

**INTERORGANIZATIONAL COST MANAGEMENT
AND RELATIONAL CONTEXT**

by

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Abstract

Many firms today form alliances with their suppliers and customers that do not fit into the classical dichotomy of hierarchies and markets. The emergence of so-called hybrid relational forms makes the make-or-buy decision more complicated than identified by the neo-classical economic perspective. One of the outcomes of these hybrid relational forms appears to be the development of cost management techniques that cross the organizational boundary between buyers and suppliers and whose objective is to reduce costs through collaborative efforts. This paper explores how firms enact interorganizational cost management during product design and the characteristics of the relational contexts associated with them. It also discusses the implications of such developments to the make-or-buy decision.

Keywords: cost management, make-or-buy decision, outsourcing, buyer-supplier relationship, new product development.

Interorganizational Cost Management and Relational Context

Introduction

The neo-classical economics literature represents the make-or-buy decision as one of dichotomous competition between the firm and an external supplier. Two fundamental assumptions underlying this model are that there is no information asymmetry between the buyer and the supplier and that the contract between the two trading partners is complete (Baiman & Rajan, 2000). Despite the restrictiveness of these assumptions, a broad range of items can be acquired using such a pure market approach, including commodity products (such as nuts and bolts) and commodity processes (such as surface-mounting parts onto a printed circuit board). However, as firms increasingly focus their attention on their core competencies, they are outsourcing both a higher percentage of the total costs of their products and more substantial items that do not rely upon their core competencies (Pralhad & Hamel, 1990; Kotabe & Murray, 1990; Quinn, 1992; Venkatraman, 1989; Gilley & Raheed, 2000; Bryce & Useem, 1998). The rationale for using an external supplier for such items includes the supplier's superior levels of cost, functionality and quality, and their ability to incorporate new technologies in a timelier manner (Monczka & Trent, 1991; Nishiguchi, 1994). Consequently, not all items that firms are outsourcing can be described as being either product or process commodities. Instead, many of them rely upon knowledge that is proprietary to the buyer or supplier.

The outsourcing of more significant items introduces the problem of information asymmetry between the buyer and the supplier into the make-or-buy decision. This information asymmetry can cause the buyer to establish specifications that unnecessarily increase the costs incurred by the supplier. For example, by requiring certain functional specifications the buyer might force the supplier to develop the outsourced part using expensive raw materials. One of the ways to reduce the costs associated with this form of information asymmetry is for the product engineers at the buyer and supplier to meet during the product development process and identify opportunities to change the buyer's

specifications in ways that lower overall costs. Such formalized buyer-supplier interactions, whose objective is to identify opportunities for joint cost reduction, are the domain of interorganizational cost management (IOCM) (Cooper & Yoshikawa, 1994; Cooper & Slagmulder, 1999).

As firms outsource more significant items and engage in IOCM, they develop relational contexts that do not fall into the simple dichotomy of markets and hierarchy (Williamson, 1979, 1985). Instead, these relationships represent intermediate or hybrid modes of governance that enable firms to access the economies of scale and scope of their trading partners in more efficient ways than are possible through either pure arm's length transactions or through vertical integration (Powell, 1990; Williamson, 1991; Sheppard & Tuchinsky, 1996). Many different forms of relational context between buyers and suppliers have been observed, ranging from relationships where the interactions are close to market driven, to strategic partnerships where the firms have signaled their desire to work together closely over the long-term (Heide & John, 1990). These hybrid relational contexts are characterized by incomplete contracting as it is either impossible or impractical to develop contracts that completely specify all of the potential outcomes of the interactions between both parties (Baiman & Rajan, 2000).

One outcome of these hybrid relational contexts is that the calculus of the make-or-buy decision becomes more complex (Gietzmann, 1996). Some of this complexity derives from the fact that the transaction costs are difficult to quantify with any accuracy or rigor, therefore they are likely to be assigned reduced importance in the decision-making process (Walker & Weber, 1994). Management accounting textbooks typically avoid the measurement problem and treat them as qualitative factors (Horngren, Foster & Datar, 2000; Atkinson, Banker, Kaplan & Young, 2001). This treatment is problematic since the accounting justification of the decision to source an item internally versus externally frequently appears to err by systematically underestimating the magnitude of the qualitatively determined costs (Drtina, 1994; Lacity, Willcocks & Feeny, 1996). Furthermore, as the complexity of the product design project increases, so does the scope of management control systems to include not just the narrow accounting numbers (cost,

profitability, and budget), but also a broader information set that captures customer, product design, and time-sensitive measures (Davila, 2000).

Thus, the increased complexity of the outsourcing decision and the emergence of IOCM place new demands upon the accounting and control systems of firms. Yet, despite the increased interest in interdependencies and information flows that transcend organizational boundaries and their potential implications for management accounting, the topic has largely been ignored in the accounting research literature (Hopwood, 1996, Van der Meer-Kooistra & Vosselman, 2000). In this paper, we address this limitation of the literature by exploring IOCM practices and the relational contexts associated with them.

Based on field research on a sample of seven companies in three supply chains, we identify three different IOCM techniques that are being used by buyers and suppliers to achieve joint cost savings through more effective product design. These techniques vary in scope from incorporating quite modest design changes to virtual complete redesign of major aspects of both the end product and the outsourced item. Furthermore, we provide evidence that suggests that each IOCM technique is associated with a different relational context. Our research identifies six attributes of the buyer-supplier relationship that vary across the three different relational contexts observed. Four of these attributes capture the richness of the interactions between the buyer and supplier. These attributes are design dependence (the extent to which the buyer relies upon the supplier for design expertise), resource sharing (the extent to which the two firms dedicate resources to the joint design task), supplier participation (the extent to which the supplier participates in the design process), and bilateral commitment (the degree to which the two firms visibly commit to the long-term health of the relationship). The other two attributes deal with the mechanisms used to govern the relationship. One set of mechanisms is designed to create incentives for both firms to maintain and support the relationship. The other is designed to create protection against unilateral defection by either party. Our findings suggest that as the level of intensity of IOCM increases, so does the magnitude of the first four relationship attributes. In addition, the incentive and protection mechanisms become less

mechanistic and more self-enforcing and reciprocal in nature. Finally, we provide evidence that suggests that the higher the level of IOCM intensity, the greater the effect on joint performance. Thus, we describe a complex array of decision variables that come into play as firms enter into rich outsourcing relationships. We conclude from our observations that the calculus for make-or-buy decisions at these firms is more complex than described in most accounting textbooks since each of these variables presumably must be factored into the analysis, as must the benefits derived from the interactions.

The paper is structured as follows. In the next section we provide a discussion of the field-based research method used and a brief description of the firms in the research sample. In section 3 we give a detailed description of the three IOCM techniques that we observed and how they are enacted at the sample firms. In section 4 we identify the characteristics of the relational contexts in which these IOCM techniques were observed. In section 5 we show how each of the observed clusters of IOCM practices are associated with a specific relational context and we discuss the perceived impact of the different levels of IOCM on the joint performance of the sample firms. Finally, we discuss the implications of the research findings upon the field of cost management in general and the make-or-buy decision in particular.

Research Method

To gain insights into the IOCM practices of firms and the relational contexts associated with them, an exploratory field-based research project was undertaken. The choice of exploratory case-based research was dictated by the nature of the research problem and the lack of extant literature about interorganizational cost management (Yin, 1984). Three large Japanese manufacturing enterprises, a first-tier supplier to each of them, and a second-tier supplier to one of the firms were visited and their IOCM practices documented. Product development was selected as the domain of IOCM to be studied as prior research has indicated that joint product development represents a significant source of economic benefit in buyer-supplier relations (Clark & Fujimoto, 1991; Cooper & Yoshikawa, 1994).

Research Site Selection

The research findings reported in this paper are based on an in-depth examination of the IOCM practices observed at seven Japanese manufacturing companies, belonging to three different supply chains (see the Appendix for a short description of each company). The research sites were identified and selected in various ways. Komatsu was selected because of its reputation for effectively managing costs across its supply chain. Isuzu was chosen because of its reputation as one of Japan's best practitioners of value engineering and cost management during the product development phase. Finally, Tokyo Motors was selected for its reputation for undertaking thorough customer requirements analyses that were tied to its target costing system.

To capture IOCM practices from the supplier's perspective, we requested that each of the three buyer firms identify a first-tier supplier that management felt was especially adept at undertaking IOCM. Komatsu identified Toyo Radiator as an excellent first-tier supplier with which it undertook particularly effective IOCM. Isuzu identified Jidosha Kiki Company (JKC) as one of its most innovative suppliers with whom it had developed a highly effective cost management relationship. Finally, Tokyo Motors identified its first-tier supplier, Yokohama Corporation, and its second-tier supplier, Kamakura Iron Works, since they formed a three-firm supply chain that was particularly successful at practicing multi-firm cost management. The choice of Yokohama and Kamakura was fortuitous because the three firms were essentially independent, as opposed to part of a *kereitsu*¹. Independence was considered important because it allowed the buyer-supplier interactions to be observed in their purest form. If the firms were part of a *kereitsu*, then "invisible" offsetting transactions, such as low interest loans, might cause one of the firms to agree to "sub-economic" selling prices. In addition, while the research was primarily focused upon the relationships between the three buyer firms and their identified suppliers, we also documented the general relationships between the three buyer firms and their entire supplier bases.

¹ This supply chain was the focus of the Cooper and Yoshikawa (1994) paper.

Data Collection

The field research was based upon open-ended interviews with managers, design and manufacturing engineers, and blue-collar workers at the seven firms in the sample. The interviews focused primarily on their IOCM practices. Given the objective of the research to study IOCM practices during product design, the data collection process was limited to design-related variables. Individuals in the sales function, for example, were not interviewed, as they were considered unlikely to interact with the suppliers' IOCM systems. This decision was validated by our discussions with senior management at all of the sample firms, which revealed that the process of IOCM was predominately limited to the design, engineering, and manufacturing functions of the firm.

The individuals interviewed at each site were actively involved in developing, implementing, and applying the various IOCM techniques used by the firm. The interviews were held in English with translator support as appropriate. Typically, between three to five persons were interviewed at a time (though sometimes, there was only one person in the room and at others over five). Job titles of those interviewed included general manager of product planning, manager of corporate planning, chief engineer, and senior manager of group accounting. The total site visits lasted 16 days. The typical time spent at each firm was between two and three days. Initially, each firm was visited for one to two days and from the information collected a draft of the case was prepared. Follow-up visits typically lasting half to a whole day were used to clear any major outstanding issues and for the company appointed contact manager to sign and hence release the final draft of the research case.

Company documents, copious notes, and tape recordings of the interviews were the basis for seven research cases of approximately 5,000 words each. The majority of the data collected was qualitative in nature. The aim of the research was to identify and understand the firms' IOCM practices and the contexts within which they occurred. Consequently, the focus of the research was more on exploring the processes that enabled

the firms in the sample to collaborate effectively, such as guest engineer programs², than on collecting quantifiable metrics, such as the number of engineering hours dedicated to joint design. With the small number of firms in the sample and the selection processes used to identify them, this research only provides evidence about the *existence* of IOCM practices. It should not be construed as either providing evidence of central tendency behavior or justifying the investment of resources made in these techniques.

The cases were sent to the contact manager in each firm for review. The first draft of the cases contained numerous questions that could not be answered from the tape recordings and notes. The cases typically went through two to three revisions before being cleared. It took between 3 to 12 months to clear each case. When necessary, the questions and appropriate textual portions of the case were translated into Japanese so that managers with inadequate English skills could answer the questions and review the text for accuracy. During a typical clearance procedure, approximately 30 questions were answered and about one-third of the case was rewritten or amended in some way. While the majority of these changes related to the author-initiated questions, others were corrections to the drafts made by the reviewing managers before releasing the cases. The purpose of this iterative process was to increase the probability that the observations captured in the cases were factually correct and accurately reflected actual practice.

Data Analysis

Data analysis was undertaken in a modified, three-stage version of the process suggested by Eisenhardt (1989). First, within-case analysis was used to identify the IOCM techniques used at each individual firm. Second, a cross-case analysis of the firms within the same supply chain was undertaken to identify the unique buyer-supplier interactions across the firms' boundaries that enabled them to achieve IOCM. Finally, cross-case analysis was used to uncover patterns of IOCM techniques utilized and buyer-supplier interactions that were common to multiple firms and supply chains in the sample. Patterns of association between IOCM practices and relational contexts were identified based on the cross-case analyses and evidence from each case was used to support or

² Guest engineers are employees from the supplier who spend an extended time at the buyer, or vice versa,

extend the emerging theory. The data analysis was considered complete when no additional general patterns could be identified from the field observations.

In this paper, we primarily analyze the practices observed between the dyadic pair Komatsu and its supplier Toyo Radiator, both of which had developed sophisticated IOCM skills. Komatsu, Ltd. is one of Japan's largest heavy industrial manufacturers and the world's second-largest manufacturer of a complete line of construction equipment. The firm's product line contains over 300 models, including bulldozers, hydraulic excavators, wheel loaders, and dump trucks. Toyo Radiator Co. Ltd. (Toyo) was founded in 1936 as a radiator supplier to the fledgling Japanese automobile industry. Over the years, it has diversified into all arenas of heat exchange applications and is now one of the world's largest independent heat-exchange equipment manufacturers for construction equipment. Komatsu has been a Toyo customer since 1955.

We chose to focus on the Komatsu-Toyo dyadic pair because our observations at those two firms captured a contemporaneous change in their IOCM practices and the relational context between them. Consequently, the interplay between the buyer and supplier and the role of the relational context in IOCM were more directly visible at Komatsu-Toyo than at the other research sites. We used the observations at the other firms to both fill in gaps in the observations at Komatsu-Toyo (for example, about other IOCM techniques and their associated relational contexts) and to provide confirming evidence of any interpretations of the observations at Komatsu-Toyo. From our collective observations, we developed a rich description and analysis of the observed IOCM techniques and the relational contexts associated with them.

Observed IOCM Practices

IOCM is used to help reduce the information asymmetry that exists between the buyer and supplier regarding the relationship between the specifications for the outsourced item established by the buyer and the resulting costs at the supplier. An IOCM intervention is triggered when this information asymmetry causes the buyer to set specifications that

to resolve joint design problems. For a discussion of guest engineers, see Holden and Burgess (1994).

cannot be met by the supplier if the latter is to make an acceptable profit. The primary mechanism for identifying when an IOCM intervention is required is target costing. Target costing lies at the heart of IOCM in the sample firms as it links customer demands through product design to the parts acquisition process (Koga 1998; Cooper and Slagmulder, 1997; Cooper and Chew, 1996; Kato et al., 1995; Monden, 1995). However, as described in the literature, target costing is an arm's-length cost management technique; it does not actively involve the supplier in the buyer's cost management program. Instead, the buyer's target costing system identifies the purchase price of the outsourced item and this signals to the supplier's target costing system where cost reduction is necessary. The key extension of IOCM beyond other cost management techniques is the active involvement of both the buyer's and supplier's design teams in the joint management of costs.

Three IOCM techniques were observed at the sample firms. The first, functionality-price-quality (FPQ) tradeoffs, was used to help resolve relatively minor cost overrun problems and involved only modest specification changes and hence interactions amongst the firms' design engineers. The second, interorganizational cost investigations, was applied when FPQ trade-offs were unable to produce the desired level of cost reductions. The technique involved more intense interactions amongst the design engineers and more significant changes to the design of the outsourced item and occasionally changes to the specifications of the end product. The final IOCM technique, concurrent cost management, was used to address the cost problems that demanded the most significant levels of cost reduction of all three techniques. It required the most significant interactions between the buyer's and supplier's design engineers and led to fundamental changes in both the buyer's product and the outsourced components.

Functionality-Price-Quality Tradeoffs

An FPQ trade-off is initiated whenever the supplier determines that the manufacturing cost of the outsourced item is going to exceed its target cost and that the only way to reduce costs to the target level is by relaxing the functionality and or quality specifications of the outsourced item in ways acceptable to the buyer. Once such

relaxations are identified, the supplier requests a meeting with the buyer and the two design teams to discuss the proposed changes and hopefully obtain buyer approval to make them. Successfully identifying such opportunities helps the supplier ensure that it generates adequate returns. For example, senior management at Yokohama identified the firm's ability to identify opportunities for cost reduction through FPQ trade-offs as being critical to its long-term success.

At the heart of a successful FPQ trade-off is an effective value-engineering program. At Yokohama, value engineering is applied to all products and the technique is fully integrated into the firm's new product development process. In that process, the basic functions of the product are first identified and the target cost of the product established. The next step is to develop prototypes and analyze their costs and compare them to the product's target cost. If the final prototype's costs are considered acceptable, it is subjected to reliability tests and then submitted to the customer for approval. Once customer approval is received, the product is subjected to a second design round and its production costs are re-estimated. If these costs exceed the target cost, then a first-look value-engineering project is initiated. The aim of this project is to identify ways to change the design of the product so that it can be manufactured at its target cost. Once the second generation of design is established, another round of cost estimation is undertaken. If the design is considered acceptable, it is subjected to an analysis to ensure that the product meets its quality specifications. Once this third design analysis is successfully completed, experimental mass production is commenced. During this phase of the design process, the manufacturing cost of the product is again estimated and the quality and functionality of the produced items evaluated. If necessary, a fourth design review is initiated and any deficiencies corrected and the product released for mass production.

Typically, an FPQ trade-off is an outcome of a first-look value-engineering project. However, it can be initiated at any time in the design process up to the release of the item into mass production. Yokohama's success at initiating these interventions relies upon the in-depth knowledge that its engineers have developed about the way that its customers

use the firm's products. This knowledge allows the engineers to identify where and to what extent relaxations in the specifications of the outsourced item are likely to be acceptable to the buyer. Examples of the types of changes in specifications that result from FPQ trade-offs include requesting that the color of part be limited to black or silver instead of matching the color of the end-product; requesting that surface tolerances be relaxed when they are not visible to the end-user; reducing the number of strengthening bars; shifting to pressing a part as opposed to machining it; and reducing the material content without reducing the strength of the part. Under FPQ tradeoffs, only minor changes can be made to the specifications of the outsourced item and the specifications of the end product are essentially fixed.

Interorganizational Cost Investigations

An interorganizational cost investigation is initiated whenever any firm in the supply chain for an item determines that they cannot manufacture the part at its target cost and that an FPQ trade-off will not produce sufficient cost reductions to resolve the problem. In many ways an interorganizational cost investigation is similar to a just-in-time (JIT) production line with each worker having the ability to shut down the line when a defect is identified, except that the workers are here replaced by supplier firms and the defect is in the relationship between the specifications of the outsourced item and its purchase price. Just as in JIT, once the interorganizational cost investigation is initiated, all of the involved players send representatives from their design teams to resolve the problem. Thus, the first major difference between an FPQ trade-off and an interorganizational cost investigation is the ability to include design engineers from more than two firms in the supply chain. The second major difference is the scope of the design changes contemplated. More specifically, an interorganizational cost investigation allows parts to be redesigned so that all of the steps from raw material to finished product are more cost efficient. This increased scope of the design changes enables greater cost savings across the entire supply chain to be identified and implemented. However, just as with FPQ tradeoffs, the fundamental design of the end product is still treated as essentially fixed.

There are two ways in which costs can be reduced through interorganizational cost investigations. First, the need to perform activities can be reduced or avoided by redesigning the product and the components it contains to take full advantage of the manufacturing skills located throughout the supply chain. Second, the location of where activities are undertaken can be changed so that they are performed more efficiently. The interorganizational cost investigation process is best illustrated by example. An interorganizational cost investigation between the engineers of Tokyo Motors, Yokohama, and Kamakura was triggered by Kamakura when Tokyo Motors established specifications for an internal part that could only be met if Kamakura forged, as opposed to cast, the blank. Tokyo Motors' target costing system specified the purchase price of the part and this price along with the functionality and quality specifications were transmitted to Yokohama. The engineers at that firm identified the manufacturing processes that they would use and thus, the specifications of the item that they would source from Kamakura. They used their target costing system to identify their purchase price for the outsourced part. When the specifications and associated purchase price were transmitted to Kamakura, the engineers at that firm identified their production processes and determined that an expensive forging was required as opposed to a less expensive casting. Consequently, they concluded that the purchase price set by Yokohama was insufficient to enable Kamakura to generate an adequate profit.

At this point in the process Kamakura had two options. The first was to refuse the business and the second was to request an interorganizational cost investigation. Kamakura's engineers chose the latter course and requested a joint meeting of the engineers from all three firms. Since only Kamakura's engineers had the necessary expertise in forging and casting technology to understand the implications of the shift between the two, they ran the meeting. The solution that they identified was for Kamakura to start with a cheaper casting and to undertake the first stage in the surface preparation process by removing the ridges that were inherent to the casting process. Yokohama would then take delivery of the part and machine it to the shape required by Tokyo Motors. In addition, the firm would machine the surface of the part (an extra step) to ensure that it conformed to the specifications provided by Tokyo Motors. Finally,

while Tokyo Motors was not requested to change the purchase price of the part, it was required to change the specifications in two ways. First, its engineers reduced the minimum acceptable tensile strength of the part and second, they allowed for small blemishes in the surface of the part. Both changes were necessary to enable casting, as opposed to forging, technology to be utilized for the blank. The two changes were acceptable to Tokyo Motor's engineers because the part was not subjected to much strain and the imperfections on the surface were not visible to the owner of the vehicle. In effect, the original specifications had been too demanding and thus had caused the manufacturing cost of the part to be excessive. Once all three firms had agreed to the changes, the engineers at Tokyo Motors set Kamakura's selling price and thus specified the distribution of profits between Kamakura and Yokohama. It was Tokyo's responsibility to distribute the profits as it was the most powerful firm in the relationship and could thus legislate the split to the other firms.

Concurrent Cost Management

Concurrent cost management is designed to aggressively reduce costs by increasing the scope of design changes that can be undertaken by the supplier. One of the triggering events that lead to the emergence of concurrent cost management at Komatsu was the requirement that Toyo Radiator produce an engine cooling system with 40% more capacity at only 18% higher cost. Komatsu engineers realized that only heroic efforts on both sides would enable them to achieve that objective. Concurrent cost management helps achieve greater cost savings through increased design changes in two ways. First, it increases the amount of time that a supplier's engineers have for developing innovative solutions to the customer's requests and second, it concentrates the sourcing of an entire major function with a single supplier. Because of the high cost involved concurrent cost management is used only for high-value items such as major functions. The aim of involving the supplier much earlier in the design process is to provide that firm with more time to undertake fundamental redesigns of the major function. For example, in the case of the A20 and A21 power shovels, interaction between the design teams of Komatsu and Toyo Radiator began a full twelve months earlier than usual. The increased supplier concentration is important because it allows the supplier to make more fundamental

changes to the design of the major function than would be possible if it were sourced from multiple suppliers. For example, Toyo Radiator redesigned the engine and oil cooling systems of the A20 and A21 power shovels by placing the oil condenser in front of the radiator and thus reducing the need for two fan units (one to cool the condenser and the other to cool the radiator). Such a modification would not have been possible if responsibility for the design of the engine cooling system resided at one firm and the design of the oil cooling system at another.

Under the concurrent cost management approach, cost negotiations between Toyo and Komatsu began earlier in the development process as the two firms now began interacting while the product was still being conceptualized, and not after conceptualization had been completed. Toyo's engineers estimated the cost of manufacture and, if it appeared too high, tried to find ways to alter Komatsu's specifications so that the part could be manufactured for its target cost. Changes in the specifications for Toyo parts were only allowed if the functionality of the final Komatsu product was not excessively compromised. The aim was to make the negotiations that surrounded setting target costs (i.e., the process by which the selling prices of Toyo products to Komatsu were established) more substantive and two sided. Once these target costs (i.e., Toyo's contracted selling prices) and the corresponding production costs at Toyo were established, it was up to the engineers at both firms to find ways to achieve them. The earlier establishment of the target costs meant that Toyo had to be more aggressive in its negotiations and more willing to push back on Komatsu if it felt that the target costs for the major functions it supplied were too low. Komatsu changed the way it enacted target costing by bundling all of the cost of the major function together and letting Toyo Radiator determine the appropriate target costs of the individual components in the engine cooling systems it designed and produced.

Two fundamental approaches to concurrent cost management were observed, parallel and simultaneous. In the parallel approach the engineering teams at the buyer and supplier operate essentially independently, whereas in the simultaneous approach they work together to co-design the end product and the outsourced major function. The choice

between parallel and simultaneous engineering is driven by the perceived benefits from close interactions of the buyer and supplier design teams. If the value of such interactions is considered high, then the firms use simultaneous engineering; otherwise, parallel engineering is utilized.

The primary advantage of parallel engineering is the ability of the supplier to uncouple its own product development program from that of the buyer. For example, under the old approach Komatsu would tell Toyo Radiator that the engine power of a particular product model was to be increased by X% and that a new engine cooling system with the appropriately increased capacity was required in 12 months. However, because Toyo Radiator did not know that increasing engine power was planned for the following generations, it could only react to the requests for increased engine cooling capacity as they were received. Under the new approach, Komatsu informed Toyo Radiator that for the next few generations increased engine cooling capacity would be required at essentially the same cost. Toyo Radiator engineers could then determine that the best long-term solution was to launch a research project to develop a more efficient, low-cost approach to engine cooling. The first new technology engine-cooling system might not be available until the third generation of Komatsu designs, but at least it would be available, whereas, under the old approach, Toyo Radiator would never have the confidence to launch the project in the first place. As long as Toyo Radiator's engineers knew the general level of increased engine power planned by Komatsu, they needed only communicate infrequently with Komatsu's engineers, typically via periodic meetings and telephone calls. Thus, in parallel engineering the engineering teams operate essentially independently of each other.

In contrast, the aim of simultaneous engineering is to allow the design teams to cooperate intensively during the early stages of the design process so that they can co-design the end product and the outsourced item with the objective of finding ways to deliver the desired level of functionality and quality of the end product at its target cost. Successful co-design allows the two design teams to achieve solutions that they could not achieve separately. The process of simultaneous engineering was demonstrated by Komatsu and

Toyo Radiator with the development of the mixed flow fan, which allowed a more effective air flow to be generated and thus a smaller, lower-cost radiator to supply the same level of cooling. However, it also required that Komatsu engineers work closely with the Toyo Radiator design team to test the cooling efficiency of the fan to ensure that it would indeed be adequate. This testing was carried out simultaneously with the development of the fan. Under the old approach, Toyo Radiator would have completed the development of the new engine cooling system and then provided prototypes for Komatsu to test. This sequential approach would have made the development of the new fan design too slow to incorporate into the current generation. Consequently, either the product launch would have had to be delayed, thus losing sales, or the existing cooling system and engine designs would have had to be retained at higher cost. Both outcomes were considered unacceptable as they led to reduced profits at both Komatsu and Toyo.

Clusters of IOCM Practices

The three observed IOCM techniques were associated with different magnitudes in the design changes of the items being produced by the interacting firms. FPQ tradeoffs are associated with small design changes that can be accommodated by a single firm in the supply chain with the permission of at least one other firm (it is this need for permission that renders the technique interorganizational). Interorganizational cost investigations are associated with more significant changes that require modifications to the design or production processes of the items produced by more than one firm in the chain. These design changes are interrelated, but they can be accomplished independently of each other with relatively low levels of communications between the design teams after the outsourced item has been redesigned. These changes also have minimal impact on the buyer's product. Finally, concurrent cost management is associated with the most significant changes. Frequently, these changes are so substantial that the designs of both the buyer and supplier's products have to alter, and these alterations have to be codetermined. Thus, although the scope and magnitude of the changes to the design of the products constitute a continuum, ranging from small changes that are almost imperceptible to large changes that are obvious to the customer, the observed IOCM practices consist of three discrete clusters (see Table 1).

[Insert Table 1]

The first cluster captures the firms that were capable of performing all three IOCM techniques. For example, one of the product development projects studied was subjected to both a concurrent cost management intervention and an interorganizational cost investigation. In the second cluster, the firms were able to perform interorganizational cost investigations and FPQ trade-offs, but could not undertake concurrent cost management. The third cluster captures the firms that have the lowest ability to perform IOCM. Here only FPQ trade-offs were observed. Managers at the three top firms confirmed that these patterns of IOCM capability were replicated throughout their supplier networks.

Observed Relational Contexts

Managerial accounting practices cannot be understood in isolation from the broader organizational settings in which they occur (Hopwood, 1983). In our sample, five different relational contexts were observed between buyers and suppliers. One of these contexts essentially fits into the pure market perspective. This context was observed for external suppliers that sold standard products, such as nuts and bolts, to multiple customers. Another context maps into a pure hierarchy perspective where the firms internally source critical parts; for example, Komatsu internally sources the engines and hydraulic systems for its bulldozers and excavators. The other three relational contexts were hybrid forms that did not fit into the classical dichotomy of markets and hierarchies. Since these hybrid relational contexts were associated with IOCM, they were the only ones that were studied in depth. Individuals at both the buyer and supplier firms used the common supplier context as the reference point for their descriptions of the other three contexts; consequently, baseline information about that context was also collected.

Hybrid organizations reflect a wide range of decisions on the part of the management about the location of the boundaries of the firms and the nature of the governance structure that controls the relationship (Gulati & Singh, 1998; Zaheer & Venkatraman, 1995; Dyer & Singh, 1998). However, for the study of IOCM, we can limit the analysis

to those elements of the organizational setting that facilitate interactions across the organizational boundary between buyers and suppliers. Of particular interest is the way that this relational context varies in firms that undertake different forms of IOCM. While relational contexts might be expected to be continuously varying from markets to hierarchies, in practice a limited number of distinct relational contexts appear to be developed. Six attributes appear to be of particular importance when determining the appropriate relational context for IOCM. Four of these attributes – design dependence, resource sharing, supplier participation, and bilateral commitment – relate to interaction characteristics of the buyer-supplier relationship. The final two – incentive and protection mechanisms – relate to the choices surrounding the governance structure of the buyer-supplier relationship.

Design Dependence

According to transaction cost economics, relationships between buyers and suppliers are characterized by some degree of mutual dependence depending upon the specific investments made and the switching costs they entail (Williamson, 1985, 1991). In the context of product development, mutual dependence arises in the form of design dependence. Design dependence is created when the buyer and supplier split responsibility for establishing the specifications of the outsourced item and/or for designing it. The highest level of design dependence occurs when the supplier and the buyer jointly establish specifications and jointly take responsibility for product design. Under these conditions, the two firms must actively integrate their product development processes:

Under the new supplier approach Toyo Radiator could negotiate with us to move the condenser and hence delete a complete fan and motor assembly from the new design.

Komatsu Design Engineer

The next level of design dependence occurs when the supplier accepts responsibility for design and manufacture, but the buyer retains sole responsibility for establishing high-

level specifications. Here the level of integration is lower, but still demanding since the two firms must ensure that the end product and the outsourced item are compatible. Finally, design dependence is low when the buyer both establishes the specifications and takes responsibility for design and the supplier only accepts responsibility for manufacture. Here the buyer must ensure that the outsourced components are designed in a way that enables the supplier to manufacture them for a reasonable cost. The supplier has few additional responsibilities other than ensuring that the parts are delivered on time and on spec.

The triggering event that led to a change in relational context at Komatsu-Toyo was the improved performance that Komatsu was demanding for its A20 and A21 power shovels. The new designs required engine-cooling systems whose radiator size was 36% larger than the previous generation's. Normally, this increase in size would have raised Toyo's costs by approximately the same percentage. However, Komatsu's customers were only willing to pay about half of the extra costs for the proposed increased performance. Komatsu management realized that the target cost it was forced to set for Toyo (118% of the prior generation's cost) was too aggressive to be achieved without changing the way the two firms interacted. Hence, it adopted a new form of supplier relationship with Toyo that was characterized by higher levels of design dependence. Under the new relationship, the interdependence between Komatsu and Toyo was primarily reciprocal as both partners exchanged outputs with each other simultaneously and the output of each partner became the input of the other (Gulati & Singh, 1998; Thompson, 1967). Komatsu used the term "family member" to differentiate its suppliers with the highest levels of design dependence from other types of suppliers. Toyo had previously been a "major supplier", the term Komatsu used for suppliers that took responsibility for the design of the group component they supplied, but not for establishing its specifications.

Komatsu used two additional terms to differentiate among the other types of relational contexts it had established with external suppliers, namely "subcontractors" and "common suppliers". Subcontractors manufacture outsourced items that are designed by the buyer. They have little or no internal design capabilities, but are typically highly

skilled at manufacturing specialized items. Consequently, they only accept responsibility for manufacturing, whereas the buyer is responsible for establishing specifications and designing the part. Finally, common suppliers typically publish catalogues that detail their product offerings. Common suppliers take responsibility for all aspects of the items' design and manufacture. Consequently, there is no design dependence between Komatsu and its common suppliers. Similar relational contexts were observed at the other firms in the sample that occupied the top position in their supply chains. The relationship between the level of design dependence – determined by the responsibility for establishing specifications and product design – and the relational context is illustrated in Table 2.

[Insert Table 2]

These findings are in keeping with earlier research that focuses on analyzing and categorizing relationships between buyers and suppliers. Asanuma (1989), for example, identified three types of suppliers based on their responsibilities in product design, which are equivalent to major suppliers, subcontractors, and common suppliers; however, he does not discuss a relational context similar to family members. Other researchers have identified additional types of buyer-supplier relationships to those discussed in this paper, some of which appear to be motivated by other forms of joint action than IOCM (Asanuma, 1989; Kamath & Liker, 1994; Bensaou & Venkatraman, 1995).

Resource Sharing

The various relational contexts observed enabled the buyer and supplier to share different proportions of their design-related resources. The objective of any increased sharing was to enable more sophisticated interactions between the two design teams to occur. The resource sharing took two major forms. The first was increased asset specificity and the second was increased sharing of strategic information. Previous research has also highlighted the importance of both aspects of resource sharing to the effectiveness of buyer-supplier relationships (Dyer, 1996, 1997; Zaheer & Venkatraman, 1995; Lamming, 1993; Hines, 1994).

Asset Specificity

Asset specificity relates to the degree to which an asset can be redeployed to alternative uses without sacrifice of productive value (Williamson, 1979). Most of the extant literature on buyer-supplier relationships has attributed a central role to the various types of asset specificity, in line with Williamson's transaction cost economics theory (Nishiguchi, 1994; Dyer & Ouchi, 1993; Mudambi & Helper, 1998; Dyer & Singh, 1998). In our sample, Komatsu and Toyo altered the level of asset specificity associated with their relationship in order to increase the level of joint design changes. The two firms had previously invested in assets that were specific to their relationship; for example, through the development of a proprietary stacked fin oil cooler, the investment in dedicated production lines, and the use of guest engineers. However, several instances of increased asset specificity were observed. First, the level of physical asset specificity was increased through the development of proprietary software to model engine cooling and through the sharing of prototyping assets. In addition, the new approach to product development often led to new solutions that were proprietary to the Komatsu-Toyo relationship (such as a new mixed flow fan). To manufacture these new proprietary parts required additional dedicated equipment at Toyo.

More importantly, the level of human asset specificity increased significantly. First, a larger number of individuals were involved in the joint product development process. For example, engineers at both firms were now jointly working on improving the overall performance of future products. As one manager at Toyo Radiator put it:

Our new relationship with Komatsu requires us to dedicate more resources, especially engineers to their products. For example, in the past only design engineers would visit Komatsu, now we want cost engineers to visit as well.

Second, the individuals involved in the joint development process were more intensely involved. For example, the guest engineers had added cost considerations to their design activities. Third, the design activities were more specific to Komatsu than before as the

new designs were now the outcome of joint product development. Finally, the location where individual engineers spent their time changed. In particular, the engineers spent more time co-located.³ Much of the skills and knowledge that were created through this increased intensity of interaction was viewed as proprietary; for example, Toyo was not allowed to change the way that it dealt with the prototypes of the engine cooling systems of its other customers in the near future. Thus, for at least the foreseeable future, these investments had no appreciable value outside the relationship.

The observations at the other firms in the sample indicated that the level of both physical and human asset specificity varied across the different relational contexts. It was only when the suppliers were considered major suppliers or family members that significant levels of design-related asset specificity were observed. As an illustration, Isuzu provided considerable design support to its major supplier JKC. This assistance included resolving manufacturing problems created by new Isuzu parts with complicated shapes that were difficult to machine. However, none of the firms dedicated any significant design-related assets to subcontractors or common suppliers.

Strategic Information Sharing

Achieving cooperative buyer-supplier relationships requires intensive bilateral communication and information sharing to engender appropriate levels of learning and trust (Lamming, 1993; Carr & Ng, 1995; Dyer & Singh, 1998). Increased sharing of strategic information played an important role in enabling Komatsu and Toyo to effectively undertake joint product development projects. Effective co-design became possible because Komatsu and Toyo were sharing considerable information about each other's design plans early in the product development process. For example, right at the beginning of the development process, Komatsu told Toyo that its plans for the new A20 and A21 power shovels included an increase of 40% in engine power. Early conveyance of such strategic information was necessary to give both Komatsu and Toyo adequate

³ There were other ways in which resources were shared among the network firms, such as employee placement. However, since these were not related to cost management, they were not documented for the purpose of this paper.

time to jointly make the significant changes in their product designs that were necessary if the project was to achieve its cost objectives:

As a family member we are told about Komatsu's long-term development plans a lot sooner than we used to be. This earlier notification allows us to match our research efforts with Komatsu's and ensure that difficult technical and cost challenges created by Komatsu's product plans are overcome.

Toyo Radiator Manager

Under family membership, Komatsu and Toyo shared an extensive range of information with each other, despite being separate firms. Komatsu had access to all of Toyo's cost information regarding Komatsu-related products, even to the level of knowing the price that Toyo paid for a single bolt used in a part that went into a Komatsu product. The objective of this cost information sharing was to allow Komatsu to find new ways to reduce costs. For example, it might increase discounts by purchasing the bolt centrally and have the bolt manufacturer deliver it directly to all its users in the Komatsu group and at its family members.

At the other firms in the sample, the level of strategic information sharing also varied across the three relational contexts. While still sharing a considerable amount of information with their major suppliers, the buyers did not share as much strategic information as they did with their family members. When the suppliers were considered subcontractors, little strategic information sharing was considered necessary since design responsibility resided at the buyer and the supplier was only asked to manufacture the part. Strategic information sharing was markedly absent for common suppliers. Here the relationship was essentially arm's length market-based and the two firms shared almost no knowledge outside of price and delivery information.

Supplier Participation

The increased resource sharing between Komatsu and Toyo enabled the suppliers' product engineers to play a more substantive role in the development of the buyer's products. However, for this objective to be achieved, the relational context was modified in two major ways. First, more substantive items and, in particular the research and development associated with them, were outsourced. Second, family members were involved at an earlier stage in the product development process so that they could have more time to identify innovative, low-cost designs.

Outsourcing More Substantive Items

In the case of Toyo Radiator, Komatsu management decided to outsource most of the research and development and all of the manufacture of the engine cooling system. Previously, when only simple components were transferred, Komatsu had undertaken the majority of the research and development in-house and had purchased discrete components from Toyo and other radiator manufacturers, and then assembled the engine cooling system in-house. By outsourcing more substantive items, primarily major functions, Komatsu was able to rely more heavily upon the design skills of its new family members. An important outcome of this outsourcing policy was a reduction in the number of suppliers. As one Komatsu manager put it:

Toyo used to produce only the radiator and other firms produced the fan and electric motor. However, split design made it difficult to increase efficiency, so we decided that under the new supplier program Toyo would produce the motor, fan and radiator in one integrated package.

The value and complexity of the items that were outsourced varied by relational context. For family members, the outsourced items were typically major functions, such as engine cooling systems. In contrast, for major suppliers they were group components, for example, radiators. For subcontractors, the items that were typically outsourced were simple components, such as radiator fan blades. Finally, for common suppliers the outsourced items were standard components, essentially such as nuts and bolts. This

observation is in keeping with the results from an empirical study by Heide & John (1990), who found that closer relationships between buyer and supplier are associated with higher values of the outsourced parts as a percentage of the end product.

Timing of Supplier Involvement

In the case of the A20 and A21 power shovels, interaction between the design teams of Komatsu and Toyo Radiator began twelve months earlier than would have been the case if Toyo was still a major supplier. This additional time was critical because it allowed Toyo and Komatsu to consider more fundamental redesigns of the cooling system and engine.

Previously, we waited until Komatsu presented us with work to perform before we began design. Unfortunately, the contracts were signed too late in the overall design process to give us the time we really needed to design low-cost solutions into our products. Now we work together much earlier in the process and can propose more substantive design changes.

Toyo Radiator President

These findings are consistent with previous research that associates early and extensive supplier involvement with a faster and more efficient product development process (Clark & Fujimoto, 1991; Birou & Fawcett, 1994; Ward, Liker, Cristiano & Sobek, 1995). The buyer-supplier interactions for the other relational contexts occurred later in the product development process. Typically major suppliers were brought in after product conceptualization had been completed and the design of the product was nearly finalized. For subcontractors, the involvement occurred even later, typically after the parts list had been generated. For common suppliers there was essentially no interaction until mass production was scheduled and the orders were placed. Thus, the timing of the design interactions between buyer and supplier appeared to be related to the type of relational context and the magnitude of cost reduction envisioned.

Bilateral Commitment

The increased resource sharing and reliance upon the supplier's product development skills associated with some of the observed relational contexts required that the buyer and supplier strengthen their bilateral commitment. They achieved this objective by increasing the stability of their relationship and the degree of collaboration between the two design teams.

Stability

Stability relates to the bilateral expectation of continued future interactions between the buyer and supplier (Heide & John, 1990). The underlying stability of the buyer-supplier relationships observed at the sample firms varied with the relational context. Previously, when Toyo was supplying relatively simple parts designed by Komatsu, it was fairly easy for Komatsu to find other firms to supply those parts (even though it typically would choose not to do so). Under the new approach Toyo supplied Komatsu with highly specialized parts that relied heavily upon specific knowledge of Komatsu's products. Therefore, Komatsu was far more dependent upon Toyo than previously. Because of the high switching costs they worked to maintain a stable, productive relationship. Furthermore, Toyo had come to rely upon Komatsu for a larger share of its business and as a source of special design skills and engineering support. Consequently, it was also less likely to consider severing the relationship. The two firms were thus highly interdependent and therefore, they were more willing to support each other. Toyo could rely upon Komatsu to continuously give it a steady stream of business and Komatsu could rely upon Toyo to develop customized, innovative engine cooling systems. The stability of the relationship was further enhanced by the reduction in the number of suppliers that accompanied the adoption of a more integrated buyer-supplier relationship.

Increased stability is important because it takes considerable time for the buyer and supplier to develop the in-depth knowledge of each other that is required for the high level of effective co-design required by family membership. This knowledge includes joint technical expertise, mature personal relationships, and extensive prior experience. For example, over time, Toyo engineers had developed considerable expertise that was

specific to Komatsu. While other engine-cooling suppliers existed, they did not have this Komatsu-specific know-how and technology. It would take considerable time and resources on the part of Komatsu to bring them up to the same level of capabilities as Toyo Radiator.

At the major supplier level, the relationships were still quite stable. Only if a major supplier consistently failed to be competitive would it cease to remain in that supplier group. In contrast, at the subcontractor level, the buyer firms were willing to take back in-house certain items that were previously outsourced if there was not enough work to keep their own workforce occupied. Finally, for common suppliers there was almost no stability, as the buyers would simply select the common supplier from a group of certified firms that gave them the best value for each item.

Collaboration

Collaboration between buyers and suppliers is considered a necessary condition for effective buyer-supplier interactions that go beyond pure arm's-length contractual relationships (Heide & John, 1990; Gietzmann, 1996; Dyer, 1996). The relationship between Komatsu and Toyo Radiator had always been collaborative. However, when Komatsu designed the engine cooling system itself, its design engineers did not have to interact so extensively with Toyo's engineers. Toyo and the other major suppliers were manufacturing group components and their primary task was to achieve high quality and on-time delivery at the right price. Komatsu's primary task was to develop specifications, identify capable suppliers, review their bids, and accept the highest value bid. In contrast, when Toyo became responsible for the development and manufacture of entire engine cooling systems, the product development engineers of the two firms had to work closely together to identify new approaches to engine cooling technology that might involve concurrent changes in the design of the engine. Consequently, the new buyer-supplier relationship adopted was designed to create a culture of intense collaboration.

Toyo Radiator is closely related to Komatsu, it is part of a cooperative group. Only a few dozen suppliers have such a rich relationship with Komatsu.

Toyo Radiator President

The relationship between Komatsu and Toyo achieved this objective by stimulating regular meetings between the design teams of the two firms. The simultaneous redesign of both the engine and the engine cooling system required considerable coordination between the two engineering teams since the product development process was highly iterative. The aim of these periodic meetings was to integrate the research and development efforts of the two groups, allow suppliers to provide greater input earlier in the development process, and help ensure that cost reduction negotiations were more substantive.

The other firms in the sample also collaborated and helped each other overcome cost problems during product development. For example, if one of the firms encountered an engineering challenge, it was not unusual for engineers from other firms in the chain to help solve the problem. Isuzu, in particular, used value engineers to help its suppliers resolve cost problems. Similarly, the design teams of all of the firms in the Tokyo-Yokohama-Kamakura chain often got together to identify ways to jointly reduce costs.

The magnitude and intensity of the collaboration varied with the relational context. For example, since subcontractors were not responsible for any of the design aspects of the parts they manufactured, the help they received was limited to the manufacturing process. In addition, the buyer did not look to the subcontractors for any significant help, as there was little additional value that they could provide to the buyer in terms of design support. Finally, with common suppliers no assistance was offered by either party.

Governance Structure

To reap the full benefits from enhanced buyer-supplier relationships, consideration has to be given to necessary shifts in governance structure (Gietzmann & Larsen, 1998). Our observations showed that as the relational context between Komatsu and Toyo changed, the governance structure was modified accordingly. Governance structure is defined here as the mechanisms that create both incentives (i.e., reward and coercion mechanisms) for the buyer and supplier to interact, and safeguards that protect each transactor against the risk of opportunistic behavior on the part of the other (Williamson, 1979, 1985). In

particular, our sample firms' governance structure relied heavily upon trust rather than the classical disciplining mechanisms of authority and price (Nooteboom, Berger & Noorderhaven, 1997).

Trust played an important role in the relational contexts associated with both family members and major suppliers, unlike the other two relational contexts of subcontractors and common suppliers. The key role that trust appeared to play was to stimulate innovation among the various firms in the supply chain. For example, it was the relational context and its associated governance structure that allowed Komatsu and Toyo to find new ways to integrate the engine and its cooling system together for the A20 and A21 power shovels. Our observations regarding the role of trust and innovation are in line with prior research findings that have demonstrated how low trust relationships fail to stimulate new ideas (Korczynski, 1996). In addition, it has been suggested that both the classical hierarchy and market relational contexts do not support innovation; "The hierarchy/authority mode of inter-firm relations clearly risks impeding innovation by stifling the upward flow of new ideas from subordinated suppliers. Their narrow specialization leaves them without the technological know-how needed for innovation, and their subordination leaves them few incentives to contribute innovative ideas to customers.... The market/price mode facilitates innovation by creating incentives to generate new ideas, but this mode, too, impedes innovation because suppliers and customers of innovations have difficulty agreeing on a price for these innovative ideas" (Adler, 2001, p. 224). In contrast, trust-based communities have indeed been shown to be effective when the buyer needs to encourage the supplier to be both innovative and a source of knowledge (Dyer, 1996; Sako, 1992; Helper, 1991; Bensaou and Venkatraman, 1995).

There are three primary sources of trust: familiarity through repeated interaction, calculation, and behavioral norms (Adler, 2001). In our sample, two of these sources of trust were essentially held constant. First, all of the buyer-supplier relationships between the firms had existed for an extended period of time. Thus, the firms were familiar with each other and had built trust through their repeated interactions. Second, they had

developed norms of behavior that were “binding”. All of the firms studied had demonstrated the ability to consistently deliver high quality products in a timely and accurate manner; therefore they had already established a strong reputation as being “good” players (where reputation is defined as repeated consistency over time). Since none of the firms in the sample failed to maintain their reputation across the period of observation, the role of reputation as a self-enforcing safeguard in the buyer-supplier relationships was not observed.

Thus, primarily it was the level of calculative trust that varied across the observed relational contexts and whose role was observed. Calculative trust is developed when each of the parties undertakes a sober assessment of the costs and benefits to the other party of exploiting any vulnerability, and determines that the calculus favors maintaining the relationship on both sides (Adler, 2001). The firms in the family member and major supplier relationships were observed to actively manage their calculative trust to create adequate self-enforcing incentive and protection mechanisms.

Incentive Mechanisms

The nature and importance of the incentive mechanisms utilized varied across the relational contexts. For family members, the primary incentive mechanism was trust-based and took the form of mutual benefit. Family members relied predominately on the principle of mutual benefit by actively working together to increase the joint economic benefit from their cooperative product design efforts. Furthermore, the need to maintain an adequate level of trust played a role in ensuring that some of the reward and coercion mechanisms remained effective. For example, the incremental value created by the relationship had to be shared to some extent – though not necessarily equitably according to both parties – if trust was to evolve (Contractor & Lorange, 1988). Thus, Komatsu, as the more powerful firm in the chain, had to ensure that it did not reap all of the additional profits generated through collaboration.

Sometimes our sharing of cost information coupled to our knowledge of Toyo's profits can lead to a conflict of interest, with pressure building

within Komatsu to reduce target costs where Toyo's profits are known to be high. However, we share a common goal - getting costs as low as possible - which ensures that these conflicts rarely become serious. To reduce the incidence of such conflicts, we do not set our targets costs for parts manufactured by Toyo based upon our knowledge of Toyo's costs. Instead we try to set our target costs independently of Toyo and let Toyo make as much profit as possible.

Komatsu Purchasing Manager

At the major supplier level, the principle of mutual benefit was still operative, but it was less important. For major suppliers such as Toyo (before it became a family member), JKC, and Yokohama, the primary incentive mechanism was the volume of business that the buyer gave the supplier. For example, Isuzu used direct competition between its major suppliers to ensure that the suppliers were as innovative as possible. When a supplier failed to remain competitive, Isuzu punished that firm by awarding it slightly less volume than in previous years. Similarly, it awarded innovative suppliers with slightly more volume than in previous years. To help the poorly performing suppliers become competitive, Isuzu provided them with additional engineering support. This observation is in line with Helper (1996), who found that Japanese firms typically opt for the "voice" strategy of joint problem solving, rather than following the "exit" strategy of ending relations with poorly performing suppliers.

For subcontractors, the primary incentive appeared to be continued business. While severing relationships was rare, it was understood that the supplier would only be retained as a subcontractor if the firm maintained adequate performance levels. At the subcontractor level, the principle of mutual benefit was still in operation, but played a relatively minor role. It was enacted primarily by the firms sharing engineering expertise where beneficial. For example, the buyer might provide the supplier with engineering support to resolve particularly difficult manufacturing problems associated with its outsourced items so as to help ensure that the supplier's target costs were achieved. At the common supplier level, the only incentive that appeared to be in effect was the

economic benefit both sides derived from a market price-based transaction. The principle of mutual benefit was not observed to operate.

Protection Mechanisms

To mitigate the risk of opportunistic behavior by their trading partners, the firms relied upon a number of protection mechanisms, which varied with the relational context. In trust-based relationships the dominant risk is unilateral defection (Granovetter, 1985). One way that firms can signal a low risk of defection is by structuring the relationship so that the commitment of both sides is clearly observable (Parkhe, 1998). In the case of family members, trust was maintained by ensuring that both parties were visibly mutually interdependent. For example, Komatsu openly relied upon Toyo Radiator for its expertise in engine cooling systems and Toyo Radiator openly relied upon Komatsu for a significant portion of its business and for engineering support to develop new technologies. Thus, for family members, the dominant protection mechanism was mutual interdependence. This high level of mutual interdependence led to barriers to unilateral defection and created an additional safeguard against opportunistic behavior. More specifically, Toyo had access to Komatsu's future product plans, which was highly valuable information for Komatsu's competitors. However, Komatsu in turn had access to highly proprietary information about Toyo and if Toyo defected, Komatsu could retaliate by sharing that information with Toyo's competitors. Within these close relationships, personal connections also play an important role in reducing the risk of opportunistic behavior (Ring & Van de Ven, 1989; 1994). For example, both sides viewed the new relationship as akin to a strong friendship, an example of a self-enforcing safeguard that reduces the need for legal and other formal protection mechanisms (Dyer, 1997).

Komatsu is a very important customer with whom we have a highly supportive relationship that can be likened too a very strong friendship.

Toyo Radiator President

For major suppliers, mutual interdependence was still a major protection mechanism, but less significant than for family members. The sequential nature of the design process across the interorganizational boundary for major suppliers coupled to the existence of multiple competing suppliers reduced the dependence of the buyer upon the supplier. However, major suppliers still had extensive and specialized knowledge of the needs of their customers. It was therefore not feasible for the buyer to switch from an existing major supplier to a new one from outside their supplier base. Furthermore, the small number of firms in the supplier base that could make a given family of products made it virtually impossible for the remaining major suppliers to immediately expand production to offset the loss of capacity. Thus, the buyer had visibly rendered itself dependent upon each of its major suppliers for a reasonable period into the future. The major suppliers had rendered themselves similarly dependent on their customers because they only transacted with a limited number of customers in this type of relationship.⁴ Therefore, they would suffer considerable economic hardship by the loss of a customer to whom they were a major supplier. Since it was difficult to create new major supplier relationships in the short-term, the suppliers were equally committed for a reasonable period into the future. Thus, major suppliers and their customers were mutually interdependent, however not to the same extent as family members and their customers.

For subcontractors, the level of mutual interdependence was much lower than for family members and major suppliers. The buyer typically dealt with multiple subcontractors and could relatively easily compensate for the defection of a subcontractor. Finally, for common suppliers there was essentially no mutual interdependence since the buyer could go to any number of equivalent firms for the outsourced items and typically, the buyer represented only a small portion of the suppliers' overall volume. Here, the dominant protection mechanism was market price.

Levels and Nature of Trust

The level and nature of trust differed across the relational contexts at the sample firms. Our observations suggest that the variations in the level of calculative trust can be viewed

⁴ Some of the suppliers transacted with other types of customers – for example, it was not usual for some of

as the result of the interaction between mutual benefit and mutual interdependence. For family members, mutual benefit and mutual interdependence were both high and so was the level of calculative trust. In contrast, the level of mutual benefit and interdependence decreased for major suppliers and even more so for subcontractors, and overall trust was also observed to be lower. Finally, for common suppliers the level of calculative trust was close to zero as both mutual benefit and mutual interdependence were essentially nonexistent.

The nature of the trust engendered by the observed relational contexts was also different. Trust between Komatsu and its family members took the form that has been described in the literature as ‘goodwill trust’ (Sako, 1992; Sako & Helper, 1998). Goodwill trust is characterized by the willingness of both parties to go beyond the contract and act in the best interest of the other party, even at a slight disadvantage to themselves. Such trust can also be described as taking the strong form, i.e., while the firms were significantly vulnerable to each other, they were so committed to the relationship that they had internalized values, principles, and standards of behavior that protected the relationship (Barney & Hansen, 1994). These findings are in keeping with earlier research findings that concluded that self-enforcing mechanisms are more effective than third-party enforcement mechanisms, such as contracts, at both minimizing transaction costs and stimulating value-creation initiatives (Dyer & Singh, 1998).

Komatsu and its major suppliers were not mutually interdependent to the same extent as the firm was with its family members, nor were the mutual benefits as high. In these relationships trust took the form of competence trust (Sako 1992) or the semi-strong form of trust (Barney & Hansen 1994). Competence trust implies that the buyer believes that the supplier has the competence to complete the order and need not be monitored during or after the process. The observed relationships between buyers and subcontractors were less dependent upon self-enforcing safeguards than those observed with major suppliers and, in particular, family members. Instead, the predominant form of protection was through written contracts designed to maintain the relationships and through the risk of

the major suppliers to also be subcontractors to other customers.

termination for poor performance. Thus, the maximum level of trust between the two firms is 'contractual trust' (Sako, 1992) or the weak form trust (Barney & Hansen, 1994). This form of trust is based upon the mutual expectation that promises of a written or verbal nature will be kept. In other words, the two parties assume that each will perform to the contract without any coercion being required.

The dominant protection mechanism between the buyers and common suppliers was price. The buyers would typically choose from a limited number of common suppliers depending upon which one was perceived as offering the best value. If a common supplier failed to deliver upon a given contract, they were essentially dropped from the list of acceptable suppliers. Thus, there is essentially no calculative trust between the two firms, and legal action is the sole remedy for non-performance.

Thus, when little or no benefits are to be derived from joint action, the firms in a supply chain avoid becoming interdependent upon each other and thus reduce the need for self-enforcing safeguards. Instead, the firms rely upon arm's-length market transactions and written contracts. Arm's-length contracts work well when the interactions between the parties are straightforward, but not when they are highly interdependent. In the former case only the quantity, price, quality, and delivery times need to be specified, whereas in the latter it is almost impossible to *a priori* specify all of the actions that might be required and define payment schemes for them. According to transaction cost economics, complex contracts are inevitably incomplete because it is impossible or too costly to contract upon all future contingencies as a result of bounded rationality (Williamson, 1979). Therefore, an alternative, non-contractual and more flexible form of governance based on trust is required where the two parties bilaterally act to maximize the joint return.

The relational contexts that we observed are not true hybrids of the classical market and hierarchy ones. The original markets and hierarchies model assumed that there were only two discrete relational contexts and that trust played no role in business transactions (Williamson, 1992). This highly constrictive view was later replaced by a "swelling

middle” perspective, where the hybrid relational contexts were linear mixtures of the two classical ones (Zenger & Hesterly, 1997). However, in our sample the natural progression is not on a continuum from market to hierarchy as a third factor, trust, is getting both stronger and more encompassing. With the acceptance of the role of trust, hybrid relational contexts can either be viewed as the outcome of a three-way trade-off (Ouchi, 1980) or as solutions in a three-dimensional space consisting of hierarchy/authority, market/price, and community/trust (Adler, 2001).

IOCM Techniques and Relational Contexts

Each of the three observed IOCM techniques was associated with a distinct hybrid relational context. There are two aspects to this association. First, the motivation behind the linkage appears to be the level of interorganizational cooperation and coordination required by the various IOCM techniques on the one hand and the level of cooperation supported by the relational contexts on the other hand. The more demanding the technique, the further the relational context is removed from a pure market. Second, the perceived effect on joint performance varies with the IOCM technique and the anticipated savings apparently play a role in motivating the adoption of a specific type of relational context.

Establishing the Linkage Between IOCM Technique and Relational Context

Our observations suggest that the IOCM techniques practiced by buyers and suppliers are linked to their relational context. The relational context of common suppliers was observed to come closest to the pure market form.⁵ If we define the attributes of the common supplier as the reference point to compare the three hybrid relational contexts and their departure from pure market interactions, then a pattern emerges. First, each cluster of IOCM techniques was associated with a particular relational context and vice versa, i.e., a one to one relationship between IOCM cluster and relational context was observed. Second, for all relational context attributes studied (i.e., those related to design

⁵ There are some minor differences in the observed relational context compared to the theoretical one. For example, some of the firms were loyal to a limited number of common suppliers and would not switch

dependence, resource sharing, supplier participation, bilateral commitment, and governance structure), the subcontractor relational context is the closest of the three to a common supplier, followed by the major supplier, with the family members being the furthest removed from the classical market form. Thus, a systematic monotonic relationship was observed in the attributes associated with each relational context. Third, the IOCM techniques were observed to be associated with different magnitudes in the design changes of the items being produced by the interacting firms. If we treat the market pricing associated with common suppliers as the baseline for IOCM on the basis that no joint design changes are implied, then the smallest level of design changes are associated with the FPQ trade-offs, the middle level of changes are associated with interorganizational investigations, and the highest value design changes with concurrent cost management. Thus, again a monotonic relationship was observed in the magnitude of the design changes and the ability to perform IOCM in each cluster.

The observed sets of pairing between IOCM technique and relational context can now be cautiously interpreted (see Table 3). The higher the level of design changes envisioned, the more buyers and suppliers are required to interact in a rich and varied manner. Thus, concurrent cost management, which involves the largest design changes, is associated with a family member context. This context enables the richest interactions between the design teams of the two firms and is furthest removed from the pure market form. It is important to observe that family membership and concurrent cost management evolved simultaneously at Komatsu and Toyo Radiator and that senior management perceived them as essentially a single outcome. FPQ trade-offs, which involve the smallest design changes, are associated with a subcontractor relational context, which is the closest to pure markets of all the hybrid relational contexts observed. Finally, the middle level of design changes involved in interorganizational cost investigations is associated with the intermediate relational context, major suppliers. Thus, the three observed clusters of IOCM practice are associated with three different relational contexts. The highest ability to perform IOCM is associated with family membership and the lowest ability with a

suppliers simply because of price considerations. This decision was based in part upon the perceived benefits of long-term relationships in sourcing decisions even for common suppliers.

subcontractor context, whereas the middle IOCM cluster is associated with the major supplier context. The sample firms studied did not undertake IOCM and then adapt their relational context to make it more aligned. Nor did they change their relational context and then subsequently develop the ability to undertake IOCM. Instead, the relational context was modified contemporaneously with the development of the ability to undertake IOCM.

[Insert Table 3]

An underlying assumption in this analysis is that the pressure on the firms to undertake IOCM was sufficiently high to cause them to change their relational context accordingly, therefore, certain central associations between IOCM and relational context can be observed. However, we acknowledge that a large number of factors may well influence the design of relational contexts. In particular, the relational contexts observed will reflect the influence of all forms of joint action undertaken by the buyer and supplier, not just IOCM. Furthermore, we cannot rule out the role of idiosyncratic influences on IOCM and relational contexts. However, since our objective is to highlight that a pattern of relationships between IOCM practice and relational context emerges and not to suggest causal relationships, we can ignore idiosyncratic influences for the purpose of this paper.

Two potential errors can be introduced by these sources of “noise”. First, the effect of a contextual variable that plays a role in the IOCM process might be rendered undetectable because the noise overrides the underlying signal. Second, spurious correlations may cause a variable that plays no significant role in IOCM to appear important. We mitigated the risk of these two types of error by integrating the views of multiple individuals in the firm and by comparing observations across the sample firms. Our aim is to highlight an observed consistency between the demands of the IOCM techniques used and the relational contexts adopted, not to demonstrate causality at the individual attribute level. Since there are numerous decisions surrounding the adoption of a relational context, we have identified a large number of potentially dependent variables for the number of data points. Therefore, further statistical testing is required to ensure that the relationships

indeed have an economic basis that is derived from IOCM and are not simply observed correlations.

Perceived Effect on Joint Performance

The managers in the sample firms appear to adopt the IOCM techniques and associated relational contexts because they believe that these combinations will lead to superior joint performance, as illustrated by the following quote by a manager at Toyo Radiator:

Under the old approach to supplier relations Komatsu would identify the performance specifications for their next model and develop the basic design concepts. Toyo would then develop new technologies on its own and present Komatsu with their ideas of how to achieve the basic concept. However, with the A20 and A21 power shovels, that approach would not have achieved our objective. In order to get the costs low enough, we had to undertake a concurrent cost management program.

It is extremely difficult to generate *a priori* numerical support for the contention that the application of IOCM in the relational context of hybrid organizations is more effective than conventional cost management in the context of a market or a hierarchy. Consequently, the decision to adopt a new cost management technique can be viewed as a calculated gamble based upon the expected benefits and costs of developing the expertise necessary to undertake the IOCM technique and creating its associated relational context.

There are two ways to measure the effectiveness of a given IOCM technique. The first way compares the savings to the incremental cost of an individual IOCM intervention. The second way compares the total savings associated with a given IOCM technique from all affected suppliers discounted over time, to the cost of creating the ability to undertake the technique and establishing the appropriate relational context.

Effectiveness of Individual IOCM Interventions

The economic justification of an individual IOCM intervention compares the anticipated cost savings against the cost of undertaking the intervention. The anticipated joint savings of a single intervention, when considered as a percentage of the overall value of the outsourced item, were considered to vary with the IOCM technique utilized. The savings from FPQ tradeoffs were expected to be modest, representing only a few percentage points of the cost of the outsourced item. For interorganizational cost investigations the savings were typically expected to be in the 5-10 percent range. Finally, for concurrent cost management the savings were expected to be between 10-15%. Since the value of the outsourced item increases with the distance of the relational context from a pure market situation, so apparently do the expected cost savings (see Table 4).

[Insert Table 4]

Some *ex post* evidence supports the adoption of concurrent cost management for the A20 and A21 power shovels at Komatsu and Toyo Radiator. Using simultaneous engineering and an interorganizational cost investigation, the two design teams managed to overcome a particularly severe cost problem – an a priori predicted 36% cost overrun. These savings were achieved by jointly designing a new engine cooling system and engine, changing the shape for the cooling fan blades, reducing the number of fans and electric motors from two to one, and by changing the design of the diesel engine so that it could accommodate the new engine cooling system. Komatsu and Toyo engineers who were involved in the project believed that the new approach was paramount in the success of the project in that the ability to reduce a cooling system's costs by 18% demonstrated the power of a simultaneous engineering approach. Neither Komatsu nor Toyo undertook a formal analysis of the costs and benefits of the intervention. However, the engineers at both firms were convinced that the savings far outweighed the incremental costs associated with the interventions –concurrent cost management and interorganizational cost investigations.

Effectiveness of an IOCM Technique

The effectiveness of an IOCM technique is captured by the net present value of the savings derived from all suppliers using the technique over the time frame that they use it, minus the cost of establishing and maintaining the technique and its associated relational context. None of the firms in the sample had even attempted a formal economic justification of their IOCM programs. Instead, they relied upon their perceptions of the economic success of the programs. For example, Komatsu management adopted a holistic view of the make-or-buy decision and the development of concurrent cost management. They believed that the benefits from the new technique quantified by the reduction in the costs of outsourced items exceeded any additional investment and coordination and transaction costs associated with the new approach. However, they admitted that there was no easy way for them to evaluate the net benefits inherent to the new buyer-supplier relationship. The problem was that while the increased investment in specific assets and hence their costs could theoretically be measured, the incremental coordination and transaction costs were difficult to observe and incorporate into any formal economic evaluation of the overall process.

Most of the benefits to Komatsu from its new relationship with Toyo were from the improved design capabilities of the dyadic pair. These benefits included the lower costs and higher functionality of the end products that resulted from the joint design activities. The benefits to Toyo, however, were less obvious. While indeed the value-added and the profit margin of an engine cooling system were higher than for Komatsu-designed components, Toyo now had to invest in a more extensive research and development program. Unfortunately, there was no way to determine if Toyo's profits from its business with Komatsu were higher under the new versus old approach because of the problem of isolating the incremental revenues and costs (in particular, the costs associated with the new relational context). Neither firm had maintained detailed records of their prior investments in each other; therefore there was no way to determine the incremental costs. Consequently, a formal incremental profit analysis was not considered feasible. However, both Komatsu and Toyo management stated that, in their opinion, the two firms were better off and they actively supported the new relationship. There is some

evidence in the literature that the outsourcing decision is not a simple trade-off between increased performance and increased transaction and coordination costs. Dyer (1997) has suggested that in the type of relationship we have characterized as family membership, ongoing transaction costs (and presumably coordination costs) actually decrease although initial set-up costs may be higher.

Re-contracting

The success of Komatsu's first concurrent cost management project with its first family member renders somewhat moot any discussion about how the firms would have reacted, had the interaction resulted into failure. Two possible alternatives suggest themselves. First, the two firms could have returned to their prior relational context and limited their IOCM practices to interorganizational cost investigations and FPQ trade-offs. Alternatively, they could have tried to redefine the relational context so that concurrent cost management was successfully supported. What is clear from discussions with both management teams is that the two firms had entered into a calculated gamble that, together, they could reduce overall costs to a greater extent than they could in isolation, or even jointly under the relational context of a major supplier. The process of achieving the desired savings for the A20 and A21 power shovels was a risky and complex undertaking that required multiple joint design efforts and encompassed multiple solutions to achieve. The fact that neither firm had the technical expertise to solve the problem on its own was critical. More specifically, the degree to which overall cost was a function of joint design efforts appeared to be an important consideration. Finally, the perceived inability to solve the cost challenge using "conventional" approaches was a significant motivating factor for adopting a family membership context and undertaking concurrent cost management.

Summary and Conclusion

The make-or-buy decision at the sample firms is far more complex than suggested by the neo-classical economic perspective. Rather than being a simple dichotomous competition between the firm and its external suppliers, the process often involves a rich interplay between buyer and supplier to find ways to take advantage of their disparate capabilities. Four different approaches to outsourcing were observed. The first approach, common

supplier, can be described as the pure market approach where the supplier designs and manufactures a common component. The second approach, subcontractor, is to have the buyer design the part and the supplier to manufacture it. The third approach, major supplier, is where the buyer sets the functional specifications for the item and the supplier designs and manufactures it. The final approach, family member, has the supplier undertaking specific research and development for the buyer and subsequently designs and manufactures the part.

IOCM is observed in the last three of these approaches – subcontractor, major supplier, and family member. Its purpose is to render the make-or-buy decisions more efficient than can be achieved without coordination and cooperation on the part of the buyer's and supplier's design teams. Such IOCM interventions are necessary because the three approaches to the make-or-buy decision create information asymmetries about the relationship between the specifications provided by the buyer and the supplier's costs that do not occur in a pure market or hierarchy approach. When one of the firms in the supply chain identifies this information asymmetry as the cause of a cost overrun, an IOCM intervention is triggered to find ways to reduce costs by modifying the item's design specifications. While the desired level of specification changes presumably falls on a continuum ranging from none to major, only three distinct IOCM techniques involving such design changes were observed in practice. The first technique, FPQ trade-offs, requires the lowest level of interaction between the design teams at the buyer and supplier firms. The primary role of the supplier's design team is to use value engineering to identify ways in which the functionality and quality of the outsourced item can be relaxed without detriment to the customer's products. Successful FPQ trade-offs enable the supplier to achieve their target profit levels without having to increase the selling price of the outsourced item or altering the specifications of the end product.

The second technique, interorganizational cost investigations, requires more substantive interactions among the design teams as it can lead to more significant changes in the design specifications of the outsourced items than an FPQ trade-off. In addition, it is quite common for all of the firms in the supply chain of the outsourced item to be

involved in the intervention. In an interorganizational cost investigation the supplier's design team is primarily responsible for identifying solutions to the manufacturing cost overrun problem by recommending changes to the design specifications of the item, including substituting the starting material, modifying the manufacturing processes, and redefining the item's functionality and quality. The buyer's design team is primarily responsible for agreeing to any design changes and for overseeing the distribution of profits to the other firms in the supply chain. Successful interorganizational cost investigations enable all of the firms in the supply chain to achieve adequate levels of profitability while maintaining the target cost of the end product, but not necessarily its original specifications.

The final technique, concurrent cost management, can lead to recommendations that alter the technology content of the outsourced item and thus requires the highest level of interaction between the buyer and supplier design teams. There are two forms of concurrent cost management, parallel and simultaneous. In parallel engineering, the suppliers are brought into the product development process as early as possible and then allowed to design the outsourced item independently. The advantage of this approach is that the supplier can uncouple their new product development program from that of their customers allowing for the development of new technological solutions. In simultaneous engineering, the design teams work closely together to identify a solution that requires major simultaneous modifications to both the end product and the outsourced item. These changes can include the technology, design, and functionality and quality specifications of the outsourced item and the end product. Successful concurrent cost management allows both firms to achieve their target profits while increasing the technological sophistication of the design.

The conversion of a continuum of design changes to a discrete set of IOCM techniques appears to reflect the necessity of developing formalized mechanisms by which the buyer and supplier design teams interact. Furthermore, these mechanisms create clusters of IOCM ability among the firms. The first cluster of firms can undertake all three techniques, the second cluster can only undertake interorganizational cost investigations

and FPQ trade-offs, and the final cluster can only undertake FPQ tradeoffs. Thus, the ability to interact at one level brings automatically with it the ability to interact at lower levels. However, the ability to interact at lower levels does not bring with it the ability to interact at higher levels. Thus, the firms are acting as though the adoption of a limited number of interaction mechanisms is more efficient than the adoption of a continuum of interactions.

IOCM is not performed in a vacuum, but rather within the context of the relationship between the buyer and supplier. For the purpose of IOCM, the relational context can be characterized by four attributes that capture the level of interaction between the buyer and supplier and two attributes that relate to governance structure. The interaction attributes are design dependence, resource sharing, supplier participation, and bilateral commitment. The governance structure involves both incentives to interact in mutually beneficial ways and protection against unilateral defection. If a pure market relational context is used as the starting point of the analysis, then the three hybrid forms are monotonically further removed from a pure market for all of the six attributes, when ranked in the order of the highest degree of design changes allowed.

The relational context established between the buyer and supplier appears to be linked to the IOCM technique that supports the highest level of design changes undertaken by the two firms and hence involves the highest level of interaction between the two design teams. The linkage between IOCM and relational context appears to be driven by the level of cost reduction that can be achieved as a percentage of the total cost of the end product. The family member relational context, which provides the richest support for interactions between buyer and supplier, was only observed in the cluster of firms that could undertake all three IOCM techniques. The highest level of cost reduction was associated with this cluster as the firms were able to perform concurrent cost management, the most intensive and demanding of the IOCM techniques, in addition to the other two techniques. In contrast, the subcontractor relational context could only support relatively low levels of buyer-supplier interactions; therefore it was observed in the cluster of firms that could only undertake FPQ trade-offs. The lowest level of cost

reduction was associated with this cluster that could only undertake the least demanding of the three IOCM techniques. Finally, the major supplier relational context could support an intermediate level of interactions, consequently it was observed in the cluster of firms that could undertake interorganizational cost investigation and FPQ trade-offs, but not concurrent cost management. An intermediate level of cost reduction was associated with the major supplier cluster.

IOCM adds additional levels of complexity to the economic calculus of the make-or-buy decision. Some of them deal with the individual make-or-buy decision and others deal with the overall analysis of establishing the ability to undertake a particular IOCM technique and the associated relational context. In somewhat simplified terms, the neo-classical economic calculus compares the purchase price of an outsourced item to the opportunity costs of the resources freed up by outsourcing it. This calculus assumes that the make-or-buy decision is characterized by a dichotomous competition between the firm and its common suppliers, where the relationship can be managed exclusively via short-term bidding under a complete contract. In many contemporary settings this calculus has to be expanded to allow for a plurality of relational contexts and incomplete contracts (Gietzmann, 1996). Thus, the objective of the calculus not only includes which parts will be outsourced and to whom, but also has to take into account the nature of the relationship between the buyer and supplier that should be adopted for the transaction. Because of incomplete contracting the calculus has to be expanded to incorporate both bargaining costs where the parties are acting in their own self-interest but in good faith, and opportunism costs where they are acting in their own self-interest but in bad faith (Vining & Globerman, 1999). For firms that undertake IOCM, another two layers of complexity have to be introduced into the make-or-buy calculus. The first deals with the costs associated with an IOCM intervention, including the time spent by the buyer's engineers in discussing and negotiating solutions with the supplier, and the cost of formalizing any design changes to the buyer's product and the outsourced item. The second layer of complexity further distances the make-or-buy decision from the classical neo-economic analysis of internal versus external costs by introducing a higher level of analysis into the calculus, where the nature of the long-term relationship is established

independently of individual short-term outsourcing decisions (Anderson, Glenn & Sedatole, 2000). A single outsourcing decision will rarely result in sufficient savings to justify the adoption of a new IOCM technique and its associated relational context. Instead, the analysis must be applied to the savings associated with all of the suppliers that are likely to be affected by the adoption of the new IOCM technique discounted over the time period that they occur. These discounted savings must then be compared to the incremental cost of developing and maintaining the ability to undertake the technique and its associated relational context.

The small number and limited diversity of the sample firms used in this study reflects the exploratory nature of our research. To increase the validity of the results and help determine the extent to which they can be generalized, the findings from the small sample field research need to be tested on a larger and more diverse sample that includes non-Japanese firms in a wider range of industries. In addition, there are several extensions to this research that appear worthy of further study. First, the assumption that the boundaries of the firm are the natural limits of a firm's cost management program appears to break down with the emergence of hybrid relational contexts. In this paper we have only explored a limited range of relational contexts and IOCM techniques. Therefore, one possible extension of this research is to study other types of relational contexts between firms, such as strategic alliances and joint ventures, in which different forms of IOCM may emerge. Furthermore, other forms of relationship may exist between firms than that of a buyer and supplier. For example, some firms create horizontal relationships where they cooperate to deliver a single product with both being suppliers to the end buyer. These different types of relationship might lead to alternative forms of IOCM. Second, in this paper we explored IOCM practices that are design-driven. However, nothing we observed appears to be idiosyncratic to product design. Therefore, another logical extension of this research would be to examine to what extent other forms of joint action between firms trigger interorganizational cost management interventions. Third, the mechanisms that govern the interplay of IOCM and relational context are still poorly understood. The monotonic relationships between the attributes of relational context and the IOCM techniques supported do not identify the causal mechanisms that relate the

attribute to the techniques. Nor do they identify the boundary values that the attributes can take and still support a given IOCM technique. Finally, attributes that facilitate interactions across the organizational boundary other than the ones identified in this research may play a critical role in the support of IOCM.

Appendix

The seven firms and three supply chains included in the sample are:⁶

Isuzu – Jidosha (I-J) Chain

- Isuzu Motors, Ltd., one of the largest automobile manufacturing companies in Japan. The firm had a specialized market strength in heavy- and light-duty trucks and in the bus market.
- Jidosha Kiki Co., Ltd. (JKC), a first-tier supplier to the automobile industry. The company's products were related to the basic functions of a vehicle and included brakes, clutches, steering systems, and pumps.

Komatsu – Toyo (K-T) Chain

- Komatsu, Ltd., one of the largest heavy industrial manufacturers in Japan. It was organized in three major lines of business-construction equipment, industrial machinery, and electronic-applied products. Since 1989, the company had been aggressively diversifying and expanding globally.
- Toyo Radiator Co., Ltd., one of the world's largest independent manufacturers of heat-exchange equipment for use in automobiles, heavy construction and agricultural vehicles, air conditioners for home and office, and freezers. Its product lines included radiators, oil coolers, inter-coolers, evaporators, and condensers.

Tokyo – Yokohama – Kamakura Chain

- *Tokyo Motors, Ltd.*, one of the world's top ten automobile manufacturers. It produced vehicles at 20 plants in 15 countries and marketed them in 110 countries through 200 distributorships and over 6,000 dealerships.

⁶ The names of the firms in italics have been disguised for reasons of confidentiality.

- *Yokohama Corporation, Ltd.*, a manufacturer of hydraulic systems for automobiles and trucks and associated equipment. The firm was split into three corporate divisions: injection pump, air conditioning, and hydraulics & pneumatics.
- *Kamakura Iron Works Company, Ltd.*, a relatively small, family-run business which supplied automotive parts to either automobile manufacturers or suppliers to that industry.

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Table 1: Clusters of IOCM Techniques Practiced

Ability to Perform IOCM	FPQ Trade-Offs	Interorganizational Cost Investigations	Concurrent Cost Management
High	Observed	Observed	Observed
Medium	Observed	Observed	Not Observed
Low	Observed	Not Observed	Not Observed

Table 2: Design Dependence and Relational Context

Level of Design Dependence	Predominant Specifications Responsibility	Predominant Design Responsibility	Relational Context
High	Joint	Joint	Family Member
Medium	Buyer	Supplier	Major Supplier
Low	Buyer	Buyer	Subcontractor
None	Supplier	Supplier	Common Supplier

Table 3: Relational Context and IOCM Techniques Utilized.

Relational Context	Level of Design Change Supported	Predominant IOCM Technique Utilized
Family Member	High	Concurrent Cost Management
Major Supplier	Medium	Interorganizational Cost Investigation
Subcontractor	Low	FPQ Tradeoff
Common Supplier	None	None

Table 4: IOCM Technique Utilized and Typical Level of Cost Savings.

IOCM Technique Utilized	Type of Item Outsourced	Relative Value of Item Outsourced	Typical Level of Cost Savings
Concurrent Cost Management	Major Function	High	10-15%
Interorganizational Cost Investigation	Group Component	Medium	5-10%
FPQ Tradeoff	Component	Low	0-5%