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THE SHADOW OF THE FUTURE: EFFECTS OF ANTICIPATED INTERACTION AND FREQUENCY OF CONTACT ON BUYER-SELLER COOPERATION

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This research examined cooperation between 136 industrial buyers and suppliers. We identified four domains of potential cooperation: flexibility, information exchange, shared problem solving, and restraint in the use of power. Using an iterated games framework, we predicted that (1) anticipated open-ended future interaction, or extendedness, and (2) frequency of contact will increase the chances that a pattern of cooperative behavior will occur, but (3) performance ambiguity will decrease such chances. Regression analysis results indicated that extendedness and frequency are associated with joint cooperation. Neither simple structural theories of cooperation nor interactive models stressing commitment would fully predict these results, which support the potential value of interactive perspectives on interorganizational cooperation in particular and on interorganizational relationships in general.

Research on interorganizational relationships has traditionally stressed the importance of fixed organizational traits (Aiken & Hage, 1968; Galaskiewicz, 1985; Pfeffer & Salancik, 1978). Looking at cooperation in particular, researchers have sought to identify fixed antecedents to cooperative relationships. Aiken and Hage (1968) tried to identify internal organizational characteristics that would lead to cooperation. Later theorists have argued that resource dependency and uncertainty will affect both levels and types of collaboration (Pfeffer & Salancik, 1978; Williamson, 1975). At a higher level of analysis, theorists have observed that the political economy may affect the formation of organizational coalitions (Berg & Zald, 1978) and that institutional environments may promote or even require cooperation (Contractor & Lorange, 1988; Hall, Clark, Giordano, Johnson, & Van Roekel, 1977).

Other researchers, however, have called for a more interactive approach to interorganizational relationships (Cook, 1977; Levinthal & Fichman, 1988;

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Van de Ven & Walker, 1984; Zeitz, 1980). Such an approach emphasizes that interorganizational cooperation arises in the context of a specific relationship and unfolds through ongoing interaction. Theorists in this tradition have emphasized the development of trust or commitment between participants as precursors to cooperation. In this study, we explored the additional possibility that features of the interaction patterns themselves may affect cooperation. We used an interactive framework to explore interorganizational cooperation in an industrial purchasing setting. We identified four domains of potential cooperation between industrial buyers and suppliers: flexibility, information exchange, shared problem solving, and restraint in the use of power. Drawing on an iterated games framework, we predicted that (1) the degree of open-endedness of a relationship, (2) the frequency of contact as embodied in product deliveries, and (3) performance ambiguity will enhance the chances of cooperation in all four domains.

Our purpose in this inquiry was twofold. First, we wanted to add to the understanding of interorganizational cooperation. Second, we wished to explore further the potential value of interactive models in the systematic study of interorganizational relationships.

THEORY AND HYPOTHESES

Most theorists studying interorganizational cooperation have emphasized the impact of interdependency: parties may cooperate when they depend on each other or share assets (Aiken & Hage, 1968; Pfeffer & Salancik, 1978; Rogers & Whetton, 1982; Williamson, 1985). Interactive theorists, in contrast, have often suggested that cooperation springs from the development of commitment between two "players." Over time, the organizations—or the individuals within them—come to care about their partners and to cooperate out of altruism rather than because of exogenous requirements (Cook, 1977; Deutsch, 1962; Macneil, 1978). Research from this viewpoint has appropriately begun to examine the effects of a relationship's history on levels of cooperation (Levinthal & Fichman, 1988).

This study focused on an additional interactive possibility: anticipated future interaction may affect cooperation. In particular, indeterminate anticipated interaction should promote cooperation. This idea occurs in many literatures but has been developed most precisely in the study of iterated games. The idea is important because it focuses attention on the impersonal characteristics of a relationship and does not assume that commitment is required for cooperation. We first review some basic findings about cooperation in an iterated games framework and summarize relevant research results at several levels of analysis. Then we use this framework to generate three distinct hypotheses about cooperation between two interacting firms.

Anticipated Interaction in a Game Theoretic Context

Social scientists have studied the Prisoner's Dilemma game in a variety of ways for more than 30 years (Rappaport, 1989). In this game, two players

each choose whether to “cooperate” or “defect” in the absence of knowledge of what the other player will do. The incentive structure of the game is set up so that (1) it pays to defect no matter what you think the other player will do, and yet (2) if each player defects, they both end up with less than they would have gotten had they jointly cooperated. The crucial feature is that the players can gain more from joint cooperation than from joint defection, but they would gain even more individually if they could defect while their partner cooperates.

Scholars have for decades considered circumstances that would permit cooperative outcomes in this setting and in related “mixed-motive” game structures (Axelrod, 1984; Kreps, Milgrom, Roberts, & Wilson, 1982; Luce & Raiffa, 1957; Rappaport & Chammah, 1965). Traditional analysis has argued that a purely rational player should defect if there is only one round of play or if there is repeated play but a fixed, known ending point. In a single play of the game, it makes sense to defect because even the payoff for joint defection is higher than that for cooperation when the other person defects, an obvious danger in a single encounter. If there is a fixed end point, each player would anticipate that the other would defect in the final period, and thus defect then. But this reasoning would lead to defection again by both parties in the prior period, and so on, leading to an unraveling of any cooperative pattern.

In contrast, if there is repeated play and an indeterminate ending point, formal mathematical analysis shows that the players may arrive at stable cooperative outcomes through many different mechanisms (Fudenberg & Maskin, 1986; Radner, 1986). Some work has focused on simple reciprocity—a player cooperates whenever the other player cooperated in the prior game and defects in response to defection (Axelrod, 1984; Bendor, 1987; Oskamp, 1971). Interestingly, when preplanned strategies of play were pitted against each other in round-robin computer tournaments, strategies based on reciprocity performed exceedingly well, even against very sophisticated partners (Axelrod, 1984). More recent work has shown that pure reciprocity may need to be tempered with some tolerance of occasional defections when there is uncertainty about what the other player actually did, and a variety of reciprocity strategies may be effective (Bendor, 1987).

The success of reciprocity strategies, however, usually depends on sufficient value being placed on future returns, or on a sufficiently long “shadow of the future” (Axelrod, 1984: 124). Intuitively, the logic is straightforward. Future interactions permit the players to reward and punish each other. If a player cooperated in one round, the other player can reward that move by cooperating in the next round. On the other hand, if the first player defected in one game, the second can retaliate for that defection in the next game by defecting as well. Only if future rewards are important, however, will the threat of future retaliation matter to a player in the present, and thus deter that party from defecting. The length of the interaction should be indeterminate to prevent endgame defections that can lead to the unraveling of cooperation.

This approach, then, does not rest on the assumption that stable organizational traits produce specific levels of cooperation. It does, of course, rely on other assumptions: First, the players decide what to do on a given round of play independently. Second, each player chooses the action believed to produce the highest possible rewards for that party. Altruism may exist, but it is assumed to be already incorporated in the payoff structure. There is no assumption about risk propensity.

Overall, both the analytic study of possible theoretical outcomes of Prisoner's Dilemma and the results of computer tournaments provide a powerful theoretical basis for expecting that anticipated indeterminate future interaction should enhance the chances that the outcomes of repeated play of the game can be cooperative.

Empirical evidence. Empirical research at both the individual and interorganizational levels of analysis provides data relevant to the findings from analytic and tournament studies of iterated games. It has long been shown that context can influence individual's tendencies to cooperate (Lindskold, Getz, & Walters, 1986). Kelley and Thibaut (1978) reviewed experimental studies and concluded that subjects who expected ongoing interaction played more cooperatively than subjects who did not. More recently, Murnighan and Roth (1983) explicitly varied the expected probability of future play and found that expectation of continued play was an important determinant of cooperation.

Although there has been no quantitative research on the effects of anticipated interaction at the interorganizational level of analysis, field observations do provide some evidence. Observers of industrial relations in the United States, for example, have suggested that both firms and unions are much more likely to adopt cooperative strategies when they assume they are likely to interact for an indeterminate future (Bakke, 1946; Kochan, Katz, & McKerszie, 1986; Reder, 1959). Similarly, international scholars have noted that firms that take a long view of a situation are more likely to cooperate with other firms when defection is also a possibility (Buckley & Casson, 1988). Finally, Macneil (1981) argued more generally from the study of contracts that a relationship projected by both parties to last indefinitely will embody a pattern of cooperation.

There is some evidence at two levels of analysis, then, that anticipated future interaction may sustain cooperation. But there have been no systematic studies of this theme or its implications at the interorganizational level of analysis. We used the game-theoretical framework outlined above to develop and discuss three specific hypotheses about how the time horizon and the nature of interaction may affect interorganizational cooperation.

Hypotheses

Extendedness of a relationship. We defined the extendedness of a relationship as the degree to which the parties anticipate that it will continue

into the future with an indeterminate end point. The more strongly a party expects that a relationship will continue in the future and that its end point is indeterminate, the higher is the extendedness of that relationship. A relationship's level of extendedness thus reflects the strength of the expectation that it will continue indeterminately. As described above, the analysis of games implies that although anticipated open-ended interaction does not require cooperation, it does make it possible—even when neither party has altruism or concern about the other party's well-being. The first implication of the iterated games framework then, is that in a Prisoner's Dilemma situation, extendedness in a relationship should increase the probability of a pattern of cooperation.

Hypothesis 1: Extendedness in a relationship will have a positive effect on the level of cooperation between two interacting firms in a Prisoner's Dilemma context.

Frequency of contact. In this framework, the expectation of future interactions gives each party an incentive to cooperate rather than defect in the present. The higher the anticipated number of future interactions, the greater this incentive should be. For a given level of extendedness, however, a higher frequency of contact will lead to greater numbers of expected future interactions. With extendedness controlled, the frequency of interaction should have a positive effect on cooperation (Axelrod, 1984). There are a variety of behavioral mechanisms through which this relationship can unfold. Players may cooperate in the present because they anticipate possible reciprocal future responses. Or they may cooperate in the present because they know that they can retaliate for a defection by defecting later themselves. The greater the number of likely future interactions, the less important is the payoff in a current period relative to the number of potential opportunities for reward or retaliation, and the lower is the relative risk of current cooperation.

In real-world settings, frequency of contact can be increased in a variety of ways, of course. It can be increased through specialization, because when there are few potential relationship partners, one partner is likely to meet a given other partner more often (Axelrod, 1984). Or contact can be deliberately made more frequent by breaking conceptual issues into smaller pieces, a well-known practical tool in conflict resolution processes (Fisher, 1964; Schelling, 1960; Walton & McKersie, 1965). The relevant interactions are those in which concrete opportunities arise for cooperation or for defection. If cooperation arises only from fixed interdependencies or commitment, we would not expect frequency of contact to affect cooperation because it would be irrelevant. To the degree that anticipated interaction is an engine of cooperation, however, frequency of interaction should predict cooperation.

Hypothesis 2: Frequency of contact will have a positive effect on the level of cooperation between two organizations interacting in a Prisoner's Dilemma context.

Performance ambiguity. Performance ambiguity occurs when it is hard for a player to evaluate the outcomes or products received from another party. In a purchasing relationship, for example, it can be hard to assess whether the product delivered is the best it could possibly be, or the result of half-hearted quality efforts. It can be hard to determine whether the other party has faced unpredictable obstacles while trying to deliver on time, or just failed to make a good-faith effort to do so (Buckley & Casson, 1988).

When cooperation is based on observing the other player's actions and responding to them, performance ambiguity can make cooperation more difficult. If a delivery was late, for example, should the recipient interpret that as a defection or assume that the supplier made a cooperative choice that failed because of factors beyond its control? If the first party always gives the second the benefit of the doubt, it sets itself up for exploitation. If the first party treats all poor outcomes as defections, it can create a spiral of joint retaliation. This problem is well known to designers of nuclear test treaties.

This intuition has been confirmed by formal analysis showing that if there is uncertainty about what move the other player made, it is generally more difficult—although not impossible—to sustain cooperative outcomes (Axelrod, 1984; Axelrod & Dion, 1988; Bendor, 1987; Green & Porter, 1984; Molander, 1985). If so, we should find that increased performance ambiguity decreases the chances for cooperation. In contrast, we would not expect performance ambiguity to relate to cooperation arising from structural dependencies or from the development of commitment.

Hypothesis 3: Ambiguity in performance evaluation will have a negative effect on the level of cooperation between two organizations interacting in a Prisoner's Dilemma context.

Control Concepts

Customization of product. In the structural perspective, exchange partners are assumed to be much more likely to cooperate if they are interdependent (Emerson, 1962; Pfeffer & Salancik, 1978; Williamson, 1975). Technological factors are one important potential source of such interdependencies (Barnett & Carroll, 1987). For example, if product customization increases the chances of relationship-specific assets, and asset specificity is linked to increased collaboration (Williamson, 1985), customization should enhance the chances of cooperation. Highly customized products may also simply generate more direct information-sharing needs, which produce cooperative patterns. Customization could also have a negative effect on cooperation, however. In an asymmetrical relationship, the dependency may not be reciprocal, so that one partner has power over the other but not vice versa. In that case, exploitation rather than cooperation might result. Finally, level of customization may also be associated with industry-wide norms regarding cooperation (Zucker, 1987), which should also be controlled for in studying the theoretical variables.

Time to replace trading partner. We define “boundedness” as the degree of difficulty one organization would have in replacing another organization as an exchange partner. One measure of this aspect of interdependency is the amount of time that would be required for a firm to replace a trading partner. If degree of boundedness is asymmetric, the more dependent party may “cooperate” because the other party demands it. Such a pattern of apparent cooperation by the weaker party can be seen as compliance rather than cooperation (Bonoma, 1976). In any event, the time required for each firm to replace its trading partner, representing the boundedness of the firm, needs to be controlled for in predicting cooperation.

Length of prior relationship. Several theories suggest that cooperation should increase with the length of prior relationship. Interaction over time may lead to commitment (Deutsch, 1962) and to relationship-specific assets such as partners’ knowledge of each other’s procedures and values, which may in turn encourage attachment (Levinthal & Fichman, 1988). It is also possible that firms tend to be either cooperators or defectors, but it takes time for partners to find out which is which. If firms left relationships once they discovered their partners were defectors, we would also see an association between length of prior relationship and cooperation in cross-sectional data. Finally, firms could also learn about each other over time but adopt stable patterns of either cooperation or defection, so that relationship length would have no simple overall main effect on cooperation. Although our concern in this research was with the effects of future interaction, we considered it likely that prior history does affect cooperation and thus included it as our final control variable.

METHODS AND MEASURES

Setting

Purchasing relationships between industrial suppliers and original equipment manufacturers provided the setting for this study. These relationships involve purchases of finished and semifinished components intended for assembly into manufacturers’ end products. Traditional buyer-supplier interactions in these industries have been “arm’s length” or even adversarial (Dwyer, Schurr, & Oh, 1987). Many buyers purposefully establish relationships with multiple suppliers for each item purchased, with the objective of extracting price concessions (Porter, 1980). In extreme cases, buyers have been found to intentionally design strategies aimed at weakening suppliers, with the ultimate objective of ensuring their own profits (Johnston & Lawrence, 1988). To a large extent, prevailing adversarial attitudes among buyers and suppliers has been a major constraining factor in the implementation of just-in-time inventory systems, which require close coordination between buyer needs and supplier deliveries (Spekman, 1988).

Cooperation thus is not the inevitable outcome of the structure of these relationships. Cooperation has been observed in some relationships, however. Some buyers have allowed suppliers to pass along price increases for

raw materials during periods of inflation, whereas others have consistently enforced established agreements. Buyers and suppliers have sometimes worked together to design products and reduce costs and expected to share the benefits of the interactions bilaterally (Bertrand, 1986; Spekman, 1988). To apply our hypotheses to this setting, we needed to show that these buyer-seller interactions embody the structure of the Prisoner's Dilemma game (Beer, 1986).

Buyer-seller interaction as Prisoner's Dilemma. First, rational, self-interested behavior drives many of the actions of the firms involved in these buyer-seller relationships. Altruism may occur as well (Deutsch, 1962), but we assumed that it has already been incorporated into the payoff structure described below. The Prisoner's Dilemma game represents the residual of interactions not resolved through altruism. Second, the purchasing relationships studied involve two parties interacting in discrete exchanges. In any given exchange, the potential for cooperation and defection is present for both parties. The supplier, for example, can defect by delivering late, by permitting low quality that cannot be readily detected, or by refusing to adjust to a late change in product or delivery requirements (Johnston & Lawrence, 1988; Leenders & Blenkhorn, 1988.) The buyer can defect by making late payments, by unexpectedly changing a design and thereby reducing the value of the supplier's specialized tool investment, or by refusing to adjust to unexpected problems faced by the supplier (Johnston & Lawrence, 1988; Klein, Crawford, & Alchian, 1978).

Third, the ordering of payoffs for cooperation and defection that define a Prisoner's Dilemma is present in this setting. A firm's immediate payoff is (1) highest if the firm defects while the other cooperates, (2) next highest when there is joint cooperation, (3) next highest when there is joint defection, and (4) lowest if the firm cooperates while the other defects. In addition, in this industrial setting the payoff to both parties for cooperation is greater than the payoff for taking turns exploiting each other, again mirroring the assumptions for a Prisoner's Dilemma. Alternating exploitation would saddle both parties with additional costs for policing and anticipated enforcement and would saddle the buyer with the cost of maintaining safety inventory.¹ It is important to reaffirm that the benefits of joint cooperation are not so great that cooperation simply dominates defection for each player under any circumstances. If it were always beneficial for firms to cooperate no matter what the other did, we would not have observed the many decades of stable arms-length industrial relationships in which cooperation has been uncommon (Johnston & Lawrence, 1988).

Finally, two apparent deviations from an iterated games framework that characterize this setting are in fact not deviations. First, in the formal game, players do not leave the game in response to defection, but organizations can

¹ A more detailed explication of the payoff structure in the buyer-seller situation is available from either author.

in principle do so. Field evidence suggests, however, that regardless of this theoretical option, suppliers and buyers do not typically terminate relationships in response to defections of the sort described above. Second, in Prisoner's Dilemma, enforceable contracts do not exist. Although formal contracts do exist in the purchasing context, provisions against many defections (such as late payments or late delivery) are far too costly to enforce formally (Macneil, 1981). Also, many aspects of cooperation—such as flexibility and creative problem solving—simply cannot be specified in contracts.

Sample. Data were collected from both manufacturers and their component suppliers. We questioned both buyers and suppliers in order to achieve parallel tests of our propositions on each side of the buyer-supplier dyad. This data collection strategy allowed us to acknowledge possible differences in viewpoint between exchange partners with respect to the variables of interest, as symbolic interactionist theory would suggest (Marrett, 1971). This strategy also provides a stronger test for the stability of any hypothesized relationships than the more standard approach of sampling from only one group or the other. We drew a random sample of buying firms from a national listing of purchasing agents employed by manufacturing firms having three different two-digit Standard Industrial Classification (SIC) codes. These codes were 35, 36, and 37, representing general machinery, electrical and electronic machinery, and transportation equipment. Preliminary field interviews with agents employed by firms in these categories suggested that these groups were quite homogeneous with regard to purchasing structures, practices, and problems.

Prior to the administration of a mail questionnaire, we contacted each purchasing agent by telephone to ascertain the agent's ability to serve as a key informant, following Campbell's (1955) criteria for informant selection. We sought to exclude suppliers who were simply component distributors as opposed to manufacturers and buyers purchasing only for direct resale because we wanted to study relationships offering the potential of both cooperation and defection. The agent was asked to provide data on the largest firm supplier that met this criterion. Initial field interviews as well as industry evidence showed that relationships involving large quantities were more likely than others to involve mixed motives (Stern & Reve, 1980).

Questionnaires were mailed to 579 purchasing agents. A further step toward minimizing informant bias was inclusion of post hoc self-reports on the informants' knowledge of and involvement in the buyers' relationships with the suppliers. After a second mailing and the elimination of cases in which an informant exhibited insufficient levels of involvement or knowledge or in which data were missing, the final sample from the buyers' side consisted of 155 firms. On a seven-point scale, the mean scores for informant involvement and knowledge were 6.5 (s.d. = 0.85) and 6.5 (s.d. = 0.74), respectively, indicating high degrees of involvement and knowledge concerning the buyer-supplier relationships in question.

Informants from each buying firm were contacted again and asked to identify a person in their supplier's organization who was knowledgeable

about the relationship in question. In total, 96 names were obtained. We contacted those individuals by telephone to establish their ability to serve as key informants prior to mailing out the supplier version of the questionnaire. Informants who were capable of reporting on the relevant aspects of the interfirm relationships returned 60 usable questionnaires. The mean scores on the scales for informant involvement and participation were 6.3 (s.d. = 1.01) and 6.6 (s.d. = 0.67).

One distinct strength of this sample is that it contains responses from both sides of the dyad for a substantial number of cases. It is the only such sample, to our knowledge, in research studying industrial purchasing relationships. It permitted parallel testing of the relationships hypothesized and thus provided a substantive screen against sample-driven results. The response rate for this study was consistent with those in other large-scale surveys of industrial purchasing relationships (Anderson, Chu, & Weitz, 1987; Phillips, 1981), but it was low enough that we consider the research partially exploratory. Comparison of the mean size of all firms in these SIC codes with the mean size of the sample firms suggests that larger firms may be overrepresented in the sample. Caution should thus be used in generalizing our results to smaller firms.

Measures

Measure development. Many of the theoretical constructs in the study were measured using multi-item scales. Following construct domain definitions, we generated items from previous research and modified them to fit the context when necessary. New items were developed through interviews with original equipment manufacturers and suppliers. We personally administered a preliminary draft of the questionnaire to a convenience sample of buyers and suppliers and subsequently refined it. The buyer version of the questionnaire was also subjected to a larger-scale pretest involving 25 randomly selected original equipment manufacturers in the designated SIC codes. We purified the multi-item scales using item-to-total correlations, factor analysis, and Cronbach's alpha values. All the scales exhibit satisfactory evidence of internal consistency in each sample. The alpha levels exceed 0.7, with the exception of three scales which only exceed the 0.6 level. The Appendix gives the texts of all scale items.

Dependent variables. The dependent variable in this study is the level of reciprocal cooperation between two organizations. In the context of the Prisoner's Dilemma framework, an individual cooperative act is a choice to cooperate rather than to defect on a particular exchange. A pattern of reciprocal cooperation, then, is a situation in which the two parties both tend to repeatedly pick the cooperative choice on continuing exchanges.²

² This behavioral definition of cooperation extends organization theory tradition, which defines cooperation in terms of voluntary joint activities or programs between a set of parties (Aiken & Hage, 1968; Guetzkow, 1966) but permits variation in the formality or intensity of the

Such a pattern of cooperation can manifest itself (or not manifest itself) in a number of different areas of interaction (Buckley & Casson, 1988). A relationship between two firms may be cooperative in some domains and not in others. For example, cooperation and noncooperation between buyers and suppliers can occur in their actions in the face of unexpected events and in their approaches to the sharing of information, unanticipated problems in the relationship, and the use of power. Cooperation is thus a multidimensional phenomenon that includes the four domains listed below. Specific items in the scales measuring cooperation were substantially based on items developed by Kaufman and Stern (1988).

Flexibility was a four-item scale measuring respondents' assessments of the degree to which they and their partner typically adjust their own behavior to accommodate needs of the other (buyer questionnaire alpha, .88; supplier version alpha, .88). *Information exchange* was a four-item scale measuring respondents' assessments of the degree to which each party discloses information that may facilitate the other party's activities, as opposed to keeping all information proprietary (buyer version alpha, .79; supplier version alpha, .62). *Shared problem solving* was a four-item scale measuring respondents' assessments of the degree to which the parties share the responsibility for maintaining the relationship itself and for problems that arise as time goes on (buyer version alpha, .79; supplier version alpha, .74). *Restraint in the use of power* was a three-item scale measuring respondents' assessments of the degree to which the parties typically refrain from exploiting each other, given the opportunity to do so. We expected cooperation to manifest in a partner's willingness to forgo short-term profits gained at severe cost to the other party (buyer version alpha, .68; supplier version alpha, .63).

Clearly, these are not four different measures of a single construct, level of cooperation between firms, but four different domains in which both cooperation and defection are possible. In principle, a pattern of reciprocal cooperation would be possible in one domain while not occurring in another. Assuming inertia or consistency in organizational behavior, however (Cyert & March, 1963), we expected some positive correlation between the likelihood of cooperative patterns in the four areas.

Independent variables. *Extendedness of the relationship* was a four-item scale measuring respondents' assessments of the open-endedness of future interaction between themselves and their partners, or the degree to which the parties expected the relationship to continue indefinitely (buyer and supplier version alphas, .88). We intentionally avoided using a formalized measure of the anticipated length of a relationship, such as the length

interaction (Mulford & Rogers, 1982; Schermerhorn, 1975). Our definition differs from the conception of cooperation underlying some work on trust (Deutsch, 1980) as well as Macneil's (1978, 1980) study of relational contracting because it does not assume altruism or any particular cognitive state. Finally, cooperation is contrasted here to defection rather than to competition, whose meaning in this context is ill-defined.

of time stated by a formal contract between the parties. Firms frequently conduct business in the absence of formal contractual provisions (Macaulay, 1963), and even a formal contract may serve more as “a public mark upon an ongoing relation” (Gottfredson & White, 1981: 473) than as a measure of the anticipated continued duration of a relationship.

Not all contacts are comprehended by our theoretical arguments about the effect of frequency of contact on cooperation. The relevant interactions are those exchanges in which two firms can or must cooperate or defect. Foremost of these is the exchange of actual goods, or the delivery of supplies. The variable *frequency of delivery* thus consisted of respondents' estimates of how many times per quarter buyers received deliveries from suppliers. Only the buyer survey requested this information.

Performance ambiguity was a four-item scale measuring respondents' assessments of the level of effort a buyer must put forth to assess the quality of the product produced by a supplier (buyer and supplier version alphas, .66).

Control variables. *Customization of components* measured respondents' assessments of the level of standardization of the components suppliers provided to buyers, with a high value representing complete customization. *Time to replace trading partner* (boundedness) was the reported number of months it would take for a firm to replace its partner. *The logarithm of the length of prior relationship* was the logarithm of the number of months a buyer had been purchasing components from a supplier. We used this measure because we assumed the effect of prior relationship is not linear and that duration has diminishing effects at higher levels.³

Construct Validity

Since we argue that the different domains of potential cooperation are theoretically distinct, it was important to test whether our measures were also distinct. To explore this issue, we first estimated a confirmatory factor model using LISREL VI (Jöreskog & Sörbom, 1985) using the buyer sample.⁴ Although the chi-square index for the model is significant ($\chi^2_{84} = 144.82, p = .00$), suggesting discrepancies between the data and the model, past research has found this index to be an inappropriate measure of model fit

³ Correlations between the informant reports for the different independent variables range from .25 to .60, with an average correlation of .39, all significant at the .05 level, which compares quite favorably with those reported in studies of similar populations (Phillips, 1981). However, caution is required in making inferences about the psychometric properties of the measures based solely on these correlations. Measures from different informants may not be “congeneric,” or produced by a single underlying trait (Anderson & Gerbing, 1988; Jöreskog, 1971). In addition to random variance, method variance—including variance caused by any systematic differences in the viewpoint of the two informants—is expected to attenuate the raw correlation. The relatively small number of complete dyadic cases studied ($n = 60$) prevented the use of a confirmatory factor model in which we could explicitly model trait, method, and random variance and examine the magnitude of trait correlations (Schmitt & Stults, 1986).

⁴ The factor structure is available on request from the authors.

(Fornell & Larcker, 1981). The goodness-of-fit indexes from the LISREL program (goodness-of-fit = .89, root mean square residual = .06) and fit indexes devised by Bentler and Bonett (1980) ($\Delta = .86$, and $\rho = .92$) both suggested that the model accounts for substantial variance in the data. In addition, the magnitudes of the factor loadings are consistent with our expectations: the loadings ranged from .48 to .93, with 12 of the 15 loadings exceeding .6.

Next, we estimated a series of models in which we constrained the factor correlations to 1 for each pair of variables. We then carried out chi-square difference tests between the original model and each constrained model. The chi-square values for the six pairs of variables ranged from 32.77 to 133.86, all of which were significant below the .001 level. Using each variable separately, then, added significance in each case. Overall, these data suggest the presence of discriminant validity among these measures.

Extendedness and length of prior relationship might be construed as not truly distinct because old relationships may intrinsically imply expectations of future interaction. The zero-order correlation coefficients of the two variables (0.26 and 0.17) are significant at the .05 level, although not high. According to criteria developed by Tesser and Krauss (1976), discriminant validity can be shown if a third variable can be identified that is related significantly to each of two variables, with the relationships in opposite directions. We regressed flexibility on extendedness and on prior length of relationship, using the buyers' sample statistic for the latter because it was the larger. Extendedness had a significant, positive effect ($b = 0.55, p = .00$), and prior length had a significant, negative effect ($b = -0.02, p = .02$), indicating the constructs were distinct.

RESULTS

Tables 1 and 2 show the means, standard deviations, and zero-order correlations between all dependent and independent variables for the buyer and supplier samples, respectively. Correlations between the four measures of cooperation are positive, as expected. Individual correlations in the table do not suggest obvious problems of pairwise collinearity that would preclude the use of all independent variables in the model.

Table 3 summarizes the results of ordinary-least-squares regression analyses of the four cooperation variables on the independent variables. Seven out of the eight equations were statistically significant below the .01 level. The adjusted R^2 for the significant equations ranges from 0.182 to 0.344. The moderate, consistent explanatory power of the equations supports the further examination of individual coefficients testing the effects of individual variables.

Extendedness of the relationship has a large and significant positive effect on cooperative behavior in seven of the eight equations. The effects of extendedness appear in both the buyer and supplier samples. To evaluate the consistency of this effect formally, we conducted a series of Chow tests (Chow, 1960; Hanushek & Jackson, 1977) to ascertain the equality of the

TABLE 1
Means, Standard Deviations, and Correlations for Buyers

Variables	Means	s.d.	1	2	3	4	5	6	7	8	9	10
1. Flexibility	5.17	1.24										
2. Information exchange	5.60	1.13	0.443**									
3. Shared problem solving	5.05	1.25	0.412**	0.588**								
4. Restraint in use of power	5.47	1.19	0.258**	0.503**	0.545**							
5. Extendedness of relationship	5.56	1.18	0.472**	0.505**	0.554**	0.423**						
6. Frequency of delivery	13.86	19.13	0.094	0.074	0.127	0.097	-0.016					
7. Performance ambiguity	4.07	1.27	0.063	0.100	0.092	0.126	0.089	0.016				
8. Customization	4.58	2.14	0.144†	0.187*	0.173*	0.051	0.143†	-0.135†	0.313**			
9. Months to replace supplier	5.87	10.56	-0.018	0.107	0.061	-0.060	0.141†	-0.048	-0.006	0.120		
10. Months to replace buyer	4.04	3.98	-0.038	-0.030	0.178*	-0.011	0.151†	0.002	0.245**	0.361**	0.194*	
11. Logarithm of length of prior relationship	1.98	0.95	0.079	0.120	0.081	0.065	0.171*	0.113	-0.403**	-0.155†	0.169*	-0.037

† $p < .10$
 * $p < .05$
 ** $p < .01$

TABLE 2
Means, Standard Deviations, and Correlations for Suppliers

Variables	Means	s.d.	1	2	3	4	5	6	7	8	9
1. Flexibility	5.80	1.04									
2. Information exchange	5.91	0.96	0.499**								
3. Shared problem solving	5.49	1.09	0.385**	0.473**							
4. Restraint in use of power	5.71	1.18	0.383**	0.465**	0.441**						
5. Extendedness of relationship	6.18	0.97	0.394**	0.442**	0.571**	0.386**					
6. Performance ambiguity	3.52	1.30	-0.325*	0.130	-0.099	-0.249†	-0.247†				
7. Customization	4.38	2.22	-0.121	-0.194	-0.185	-0.036	-0.260*	0.134			
8. Months to replace supplier	5.52	4.99	-0.166	-0.272*	-0.235†	-0.062	0.057	0.126	0.240†		
9. Months to replace buyer	4.55	5.55	-0.453**	-0.332**	-0.229†	-0.149	-0.227†	0.079	0.259*	-0.494**	
10. Logarithm of length of prior relationship	1.96	0.91	0.214	0.124	0.278*	0.259*	0.260*	-0.476**	-0.396**	-0.252†	-0.260*

† $p < .10$
* $p < .05$
** $p < .01$

TABLE 3
Results of Regression Analysis of Cooperation Variables on Independent Variables^a

Variables	Flexibility		Information Exchange		Shared Problem Solving		Restraint in Use of Power	
	Buyers	Suppliers	Buyers	Suppliers	Buyers	Suppliers	Buyers	Suppliers
Extendedness of relationship	.556** (.078)	.249† (.134)	.484** (.075)	.403** (.124)	.583** (.083)	.578** (.116)	.473** (.086)	.490** (.193)
Frequency of delivery	.009† (.005)		.006 (.004)		.009* (.005)		.006 (.005)	
Performance ambiguity	-.076 (.074)	-.206† (.111)	.046 (.071)	-.024 (.104)	.021 (.079)	.098 (.098)	.096 (.081)	-.107 (.162)
Customization	.074† (.043)	.026 (.059)	.082† (.042)	-.011 (.056)	.067 (.046)	.026 (.052)	.007 (.048)	.082 (.087)
Months to replace supplier	-.004 (.008)	.006 (.028)	.004 (.007)	-.043 (.027)	-.004 (.008)	-.051* (.025)	-.011 (.009)	-.012 (.041)
Months to replace buyer	-.038* (.023)	-.070** (.025)	-.030 (.021)	-.019 (.024)	.019 (.024)	.012 (.022)	-.025 (.025)	-.006 (.037)
Length of prior relationship	-.236** (.096)	-.059 (.156)	.063 (.094)	-.122 (.144)	.033 (.102)	.101 (.135)	.039 (.106)	.156 (.224)
Adjusted R ²	.282**	.261**	.274**	.215**	.307**	.344**	.182**	.098
N	137	48	137	49	137	49	136	49

^a Coefficients are unstandardized. Standard errors are in parentheses.

† $p < .10$

* $p < .05$

** $p < .01$

regression coefficients for the corresponding cooperation models in the two samples. The null hypothesis of no difference between the coefficients in the buyer and supplier samples cannot be rejected at the .05 level for any of the models.

As a further audit on the distinctness of the four measures of cooperation, we conducted a multivariate regression analysis of the four cooperation measures on the independent variables. This analysis indicated that the four dependent variables were indeed related as a group to the independent variables. In the buyers' sample, the multivariate test yielded a Wilks's lambda of .45 with a significance level of less than .01. In addition, however, the univariate test for each dependent variable was significant below the .01 level, indicating that the multivariate significance was not attributable to any one particular variable's relationship to the predictor set of variables. In the supplier sample, Wilks's lambda was .33, significantly below the .01 level. Univariate tests for flexibility, information exchange, and shared problem solving were significantly below the .01 level, and restraint in the use of power was insignificant. Results of seven out of the eight univariate tests were thus significantly below the .01 level.

As one check on potential multicollinearity effects, we omitted extendedness from the model to see if doing so would unmask new effects for control variables. The resulting equations did a much poorer job of predicting cooperation, with only the model for flexibility in the supplier sample and the model for shared problem solving in the buyer sample significant at or below the .05 level. The coefficients for the control variables did not change substantially or become significant owing to reduction in the standard errors, as we might have expected if collinearity masked their effects. The only exception to this result was that the coefficient for prior length of relationship did have a positive effect at the .10 level on information sharing.

A final natural concern is that these results may be the product of common method variance. In the subsample of cases with reports from both buyer and supplier, we regressed the dependent variables from the buyer sample on the independent variables of the supplier sample and vice versa. In six of the eight equations, extendedness remains statistically significant below the .07 level. Extendedness was the only variable that achieved statistical significance in these models.

Frequency of delivery shows a positive effect for all four dimensions of cooperation and is statistically significant at the .05 level for shared problem solving and at the .06 level for flexibility. (The coefficients appear identical in Table 3 because they are rounded to three digits, but the *t*-values are 1.98 for shared problem solving and 1.92 for flexibility.) It was not possible to conduct a Chow test on consistency of effect because frequency of delivery was available only in the buyer sample. When supplier measures of cooperation were regressed on the four buyer measures of the frequency of delivery, no statistically significant effect emerged.

Performance ambiguity is statistically significant in only one of the eight equations. It has a negative effect, as predicted, on flexibility in the supplier

sample. Because there were no consistent effects within samples, we did not examine consistency and methods variance across samples.

Customization has the expected positive effect in two of the eight equations, affecting flexibility and information sharing in the buyer sample. It has no statistically significant effect on the remaining domains of cooperation in either sample. The number of months it will take a buyer to replace a supplier has a negative effect on shared problem solving in the supplier sample. Months to replace the buyer has a negative effect on flexibility in both samples. The logarithm on the length of prior relationship showed no statistically significant effect in seven equations and showed a negative effect in flexibility in the buyer sample. As noted above, prior length of relationship did have a positive effect below the .10 level on information sharing in the buyer sample when extendedness was removed from the equation. Because a curvilinear relationship of cooperation with time might be expected, we also examined the effects of the square of prior length of relationship, with no change in the results.⁵

DISCUSSION AND FURTHER RESEARCH

If cooperation between buyers and sellers can be modeled in an iterated games framework, we should see extendedness, or anticipated open-ended interaction, and frequency of interaction associated with high levels of cooperation. The evidence strongly supported our hypothesis about extendedness and partially supported the hypothesis about frequency. We also predicted that performance ambiguity should reduce cooperation, but we did not find this result. Taken as a whole, then, the results are mixed. We think they are tantalizing, however, and consider below plausible rival interpretations of our data, as well as future research directions.

A statistically significant relationship between extendedness and cooperation emerged in seven of eight equations. This result occurred after we controlled for two variables reflecting interdependence: product customization and time to replace trading partner. This is not a result structural theories of cooperation would predict since they would typically not suggest an independent effect on the time horizons of a relationship itself.

There are, however, theories that would predict a direct association between extendedness and cooperative outcomes. Some firms may develop a commitment to each other that could produce both cooperation and expectations of future interaction. Additionally, firms that report high extend-

⁵ As a further check on the possible impact of competitive context on our results, we constructed a multi-item measure of the respondents' assessments of the diversity of competition in their product markets. We used their reports on (1) whether there were few or many new entries in the market for the end product produced, (2) whether the products in that market were very similar or very different, and (3) whether their competitors' strategies in the end-product market were very similar or very different. When this competitive diversity measure was included in the original models, it was significant in one of the eight equations but did not change the results reported for the theoretical variables of interest.

edness may be early in the product development cycle (W. Barnett, personal communication, 1990). If a supplier is retooling equipment specifically to produce machine parts for a particular buyer, high cooperation may be required as the parties work out product tolerances and technical standards. During this period, both firms might also reasonably report strong expectations of open-ended future interaction. Finally, buyers and suppliers may exist who seek reputations as cooperative firms. If these firms also tend to have open-ended expectations about future interaction of all their trading partners, our results would occur.⁶ Our prediction was supported, then, but alternative explanations can be marshaled for the extendedness results.

Frequency of delivery was associated with cooperation in two of four possible equations. Structural theories would predict effects for stable traits that create fixed levels of interdependency rather than for the timing of specific interactions. Turning to commitment theories, we can easily imagine that in personal relationships commitment may lead to increased contact. But we think it is less likely that firms will decide to deliver products more frequently as a result of psychological commitment. Overall, then, we believe the frequency of delivery result, even though less consistent than the extendedness result, is also subject to fewer rival interpretations.

It should be noted that buyer reports of frequency of delivery did not significantly predict supplier measures of cooperation in our check concerning common method variance. However, the relatively exogenous nature of this variable reduces the chances that this result arose from respondents' generalized levels of affect, their wishes to appear consistent, or their efforts to give normatively correct answers.

Performance ambiguity had the predicted negative effect on cooperation in only one domain of cooperation in only one sample. A post hoc explanation rather easily reconciles this finding with our expectations. In measuring performance ambiguity, we asked respondents how much they had to make an effort to assess quality of performance, assuming that if a large effort was required, performance was more ambiguous. We did not ask if the firms actually made the effort, however. If firms who reported that a large effort was required nonetheless did make that effort, they could have assessed whether their partner had defected or cooperated. In that case, we would have predicted no effect for this variable. It is also possible, of course, that the pattern we found was not the product of measurement issues. It may reflect a true situation in which firms end up with both cooperative and noncooperative outcomes under ambiguity, as some would predict (Bendor, 1987).

Among the control variables, customization had weak effects and duration of past relationship no effects on any of the four dimensions of cooperation. Regarding the latter, field observation of this population suggests that relationships can be based on stable histories of suspicion as well as

⁶ We appreciate an anonymous reviewer's emphasis on this point.

cooperation. Firms in an industrial buyer-seller relationship may be able to learn to defect as well as to cooperate. Levinthal and Fichman's study of auditor-client relationships (1988) suggests, however, that this pattern may vary by setting.

In reviewing the total pattern of our results, we noted that although alternative explanations can be found for individual findings, almost no single alternative theory would predict the combination of results obtained. There is one exception. It is possible that in this population, some firms have adopted as a package principles of cooperative interaction, just-in-time inventory procedures, and a tendency to open-ended relationships. Norms favoring this pattern of relationship could diffuse across a population of buyers and suppliers, as neoinstitutional theories predict (Zucker, 1987), producing the results reported here. In all, although there is evidence for our perspective, the pattern of results suggests important questions for further research.

FUTURE RESEARCH

The results of this study and the unresolved issues it raises imply two crucial steps in studying interorganizational cooperation. First and foremost, we see the need for longitudinal studies. Our results are in accordance with the theoretically specified causal sequence outlined in the hypotheses. But cross-sectional data simply do not permit us to rule out some alternative models of, for example, the relationship of extendedness and cooperation. Further research using both archival and self-report data—including measures of anticipated future interaction—could probe the specific sequence of states and actions. Longitudinal studies are important for another reason as well. The concepts we have studied here emphasize conditions that may permit organizations to sustain cooperation. The question of what permits cooperation to develop in the first place is perhaps even more intriguing. Recent theoretical work has begun to provide varied answers to this question (Bartholdi, Butler, & Trick, 1986; Bendor, 1987; Feldman & Thomas, 1987), but empirical evidence on this question is sorely needed.

Second, it may be timely to move from studies that primarily examine individual theories, like this study, to research exploring multiple theories. We think it will be useful to examine both static structural theories and interactive models of cooperation. Specific attention to transaction cost arguments will be important, for example. Our modest results for customization seem consistent with the spirit of Williamson's (1975) prediction that investment in specific assets will lead to shared governance. It is also likely, however, that cooperative relationships promote investment in specific assets, a possibility that calls for investigation. Although we do not think reputational efforts account for the results in this study, they should be included in further study of rational interactive models. Interactive approaches should also try to model the potential role of inertia. Organizations may cooperate with each other out of habit or through imitation of others

(Amburgey & Miner, 1990; Cyert & March, 1963; Zucker, 1987). These processes, of course, would be consistent with the neoinstitutional prediction that routines of cooperation could diffuse across a population of organizations.

Broader studies such as those proposed could also profitably seek larger samples and add further behavioral measures on both sides of the dyad of interest, although the respondents' perceptions would remain the best measures of anticipated future interaction.

IMPLICATIONS

We see two main implications of this exploratory study. First, the results positively, although not conclusively, support the claim that the time framework of a relationship may affect cooperation, as an iterated games perspective would predict. Descriptively, our findings support the insight that expected future interaction in and of itself can influence cooperative acts in the present. They identify a source of cooperation in addition to structural interdependencies and altruism.

Normatively, our findings suggest that interorganizational cooperation might be influenced by adjusting the interaction properties of relationships. Cooperation, of course, may or may not be a valued outcome from society's point of view. It can constitute illegal collusion, like price fixing, in some contexts, but represent desirable collaboration in others—cooperation in pursuit of scientific research or the prevention of war. At present, managers face changing practices in this domain. Joint ventures, close buyer-supplier relationships, and research consortia are increasingly visible, especially in technology-related fields. Interorganizational relationships that contain elements of both competition and collaboration are thus increasingly salient.

Surprisingly, the iterated games framework offers somewhat optimistic predictions if increasing interorganizational cooperation is a goal. If cooperation results only from fixed organizational traits or the development of long-term commitment, then to increase cooperation partners must change fixed traits or invest the time required to develop commitment. In contrast, if cooperation can be increased by increasing the extent of anticipated future interaction or frequency of contact, the chances of cooperation could be sometimes increased more readily. It must be remembered, of course, that these conditions enhance the prospects of cooperation rather than guarantee it. In addition, partners can misrepresent their true intentions concerning future interaction.

Second, this study provides further evidence that interaction frameworks offer an important perspective for examining interorganizational relationships in general. In this study, the iterated games framework generated a set of rather precise testable propositions that, we suggest, traditional explanations of interorganizational cooperation would not predict.

Organization theorists often view game theoretic models with suspicion, regarding their assumptions as both unrealistic and unduly pessimis-

tic. The arguments presented here, however, make no strong assumptions about the calculative ability or foresight of organizations: simple or modified reciprocity could produce our results, for example (Patchen, 1987; Wilson, 1971). In addition, we do not suggest by any means that iterated games always represent an appropriate approach to interactive models. They are but one tool.

Many other modeling approaches can be used. Models may focus on the sequencing of actions (March & Olsen, 1984), rules concerning interpretation of action (Schelling, 1960), ecologies of interaction (Axelrod, 1984; Schelling, 1978), the effects of personal relationships (Granovetter, 1985; Seabright, Levinthal, & Fichman, 1992), and organizations learning from and about each other (Levitt & March, 1988). In all such modeling, however, the focus of attention would be on the characteristics of relationships, rather than on fixed traits of the organizations involved. An organization's fate would depend not only upon its fixed characteristics and commitments, but also upon its actions in response to the actions of others—which can neither be completely anticipated nor reliably controlled.

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APPENDIX

Measures

Dependent Variables

The response scale for the following ranged from 1, “completely inaccurate description,” to 7, “completely accurate description.”

Flexibility

1. Flexibility in response to requests for changes is a characteristic of this relationship.
2. When some unexpected situation arises, the parties would rather work out a new deal than hold each other to the original terms.
3. It is expected that the parties will be open to modifying their agreements if unexpected events occur.
4. Changes in “fixed” prices are not ruled out by the parties, if it is considered necessary.

Information exchange

1. In this relationship, it is expected that any information that might help the other party will be provided to them.
2. Exchange of information in this relationship takes place frequently and informally and not only according to a prespecified agreement.
3. It is expected that the parties will provide proprietary information if it can help the other party.
4. It is expected that we keep each other informed about events or changes that may affect the other party.

Shared problem solving

1. In most aspects of this relationship the parties are jointly responsible for getting things done.
2. Problems that arise in the course of this relationship are treated by the parties as joint rather than individual responsibilities.
3. The parties in this relationship do not mind owing each other favors.
4. The responsibility for making sure that the relationship works for both us and this supplier is shared jointly.

Restraint in the use of power

1. The parties feel it is important not to use any proprietary information to the other party’s disadvantage.
2. A characteristic of this relationship is that neither party is expected to make demands that might be damaging to the other.
3. The parties expect the more powerful party to restrain the use of his power in attempting to get his way.

Independent Variables

Extendedness of relationship (1 = “completely inaccurate description,” to 7 = “completely accurate description”)

1. The parties expect this relationship to last a lifetime.
2. It is assumed that renewal of agreements in this relationship will generally occur.

3. The parties make plans not only for the terms of individual purchases, but also for the continuance of the relationship.
4. The relationship with this supplier is essentially "evergreen."

Frequency of delivery

On average, how often do you receive deliveries of these components from this supplier (per week, per month, or other)?

Performance ambiguity (1, "strongly disagree," to 7, "strongly agree")

1. It is inadequate to evaluate this supplier based only on component prices.
2. Evaluating the performance of this supplier requires extensive incoming inspection.
3. In order to obtain a satisfactory assessment of this supplier's performance, we need to conduct on-site inspection at the supplier's plant.
4. Conducting performance evaluations of this supplier requires making sure that they follow the approved production and quality control procedures.

Control Variables

Customization of components

Please indicate the degree to which the components that you purchase from this supplier are standardized. (1 = "industry standard components," to 7 = "completely customized components")

Months to replace supplier

Suppose your company were to switch suppliers for these components and start purchasing them from some other source. How much time would the switchover take? (Consider the time required to locate, qualify, train, make the necessary investments, conduct testing, and develop a working relationship.)

_____ months until satisfactory performance could be expected from a new supplier

Months to replace buyer

Suppose that this supplier were to start selling these components to some other buyer. How much time would the switchover take for this supplier? (Consider the time required to redesign the components, modify plant and equipment, train a new buyer, develop new administrative procedures, etc.)

_____ months until a satisfactory relationship could be established with a new buyer

Prior length of relationship

How long has your company been buying these or any other items from this supplier?
_____ months ^a

^a We divided answers by 12 to produce years and transformed the results to logarithms for use in the models.

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