following text.

Table 2. Factors Affecting Knowledge Management in Network Organizations

Relevant View	Factor	References
Economic/ Strategic	Reciprocity, and symmetry in value returned to IP owners	(Dyer and Nobeoka 2000) (Lam 1997)
	Network organization strategy and business strategy alignment	(Khalifa, Lam et al. 2001; Parise and Henderson 2001)
	Risk: application, inter-organizational coordination	(Gulati and Gargiulo 1999) (Das and Teng 2001) (Nooteboom 2000)
	Knowledge diversity at both strategic and technical levels	(Vermeulen and Barkema 2001) (Pascale 1999)
Social	Commitment to appropriate learning mechanisms	(Dyer and Nobeoka 2000) (Hansen 1999) (Lincoln, Amadjian et al. 1998) (Seely Brown and Duguid 1998)
	Leadership capability and compatibility	(Khalifa, Lam et al. 2001) (Davenport, DeLong et al. 1998)
	Cultural compatibility: communications, and organizational climate	(Fretty 2001) (Lam 1997) (Tricker 1999)
	Level of inter-organizational and inter-individual trust	(Das and Teng 2001) (Lincoln, Amadjian et al. 1998) (Blois 1998) (McCutcheon and Stuart 2000)
Systems	Level of business process and business system integration	(Fretty 2001) (McCutcheon and Stuart 2000) (Albino, Garavello et al. 1999) (Papazoglou, Ribbers et al. 2000) (Scott 2000) (Lamb 2002)
	Degree of user acceptance and use of knowledge support systems	(Lin and Shao 2000) (Lucas and Spitler 2000)
	Level of knowledge management system appropriation	(Davenport, DeLong et al. 1998) (Hahn and Subramani 2000) (Levitt and March 1988)

It will be apparent from our discussion that these factors are not necessarily independent, with interdependencies extending among the three major views, even though they may represent different aspects of network organizations.

Economic Factors

Reciprocity plays a key role in network organizations, since benefits must flow to each organization if it is to maintain its membership. Lam (Lam 1997) discusses how societal differences can weaken technological relationships between partner firms and lead to asymmetries in knowledge transfer. However, a balance can be struck between customer and supplier intellectual property asymmetries through price adjustment on goods or service exchanges. Reciprocal arrangements are typically spelled out in formal contracts, but how they are composed can potentially inhibit efficient supply chain relationships (Cullen and Hickman 2001). As an example of reciprocity, in the Toyota network, intellectual property rights are treated as if they reside at the network level rather than at the firm level. The Toyota approach to knowledge sharing is to provide free expertise to its suppliers, and to allow full access to Toyota's operations and store of knowledge. In turn, suppliers must open their plants to other network members if they wish to receive consulting assistance and to take part in Toyota core groups. Suppliers receive 100% of the savings realized, but are expected to share these with Toyota through price reductions (Dyer and Nobeoka 2000).

Network organization strategy and business strategy alignment. An empirical study by Khalifa et al (Khalifa, Lam et al. 2001) showed that the alignment of organization strategy and business strategy was the most important measure in determining knowledge management effectiveness in organizations. This is in agreement with Parise and Henderson's (Parise and Henderson 2001) findings on the alignment of alliance and business strategies.

Uncertainty and risk. Gulati and Gargiulo (Gulati and Gargiulo 1999) suggest that an organization needing to form a network to cope with an uncertain environment also must deal with uncertainty resulting from a lack of information about the true capabilities, needs, and behavior of potential partners. For this reason, network formation is primarily among organizations that already have relationships, thus reducing this source of uncertainty and risk.

They also note that the formation of new alliances is more likely if organizational interdependence (complexity) is high. Das and Teng (Das and Teng 2001) link risk with trust and control in strategic alliances, and indicate that risk may be reduced through trust-building techniques and control mechanisms. Nooteboom suggests a non-exhaustive list of coordination forms to manage innovation and risk in network organizations, including coordination by: integration, legal contracting, mutual self-interest, commitment and trust, and network structure. Other sources of risk and uncertainty arising from the application and/or the marketplace may be reduced through complementary efforts of network partners.

Knowledge diversity in any organization reduces over time because of common experience and environment. This is known from experience (Oliver 2001) and can be demonstrated from complexity theory (Pascale 1999) to be a cause of organizational failure. It can be countered strategically by bringing in new organizational members from time to time. Forced interactions among firms by forming networks tends to administer shocks and counter the development of "more of the same" through internal growth (Vermeulen and Barkema 2001). This can revitalize a firm and enhance its ability to react adequately to changing circumstances. If properly initiated and managed, it may also enrich organizational knowledge bases and break the rigidities of the participating firms, enhancing the viability of later ventures. The downside is that it may lead to cultural clashes and tensions, causing initial problems and unsatisfactory performance. Of particular interest are network organizations such as the Japanese *keiretsus* that rely on long-term relationships and trust. These may or may not be effective after a period of time because of the lack of fresh external insights from time to time in these organizations, so it is necessary to encourage network knowledge growth through the persistent pursuit of innovation (Dyer and Nobeoka 2000).

A different perspective is evident when two or more organizations with similar organizational knowledge and cultures join in a network. This has the advantage that there is little tension or need for knowledge transfer, economies of scale and geographic scope can result, but the lack of diversity can inhibit innovation. One could expect this type of arrangement to be superior where the organizations were constrained by legal or professional standards to work within a specific framework such as those applicable to the accounting, legal, or medical professions.

Social Factors

Learning mechanisms. A key strategic question is whether to use inter-organizational partnerships as a learning tool to increase the stock of in-house skills, or alternatively as a means of getting the job done without the burden of acquiring such skills (Lincoln, Amadjian et al. 1998). If the choice is to share knowledge (e.g. in joint product research and development), then the concept of weak interunit ties and the notion of specific versus general knowledge can be used to explain the sharing of knowledge across organizational subunits. This is also relevant to a network organization, since the learning dimension among organizations is expected to be similar to multiunit organizations. Findings showed that weak interunit ties helped a project team search for useful knowledge in other subunits but impeded the transfer of specific knowledge, which tends to require a strong tie between the two parties to a transfer (Hansen 1999). It is worth noting that informal trading of know-how often occurs between organizations that do not formally belong to a network. In fact, these organizations may be competitors, with one extensively documented example being steel mini-mills in the United States (von Hippel 1988). There may be little value to such firms in joining a network to get access to knowledge, if it is already available informally.

Leadership. It would be surprising if leadership of a group of people who are willing to take ownership of knowledge management initiatives in a network organization were not a significant factor in knowledge management. An empirical study of knowledge management in individual organizations (Khalifa, Lam et al. 2001) found that leadership was a significant factor in these organizations. One could anticipate that the coordination role among organizations in a network would be even more critical to the success of such initiatives. Top management support in participating organizations (Davenport, DeLong et al. 1998), along with champions willing to back the initiative, would also be critical to the leadership role. A further complication in a network organization is that the styles of leadership in collaborating organizations may clash, reducing the likelihood that the organization's objectives will be achieved.

Cultural compatibility Evaluating the culture compatibility of an organization which is a prospective network partner is an important component of the due diligence that should be

exercised by the prospective partners, and is similar to the examination of a potential acquisition candidate (Fretty 2001). Cultural differences can block knowledge transfer between organizations that could otherwise benefit greatly from such interactions (Lam 1997), and these can be due to both or either of communications problems or cultural differences (i.e. "the way we do things here") among participating organizations and the knowledge workers in these organizations (Tricker 1999).

Trust. Although there are numerous definitions of trust available, in this context an appropriate definition is that trust is about positive expectations regarding the other in a risky situation (Das and Teng 2001). It can be a factor at both the individual and organizational level. Trust can be conceptualized in multidimensional terms, such as goodwill trust and competence trust (Das and Teng 2001). It is a critical factor in building business to business relationships, resulting in benefits of a cooperative and mutually supportive approach in these relationships (McCutcheon and Stuart 2000). The dynamics of these relationships are interpreted differently from a trust perspective than they would be from a power relationship perspective (Blois 1998), where damage could result if trust is lacking. Certain cases can be used to demonstrate the prevailing paradigm of how long-term, high-trust supply relations in Japan enhance organizational knowledge creation, learning, and innovation (Lincoln, Amadjian et al. 1998). Trust is essential in building cooperative and mutually supportive approaches in network relationships, and market power of individual firms that enforces such relationships is not a substitute. However, a power imbalance between larger and smaller firms can also cause a fear of becoming too dependent, and learning and knowledge transfers can be slowed down in networks if only the larger firms control product designs or technologies (Barringer and Harrison 2000).

Systems

Business process and business systems integration Supply chain management can be undertaken in the form of supplier alliances, where firms develop mutually beneficial, longer-term relationships with certain suppliers, working more closely than with traditional contract-based, arm's length relationships. Such longer-term relationships may make the suppliers more

willing to invest in skills or technologies specific to the partner firm (McCutcheon and Stuart 2000), often integrating business processes among the firms and automating repetitive tasks (Archer and Gebauer 2001). Although such alliances have been widely touted as a solution to supply chain management, there are probably a limited number of situations where they are applicable. However, the advantages of such alliances can include cost reductions, better access to beneficial, although not necessarily core, technologies, and better technology transfer (McCutcheon and Stuart 2000) (Albino, Garavello et al. 1999). In terms of inter-organizational interaction for the purpose of sharing knowledge, a social actor approach can provide a framework for examining the effectiveness of inter-linked communication systems such as intranets (Lamb 2002).

The integration of inter-organizational systems is a critical aspect of network organizations (Papazoglou, Ribbers et al. 2000). Explicit knowledge can be stored and accessed in an informal and unstructured format or through a formal knowledge management system (KMS), but effective knowledge management requires that inter-organizational linkages be available when and as required so knowledge can cross organizational boundaries easily. One would expect that a combination of stored and updated knowledge in a KMS, combined with an integrated communications system to convey tacit knowledge, would be the best way of supporting inter-organizational knowledge transfer. Integrated IT systems are ideal for codifying and transferring explicit knowledge, while e-mail, groupware, intranets, videoconferencing, or electronic document-based systems help to convey tacit knowledge through dialogue and interaction. Integrated IT systems have been found to facilitate inter-organizational learning (knowledge transfer) through: lower-level learning via feedback mechanisms using explicit knowledge encoded in information systems (e.g. inventory levels, orders); higher level learning using modeling technologies (e.g. decision support systems); direct learning by tracking supplier performance and encouraging collaboration; and indirect learning by improving collaboration through various technologies such as e-mail and videoconferencing (Scott 2000).

User acceptance and use of knowledge support systems. Most modern organizations make use of a variety of technologies to enhance communications, so employees can often choose among telephone, mobile phone, fax, e-mail, video conferencing, and other techniques for

contacting and sharing knowledge with colleagues, customers, suppliers and other organizational stakeholders. However, it is well known that employees who have an option to use or not to use a new system will be less likely to use it if they were not in some way involved in choosing and/or developing the system (Lin and Shao 2000). Furthermore, technology acceptance by users has a strong impact on the effectiveness of technology implementations (Lucas and Spitler 2000).

Knowledge management systems. A knowledge management system (KMS) is a system designed specifically for the storage, retrieval and distribution of knowledge. However, the implementation of KMS by organizations may have widely different objectives. A review of the objectives of 31 KMS projects by Davenport et al (Davenport, DeLong et al. 1998) resulted in four classifications for such projects: a) to create a knowledge repository, b) to improve knowledge access, c) to enhance the knowledge environment, and/or to d) manage knowledge as an asset. The usual assumption in installing a KMS is that the objective and the means of achieving that objective are well defined. However, a KMS by its nature may be ill-defined if not carefully planned in advance. Flexibility and maintenance of knowledge flows are thus important issues, including motivation of users to contribute to the knowledge base. In addition, the size and diversity of the knowledge network will affect its potential application – a more diverse and large set of knowledge requires more organization if it is to be useful (Hahn and Subramani 2000). A particular drawback of a KMS is that its continued use may result in a competency trap that inhibits rather than encourages organizational learning and adaptation (Levitt and March 1988).

7. Knowledge Dimensions and Network Organizations

Network organizations are not necessarily stable organizations, since their purpose for existence may change or disappear. However, if these organizations are to prosper during their useful lifetimes, certain relationships must be developed and fostered among their members (Cousins 2002). "To reduce the search costs and to alleviate the risk of opportunism associated with strategic alliances, organizations tend to create stable, preferential relationships characterized by trust and rich exchange of information with specific partners." (Gulati and

Gargiulo 1999) On the other hand, the dominant form of knowledge held in organizations, its degree of tacitness, and the way in which it is structured, utilized, and transmitted, can vary considerably between firms in different social settings. These differences have contributed to project failures, weakened relationships between partner firms, and resulted in asymmetries in knowledge transfer (Lam 1997). Although there is great interest in harnessing knowledge applications for the wider benefit of organizations, the failure rate of such efforts is estimated to exceed 50% (Ambrosio 2000), similar to the failure rate for network organizations (Kok and Wildeman 1999). Ineffective knowledge sharing may lead to the network's failure and disbandment, so it is important to anticipate and mitigate these problems in advance.

With these ideas in mind, an empirical analysis of a sample of network organizations can be used to evaluate the characteristics of effective knowledge management in such organizations. To do so, we must develop measures or dimensions that describe knowledge and network organizations, so suitable comparisons can be made. No two network organizations are likely to be the same in how they collaborate in generating, informing, and using knowledge in their activities, and the nature of the knowledge resource being shared can also vary on several dimensions. We have chosen as three of the three network knowledge dimensions (interdependence/complexity, tacitness, and specificity) identified by Parise and Henderson (Parise and Henderson 2001) to characterize knowledge management in network organizations. These have also been indicated as important by Lam (Lam 1997). Parise and Henderson also note that relationships between organizations (supplier, customer, competitor, complementor, or other) within the network affect its characterization, and we have added market power as fifth dimension since this will affect the willingness of organizations to join together in a network.

We are motivated in choosing the knowledge dimensions through the conclusions derived by Parise and Henderson (Parise and Henderson 2001), from a model they used to charactize relatively complex network organizations with many members. Knowledge dimensions in their model were those we show below in Table 3. For example, in a situation where all three knowledge dimensions are at their highest (highly tacit, high specificity, and high complexity), one would expect the situation to be high risk, but a successful outcome would be strategic with substantial competitive advantage. Situations where all three dimensions were low would tend to

result from an emphasis on improving operations, as in supply chain management. Many other situations can be derived from this model, making it useful for our purpose of analyzing binary relationships. For example, one partner could provide a low level of knowledge resource and another partner a high level of implicit knowledge through a resource such as product or technology licensing, including the provision of expert advice on the product. In this particular case, both complexity and specificity would tend to be low.

Table 3. Knowledge and Organizational Dimensions

Dimension	Levels	References
Interdependence/complexity among network firms	Low, Medium, High	(Gulati and Gargiulo 1999) (Rockart and Short 1991) (Parise and Henderson 2001) (Lam 1997)
Degree of knowledge tacitness	Low, Medium, High	(Bresman, Birkinshaw et al. 1999) (Parise and Henderson 2001) (Lam 1997)
Knowledge resource specificity	Low, Medium, High	(Parise and Henderson 2001) (Dyer 1996)
Inter-organizational relationships	Supplier, Customer, Competitor, Complementor, Other	(Parise and Henderson 2001) (Nalebuff and Brandenburger 1996)
Difference in relative market power of participating organizations	Low, Medium, High	(Barringer and Harrison 2000) (Dyer and Nobeoka 2000) (Mitchell and Singh 1996)

The following describes dimensions chosen for categorizing and comparing network organizations.

Interdependence/Complexity. Various environmental changes such as globalization, increased market risk, greater emphasis on customer services and team-based competencies, and competition have increased the extent of interdependence and its significance in organizational activities (Rockart and Short 1991). This phenomenon of interdependence has had an effect both internally within organizations, and among organizations. Lam (Lam 1997) indicates this dimension as the method of coordination and transmission among organizations. Parise and Henderson (Parise and Henderson 2001) describe interdependence as complexity in the context of organizational alliances, with high interdependence meaning high complexity and vice versa.

(See Appendix I for a more detailed description of the forms of interdependence). They suggest that low complexity derives from partner activities that precede one another and are linear or sequential, as in the case where one partner acquires knowledge the other partner already has.

At high levels of complexity, partners exchange knowledge resources simultaneously to achieve a shared strategic goal, involving a high degree of integration and coordination of knowledge resources for optimal learning, as in research and development agreements. Organizations may enter relationships with other organizations in response to the challenges posed by the interdependencies that shape their common environment. These interdependencies include resource procurement and uncertainty reduction. Organizations may also work with other organizations to meet their requirements and goals, causing interdependencies, which can be managed through cooperative efforts. Asymmetry, reciprocity, efficiency, stability, and legitimacy lead to cooperative ties that organizations use to address needs resulting from such interdependencies (Gulati and Gargiulo 1999).

Knowledge Tacitness. Tacit knowledge may be difficult to articulate and transfer, and it forms part of an organization's core competency (Lam 1997). On the other hand, since explicit knowledge is more likely to be tangible and contractual in form, it can be formally articulated. It is clear that the difficulty in knowledge sharing and transfer operations in network organizations will differ greatly, depending on the degree of tacitness of the knowledge in question. Techniques used in transferring knowledge will depend both on the nature of knowledge and on the relationships and characteristics of the organizations involved (Bresman, Birkinshaw et al. 1999).

Knowledge resource specificity. Knowledge resource specificity is defined as the specificity of a firm's knowledge resource contribution to the network. If the network involves exclusive and specialized resources for particular applications, such as an exclusive software or hardware license, specificity is high. There is some indication that higher resource specificity in a network organization can lead to better performance (Dyer 1996), although it is likely that other less positive considerations will also affect such organizations. For example, organizations with large investments in network-specific infrastructure for knowledge management will be less

likely to abandon such arrangements without first exploring all possibilities to make them work. Parise and Henderson (Parise and Henderson 2001), through an analysis of well-known network organizations with different knowledge specificity levels, concluded that specificity is important in network organizations.

Inter-organizational relationships. Relationships between firms (customer, supplier, complementor, competitor, or other), as suggested by Brandenburger and Nalebuff (Nalebuff and Brandenburger 1996) in defining co-opetition, and applied by Parise and Henderson (Parise and Henderson 2001)) to organizational alliances, will have a strong effect on how knowledge management is implemented. Categorizing networks according to these relationships will assist in comparing organizations in similar situations. For example, customer firms may be able to influence suppliers in network formation, operations, and policies on knowledge management.

Market power is another measure that can affect inter-organizational relationships. Market power can be viewed as a resource (Das and Teng 2001) that can be strengthened by the formation of network organizations to survive in the face of competition (Mitchell and Singh 1996). Such networks may be formed to neutralize competitor activities, when the individual organizations do not have the necessary resources to improve their own competitive position. Purchasing efficiency may also be negatively affected by a focus on power-dependence balancing if the object of exchange is subject to continuous joint development, obscuring potential for enhancing productivity and innovation through other relationships that impact collaboration (Dubois and Pedersen 2002). Another aspect of market power is that some organizations may have enough market power that the clusters of supplier or customer organizations with whom they interact have no alternative to joining the network, often on the terms of the majority player. Firms with significant market power and prestige may also form joint ventures with similar firms in other jurisdictions, extending and increasing market power through monopoly-type influence (Barringer and Harrison 2000).

8. Knowledge Management Effectiveness Measures

Network organizations that are considering or that have initiated knowledge management programs are struggling with the development of appropriate metrics to assess the effectiveness

of their initiatives. An important question for all such initiatives is whether they should be justified financially on a short term basis, or should they also be viewed as a long-term strategic approaches that can be likened to investments in research and development that may some day lead to innovations and increased efficiency? Knowledge management initiatives that impact performance positively can help justify the investment to senior management in participating organizations.

Measures of knowledge management effectiveness that were suggested by Davenport et al (Davenport, DeLong et al. 1998) to characterize knowledge management system (KMS) projects included: a) growth in resources attached to the project, b) growth in the volume of knowledge content and usage, c) likelihood of survival without the support of particular individuals (i.e. it is an organizational initiative), and d) evidence of financial return for the activity or for the organization within which the project is contained. We have adapted the latter two of these as network organization knowledge effectiveness measures, since they are related to outcomes rather than the internal workings of the organizations involved. We have added two others: evidence of long range strategic impact (independent of the short term financial return), and knowledge worker perceptions of value (knowledge management is strongly dependent on this user measure). The metric defined in Table 4 is proposed for knowledge management effectiveness in network organizations. Until empirical evidence can be gathered to validate this metric, we will assume that the overall effectiveness of knowledge management is based on equally weighted contributions from each dimension.

Table 4. Knowledge Management Effectiveness

Knowledge management effectiveness is an equally weighted contribution of the following:	
1.	Likelihood of survival of KM activities if a few key individuals are withdrawn from related activities (i.e. KM has become embedded in the network culture) (Davenport, DeLong et al. 1998)
2.	Evidence of financial returns to the component organizations (as derived from senior management views) (Davenport, DeLong et al. 1998)
3.	Evidence of long range strategic returns to the component organizations (as derived from senior management views)
4.	Knowledge worker perceptions of value returns

9. Framework for Knowledge Management Effectiveness in Network Organizations

This paper is part of a broader project for which the ultimate objective is to define best practices that can be used by organizations in transforming organizations to meet the challenges of the new economy. To develop an empirical basis for measuring effectiveness of knowledge management in network organizations, we have developed a framework (see Figure 1) based on the factors shown in Table 2. We propose these as potential success factors for knowledge management in network organizations, although a thorough empirical study will be required to determine if these are in fact critical success factors. A validated framework will help firms to determine the value of forming network organizations for the exchange of knowledge. If critical success factors can be identified, these can lead to the development of best practices for investigating, forming, and operating successful network organizations.

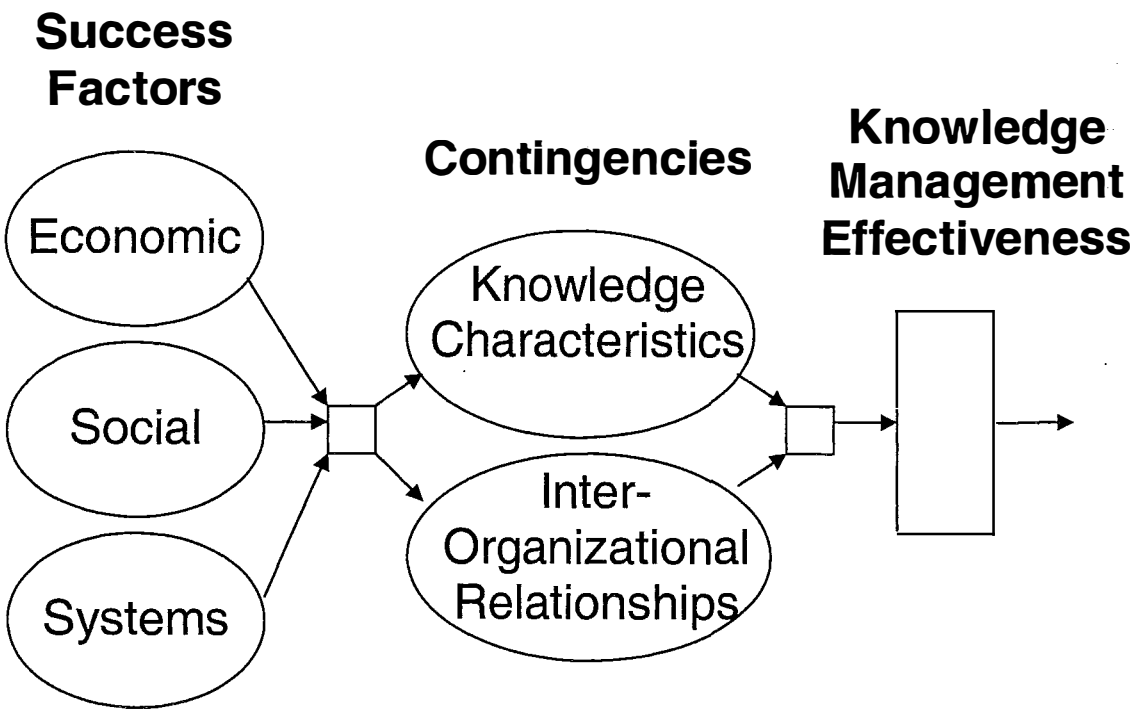

Figure 1

Knowledge Management Framework

The dimensions listed in Table 3 will be used to differentiate among situation dependencies that we expect to encounter, so comparisons can be made among similar network organizations.

The framework demonstrated in Figure 1 shows how the effectiveness metric defined in Table 4 can be used to evaluate specific situations.

10. Case Analysis Using the Proposed Framework

Five cases were selected from the literature in order to apply an initial test to the framework. These cases were deliberately widely varied, in order to test for initial flaws in the structure. Empirical data from a number of additional cases will be gathered from the field to finalize the framework, since the published cases were missing some of the information needed for validation. For example, as far as could be determined there has been no formal effort to implement a knowledge management system in any of the cases studied (see Table 7, where the "level of knowledge system application" is indicated as "U"). Cases are listed in Table 5. There is a summary description of each case in Appendix II, and more detailed discussion is available from the publication sources in Table 5. Table 6 has the situation descriptors for each case, and Table 7 lists the evaluations of the factors in each case. Finally, Table 8 includes the estimated effectiveness measures for these cases, using a simple + or – indicator for each component, conveying the necessary judgment outcomes.

Table 5. Case Organizations

Case No.	Case	Sources
1.	Japanese-British Technological Partnership (electronics industry)	(Lam 1997)
2.	Expressroses.com (Internet consumer sales and distribution)	(Timmers 1999; Slofstra 2000)
3.	Toyota (supplier network for auto manufacturer)	(Dyer 1996; Lincoln, Amadjian et al. 1998; Dyer and Nobeoka 2000)
4.	British Aerospace and CSC (IT outsourcing)	(Currie 2000)
5.	Omnexus (eMarketplace for injection and blow molding supplies, equipment)	(Rai, Weinlein et al. 2001)

Table 6. Knowledge and Organizational Dimensions for Case Organizations

Dimension	Levels	Case				
		1.	2.	3.	4.	5.
Interdependence/ complexity among network firms	Low, Medium, High	H	L	H	H	H
Degree of knowledge tacitness	Low, Medium, High	H	L	M	M	M
Knowledge resource specificity	Low, Medium, High	H*	L	M	M	H
Inter-organizational relationships	Supplier, Customer, Competitor, Complementor, (Sup,Cus,Comp,Cmpl)	Cmpl	Cmpl	Sup	Sup	Comp
Difference in relative market power of participating organizations	Low, Medium, High	L	H	H	L	M

* Firm 1 owned a controlling interest in Firm 2, but Firm 2 had a great deal of autonomy

Case 1. Japanese-British Technological Partnership

In this case, the two firms had roughly the same market power, and the intent of forming the network organization was to establish a complementary working relationship to exchange a significant amount of knowledge while working together on product innovations. The relative amount of tacit knowledge to be exchanged was high, knowledge resource specificity was high, and there was a high degree of interdependence established between the firms overall (the Japanese firm owned a controlling interest in the British firm, but allowed it a great deal of freedom). In the independent variables (see Table 7), the key measure is the low value of cultural compatibility. This in turn affected other variables, resulting in low levels of trust, and low symmetry in returns to the IP owners. The network strategy appeared to be well-aligned with business strategy, there was a moderate commitment to learning mechanisms, while application risk and leadership capability were moderate. Knowledge diversity was moderate, but the chief difficulty arose in communicating knowledge. No information was given on integration of business processes, information technology, or knowledge systems application.

This case was a failure (see Table 8), since both companies backed off from any significant knowledge exchange after the negative reaction to knowledge transfer, as reported in the published case. The main reason for failure was a severe mismatch of development and

production culture between the two companies. They probably would not have entered into this arrangement if this difficulty had been identified in advance of the partial takeover that preceded the attempted collaborative work. The problem might have been averted with a large amount of attention to selecting and coaching the individuals involved in knowledge transfer activities, but the problems they faced would be extremely difficult to overcome.

Table 7. Factors Affecting Knowledge Management in Network Case Organizations

Relevant View	Factor	Case[†]				
		1.	2.	3.	4.	5.
Economic/ Strategic	Reciprocity, and symmetry in value returned to IP owners	L	H	H	H	M
	Network organization strategy, business strategy alignment	H	H	H	H	H
	Risk: application, inter-organizational coordination	M	L	M	M	H
	Knowledge diversity at both strategic and technical levels	M	H	M	H	H
Social	Commitment to appropriate learning mechanisms	M	U	H	H	U
	Leadership capability and compatibility	M	H	H	H	H
	Cultural compatibility: communications and organizational climate	L	L	H	H	M
	Level of inter-organizational & inter-individual trust	L	H	H	M	M
Systems	Level of business process & business system integration	U	H	H	H	H
	Degree of user acceptance and use of knowledge support systems	U	U	H	H	U
	Level of formal knowledge systems appropriation	U	L	U	U	U

[†] L,M,H,U for Low, Medium, High, Unknown respectively

Table 8. Effectiveness Estimation

Effectiveness Measure	Case				
	1.	2.	3.	4.	5.
Likelihood of survival of KM activities if key individuals withdrawn from related activities	–	+	+	+	+
Evidence of financial returns	±	+	+	+	–
Evidence of long range strategic returns	–	+	+	+	+
Knowledge worker perceptions of value returns	–	U	+	+	U
Outcome‡	F	S	S	S	P

‡ Indicated outcome of the knowledge management case: F,P,S for Failure, Partially Successful, and Successful, respectively

Case 2. Expressroses.com

This is the simplest of the five cases studied. It is included because the key company is small and, while its relationship with its much larger partner is simple, the network has been highly effective. Interdependence is low, because the firms deal with a standardized interface for exchange purposes. Almost all knowledge is explicit, and knowledge resource specificity is low because the system being used by the network is easily available for use elsewhere. Expressroses has low power in its marketplace relative to FedEx, its main courier, in its marketplace, and the two organizations work in a complementary manner. There is symmetry in value returned to the two organizations according to their inputs, the network organization is fully aligned with the business strategy of both organizations, and application uncertainty and risk is low. Knowledge diversity is high, since both organizations know little about the knowledge used by their partners, and the leadership capability (in this case, the president of Expressroses) is high. Cultural compatibility appears to be low, since these companies are differ widely in many respects (Expressroses is a small entrepreneurial company with close relationships among managers and employees, while FedEx is a very large company with less personal interrelationships, and these companies are in totally different businesses). However, we perceive that the level of inter-organizational trust is high. Commitment to learning mechanisms is unknown. We assume that the level of knowledge systems application is low, and is represented, for example, by the online tracking system provided by the courier to

Expressroses customers. The level of business process integration and business system application integration are both high, and are key to Expressrose's ability to provide very fast order turnaround time.

In terms of effectiveness, although Mark Thiessen, President of Expressroses, was key to organizing and implementing the network, it is stable enough that his departure would have no negative effects on performance. It is very clear that both organizations are enjoying financial returns from the network and that it has been a highly successful strategic move. Knowledge worker perceptions of value are unknown. We classify this network as a success. In networks such as this, with low measures on the three knowledge dimensions, we believe that knowledge-dependent variables will have less effect on effectiveness, but that the other variables (including trust and cultural compatibility) continue to play key roles.

Case 3. Toyota Supplier Network

The Toyota network has been studied by many academics and other organizations wanting to learn how to manage knowledge effectively, since this is probably the best-known example of a successful knowledge management organization. Interdependence among the network firms is high, with Toyota playing a key role in implementing and managing knowledge transfer throughout the network. Both tacit and explicit knowledge is transferred, and knowledge resource specificity is moderate (i.e. although other organizations try very hard, it is difficult for organizations outside Toyota's network to copy their techniques successfully, but investments in knowledge resources by network firms could be used elsewhere as well). There is a substantial difference in market power of the organizations involved, and Toyota's dominance helps to ensure compliance from its suppliers. Application uncertainty and risk is moderate, as is knowledge diversity among the suppliers and Toyota. However, this is key to the gainful use of knowledge by suppliers, who stand to improve their operations substantially through access to knowledge from Toyota and other suppliers. There would be little need for the network if knowledge diversity were low and, unless there is new knowledge generated internally, this diversity will tend to become less over time. Although the level of knowledge systems application is unknown for this case, all the other parameters are rated as high. A particular key parameter is reciprocity since, although Toyota does not demand direct payment for knowledge it

dispenses, it expects a resulting lower cost of operation by suppliers to be returned to it in the form of lower prices.

All the four measures of effectiveness have positive results in this case. In particular, participating organizations reap a financial short term benefit, but the network is also strategically beneficial to its members in the long term.

Case 4. British Aerospace and CSC Corporation

This case is an example of total IT outsourcing by British Aerospace, the client, to the CSC Corporation as the supplier, that appears to be working well. There is a high degree of interdependence between the two firms, with knowledge being transferred between them simultaneously on various projects. Both explicit and tacit knowledge is shared, and there is a moderate level of resource specificity (i.e. some of the systems and support knowledge is specific to British Aerospace, but some is also applicable and transferable to other firms by CSC). The difference in relative market power of the two organizations is not large, and the choice of CSC as a supplier was based partly on the fact that it is a major player in its market.

Application uncertainty and risk is moderate. This is because there are many applications, and each has a manageable risk. The level of inter-organizational trust is moderate, because a healthy tension must be maintained between the two companies so both will perform well under the terms of the contractual relation. We have rated cultural compatibility high, since at the beginning of the relationship a large number of British Aerospace employees were transferred to CSC, resulting in cultural alignment. Clearly, business processes and systems would need to be integrated at a high level between the two organizations. It is not known whether a formal knowledge system application is in use. All the other parameters are rated as high. We feel confident that all the components of knowledge management effectiveness have a positive measure. In particular, there is a constant transfer of knowledge between the two organizations in support of the new developments at British Aerospace, and we believe that knowledge worker perceptions of the value of this network are positive. Because of the size of this operation, it is unlikely that it is dependent on a small number of individuals, and the financial and strategic benefits to both organizations are demonstrated by the fact that the contract continues.

Case 5. Omnexus eMarketplace

Omnexus is an eMarketplace in the injection and blow molding plastics industry, formed originally in 2000 by a consortium of five rival chemical companies to sell chemicals to the industry. Since then, eleven more suppliers have been added, including new and used equipment and related materials for the market. Both tacit and explicit knowledge is exchanged among the consortium, including catalog details, specialized software, and site management knowledge. Knowledge resource specificity is high, since inputs to this organization and the related online site would probably not be transferable to other sites (standards are not common in online marketplaces as yet). We have rated interdependence among the firms as high, since all are contributing knowledge that is being used simultaneously in the network. There is a moderate difference among the market power of the consortium firms, although this difference will grow as new (often smaller) consortium members are added.

Reciprocity is rated as moderate, because newer organizational members are joining on different terms (probably considerably less initial investment, for one thing) than the original five members. Knowledge diversity is high because, although the chemical firms bring much the same knowledge to the operation, there is a great deal of system and management knowledge specific to the eMarketplace that the member firms will be learning. No information is given about commitment to learning mechanisms, but cultural compatibility is indicated as moderate (the member organizations will tend to have their own specific ways of operating). The level of inter-organizational trust is moderate since these are competitors. We did not rank trust low because they would never collaborate if that were the case. Application and market uncertainty and risk is high, because there is no guarantee that, even after all this investment of time, money, and talent, that customers will actually use the marketplace. Clearly business process and business system integration are high; this is one premise that makes an eMarketplace work since it allows the automation of many transactional aspects.

We have rated this case as partly successful. It is not likely that the withdrawal of a few key individuals will harm the network seriously. However, there is no evidence of financial returns to this network. The strategic long-term benefit will be there, depending on whether the marketplace can attract a substantial fraction of potential business customers, since its operating

income is derived from transaction fees. We do not have enough information on knowledge worker perceptions of value. This case is likely more an example of market risk rather than knowledge application risk. If the consortium is willing to continue to support this network for long enough, it may succeed, but the investment at this point is still at relatively high risk.

11. Discussion

In this paper we have begun to address the broad issues of effective knowledge management in network organizations. We have identified the characteristics of network organizations and of knowledge, and described a number of knowledge applications in network organizations. A literature review has distilled the factors recognized as impacting knowledge management in network organizations, and we have developed the knowledge and organizational dimensions that can be useful in organizational categorization. We also defined a metric for evaluating the effectiveness of knowledge management. Based on these results we developed a framework for determining the effectiveness of knowledge management in network organizations, and demonstrated the framework in the context of a number of widely different published cases.

Preliminary conclusions, based on our findings thus far, include:

a) Knowledge and organizational dimensions, as listed in Table 3, are uncontrollable or independent factors, while the factors listed in Table 2 are controllable (mediators). We need to examine a substantial number of cases with widely differing dimensions to develop a good understanding of how well-managed networks ensure proper management of the controllable factors.

b) We can learn as much or more about effective knowledge management in network organizations by studying cases where the process failed, as we can by studying successful cases. Failures help to identify the true critical success factors. For example, the Case 1 failure was due primarily to a mismatch between the cultures of the two organizations involved. This in turn had a negative impact on trust and on reciprocity between the organizations, which therefore might be closely related to the same factor. Cultural compatibility was a critical success factor in this case, and may turn out to be a critical success factor for a particular class of organizations

identified by their controllable factors, when we have completed a statistical analysis of survey data based on the framework.

c) In all the cases studied, network organization strategy and business strategy alignment were judged to be high. But not all of the networks were successful. Does this mean this is not a critical success factor? No, because it is quite likely that a number of these factors have to be satisfactory before the network becomes a success. A statistical survey of network organizations is needed to improve our understanding of the importance of these factors.

d) Case 3, the Toyota supplier network, is an example where all of the factors we have identified appear to be in correct alignment. But this does not mean that all of these are critical success factors. Again, improved understanding awaits a proper statistical analysis of survey data.

As we have mentioned above, this paper represents only the beginning of the research project. The research methodology for examining knowledge management in network organizations consists of five stages of which the first two are now complete: (1) framework development based on a comprehensive literature review, (2) initial tests of the framework, based on published cases, (3) further refinement of the framework structure through additional field case studies, (4) instrument development, using appropriate methodologies (Moore and Benbasat 1991) and pre-testing, and (5) model validation through a survey of a significant number of network organizations. This paper has reported on the first two of these stages, and the remainder of the work is already underway.

12. References

Albino, V., A. C. Garavello, et al. (1999). "Knowledge transfer and inter-firm relationships in industrial districts: The role of the leader firm." Technovation 19: 53-63.

Ambrosio, J. (2000). "Knowledge management mistakes." Computerworld 34(27): 44.

Archer, N. and J. Gebauer (2001). B2B Applications to Support Business Transactions: Overview and Management Considerations. Business-to-Business Electronic Commerce: Challenges and Solutions. M. Warkentin, Idea Publishing Corp.: 19-44.

Archer, N. and Y. Yuan (2000). "Managing business-to-business relationships throughout the e-commerce procurement life cycle." Internet Research 10(5): 385-395.

Barringer, B. R. and J. S. Harrison (2000). "Walking a tightrope: Creating value through interorganizational relationships." Journal of Management 26(3): 367.

Blois, K. (1998). "A trust-based interpretation of business to business relationships: A case-based discussion." Management Decision 36(5-6): 302-309.

Bremer, C. F., A. P. F. Mundim, et al. (1999). New product search and development as a trigger to

competencies integration in virtual enterprises. Organizational Virtualness and Electronic Commerce, Zurich, Switzerland, Simowa Verlag Bern.

Bresman, H., J. Birkinshaw, et al. (1999). "Knowledge transfer in international acquisitions." Journal of International Business Studies 30(3): 439.

Camuffo, A., P. Romano, et al. (2001). "Back to the future: Benetton transforms its global network." Sloan Management Review 43(1): 46-52.

Chen, C. (1999). Information Visualisation and Virtual Environments. London, Springer-Verlag.

Cole, R. E. (1998). "Introduction to special issue on knowledge and the firm." California Management Review 40(3): 15-21.

Cousins, P. D. (2002). "A conceptual model for managing long-term inter-organisational relationships." European Journal for Purchasing and Supply Management 8: 71-82.

Cullen, P.-A. and R. Hickman (2001). "Contracting and economics alliances in the aerospace sector: Do formal contact arrangements support or impede efficient supply chain relationships?" Technovation 21: 525-533.

Currie, W. (2000). The Global Information Society. Chichester, UK, Wiley.

Das, T. K. and B.-S. Teng (2001). "Trust, control, and risk in strategic alliances: An integrated framework." Organization Studies 22(2): 251.

Davenport, T. H., D. W. DeLong, et al. (1998). "Successful knowledge management projects." Sloan Management Review 39(2): 49-58.

Davenport, T. H. and P. Klahr (1998). "Managing customer support knowledge." California Management Review 40(3): 195-209.

Dixon, N. M. (2000). Common Knowledge: How Companies Thrive By Sharing What They Know. Cambridge, MA, Harvard Business School Press.

Dubois, A. and A.-C. Pedersen (2002). "Why relationships do not fit into purchasing portfolio models: A comparison between the portfolio and industrial network approaches." European Journal for Purchasing and Supply Management 8: 35-42.

Dyer, J. H. (1996). "Specialized supplier networks as a source of competitive advantage: Evidence from the auto industry." Strategic Management Journal 17: 271-291.

Dyer, J. H. and K. Nobeoka (2000). "Creating and managing a high-performance knowledge-sharing network: The Toyota case." Strategic Management Journal 21(3): 345-367.

Faulkner, D. (1995). International Strategic Alliances: Cooperating to Compete. Maidenhead, McGraw-Hill.

Fretty, P. (2001). Celestica - Champions of change. Advanced Manufacturing Magazine.

Geisler, E. (1999). "Harnessing the value of experience in the knowledge-driven firm." Business Horizons 42(3): 18-27.

Grant, R. M. (1996). "Toward a knowledge-based theory of the firm." Strategic Management Journal 17: 109-122.

Gulati, R. and M. Gargiulo (1999). "Where do interorganizational networks come from?(1)." The American Journal of Sociology 104(5): 1439.

Hahn, J. and M. Subramani, R. (2000). A framework for knowledge management systems: Issues and challenges for theory and practice. Twenty first International Conference on Information Systems, Brisbane, Australia, ACM Press.

Hall, H. (2001). Social exchange for knowledge exchange. Managing knowledge: Conversations and critiques, Leicester, England, University of Leicester Management Centre.

Hansen, M. T. (1999). "The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits." Administrative Science Quarterly 44(1): 82-111.

Harbison, J. R. and P. Pekar (1998). Smart Alliances: A Practical Guide to Repeatable Success. San Francisco, CA, Jossey-Bass Publishers.

Jarillo, J. C. (1988). "On strategic networks." Strategic Management Journal 9: 31-41.

Khalifa, M., R. Lam, et al. (2001). An integrative framework for knowledge management success. ICIS.

Kogut, B. (2000). "The network as knowledge: Generative rules and the emergence of structure." Strategic Management Journal 21(3): 405-425.

Kok, G. and L. Wildeman (1999). Alliances and networks - business survival in the nineties (synopsis). Amsterdam, KPMG Alliances: 1.

Lam, A. (1997). "Embedded firms, embedded knowledge: Problems of collaboration and knowledge transfer in global cooperative ventures." Organizational Studies 18(6): 973-997.

Lamb, R. (2002). Intranet boundaries: Social actors and systems integration. 15th Bled Electronic Commerce Conference, Bled, Slovenia, Bled Electronic Commerce Conference.

Lamming, R. C., N. D. Caldwell, et al. (2001). "Transparency in supply relationships: Concept and practice." Journal of Supply Chain Management 37(4): 4-10.

Lee, J.-N. (2001). "The impact of knowledge sharing, organizational capability and partnership quality on IS outsourcing success." Information & Management 38: 323-335.

Leonard, D. and S. Sensiper (1998). "The role of tacit knowledge in group innovation." California Management Review 40(3): 112-132.

Levitt, B. and J. G. March (1988). "Organizational learning." Annual Review of Sociology 14: 319-340.

Lieberman, M. and S. Asaba (1997). "Inventory reduction and productivity growth: A comparison of Japanese and U.S. automotive sectors." Managerial and Decision Sciences 18: 73-85.

Lin, W. T. and B. B. M. Shao (2000). "The relationship between user participation and system success: A simultaneous contingency approach." Information & Management 37: 283-285.

Lincoln, J. R., C. L. Amadjian, et al. (1998). "Organizational learning and purchase-supply relations in Japan: Hitachi, Matsushita, and Toyota compared." California Management Review 40(3): 241-265.

Lucas, H. C. J. and V. Spitler (2000). "Implementation in a world of workstations and networks." Information & Management 38: 119-128.

McCutcheon, D. and F. I. Stuart (2000). "Issues in the choice of supplier alliance partners." Journal of Operations Management 18: 279-301.

Mitchell, W. and K. Singh (1996). "Survival of businesses using collaborative relationships to commercialize complex goods." Strategic Management Journal 17: 169-195.

Moore, G. C. and I. Benbasat (1991). "Development of an instrument to measure the perceptions of adopting an information technology innovation." Information Systems Research 2(3): 192-222.

Nalebuff, B. J. and A. M. Brandenburger (1996). Co-opetition. New York, Doubleday.

Nasukawa, T. and T. Nagano (2001). "Text analysis and knowledge mining system." IBM Systems Journal 40(4): 967-984.

Nooteboom, B. (2000). "Institutions and forms of coordination in innovation systems." Organizational Studies 21(5): 915-939.

O'Dell, C. and C. J. Grayson (1998). "If only we knew what we know: Identification and transfer of internal best practices." California Management Review 40(3): 154-175.

Oliver, A. L. (2001). "Strategic alliances and the learning life-cycle of biotechnology firms." Organization Studies 22(3): 467-497.

Papazoglou, M. P., P. Ribbers, et al. (2000). "Integrated value chains and their implications from a business and technology standpoint." Decision Support Systems 29: 323-342.

Parise, S. and J. C. Henderson (2001). "Knowledge resource exchange in strategic alliances." IBM Systems Journal 40(4): 908-924.

Pascale, R. T. (1999). "Surfing the edge of chaos." Sloan Management Review 40(3): 83.

Passiante, G. and P. Andriani (2000). "Modelling the learning environment of virtual knowledge networks: Some empirical evidence." International Journal of Innovation Management 4(1): 1-31.

Phillips, T. (2000). Contract manufacturing: The outsiders. Advanced Manufacturing.

Powell, W. W. (1990). "Neither market nor hierarchy: Network forms of organization." Research in Organizational Behavior 12: 295-336.

Powell, W. W. (1998). "Learning from collaboration: Knowledge and networks in the biotechnology and pharmaceutical industries." California Management Review 40(3): 228-241.

Quinn, J. B. (1999). "Strategic outsourcing: Leveraging knowledge capabilities." Sloan Management Review 40(4): 9-22.

Qureshi, S. and I. Zigurs (2001). "Paradoxes and prerogatives in global virtual collaboration." Communications of the ACM 44(12): 85-88.

Rai, A., B. Weinlein, et al. (2001). Omnexus: The plastics eMarketplace. Atlanta, GA, Georgia State University: 20.

Ritchie, L. and B. Marshall (2002). "Applying business-to-business evidence: The client's view." International Journal of Market Research 44(1): 107-22.

Rockart, J. F. and J. E. Short (1991). The networked organization and the management of interdependence. The Corporation of the 1990s. M. S. S. Morton. New York, Oxford University Press: 189-219.

Ruggles, R. (1998). "The state of the notion: Knowledge management in practice." California Management Review 40(3): 80-89.

Scott, J. E. (2000). "Facilitating interorganizational learning with information technology." Journal of Management Information Systems 17(2): 81-113.

Seely Brown, J. and P. Duguid (1998). "Organizing knowledge." California Management Review 40(3): 90-112.

Slofstra, M. (2000). "Flower power." Infosystems Executive 5(2).

Thompson, J. D. (1967). Organizations in Action: Social Science Bases of Administrative Theory. New York, NY, McGraw-Hill.

Tillet, L. S. (2001). No more speaking in code. Internet Week.

Timmers, P. (1999). Electronic Commerce: Strategies and Models for Business-to-Business Trading. Chichester, England, Wiley.

Trethewey, K. R., R. J. K. Wood, et al. (1998). "Development of a knowledge-based system for materials management." Materials and Design 19: 39-56.

Tricker, R. J. (1999). The cultural context of information management. Rethinking Management Information Systems. W. L. C. a. B. Galliers. Oxford, Oxford University Press: 393-416.

Van Alstyne, M. (1997). "The state of network organization: A survey in three frameworks." Journal of Organizational Computing and Electronic Commerce 7(2&3): 83-151.

Vermeulen, F. and H. Barkema (2001). "Learning through acquisitions." Academy of Management Journal 44(3): 457-476.

von Hippel, E. (1988). Cooperation between rivals: The informal trading of technical know-how. The Sources of Innovation. E. von Hippel. Oxford, Oxford University Press: 76-92.

von Hippel, E. (1988). Predicting the source of innovation: Lead users. The Sources of Innovation. E. von Hippel. Oxford, Oxford University Press: 102-116.

von Krogh, G. (1998). "Care in knowledge creation." California Management Review 40(3): 133-153.

Appendix I

Organizational Interdependence

Organizational interdependence comes in a variety of forms that determine the complexity of the organizational interactions. Thompson (Thompson 1967) identified three such forms, as follows:

i) Pooled or generalized interdependence. In this case, each partner renders a discrete contribution to the whole, and each is supported by the whole. Coordination of activities is through standardization of inputs, and only a broad alignment of the partners towards a joint objective is required. An example is the creation of a database to support a frequently asked question (FAQ) online system. Provided that all contributors use the same format there is no need to organize their contributions either in time or space, since this is automatically handled by the system.

ii) Sequential interdependence, where the activities of each partner are distinct and serial, so the activities of one partner precede the other. Here, the product or service or knowledge moves from one partner to the other as it is generated. An example is a patent developed by one firm which is then licensed to a second firm.

iii) Reciprocal interdependence. Here, organizations come together to exchange outputs simultaneously. Each organization is simultaneously dependent on the other, because its inputs are the other organizations' outputs. An example is a group of organizations exchanging knowledge that is of value to the others, as in the Toyota supplier organization's groups where member organizations exchange both tacit and explicit knowledge about their production processes.

Of the three forms, pooled interdependence is the least costly in terms of communication and decision effort because there is no real coordination is involved. Sequential interdependence is more costly because of the need to coordinate the sequential nature of activities. Reciprocal interdependence is the most difficult to manage effectively, and has the highest coordination costs of all three forms.

Appendix II

Abbreviated Case Summaries

(see indicated references for more detailed descriptions)

Case 1. Japanese-British Technological Partnership (Lam 1997)

This is an example of a technological partnership in a knowledge-intensive industry. The Japanese and British partners are both global competitors in the electronics industry. The Japanese firm acquired a majority stake in the British firm about five years prior to the time of the case study. This is an example of a "horizontal" collaborative rather than an integrative relationship. The acquisition was strategically rather than financially motivated, and brought about a substantial amount of mutual interdependence between the two firms. Although there was a great deal of effort to build appropriate knowledge links between the two organizations, there was a significant difference between how their cultures work in the product development process. The differences lie mainly in the fact that British firms have a sequential product design and development process, where different levels of engineers are involved in different phases. Japanese firms, on the other hand, have engineers that understand the entire process and continue to work as a team throughout. These cultural differences caused serious difficulties in communicating tacit knowledge between the two organizations, and the anticipated advantages from linking the two organizations never materialized.

Case 2. Expressroses.com (Timmers 1999; Slofstra 2000)

Expessroses.com is a Canadian company that has been in the business of growing and selling flowers from its Leamington, Ontario, location since the 1960s. For a number of years it was a wholesale supplier of roses and other flowers to the regional marketplace. Its president, Mark Thiessen, decided to computerize its business operations in the early 1990s, and to begin selling roses online in the mid 1990s. Its current annual sales online is about 100,000 individual orders, including 10,000 orders shipped on Valentine's Day alone. The company grows in excess of 1 million roses annually. Most of its orders are sold retail via the Internet, and shipped via courier (FedEx and United Parcel), with a 12 hour turnaround. Expressroses has expanded into the U.S., where it now works with a number of affiliated companies that ship flowers ordered through the

Expressroses Web site, across North America. A key characteristic of its success has been its very close relationship with certain courier companies. These companies take over all aspects of order management and delivery, allowing Expressroses to focus on its core competence of growing and packaging flowers for shipment.

Case 3. Toyota Supplier Network (Dyer 1996; Lincoln, Amadjian et al. 1998; Dyer and Nobeoka 2000)

Toyota is widely recognized as a leader in continuous learning and improvement. It is the largest Japanese company and is regularly voted as the best-managed and most respected company in Japan. In a study of automobile manufacturing companies over the period 1990-1992, Toyota had the highest quality rating (fewest defects), lowest new model cycle time, the lowest total inventory to sales ratio, and the highest profitability. Much of Toyota's success has been as the result of a concerted effort at inter-organizational learning among itself and members of its supply network (referred to in Japanese as keiretsu). Toyota is currently exporting its techniques to North America, where it is creating a learning network among its suppliers there.

There are three dilemmas that must be surmounted if knowledge is to be shared effectively among independent organizations within a network such as Toyota's: a) how to motivate self-interested network members to participate in the network and to openly share valuable knowledge with other network members, b) how to resolve the "free rider" problem, where an organization participates in sharing to acquire desired knowledge, and then exits the network or refuses to contribute to shared knowledge, and c) how to maximize the efficiency of knowledge transfer among a large group of individual organizations. Knowledge sharing of explicit or codified knowledge may be accomplished in a large group setting (e.g. meetings or conferences), while tacit knowledge requires intense interaction and is likely to require work in a small group setting at a specific location where it is being used.

Toyota's approach to resolving these dilemmas can be summarized as follows:

i) Toyota subsidizes the network heavily with knowledge and resources during its formative stages, so suppliers begin to realize benefits early in the process. They quickly learn

that participating in collective learning is vastly superior to isolating their own proprietary knowledge.

ii) Network-level knowledge sharing processes include

- a supplier association, with regular meetings on special topics, and plant tours where they exchange explicit knowledge,
- consulting teams that provide expertise in solving operational problems at both Toyota and its suppliers (e.g. reducing inventory, or increasing productivity)
- voluntary learning teams, that assist each other with productivity and quality improvements. This assists in spreading tacit knowledge among the organizations
- inter-firm employee transfers

iii) Network rules that inhibit free riding, by prevent members from protecting or hiding valuable knowledge within certain domains such as production. Toyota sets an example by openly sharing its own production know-how. Members must open their plants to other network members. Toyota can impose sanctions on members who violate the rules, primarily be cutting or eliminating purchasing from such suppliers. Over time, suppliers are expected to share their savings with Toyota, through price reductions.

iv) Developing subnetworks among suppliers with common interests, so Toyota itself does not necessarily have to be involved directly.

Case 4. British Aerospace and CSC Corp. (Currie 2000)

British Aerospace was formed in 1978 by nationalization of various components of the UK aerospace industry at that time, and was de-nationalized in 1981 by a different government. An economic recession in the late 1980s to early 1990s, coupled with the end of the cold war, caused severe dislocations in British Aerospace since it was heavily dependent upon defence business. As a consequence, it went through a period of heavy losses and consolidation, divesting businesses and employees, dropping it from an employment level of 125,000 to 44,000. At the same time, it became apparent that the IT infrastructure at British Aerospace was highly decentralized and composed of a number of relatively independent entities, resulting in over-capacity and structural inefficiencies. In order to cut the costs of its IT operations, the company decided to choose between internal rationalization and outsourcing the majority of its IT operations. After a period of analysis and consideration of various outsourcing companies, it

was decided to outsource the entire IT operation to CSC Corporation through a long-term contract.

The contract included four types of IT operations: a) data centre services, b) networks, c) distributed computing environment, and d) applications development, support, and maintenance. It also specified hard measures of service delivery through service level agreements, and soft measures that involved a customer performance assessment reporting system. In addition, a three tier definition of value added that would be supported by CSC included: a) exploiting IT for the client's business purposes, b) improvements in capacity (skills, methodologies, and capabilities in staff), and c) better, more efficient IT services. Training of customer staff was an important component, including planning for IT services, and workshops for business and IT skills.

Case 5. Omnexus Plastics eMarketplace (Rai, Weinlein et al. 2001)

Omnexus is an online marketplace (a supply-side operation) with corporate headquarters in Atlanta GA and European headquarters in Zurich, Switzerland. It was founded in March 2000 by a consortium of five major chemical company suppliers (BASF, Bayer, Dow, Dupont and Ticona/Celanese) of chemicals to the injection and blow molding thermoplastics industry. This market segment annually generates $50 billion in sales, $40 billion in polymers and $10 billion in equipment, etc., out of the total $589 billion sales for the worldwide plastics industry. The initial investment by the founding companies was $40M U.S. Omnexus operates as an independent entity, thus avoiding anti-trust action by the U.S. government. The Accenture consulting company played a large role in initial structuring and staffing for the company. IBM was the key player in providing and managing the implementation of the technology platform for the marketplace operation, through its alliance with key system providers Ariba and i2. The company executed its first transaction in October 2000. Omnexus has integrated its systems with both suppliers and purchasers to simplify the order entry and management process, providing both supplier and purchaser with copies of relevant information as needed.

Omnexus has specifically targeted the molders (companies who make the plastic products) primarily because they purchase the majority of the resins used in the injection molding business.

There are approximately 8,000 such companies in the U.S., Canada, and Mexico. Services provided by Omnexus included a) information about the company and how to become associated with it as a buyer, b) catalogues from the supplier companies, c) purchasing capability, and d) settlement capability. Omnexus added nine more suppliers during its first year of operation, and at the time the case was written the consortium was considering whether to follow horizontal and/or vertical integration strategies. From its Web site, it now appears to have entered the equipment marketplace, featuring eleven suppliers of plastics molding equipment, as well as used equipment and tooling services and supplies.

Omnexus faces significant threats from a variety of sources: a) online suppliers and distributors, b) other online marketplaces, c) solution sellers, d) procurement specialists, and e) direct offline selling. Online business to business marketplaces (eMarketplaces) have been going through a very difficult time during the past year, with many failures and few successes. A major problem is attracting sufficient customers to generate the transaction volume from which the eMarketplace derives its income. No recent data are available publicly on Omnexus annual revenues, but we suspect that it is not yet at breakeven operations.

END

Michael G. DeGroote School of Business
McMaster University

WORKING PAPERS - RECENT RELEASES

428. Halit Üster and Robert F. Love, "On the Directional Bias of the l_{bp}-norm", April, 1998.

429. Milena Head, Norm Archer, and Yufei Yuan, "MEMOS: A World Wide Web Navigation Aid", October, 1998.

430. Harish C. Jain and Parbudyal Singh, "The Effects of the Use of Strike Replacement Workers on Strike Duration in Canada", February, 1999.

431. Parbudyal Singh and Harish C. Jain, "Strike Replacements in the United States, Canada and Mexico: A Review of the Law and Empirical Research", February, 1999.

432. John W. Medcof and Jeremy Boyko, "Reinforcing, Revising and Reconciling Attributions in the Employment Interview", March, 1999.

433. Norm Archer, "World Wide Web Business Catalogs in Business-to-Business Procurement", March, 1999.

434. Diwakar Gupta and Saifallah Benjaafar, "Make-to-order, Make-to-stock, or Delay Product Differentiation? - A Common Framework for Modeling and Analysis", April, 1999.

435. Harish C. Jain, Parbudyal Singh and Carol Agocs, "Recruitment, Selection and Promotion of Visible Minorities and Aboriginals in Selected Canadian Police Services", April, 1999.

436. Harish C. Jain and Angus Bowmaker-Falconer, "Employment Equity/Affirmative Action Codes of Practice and Best Practices in USA, Britain, Canada and Other Selected Countries", May, 1999.

437. Diwakar Gupta, Yavuz Günalay, and Mandyam M. Srinivasan, "On the Relationship Between Preventive Maintenance and Manufacturing System Performance", June, 1999.

438. Jinliang Cheng, George Steiner, and Paul Stephenson, "A Fast Algorithm to Minimize Makespan for the Two-Machine Flow-Shop Problem with Release Times", June, 1999.

439. Jinliang Cheng, George Steiner, and Paul Stephenson, "A Fast Algorithm to Minimize Maximum Lateness for the Two-Machine Flow-Shop Problem with Release Times, June, 1999.

440. Norm Archer and Yufei Yuan, "Electronic Commerce and the Business-to-Business Customer Relationship Life Cycle", August, 1999.

441. Halit Üster and Robert F. Love, "Calculation of Confidence Intervals for Estimated Distances", August, 1999.

442. George O. Wesolowsky, "Detecting Excessive Similarity in Answers on Multiple Choice Exams", October, 1999.

443. Naresh C. Agarwal, "Mandatory Retirement and the Canadian Human Rights Act", November, 1999.

444. Susan Sproule and Norm Archer, "Software Agents in Electronic Commerce", March, 2000.

445. Milena Head and Yufei Yuan, "Privacy Protection in Electronic Commerce – a Theoretical Framework", June, 2000.

446. Susan Sproule and Norm Archer, "Knowledgeable Agents for Search and Choice Support in E-commerce: A Decision Support Systems Approach", July, 2000.

447. Norm Archer and Judith Gebauer, "Managing in the Context of the New Electronic Marketplace", August, 2000.

448. Norm Archer and Yufei Yuan, "Business-to-Business E-commerce and Customer Relationship Management: Trends and Issues", August, 2000.

449. Janet Romaine and I.U. Zeytinoglu, "Are Women Managers Really More Participative? Some Conflicting Evidence from a Field Study", September, 2000.

450. Norm Archer, "The New Economy: Some Issues and Impacts of Electronic Commerce", January 2001.

451. Norm Archer, Milena Head, and Yufei Yuan, "Matching Customer Expectations and Perceptions in e-Commerce", February 2001.

452. Xiaoqing Li and Ali R. Montazemi, "A Methodology for the Assessment of Buddy-Agents", March 2001.

453. Yufei Yuan, T.P. Liang, and Jason J. Zhang, "Using Agent Technology to Support Supply Chain Management: Potentials and Challenges", October 2001.

454. Jason J. Zhang, Yufei Yuan, and Norm Archer, "Driving Forces for M-commerce Success", December 2001.

455. Alexander Serenko and Brian Detlor, "Agent Toolkits: A General Overview of the Market and an Assessment of Instructor Satisfaction with Utilizing Toolkits in the Classroom", July 2002.