"INTERORGANIZATIONAL COOPERATION: THE ROLE OF INFORMATION TECHNOLOGY. AN EMPIRICAL COMPARISON OF US AND JAPANESE SUPPLIER RELATIONS"

by
M. BENSAOU*

94/68/TM/SM
(revised version of 93/62/TM/SM)

* Assistant Professor at Large at INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, France.

Printed at INSEAD, Fontainebleau, France

Interorganizational Cooperation: the Role of Information Technology.

An Empirical Comparison of US and Japanese Supplier Relations

M. Bensaou

INSEAD
Boulevard de Constance
77309 Fontainebleau, FRANCE
Tel: (33-1) 6072-4021
Fax: (33-1) 6072-4049
E-mail: bensaou@insead.fr

The manuscript is based on the doctoral research done by the author at MIT Sloan School of Management, which won the first prize at the 1992 ICIS dissertation competition, and was a finalist in the 1993 Business Policy and Strategy Division dissertation competition at the Academy of Management. I acknowledge the financial support for this research made available by Alfred P. Sloan Foundation under the MIT *International Motor Vehicle Program,* the *Management in the 1990s Research Program,* and by the MIT *Center for Information Systems Research (CISR).* I also thank the managers in the leading firms in the auto industry both in the USA and Japan for spending time with us and providing the required data and interpretations.

Interorganizational Cooperation: the Role of Information Technology.

An Empirical Comparison of US and Japanese Supplier Relations

ABSTRACT

This paper investigates the comparative role of several factors, including information technology (IT), predicting the level of cooperation between two independent organizations. Drawing upon multiple theoretical perspectives we develop five hypotheses about the impact on cooperation of three sets of factors: (1) the characteristics of the environment within which the relationship operates, (2) the characteristics of the relationship itself, and (3) how information technology is used across organizational boundaries. Each conceptual construct is operationalized and measured within the context of buyer-supplier relationships in the US and Japanese automobile industries. The five hypotheses are tested using multiple regressions conducted on a data set of 447 distinct relationships.

The data analysis suggests that relational characteristics (i.e., the climate of the relationship) are the most consistent predictor of cooperation in both countries when compared with other structural (e.g., asset specificity) or technological factors (use of EDI). Environmental uncertainty (i.e., technological unpredictability) is positively associated with cooperation only in Japanese supplier relations. Governance structure is a strong and highly significant predictor of cooperation in both samples, but with the opposite sign. Similarly, information technology does not play the same predictive role in the two countries. Significant only in Japan it reflects an 'electronic partnership' approach to the use of IT in supplier relations.

Interorganizational Cooperation: the Role of Information Technology.

An Empirical Comparison of US and Japanese Supplier Relations

Introduction

In recent years, many large firms have been undergoing profound transformations, streamlining their operations, typically moving away from vertical integration toward more external contracting of key activities. They are also transforming the nature of the relationships with their external business partners (Powell 1987, Jarillo 1988, Thorelli 1986). In particular, many manufacturers are changing their relationships with component suppliers away from traditional arm's length relations driven by a competitive logic toward new arrangements based on a cooperative logic. These take the form of complex ***cooperative relationships***, also described as "value-adding partnerships" (Johnston and Lawrence 1988), or "alliances" (Heide and John 1990, Anderson and Narus 1990).

While there are several factors that explain this trend toward more cooperative relationships, we are in this paper concerned with the phenomenon of interorganizational cooperation that explicitly leverages information technology (IT) capabilities -- that has been variously described as: 'inter-organizational systems' (Barrett and Konsynski 1982, Cash and Konsynski 1985), 'information partnerships' (Konsynski and MacFarlan 1990) and 'electronic integration' (Venkatraman and Kambil, 1991) within a broader continuum of electronic markets and electronic hierarchies (Malone, Yates and Benjamin 1987).

In this paper, we propose to examine some of the factors that may influence the level of cooperation between two firms, with a particular interest in the comparative role of information technology. Specifically, we are interested in answering the question: does the use of IT support cooperation and does it have more explanatory power that other traditional predictors. Our theory building relies on (1) previous theoretical perspectives that suggest the characteristics of the

environment within which the relationship operates and the characteristics of the relationship itself as the critical predictors of interorganizational cooperation and on (2) recent descriptions of the use of IT, especially EDI, to enable cooperation across organizational boundaries.

The paper is divided into four sections. First, we review recent developments, in particular in the automobile industry, that justify why cooperation is an important dependent variable for the analysis of interorganizational relationships. In the second section, we draw upon transaction costs economics and descriptive theories from organizational and MIS research and derive some conceptual predictors of inter-firm cooperation. Specifically, we develop five hypotheses relating interfirm cooperation, the dependent variable, to environmental characteristics, partnership characteristics (we analytically distinguish between the structural characteristics of the relationship and its socio-political climate) and the interorganizational use of information technology, the independent variables. The third 'methods' section describes how these conceptual constructs are operationalized and measured in the specific context of the automobile industry in the US and Japan. The final section discusses the analysis of the data collected about 447 buyer-supplier relationships, the key findings, the conclusions and implications of the study.

INTERORGANIZATIONAL COOPERATION AS A DEPENDENT VARIABLE

The selection of the auto industry as the empirical setting is based on the following factors. Recent studies (see especially, Cusumano and Takeishi 1991, Nishiguchi 1989, Helper 1987, Lamming 1989) have documented that supplier relationships in the auto industry have been undergoing major changes, "indicating far reaching transformations in the way automobile production and automobile companies themselves are organized" (Sabel, Kern and Herrigel 1989).

Traditionally, US automakers were characterized by a high degree of vertical integration having designed the car, manufactured nearly all the necessary core

components and coordinated final production. The trend, however, is towards a car company becoming the *"electronic" coordinator* of an intricate IT-mediated production network, typically purchasing more core components from outside, thus reducing its level of vertical integration and at the same time reducing its total number of suppliers. The emerging relationships tend to be longer term, based on mutual trust and benefits, and involve higher levels of cooperation.

Despite the importance of these changes, no study has yet reported on the factors, including information technology, affecting the level of cooperation between an auto assembler and its suppliers, nor has any study compared these factors systematically across countries (with the exception of Bensaou 1992, Bensaou and Venkatraman, forthcoming). We believe that such an extension is timely and important: one, the inter-organizational level of analysis has become attractive in view of the emergence of hybrids or partnership-like arrangements as opposed to traditional, pure forms - market and hierarchy - and the growing use of IT applications to support coordination across organizational boundaries (e.g. EDI, electronic JIT, CAD/CAM transfer).

Underlying these new relationships is a notion that recognizes benefits to cooperation with fewer selected suppliers over the traditional system of arm's length relationships and competitive bidding within a large pool of suppliers (Dore 1983). *At a basic level, our theoretical argument is that interorganizational cooperation corresponds to a shift away from market-based exchange toward more bilateral and cooperative governance* (Williamson 1985). As for IT, researchers have been more concerned with developing frameworks linking IT and competitive strategy (see for instance: Porter and Millar 1985, Johnston and Vitale 1988) or based on new institutional theories (such as: agency and transaction costs) of economics (see for instance, Malone, Yates and Benjamin 1987, Gurbaxani and Whang 1991).

Two, the international dimension in information systems research needs to develop greater momentum in light of the vigorous internationalization and

globalization of business. Thus, a systematic comparison of the importance of various predictors of cooperation at the inter-organizational level of analysis across different countries (i.e., the US and Japan) within the same auto industry would offer significant insights.

We define interorganizational cooperation as the degree to which focal activities to the relationship are carried out jointly. Implicit in this definition is "the interpenetration of organizational boundaries" (Heide and John 1990, p. 25; see also Guetzkow 1966) which implies more than just the sequential division of labor and tasks conducted within a cooperative climate. In the traditional competitive model the responsibilities for key tasks are allocated along a clear division of labor and a strong relational asymmetry in terms of ownership of a product or rents appropriation. In partnership-like relationships cooperation can occur over a large set of activities, including long range planning, development and product design, quality and delivery coordination, training and education.

PREDICTORS OF INTERORGANIZATIONAL COOPERATION

In this paper, we wish to determine what exogenous and endogenous factors lead to greater cooperation between two independent business partners, i.e., an auto assembler and its component supplier. Specifically, we identify and empirically test for the relative importance of four types of predictors: (1) the *environmental uncertainty* surrounding the relationship; (2) the uncertainty about the partner or *partnership uncertainty* analytically decomposed in two elements: one related to the governance structure of the relationship and the other related to the socio-political climate of the relationship; and finally (3) the use of IT applications to support interorganizational coordination.

Transaction cost analyses argue that, under ceteris paribus conditions, firms will adopt a transaction cost minimal arrangement that would not only involve the choice between markets or hierarchies but also various forms of hybrid arrangements

(Richardson 1972, Williamson 1979). An important factor that affects the choice between these various options is uncertainty. We consider inter-organizational cooperation as a component of such a decision, thus derive its predictors by drawing upon theoretical perspectives that recognize uncertainty as a critical design contingency factor. These are: (a) *transaction cost economics* (Coase 1937, Williamson 1975, 1985). As noted by Williamson: "When transactions are conducted under conditions of uncertainty...the bounded rationality constraint is binding and an assessment of alternative organizational modes, in efficiency respects, becomes necessary" (1975, p.23); (b) *organization theory* where uncertainty has long been viewed as a dominant contingency as noted by Thompson: "Uncertainty appears as the fundamental problem for complex organizations and coping with uncertainty, as the essence of administrative process" (Thompson 1967, p.159) and (c) *political economy* (Benson 1975) where a social system is viewed as "comprising interacting sets of major economic and socio-political forces which affect collective behavior and performance" (Stern and Reve 1980 p.53). Rooted in this line of reasoning, we focus on two sources of uncertainty: uncertainty about the environment surrounding the relationship, and uncertainty about the partnership itself.

Environmental Uncertainty: Technological Unpredictability

On the basis of transaction cost reasoning, uncertainty is a critical factor that evokes shifts from market-based relationships toward more cooperative relationships. At a basic level, uncertainty about the environment creates adaptation and information processing problems for a firm (Galbraith 1973, March and Simon 1958). Specifically, in a manufacturing context one key source of environmental uncertainty is *technological unpredictability*. In particular, the inability to forecast accurately new technical or design requirements for the products exchanged within the relationship may be managed more efficiently through none or loose coupling (i.e., source selection can be done by competitive bidding based only on price between a large number of suppliers provided with detailed design specifications) and therefore less investment in joint efforts, such as joint planning, joint process and

product design, joint testing and tool development, education or technical assistance. By not engaging into such expensive cooperation, firms retain the flexibility to terminate a relationship and switch to partners with more appropriate technological capabilities (Balakrishnan and Wernerfelt 1986). This reasoning leads to the following hypothesis:

> ***Hypothesis 1:*** *Greater the technological unpredictability associated with the component exchanged between the two firms, lesser the cooperation between the buyer and its supplier.*

Partnership Uncertainty: Governance and Climate of the Relationship

The characteristics of the partnership itself also constitute an important source of uncertainty. We define partnership uncertainty as the *'uncertainty a focal firm perceives about its relationship with a business partner.'* This uncertainty about the partner has been traditionally subsumed under two other sources of uncertainty but we wish to distinguish it in this stream of research. For instance, when market-like transactions are predominant, environmental uncertainty is the critical thrust; for predominantly hierarchical transactions, task uncertainty is the relevant thrust. Under conditions where transactions occur through these pure modes (market or hierarchy), partnership uncertainty is of secondary importance. However, in view of the emergence of hybrids or partnership-like arrangements (Williamson 1991), partnership uncertainty should be distinguished from the broader environmental uncertainty and the narrower task uncertainty. We contend that there are two primary sources of partnership uncertainty: (i) the governance structure of the relationship, and (ii) the climate of the relationship.

Governance Structure of the Relationship. These two sources of uncertainty about the partner are consistent with the theoretical arguments in the resource-dependency stream of organization theory (Pfeffer and Salancik 1978) and the transaction cost economics perspective (Williamson 1985). In our manufacturing context, for instance, the auto assembler's asset specificity represents investments highly specific to the

relationship, i.e., investments considerably of less value outside the focal relationship, through which the supplier may hold the buyer hostage. These specific investments make it costlier and more difficult for the buyer to switch to another supplier, thus encourage cooperation. Moreover, when these investments represent direct capital participation by the assembler, i.e., a higher ownership ratio, the incentives are even greater for cooperation. Hence, the hypothesis:

> ***Hypothesis 2a:*** *Higher the assembler's switching costs and higher its ownership ratio, greater the cooperation between the two firms.*

Several researchers have described continuity as another factor affecting the emerging type of buyer-supplier relationships (Joskow 1988, Spekman 1988). We define continuity as the expectation of repeat transactions and future interaction. Whereas traditional arm's length relationships are based on discrete or short-term transactions, the new cooperative forms tend to be continuous or open-ended (Macneil 1980). Our basic axiom is that continuity, operationalized as contract length, encourages cooperation. Hence, hypothesis 2a':

> ***Hypothesis 2a':*** *Higher the continuity, i.e., longer the contract, greater the cooperation between buyer and supplier.*

Climate of the Relationship. Some researchers have strongly argued that other factors besides assets specificity may also affect the uncertainty about the opportunistic behavior of the partner (Axelrod 1984, Dore 1983). Reve and Stern (1976), for instance, introduce the concept of transaction climate as "the sentiments that exist between the parties to the transaction" (p. 76). These sentiments arise due to "the extent to which inter-firm transactions are based on mutual trust, whereby the parties share a unit bonding or belongingness" (p.78). In essence, these reflect the socio-political processes embedded in the relationship (Arndt 1983) that contribute to reducing partnership uncertainty. For instance, we argue that mutual understanding and commitment to the relationship contribute to lower partnership uncertainty, hence increase cooperation:

Hypothesis 2b: *Greater the mutual understanding and the assembler's commitment to the relationship, greater the inter-organizational cooperation.*

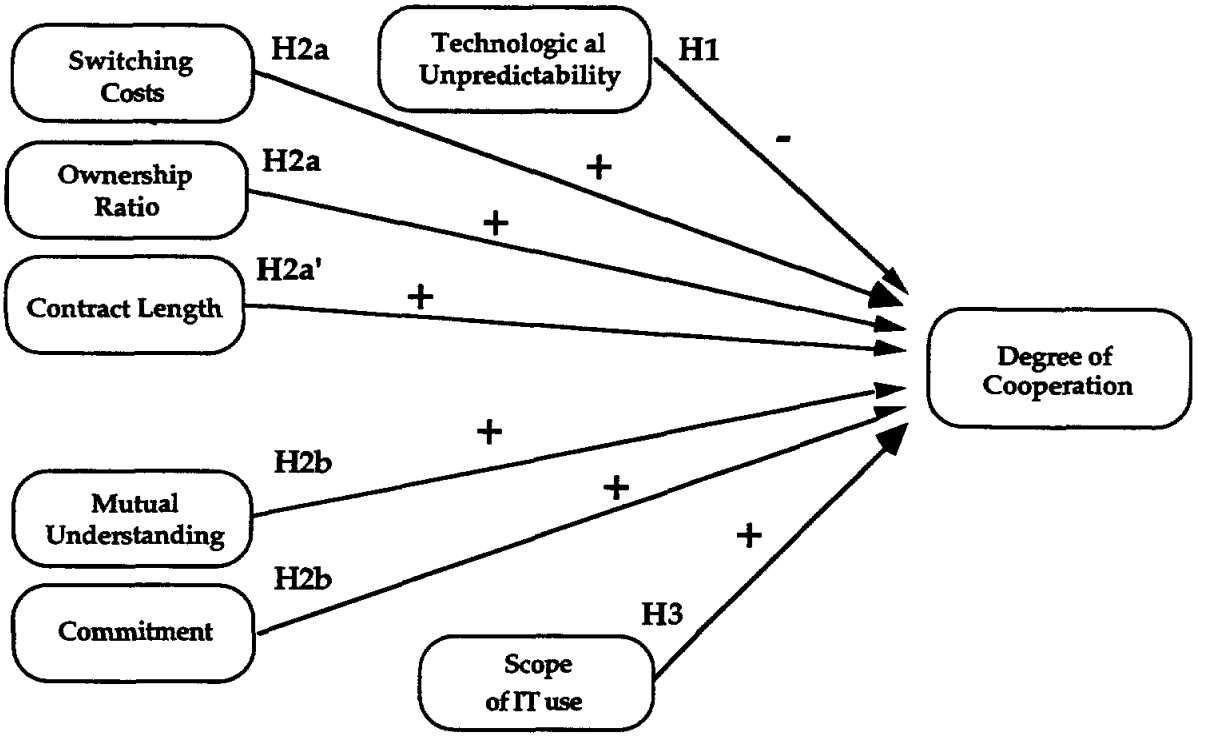
Role of Information Technology: Reduce Uncertainty

Cooperation introduces more uncertainty into a firm's decision-making as it sees its activities more directly influenced by its partner's role performance and it must concede some greater degree of organizational autonomy (Pfeffer and Salancik 1978). In addition, as proposed by Galbraith (1973) and other proponents of the information processing view of organizational design (Tushman and Nadler 1978, Daft and Lengel 1986), uncertainty gives rise to information processing needs that firms need to match with appropriate information processing capabilities for greater performance. Information technology represents one of the mechanisms used to increase interorganizational information processing capabilities and reduce task uncertainty. Venkatraman (1991), for instance, proposes *electronic integration*, the interconnection and integration of the business processes of two or more independent organizations through IT applications, as an alternative to traditional vertical integration.

Electronic integration strategies may range from the mere electronic exchange of standardized documents between two business partners, to the integration and redefinition of fundamental management processes within and between the partners. American Airlines' SABRE systems, Baxter's ASAP system and GM's MAP program are some of the more popular examples of systems that support such an electronic integration strategy. A key role for information technology is therefore to increase information processing capabilities of a relationship, thereby enabling or supporting greater inter-firm cooperation (in addition to reducing uncertainty). In particular, in the manufacturing sector, the use of EDI applications across multiple functions (such as design, purchasing, production control, delivery or payment) provides greater information processing capabilities that support greater cooperation:

Hypothesis 3: *Greater the scope of information technology use within the relationship, greater the buyer-supplier cooperation.*

Figure 1: The Conceptual Model



Additional Explanatory Role of Information Technology

Does information technology make any difference and does it have any explanatory power, especially when analyzed within a broader framework including environmental and partnership characteristics. Information systems researchers argue that IT as it reduces coordination costs does affect the comparative advantage of different coordination and governance mechanisms (Malone, Yates and Benjamin 1987, Gurbaxani and Whang 1991). This emerging body of work recognizes a critical role for information technology, and sees it as the next technological revolution which will change the way firms do business. In particular, in this study *we argue that information technology may provide a customer with the coordination and cooperation capabilities traditionally associated with vertical integration without the cost of ownership.* Hence the hypothesis:

> ***Hypothesis 4:*** *Information technology variables will have a positive and significant additional explanatory power on the degree of cooperation.*

Comparative Effects across Countries

Recent international studies of supplier relationships highlight the fundamental differences in supply management in the US and Japanese industries (see Bensaou 1992, Bensaou and Venkatraman, forthcoming). Womack, Jones and Roos (1990) distinguish between the logic of mass production still strongly prevalent within the US auto industry and the predominantly Japanese logic of lean production. In the purchasing area, Lamming (1993) argues for similar differences in supply management between US and Japanese automobile manufacturers. Consistent with these reported differences in US and Japanese production and supply management practices we suggest that the use of information technology will also accordingly differ across the two country settings. Hence the hypothesis:

> ***Hypothesis 5:*** *The relationship between the use of information technology and cooperation is different across the US and Japanese industries.*

METHODS

Research Design

The data required for this study was collected from managers responsible for supplier relationships in automobile firms in the USA and Japan. Our field work proceeded as follows. First, we conducted a set of 17 interviews primarily in the Detroit and Tokyo areas with senior managers responsible for purchasing or engineering. These were complemented by visits to assembly plants, design and engineering facilities at both assemblers and suppliers. Both countries were included for these field studies to ensure that we were not reflecting a US-bias on the Japanese firms and vice versa. These interviews were focused at two boundary-spanning functions that were considered to be most critical for supplier relations in the auto industry, i.e., purchasing and design. The interviews were exploratory in nature but focused on clarifying the following issues: (a) a preliminary corroboration of the applicability and appropriateness of the constructs and hypotheses developed to capture the antecedents and measures of interorganizational cooperation; (b)

assessing the role and importance of information technology mechanisms, and partnership characteristics within the model as these were the two distinguishing dimensions of this study; and (c) ensuring that we have an adequate basis to sample the relationships covering the vast array of suppliers and components.

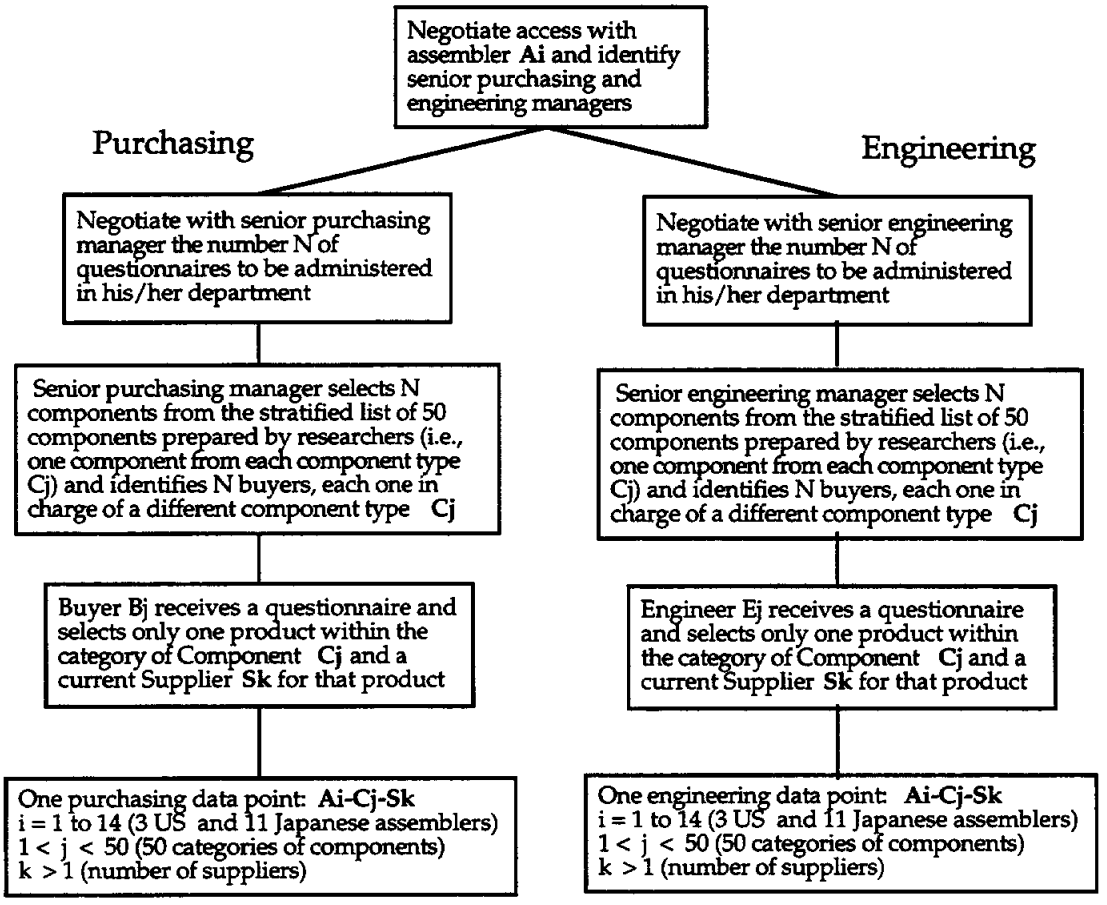
Subsequently, we developed a structured questionnaire (see table 1 for the operationalization of the constructs) to measure the variables -- both in English and Japanese for the two samples (an initial English version was first translated into a Japanese version by the author itself independently translated back into English to check for and correct inconsistencies). Pre-tests of the instruments were conducted in 4 companies and 8 focus groups with potential respondents (i.e., those purchasing agents and design engineers responsible for a given component account) to ensure that the target informants in both settings understood the wording consistent with the researchers and that the Japanese version was a valid translation of the US version.

Sampling Procedures

Sampling followed the same process in all three US and all eleven Japanese auto companies (see figure 2). A purchasing and engineering senior manager at the central division or platform level were first asked to select a set of car components under their responsibility from the stratified list of 50 components prepared by the authors (i.e., to prevent from selection bias). Then for each of the selected components these senior managers helped identify the purchasing agent and/or engineer to whom we could send the questionnaire. The final decision about which specific supplier and which part number to choose was at the respondent's discretion (the respondent's name as well as the name of the supplier were not asked). In summary, each questionnaire represents a data point, that is a unique component-relationship-task triplet, where the controlled range of components included in the sampling contributes to variance in environmental characteristics, the variety of manufacturer-supplier relationships in both countries contributes to

variance in partnership characteristics, and finally where the presence of two different boundary spanning functions dealing with different products and suppliers contributes to variance in task characteristics, thus in uses of information technology. In sum, we tested the hypotheses proposed above with a sample of n= 447 independent buyer-supplier relationships (43% response rate; n= 140 in the US and n=307 in Japan) across different auto manufacturers (i.e., all 3 US and 11 Japanese competitors), different supplier firms, and different vehicle components (e.g., standard fasteners, suspension systems, airbags).

Figure 2: Sampling Procedures



Operationalization of the Variables

Following Venkatraman and Grant (1986), we paid particular attention to issues of operationalization and measurement in this study. Operationalization of the variables was achieved through two ways: (1) for those variables that have been previously employed in research settings, we adopted the measures as long as they

Table 1: Operationalization of the Constructs

Construct	Variables	items (α US ; α Japan)	Illustrative Questions and Scaling
Inter-organizational Cooperation	**COOP** (the dependent variable)	7 (.85; .79)	Extent to which exists joint effort and cooperation between the two companies in the following areas; long range planning, product planning, product engineering (component design) process engineering (for the manufacturer), tooling development (for the supplier), technical assistance, training/education. These 7 indicators were measured using 7-point interval scales ranging from: no or minimal joint effort, to extensive joint effort.
Environmental Uncertainty	Technological Unpredictability **(ENVT)**	4 (.79; .85)	- product technological unpredictability - how likely will major changes occur in the component in four areas (i.e., functionality improvements, major product innovations, major manufacturing innovations, price/performance ratio improvements) during the next 5 years - was measured using 7-point interval scales ranging respectively from very unlikely to very likely
Partnership Uncertainty	Switching Costs **(SWITCH)**	1 **(na)**	- if your firm decided to terminate the current contract with this supplier, how easy would it be for you to switch to another supplier to provide you with the same component - was measured using a 7-point interval scale ranging from very easy to very difficult
Governance Structure	Ownership ratio **(OWNER)**	1 **(na)**	- indicate whether your firm owns all or part of this supplier - 5 point scale ranging from independent supplier, we own 1 to 10%; 11 to 50%; 51 to 99% and one of our divisions or subsidiaries
	Continuity (contract length) **(CONTINU)**	1 **(na)**	- how long is this supplier's current contract for the production and delivery of this component - measured on a 6-point interval scale ranging from no contract, less than a year; 1 year; 2 to 3 years; 4 to 5 years; more than 5 years
Climate of the Relationship	Mutual Understanding **(UNDERST)**	4 (.87; .75)	- extent to which both firms understand each others goals and priorities; products and processes; roles and responsibilities - was measured using a 7-point interval scales ranging respectively from strongly disagree to strongly agree
	Commitment **(COMMIT)**	3 (.65; .82)	Extent to which their exists an equal sharing between the two firms of risks, burden, and benefits. This indicator is measured using a 7-point interval scale ranging from your firm has more of the share to this supplier has more of the share
IT use	Scope of EDI use **(IT)**	1 **(na)**	This indicator is the sum of 6 dichotomous items measuring each whether data is exchanged in electronic form with this supplier in this function. The six functions are: purchasing, engineering, quality, production control, transportation and payment.

satisfied acceptable measurement quality; and (2) for those variables that were unique to the hypotheses developed here, we developed operational measures; these were assessed for content validity through interviews with managers in Detroit and Tokyo. The detailed operationalization for each construct is described in table 1 with examples of the specific indicators and the anchors used to calibrate them.

Analytical Approach

To test the hypotheses developed above, we conducted multiple regression analyses on the data set for each country separately. As the primary objective of the paper is to test the comparative influence of several sets of predictors of inter-organizational cooperation, we entered the independent variables into stepwise regressions in blocks. Each block groups together operationalizations of the same conceptual construct (e.g., switching costs, ownership ratio and contract length operationalize the governance structure construct). The influence of each individual construct, i.e., the collective influence of its operational measures is assessed by the significance of the change in R^2 when the corresponding block of variables is entered into the regression. For instance, the comparative explanatory power of information technology as a construct is assessed by the significance of the change in R^2 (sig. ΔR^2) when we enter the variable, scope of EDI use into the multiple regression.

The equation representing the model developed in this study can be specified as follows:

$$\mathbf{COOP} = b0 + b1\ \mathbf{ENVT} + b2\ \mathbf{SWITCH} + b3\ \mathbf{OWNER} + b4\ \mathbf{CON\_LEN} + b5\ \mathbf{UNDERST} + b6\ \mathbf{COMMIT} + b7\ \mathbf{IT}$$

where:	COOP	= level cooperation between the buyer and the supplier
	ENVT	= Technological Unpredictability
	OWNER	= Level of Ownership
	CON_LEN	= Contract Length
	SWITCH	= Switching Costs
	UNDERST	= Mutual Understanding
	COMMIT	= Commitment
	IT	= Scope of EDI use

The sequence in which the seven independent variables were entered into the regression is consistent with the conceptual logic of the paper, i.e., explore the effect of the characteristics of the environment within which the relationship operates, then the characteristics of the partnership itself and finally the way information technology is used within the relationship. The first block of variables entered into the regression consisted therefore of technological unpredictability (i.e., the variable pertaining to hypothesis 1), the second block included the assembler's switching costs, ownership ratio and contract length (i.e., hypotheses 2a and 2a'), the third block included mutual understanding and commitment (i.e., hypothesis 2b), and finally the fourth block consisted of the scope of EDI use (i.e., the variable pertaining to hypothesis 3).

Table 2 summarizes how the five hypotheses developed in this paper have been tested using the data collected in the US and Japan. Hypothesis 1 is supported if coefficient b1 is statistically different from zero and negative. Hypotheses 2 and 3 are supported if coefficient bi (i = 2 to 7) are statistically different from zero and positive. Hypothesis 4, as it pertains to the differential influence of information technology as a construct, it is supported if the change in R^2 due to the scope of EDI use variable is significant. Finally, the differences across countries (i.e., hypothesis 5) will be examined by comparing the signs of b7 across the two samples.

Table 2: Testing hypotheses 1 to 5

Hypothesis 1	**b1 < 0 and statistically ≠ 0**
Hypotheses 2a and 2a'	**b2, b3 and b4 > 0 and statistically ≠ 0**
Hypothesis 2b	**b5 and b6 > 0 and statistically ≠ 0**
Hypothesis 3	**b7 > 0 and statistically ≠ 0**
Hypothesis 4	**ΔR^2 due to IT significant**
Hypothesis 5	**b7 different signs across the two country samples**

RESULTS AND FINDINGS

Table 3 summarizes the results from the multiple regressions (see details in Appendix) conducted separately with the US (n=140) and Japanese (n=307) samples. The R^2 scores indicate that the 7 variables derived from theory collectively constitute good predictors of buyer-supplier cooperation in the auto industry in both countries (multiple R = 0.44; R^2 = 0.19 in the US and multiple R = 0.55; R^2 = 0.30 in Japan). Further examination of the five hypotheses suggests that (1) different factors account for cooperation in the US and Japan and (2) some factors equally affect cooperation in both countries but through a different mechanism.

Table 3: Results for hypotheses 1 to 5

	Analytical Approach	Results US	Japan
Hypothesis 1	b1 < 0, statistically ≠ 0	b1 < 0 not significant	**b1 > 0 significant**
Hypothesis 2a and 2a'	b2, b3, b4 > 0, statistically ≠ 0	**b2 < 0, not significant** **b3 < 0, not significant** b4 >0, not significant	b2 > 0, significant b3 > 0, significant b4 > 0, significant
Hypothesis 2b	b5, b6 > 0, statistically ≠ 0	b5 > 0, significant **b6 < 0, significant**	b5 > 0, significant **b6 < 0, significant**
Hypothesis 3	b7 > 0, statistically ≠ 0	**b7 > 0, not significant**	**b7 > 0, significant**
Hypothesis 4	change in R^2 due to IT > 0 and significant	ΔR^2 not significant	**ΔR^2 significant**
Hypothesis 5	b7 different signs across the two countries	b7 > 0	b7 > 0

Hypothesis 1: The findings from the multiple regressions conducted with the two samples indicate that technological unpredictability plays a different role in predicting interfirm cooperation in the two countries. Highly significant with a positive β1 in the Japanese sample, it is not significant and with a negative β1 in the US. Hence, technological uncertainty appears as a critical factor in the selection of

supplier partnerships in Japan but not in the US. This finding about Japanese firms, in contradiction with hypothesis 1, is however consistent with descriptions of the tier-structure of the Japanese supply system, where first-tier suppliers typically operating in the high end of the components market are engaged in a close partnership with the buyer. They get involved in early stages of the vehicle conception and planning, in the product and tool design phases, coordinate second-tier suppliers, before finally assembling and delivering a total integrated subsystem (e.g., the suspension or breaking system) to the car manufacturer. In contrast, US manufacturers tend to avoid closely tying their processes to suppliers operating in high technological uncertainty markets.

A explanation for this contradicting positive relationship between technological uncertainty and cooperation in the Japanese context requires re-considering the direction of causality between cooperation and uncertainty. Specifically, we can argue that Japanese firms do not necessarily treat technological uncertainty as an exogenous variable*. Instead, the cooperation across multiple products and multiple transactions ever time may decrease technological uncertainty. Toyota engineers, for instance, know extremely well the design, engineering and manufacturing capabilities of the suppliers they have developed multiple generations of new products with. The joint teams contribute to greater information transparency and trust which can translate into Toyota helping the supplier resolve some of its technological uncertainty through joint long-term planning or joint advanced research. It is important to note that this study does not allow us to make any conclusion about the direction of causality, but may suggest that cooperation over time can be used to decrease technological uncertainty.

Hypothesis 2a and 2a': Governance structure is a strong and highly significant predictor of cooperation in both national settings. In particular, switching costs have a strong influence, ***in Japan as well,*** on cooperation (in the US $\beta 4 = .22$, t

---

* We would like to acknowledge and thank Yves Doz for this suggestion.

= 2.5 and t-significance = .01 and in Japan $\beta 4$ = .19, t = 3.63 and t-significance < .001). Important differences across the two countries, however, appear in the significance and sign of β coefficients for the two other variables, i.e., ownership ratio and contract length. Japanese firms actively cooperate with those suppliers in which they have invested some capital ($\beta 2$ = .31, t = 5.87 and t-significance = .000 for ownership ratio) and those suppliers bound by a longer term contract ($\beta 3$ = .085, t = 1.61 and t-significance = .1 for contract length). In contrast, the capital or equity investment made into a supplier's nor the length of the contract seem to predict the intensity of the cooperation between the US assembler and its supplier.

This set of results is consistent with additional data collected during this study (see for instance, Bensaou 1992, 1994) and previous work (Asanuma, 1988) that shows that for each category of critical products Japanese manufacturers invest into and nurture only a few potential suppliers who typically have developed the skills and capabilities to design and manufacture a wide range of related components. As explains Asanuma, Japanese auto makers rarely practice sole sourcing, and usually share the business for a given component among 2 to 3 suppliers perpetually competing and emulating each other in areas of technology development, improvement in process, product, quality and cost. Field interviews seem to suggest that the typical level of capital or equity participation by a Japanese manufacturer is not intended for control or potential take over purposes, but rather to signal to the external environment and to the supplier itself their commitment to the relationship. In such a case, ownership ratio is not a predictor but rather a reflection of the high level of cooperation developed over time between the two firms.

Hypothesis 2b: The climate of the relationship, in fact, appears as the most consistent predictor across the two countries. Indeed, in both settings coefficient $\beta 5$ for mutual understanding ($\beta 5$ = .31, t = 3.5 and t-significance < .001 in the US, and $\beta 5$ = .16, t = 3.06 and t-significance < .01 in Japan) and $\beta 6$ for commitment ($\beta 6$ = -.14, t = -1.6 and t-significance = .1 in the US, and $\beta 6$ = -.17, t = -3.3 and t-

significance = .001 in Japan) are positive and highly significant. This represents an important finding not only because it is consistent with hypothesis 2b, but mostly because it indicates that when compared with other sources of uncertainty, in particular those related to governance structure and asset specificity it is the relational variables that better account for variance. This cross-sectional study unfortunately cannot indicate whether climate is an outcome of cooperation or a predictor of it. However, our fieldwork suggests a 'feedback loop' from cooperation to climate. Once a manufacturer has engaged in a highly cooperative activity with a supplier and repeats this experience successful, it will result into a better climate, i.e., greater mutual understanding and trust and a fairer sharing of the burdens and benefits of the relationship. This cross sectional study is not designed to inform about the direction of causality between climate and cooperation, but nevertheless raises the argument of a dynamic interaction between the two constructs.

Hypotheses 3 and 4. Information technology does not play the same predictive role in the two countries. Its β coefficient is, nevertheless, positive in both countries though not significant in the US sample. This suggests that EDI as a coordination technology supports cooperation across organizational boundaries.

In absolute terms, US firms more heavily rely on information technology (see Bensaou (1994) reporting t-test differences conducted across the two countries for the level of EDI use and scope of use). As some US information systems managers view it "...EDI is the *strategic* weapon that should allow us to get data from suppliers faster, with less errors and at a lesser cost...". US manufacturing companies, lead by auto assemblers established a consortium, the Automotive Industry Action Group (AIAG) to develop industry-wide standards for the electronic exchange of data and documents. The objective is to build an information technology infrastructure for the standard and common use of EDI with all potential suppliers across multiple functional areas. All manufacturers would then coordinate electronically with any supplier and vice versa, eventually creating an electronic market for components.

However, the findings of this study clearly indicate that this ambitious use of IT has not yet translated into IT playing a major role in explaining cooperation between the two firms.

This is, however, not the case for Japan, where in spite of the fact that the interorganizational use of IT is mostly limited to the exchange of tapes and disks the scope of EDI use is significantly associated with cooperation (see Bensaou 1994). This suggests that in contrast to American manufacturers' policy to develop an electronic platform to support an 'electronic' market place for car components, Japanese manufacturers are engaged in an 'electronic partnership' strategy where EDI supports the coordination with the close partners. For instance, data analyses reported elsewhere indicate a greater level of data and process integration between the buyer and the supplier in the Japanese sample (see Bensaou 1994).

A Japanese manager commented: "...we are not looking for a quick [technological] fix...it is more important for us to first make sure we have compatible assessment methods and technologies, a common language, and that our scheduling and production processes are well integrated...once this is accomplished a tool like the fax can be added to the process if people think we can gain in operational efficiency..." He insisted the main objective is to detect and correct problems as early as in the design process, integrate the production processes between the two companies, and at the same time ensure the perfect execution and coordination of these processes *within* each company first. This type of activity can in fact develop only between two highly cooperative partners.

Implications and Conclusions

This study examined the factors related to the level of cooperation between a customer and its suppliers in the US and Japanese automobile industries. The conceptual model draws upon three research perspectives that have proposed different factors related to the nature of vertical relationships: (1) transaction costs analysis, (2) political economy and (3) organization and MIS studies. The empirical

study tested the relative explanatory power of these various factors that affect the inter-organizational coordination capabilities of the relationship: the characteristics of the market environment within which the relationship operates, the characteristics of the relationship itself, the characteristics of the supplier and the use of IT applications across firm boundaries.

Contribution to theory

The empirical findings discussed above indicate that all these factors collectively affect the level of interfirm cooperation. An important result is the significance of the role of information technology and the climate of the relationship in both the US and Japanese samples. This result supports predictions made by a transaction cost analysis (i.e., specific investments and switching costs as a significant predictor), but adds relational (i.e., mutual understanding and commitment) and technological factors (i.e., scope of EDI use).

In addition, we tested the influence of these factors across national settings. We found that in the US context the characteristics of the market within which a relationship operated (operationalized as technological unpredictability) do not have a significant impact, while characteristics intrinsic to the relationship and information technology do explain differences in cooperation. We also found that some of the hypotheses we derived from the research perspectives mentioned above did not necessarily apply to the Japanese context (i.e., we found an opposite sign for technological unpredictability). The results also suggest that information technology as a construct has a significant role in explaining cooperation in Japan but not in the US. This finding reflects the different strategies and perspectives on technology and its role in the two countries.

Contribution to methodology

This study represents the first systematic attempt to simultaneously test for determinants of cooperation derived from multiple research perspectives, including information technology. In addition, this is a first attempt to examine whether these

theoretical assertions held across countries. The study, indeed, tested the hypotheses with a sample of 447 distinct relationships where the sampling procedure (i.e., control over components, suppliers and tasks) was designed to have variance across the three independent variable constructs.

Contribution to practice

The findings suggest that in spite of the efforts reported by the trade press US manufacturers have not yet transformed their supplier relations. Indeed, our results are consistent with the general findings reported by Helper (1987) and Womack (1990). We found for instance that US auto makers still tend to spread their volume among multiple suppliers avoiding too much dependence over suppliers no matter the level of technological uncertainty inherent in the component, or the level of specialized investments into the relationship. The US approach towards information technology is also to "automate" relationships and develop an industry-wide technological platform to allow coordination between any of the players in the industry. In contrast, the results from the Japanese sample are consistent with the long-term nurturing strategy of most Japanese manufacturers. Those suppliers who benefit from a tight partnership are dedicated to the auto industry, tend to provide a wide range of components to the buyer, operate in high technology uncertainty markets and have specialized proprietary electronic linkages with the buyer. Instead of an industry-wide standard Japanese manufacturers rather develop proprietary VANs linking the systems in their R&D labs, plants and offices to those of their suppliers, distributors and even banks.

Our finding that information technology is a significant determinant of cooperation, however, calls for further research. In particular, this study has highlighted some intriguing relationships between for instance technology uncertainty and cooperation or climate and cooperation. More in depth ethnographic as well as longitudinal and historical studies should be developed to answer the important

question of whether cooperation can be used to reduce uncertainty and better understand the dynamic process leading to a partnership climate.

Finally, although this study provides insight into factors influencing interorganizational cooperation, in particular into Japanese auto companies' way of leveraging information technology, it does not inform about the volume of exchange between the buyer and the supplier. In other words, while we have been able to explore how IT affects "process" aspects of the relationship (i.e., cooperation) further research is needed to explore its relative explanatory role on "structural" aspects of the relationship (e.g., volume of business involved in the relationship).

References

Anderson, J. C., and Narus, J. A. "A Model of Distributor Firm and Manufacturer Firm Working Partnerships," *Journal of Marketing*, Volume 54, January 1990, 42-58.

Arndt, J. "The Political Economy Paradigm: Foundation for Theory Building in Marketing," *Journal of Marketing*, Volume 47, Fall 1983, 44-54.

Asanuma, B., (1988) "Manufacturer-Supplier Relationships in Japan and the Concept of Relation-Specific Skill," *Journal of the Japanese and International Economies*, Volume 3, 1988, 1-30.

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

Balakrishnan, S., and Wernerfelt, B. "Technical Change, Competition and Vertical Integration," *Strategic Management Journal*, Volume 7, 1986, 347-359.

Barrett, S., and Konsynski, B. "Inter-Organizational Information Sharing Systems," *MIS Quarterly*, Special Issue, 1982.

Bensaou, M., "Supplier Relationships in the Japanese Auto Industry: An Empirical Comparison with the US Industry," In Nigel Campbell and Fred Burton (Eds.), *Japanese Multinationals: Strategies and Management in the Global Kaisha*, Routledge,1994, 274-291.

———., "Interorganizational Coordination: Structure, Process, Information Technology. An Empirical Study of Buyer-Supplier Relationships in the US and Japanese Auto Industries," *MIT Ph.D. dissertation*, 1992.

———.and N. Venkatraman "Configurations of Inter-Organizational Relationships: A Comparison Between US and Japanese Automakers," *Management Science* (forthcoming).

Benson, J. K. "The Interorganizational Network as a Political Economy," *Administrative Science Quarterly*, Volume 20, 1975, 229-249.

Cash, I. J., and Konsynski, B. "IS Redraws Competitive Boundaries," *Harvard Business Review*,Volume 64 (2), 1985, 134-142.

Coase, R. H. "The Nature of the Firm," *Economica N.S.*, Volume 4, 1937, 331-351.

Cusumano, M. A., and Takeishi, A. "Supplier Relations and Management: a Survey of Japanese, Japanese-Transplant and US Auto Plants," *Strategic Management Journal*, 1991, 563-588.

Daft, R. L., and Lengel, R. H. "Organizational Information Requirements, Media Richness and Structural Design," *Management Science*, Volume 32(5), 1986, 554-571.

Dore, R. "Goodwill and the Spirit of Market Capitalism," *The British Journal of Sociology*, Volume 34(4), 1983, 459-482.

Galbraith, J. R. *Designing Complex Organizations*, Reading, Massachusetts: Addison-Wesley, 1973.

Guetzkow, H. "Relations Among Organizations," In R. Bowers (Ed.), *Studies in Behavior in Organizations*, 1966.

Gurbaxani, V., and Whang, S. "The Impact of Information Systems on Organizations and Markets," *Communications of the ACM*, 1991.

Heide, J. B., and John, G. "Alliances in Industrial Purchasing: The Determinants of Joint Action in Buyer-Supplier Relationships," *Journal of Marketing Research*, February 1990 , 24-36.

Helper, S. "Supplier Relations and Technical Change: Theory and Application to the US Auto Industry," *Harvard University Ph.D. Dissertation*, 1987.

Henderson, J. C. "Plugging into Strategic Partnerships: the Critical IS Connection," *Sloan Management Review*, Spring 1990, 7-18.

Jarillo, C. J. "On Strategic Networks," *Strategic Management Journal*, Volume 9, 1988, 31-41.

Johnston, H. R., and Lawrence, P. "Beyond Vertical Integration - the Rise of the Value-Adding Partnership," *Harvard Business Review*, July-August 1988, 94-101.

Johnston, H. R., and Vitale, M. "Creating Competitive Advantage with Interorganizational Systems," *MIS Quarterly*, 1988.

Joskow, P. L. "Asset Specificity and the Structure of Vertical Relationships: Empirical Evidence," *Journal of Law, Economics, and Organizations*, Volume 4(1), 1988, 95-117.

Konsynski, B., and MacFarlan, W. "Information Partnerships - Shared Data, Shared Scale," *Harvard Business Review*, Sept-Oct 1990, 114-120.

Lamming, R. "The International Automotive Components Industry: The next 'Best Practice' for Suppliers," *MIT-IMVP International Policy Forum mimeo*, 1989.

Macneil, I. R. *The New Social Contract, An Inquiry into Modern Contractual Relations*, New Haven, Connecticut: Yale University Press, 1980.

Malone, T. W.; Yates, J.; and Benjamin, R. I. (1987). "Electronic Markets and Electronic Hierarchies," *Communications of the ACM*, Volume 30, 1987, 484-497.

March, J., and Simon, H. *Organizations*, New York, New York: John Wiley & Sons, 1958.

Nishiguchi, T. "Strategic Dualism: An Alternative in Industrial Societies," *University of Oxford Ph.D. dissertation*, 1989.

Pfeffer, J., and Salancik, G. R. *The External Control of Organizations: A Resource Dependence Perspective*, New York, New York: Harper & Row, 1978.

Piore, M., and Sabel, C. *The Second Industrial Divide*, New York, NY: Basic Books, 1984.

Porter, M. E., and Millar, V. E. "How Information Gives You Competitive Advantage," *Harvard Business Review*, Volume 63 (4), 1985, 149-160.

Powell, W. "Hybrid Organizational Arrangement: New Form or Transitional Development?" *California Management Review*, Fall 1987, 67-87.

Reve, T., and Stern, L. W. "The Relationship between Interorganizational Form, Transaction Climate, and Economic Performance in Vertical Interfirm Dyads," In Pellegrini (Eds.), ***Marketing Channels -- Relationships and Performance***, 1976 .

Richardson, G. B. "The Organization of Industry," *The Economic Journal*, 1972, 883-896.

Sabel, C. F.; Kern, H.; and Herrigel, G. "Collaborative Manufacturing: New Supplier Relations in the Automobile Industry and the Redefinition of the Industrial Cooperation," *MIT-IMVP International Policy Forum mimeo*, 1989.

Spekman, R. E. "Strategic Supplier Selection: Understanding Long-Term Buyer Relationships," *Business Horizons*, July-August 1988, 75-81.

Stern, L. W., and Reve, T. "Distribution Channels as Political Economies: A Framework for Comparative Analysis," *Journal of Marketing*, Volume 44, 1980, 52-64.

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

Thorelli, H. B. "Networks: Between Markets and Hierarchies," *Strategic Management Journal*, Volume 7, 1986, 37-51.

Tushman, M. L., and Nadler, D. "Information Processing as an Integrating Concept in Organizational Design," *Academy of Management Review*, 1978, 613-624.

Venkatraman, N. "IT-induced Business Reconfiguration," In M. S. Scott Morton (Ed.), *The Corporation of the 1990's, Information Technology and Organizational Transformation*, Oxford: Oxford University Press, 1991.

Venkatraman, N., and Grant, J. "Construct Measurement in Strategy Research: A Critique and Proposal," *Academy of Management Review*, Volume 11, 1986, 71-86.

Venkatraman, N., and Kambil, A. "The Check's Not in the Mail: Strategies for Electronic Integration in Tax Return Filing," *Sloan Management Review*, Volume 32 (2), 1991, 33-43.

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

Williamson, E. O. "Transaction-Cost Economics: The Governance of Contractual Relations," *Journal of Law and Economics*, Volume 22, 1979, 233-263.

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

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

Womack, J. P.; Jones, D. T.; and Roos, D. *The Machine That Changed The World*, New York, New York: Rawson Associates, 1990.

Appendix: Results from multiple regression analysis

US Sample: n=140

Independent Variables	R^2	F	Sig F	ΔR^2	F change	Sig ΔR^2	β	t	Sig t
Environmental Characteristics	.0001	.01	.90	.0001	.015	.90			
Technological Unpredictability							- .004	- .05	.96
Governance Structure of the Relationship	.08	2.45	.05	.08	3.26	.02			
Ownership							- .036	- .40	.69
Contract length							- .050	-.58	.56
Switching costs							.219	2.50	.01
Climate of the Relationship	.18	4.21	.001	.10	7.19	.001			
mutual understanding							.311	3.50	.001
commitment							- .144	- 1.59	.11
Information Technology	.19	3.80	.001	.01	1.27	.26			
Scope of IT use							.10	1.13	.26

Japanese Sample: n=307

Independent Variables	R^2	F	Sig F	ΔR^2	F change	Sig ΔR^2	β	t	Sig t
Environmental Characteristics	.05	13.8	.000	.05	13.77	.000			
Technological Unpredictability							.137	2.61	.01
Governance Structure of the Relationship	.24	21.7	.000	.19	23.24	.000			
Ownership							.312	5.87	.000
Contract length							.085	1.61	.10
Switching costs							.189	3.63	.001
Climate of the Relationship	.29	18.6	.000	.05	9.65	.000			
mutual understanding							.159	3.06	.01
commitment							- .172	- 3.30	.001
Information Technology	.30	16.4	.000	.01	2.50	.1			
Scope of IT use							.083	1.58	.1