

The Acquisition and Utilization of Information in New Product Alliances: A Strength-of-Ties Perspective

In this article, the authors examine the acquisition and utilization of information in new product alliances. Drawing from research in social network theory with a focus on the strength-of-ties literature, the authors suggest that horizontal alliances have lower levels of relational embeddedness and higher levels of knowledge redundancy than vertical alliances. The authors then suggest that though embeddedness enhances both the acquisition and utilization of information in alliances, redundancy diminishes information acquisition but enhances information utilization. The authors test these ideas using a sample of 106 U.S. firms that recently have participated in new product alliances. Although the results are broadly supportive of the predictions, they are also surprising because they question key underlying assumptions of the strength-of-ties literature. For example, closely tied individual actors are typically assumed to share both high levels of embeddedness and high levels of redundancy, but the present research finds that this assumption does not hold for organizational actors. The authors discuss the implications of these findings specifically for new product alliances and for research on tie strength among organizations in general.

Perhaps the most fundamental area of research activity in the field of marketing involves the nature, antecedents, and consequences of various forms of exchange relationships (Bagozzi 1975; Dwyer, Schurr, and Oh 1987; Webster 1992). In the domain of interorganizational relations, this exchange-based paradigm has informed inquiries into the relations between buyers and suppliers (e.g., Frazier, Spekman, and O'Neal 1988; Lusch and Brown 1996), service providers and clients (e.g., Heide and John 1988; Moorman, Zaltman, and Deshpandé 1992), and manufacturers and distributors or sales agents (e.g., Anderson and Weitz 1989; Anderson and Narus 1990).

Despite this wealth of interorganizational research, several aspects of interfirm relations have eluded inquiry. First, although marketing scholars acknowledge that the nature of interorganizational relations may be substantially different among firms that are competitors rather than channel mem-

bers (e.g., Achrol 1997), the bulk of marketing's interorganizational relationship literature focuses on vertically related firms. As recently noted by Sheth and Sisodia (1999, p. 84), "we have good theories on vertical integration but not on horizontal integration or alliances." Likewise, Robertson and Gatignon (1998, p. 529) suggest that "It might be particularly useful to separate horizontal alliances (between competitors) vs. vertical alliances of firms operating at adjacent stages of the value chain." Second, although increasing numbers of firms are developing new products within a web of interorganizational exchange relationships (Millson, Raj, and Wilemon 1996), the marketing literature has little research on interorganizational new product development activity (for exceptions, see Kotabe and Swan 1995; Robertson and Gatignon 1998; Sivadas and Dwyer 2000). Therefore, Wind and Mahajan (1997, p. 7) identify new product alliances as an important research issue that represents the forefront of "the changing dynamics of competition and cooperation."

In this article, we seek to enhance marketing's understanding of these issues by examining interorganizational relations in new product development. These relationships, which we term *new product alliances*, are defined as formalized collaborative arrangements among two or more organizations to jointly acquire and utilize information and know-how related to the research and development (R&D) of new product (or process) innovations (adapted from Link and Bauer 1989, p. 5). Because of the rising costs of R&D, increased global competition, and a need for standardization, growing numbers of firms are conducting new product activities through such alliances. However, as noted by several scholars (e.g., Rosenfeld 1996; Wang 1994), the out-

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comes of these alliances are largely unknown. Managers, for example, have expressed great concern about their firms' ability to acquire information from fellow alliance participants as well as their ability to use this information to enhance new product-related outcomes (Mowery 1998; Sivadas and Dwyer 2000).

At least part of the uncertainty surrounding these alliances may arise because the structural and motivational aspects of cooperation among competitors appear to be quite different from those found in traditional vertical channel-based relationships (Galaskiewicz 1985). To understand these differences, we draw on concepts and findings from social network theory with a focus on the strength-of-ties literature. This perspective, which has been applied to several recent interorganizational studies (e.g., Achrol and Kotler 1999; Gulati 1998; Hansen 1999; McEvily and Zaheer 1999), conceptualizes information flows among social actors as heavily dependent on both their social structure (e.g., Burt 1992; Granovetter 1973, 1982) and their motivation to engage in information exchange (e.g., Brown and Reingen 1987; Frenzen and Nakamoto 1993; Uzzi 1999). Given that know-how transfer is widely cited as the major objective behind alliance participation (Macdonald 1995; Rosenfeld 1996; Watkins 1991) in specific and new product development in general (Moorman 1995; Moorman and Miner 1997), a tie-strength perspective is appropriate for the study of new product alliances.

We suggest that compared with vertical interorganizational relationships (i.e., channel members), firms in horizontal relationships (i.e., competitors) may be faced with the double jeopardy of trying to acquire information from participants that have little complementary knowledge and lack the motivation to share this knowledge (because of common structural linkages and access to similar types of information). This combination of structural and motivational features is dramatically different from the characteristics of the interindividual networks typical of most strength-of-ties research.

In contrast to these information acquisition deficiencies, we posit that horizontal alliances may realize information utilization benefits, as redundancy in the form of similar product development knowledge and skills enhances the ability of weakly tied social actors (i.e., competitors) to develop creative new products and launch them quickly. Although conceptualizations of the strength of weak ties among individuals (e.g., Granovetter 1973) assume that weak ties are advantageous because a low degree of redundancy enhances information acquisition, we suggest that in an interorganizational context, weak ties may be advantageous because a high degree of redundancy enhances information utilization. Thus, our research uncovers hidden aspects of the strength of weak ties that have not been articulated by network scholars.

The Strength-of-Ties Literature: A Brief Review

The strength-of-ties literature is primarily concerned with the nature of the relational bond between two or more social actors, as well as the effect of this bond on their information sharing activities (e.g., Frenzen and Nakamoto 1993; Granovetter 1973, 1982; Hansen 1999; Uzzi 1999). Tie-strength

researchers typically classify the relation between social actors as being linked by either a strong tie or a weak one. Strong ties are viewed as having higher levels of closeness, reciprocity, and indebtedness than weak ties (Granovetter 1973; Marsden and Campbell 1984). Although there is considerable debate about the relative advantages of these two different types of ties, it is widely accepted that strong ties increase the likelihood that social actors will share sensitive information with each other, whereas weak ties provide access to a greater amount and diversity of information (Frenzen and Nakamoto 1993; Hansen 1999).

The notion that tie strength could be used gainfully to understand information flows among social actors was first advanced by Granovetter (1973), who demonstrates the power of weak ties in information diffusion. In this classic study, Granovetter shows that information about employment opportunities was more likely to be obtained from acquaintances (i.e., weak ties) than family members (i.e., strong ties). Since then, tie strength has been applied to a variety of information-sharing contexts, ranging from word-of-mouth behavior among consumers (Brown and Reingen 1987) to information transmission among medical professionals (Burt 1987). Although tie strength typically has been applied to relationships among individuals, a growing body of researchers has applied tie-strength concepts to understand information flows in both organizational (e.g., Hansen 1999; Krackhardt 1992) and interorganizational settings (e.g., McEvily and Zaheer 1999; Uzzi 1999).

Concurrent with this shift in focus, researchers have also begun to reexamine the basic concept of tie strength itself. According to Granovetter's (1973) original conceptualization, strong ties are distinct from weak ties in terms of both structure and motivation. Specifically, Granovetter views strong ties as social networks that are structured by a high degree of redundant information and motivated by a high degree of emotional closeness and reciprocity. This conceptualization has been broadly shared by other tie-strength researchers as well. For example, using a bridge metaphor, Frenzen and Nakamoto (1993, p. 373) suggest that there is a "structural tendency for strong ties to cluster in dense, island-like cliques and weak ties to scatter widely as non-redundant bridges that link cliques together."

Growing numbers of researchers have begun to question the validity of this traditional view of tie strength (e.g., Hansen 1999; McEvily and Zaheer 1999; Reingen 1994). For example, recent research suggests that in an alliance context, strong ties may provide access to nonredundant information (Achrol and Kotler 1999; McEvily and Zaheer 1999). These findings are consistent with those reviewed by Reingen (1994, p. 154), who notes that "the little empirical research that directly relates to this issue suggests a surprising lack of redundancy among people in strong-tie relations." One reason for this growing debate over the role of tie-strength may be that researchers do not share a common conceptualization of strong ties (see Krackhardt 1992).

This growing debate regarding the conceptualization and components of tie-strength is an outcome of applications of tie-strength concepts to situations characterized by social actors in complex role relations. Much of the early research that emerged from Granovetter's (1973) original conceptu-

alization of the strength of ties deals with information exchange activity among individual actors. This early literature assumed that social actors occupy a singular role (e.g., close friend or casual acquaintance); therefore, tie strength could be viewed as a broader concept, consisting of both high levels of embedded relations and high levels of redundant knowledge (i.e., close friends display both of these qualities). Although this broader view may be suitable for interindividual relations, it may be an oversimplification of interorganizational relations, in which firms may simultaneously hold multiple roles (e.g., competitor and collaborator) and therefore may display more complex structural and motivational features. Thus, studies of information-sharing activity within interorganizational relationships have a greater need to distinguish among the dimensions of tie strength. Following previous research, we focus on two key tie-strength dimensions: (1) relational embeddedness (Gulati 1998; Uzzi 1999) as an indicant of the motivational aspect of tie strength and (2) knowledge redundancy (Burt 1987, 1992) as an indicant of the structural aspect of tie strength. We define and explain both of these constructs in the following section.

Considering the nature of the roles played by competitors in an alliance setting, we suggest that horizontal alliances are characterized by a low degree of relational embeddedness and a high degree of knowledge redundancy. Conversely, we suggest that vertical alliances are characterized by a high degree of relational embeddedness and a low degree of knowledge redundancy. This idea is based on previous research, which reveals that compared with channel members, competitors are characterized by higher levels of conflicting goals (Park and Russo 1996) and greater access to similar types of information (Powell, Koput, and Smith-Doerr 1996). Thus, as is shown in Figure 1 (and developed

in our hypotheses), the relationship between embeddedness and redundancy among interorganizational actors appears to be the inverse of the relationship found for individual actors. In the next section, we examine these alliance characteristics (i.e., embeddedness and redundancy) in greater detail and offer a set of hypotheses about their relationship to new product alliance activity.

Hypothesized Relationships

Tie Strength and Alliance Composition

Relational embeddedness. We define relational embeddedness as the degree of reciprocity and closeness among new product alliance participants. This conceptualization is derived from recent work that observes that interorganizational networks are linked by both structural and relational embeddedness (e.g., Granovetter 1992; Gulati 1998; Uzzi 1999). To date, most studies in the tie-strength literature focus on the structural embeddedness between actors by examining the position of a given organization in a broader network structure (see Gulati 1998). However, in a growing number of recent studies, researchers have begun to explore the impact of relational embeddedness on interorganizational outcomes through examinations of interorganizational reciprocal helping relations (Hansen 1999), cohesive ties (Gulati 1998), and reciprocal obligations (Uzzi 1999). These studies suggest that alliances characterized by a high degree of relational embeddedness display high levels of cooperation (Gulati 1998).

McEvily and Zaheer (1999) suggest that relational embeddedness should be higher among channel members than competitors, as channel members are more likely to have a vested interest in the success of their partners. The prospect of direct competition, in contrast, lowers a firm's incentive to engage in cooperative information-sharing activity and increases the incentive for hoarding valuable information (Achrol 1997; Vonortas 1997). This idea is indirectly supported by recent research by Park and Russo (1996), who find that joint ventures between competitors are more likely to fail than joint ventures between partners that do not compete. They suggest that this higher rate of failure is due to the competitors being more likely to face conflicting goals and objectives. On the basis of this research, we predict the following:

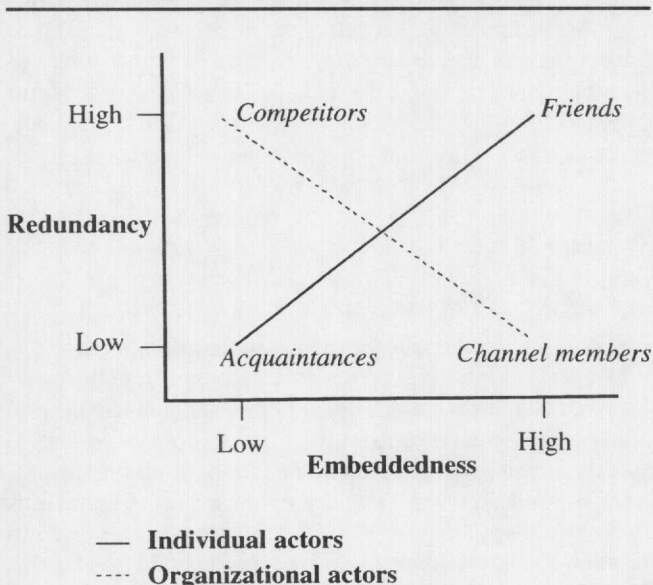
H₁: Vertical new product alliances will have higher levels of relational embeddedness than horizontal new product alliances.

Knowledge redundancy. Whereas relational embeddedness focuses on the quality of the relationship between social actors, redundancy is broadly viewed as the degree of overlap in the knowledge base between two or more social actors (Burt 1992; Krackhardt 1992). Overlapping knowledge is the product of social actors sharing equivalent structural positions in which they are exposed to similar types of information. Given our focus on the domain of new product development, we define knowledge redundancy as the degree of similarity in the new product-related information, capabilities, and skills among new product alliance participants.

The strength-of-ties literature indicates that knowledge redundancy is typically higher among actors that occupy similar social positions (Burt 1987; Granovetter 1973).

FIGURE 1

Relationship Between Relational Embeddedness and Knowledge Redundancy Among Individual Actors Versus Organizational Actors



Extending this literature, we suggest that competitors are likely to occupy similar positions within a larger social structure and share similar patterns of relations to other social actors (i.e., customers and suppliers). As Galaskiewicz (1985, p. 287) notes, "Firms that are horizontally interdependent compete with each other in obtaining similar resources and disposing of similar goods and services. One could argue that these organizations are structurally equivalent." This assertion is supported by a broad base of literature that suggests that in many industries, horizontally related firms have access to similar types of information because of common structural linkages through trade associations (Vives 1990), industry-based norms and procedures (Thomas and Soldow 1988), networks of informal know-how trading (von Hippel 1987), and membership in a common technological community (Powell, Koput, and Smith-Doerr 1996). Not all horizontally related firms share high levels of redundant knowledge. However, because of their high degree of structural equivalence, alliances composed predominantly of competitors should possess more redundant knowledge than alliances composed mainly of channel members. Thus, we predict the following:

- H₂: Horizontal new product alliances will have higher levels of knowledge redundancy than vertical new product alliances.

Relational Embeddedness, Knowledge Redundancy, and Information Acquisition

We view information acquisition as the quantity of information related to new product development acquired from other new product alliance participants. Specifically, our focus is the acquisition of technical information directly relevant to new product development, because other types of information (e.g., consumer or market information) fall outside the boundaries of most new product alliances (Hemphill 1997; Wright 1986).

Relational embeddedness. According to strength-of-ties researchers, information sharing among social actors is facilitated by a high degree of relational embeddedness in their social network (Granovetter 1973). As an example of the effects of a high degree of embeddedness, Frenzen and Nakamoto (1993) find that consumers are more likely to transmit information about a sale to a close friend than to a casual acquaintance (see also Brown and Reingen 1987). More recently, Hansen (1999) finds that frequent contact and emotional closeness among internal product development team members enhance the amount of complex knowledge transferred among team members. Finally, Krackhardt (1992) argues that in an organizational domain, information exchange is highly dependent on the degree of emotional closeness among social actors. On the basis of this research, we expect the following:

- H₃: Relational embeddedness will be positively related to information acquisition in new product alliances.

Knowledge redundancy. In addition to the benefits of embedded ties, strength-of-tie researchers also find that information sharing is enhanced by a low degree of redundancy among social actors' knowledge structures. As an example of the effects of knowledge redundancy, Uzzi

(1999) finds that within the banking industry, a firm's access to information about loan opportunities and market prices is facilitated by having a network of loosely connected, non-redundant, arm's-length ties to small business lenders. This finding supports both Granovetter's (1973) conceptualization of the "strength-of-weak ties" and Burt's (1992) conceptualization of "structural holes," which posits that information is more likely to flow among social actors that have different sets of contacts. These differential contacts lead to lower levels of knowledge redundancy and are more likely to provide access to novel information (Hansen 1999). Thus, we propose the following:

- H₄: Knowledge redundancy will be negatively related to information acquisition in new product alliances.

Relational Embeddedness, Knowledge Redundancy, and Information Utilization

Although strength-of-ties research has largely focused on the influence of tie strength on information acquisition (e.g., Burt 1987; Granovetter 1973; Uzzi 1996), a few studies have explored the effects of tie strength on higher-level information activities (e.g., Debackere, Clarysse, and Rappa 1996; Duysters, Kok, and Vaandrager 1999; McEvily and Zaheer 1999). We follow and extend these prior studies by employing our disaggregated view of tie strength to examine the independent effects of relational embeddedness and knowledge redundancy on information utilization in new product alliances. As McEvily and Zaheer (1999) note, information acquisition is not a discrete event but rather a part of a multi-stage process that includes the eventual utilization of this information to achieve organizational objectives.

The marketing literature has identified various types of information use activities (e.g., Kohli and Jaworski 1990; Moorman 1995; Slater and Narver 1995). For example, in their seminal research on market orientation, Kohli and Jaworski (1990) identify two components of organizational information utilization: response design (i.e., the use of information in developing plans) and response implementation (i.e., the speed with which plans are executed). Following this literature, we focus on the creativity and speed of development activities as two indicators of information utilization in new product alliances. We define new product (or process) creativity as the degree to which a firm utilizes new product alliance information to develop output that is novel to the industry and challenges existing standards (adapted from Moorman 1995). We define new product development speed as a firm's efficient utilization of new product alliance information in moving from conceptualization to the market introduction of a new product (adapted from Griffin 1993b).

Relational embeddedness. In addition to its positive effect on information acquisition, recent strength-of-ties research suggests that relational embeddedness should also enhance information utilization. For example, Uzzi (1999) finds that firms with embedded ties to their lending institutions are able to achieve lower financing costs than firms that share more arm's-length ties with their lending institutions. He suggests that this occurs because the lender can use information about the firm to create innovative and low-cost loans. In a new product development context, Hansen

(1999) finds that weak ties (i.e., a lack of relational embeddedness) among new product development team members may lengthen project completion time because they impede the transfer of complex knowledge among team members. In effect, embedded relations appear to enable product development activities to proceed more efficiently by lowering concerns about the loss of proprietary skills and knowledge and diminishing the likelihood of conflict over goals and implementation.

The notion that higher levels of relational embeddedness facilitate the utilization of information has also been noted by interorganizational relationship researchers. For example, Sabel (1993) documents how the development of embedded relations (what he terms "studied trust") among industrial firms in Pennsylvania provides benefits in the form of improved training and technological processes. Also, Moorman, Zaltman, and Deshpandé (1992) find that embedded relations (in the form of organizational trust) between market research providers and their clients indirectly enhances the utilization of market research information by improving the quality of the relationship between exchange partners. In a recent extension and replication of Moorman, Zaltman, and Deshpandé (1992), Grayson and Ambler (1999) find that trust is positively related to a marketing manager's utilization of information provided by an advertising agency representative. In summary, relational embeddedness appears to enhance information utilization in terms of both new product/process creativity (Uzzi 1999) and new product development speed (Hansen 1999). Thus, we suggest the following:

H₅: Relational embeddedness will be positively related to information utilization in new product alliances in the form of (a) new product creativity, (b) new process creativity, and (c) new product development speed.

Knowledge redundancy. In contrast to its negative effect on information acquisition, recent evidence from the tie-strength literature indicates that knowledge redundancy may improve information utilization. For example, Debackere, Clarysse, and Rappa (1996) find that biotechnology firms improve their innovative output by forming strong network ties to other firms in their industry (i.e., higher levels of redundant ties). Conversely, Kotabe and Swan (1995) find that firms that form strategic alliances with organizations outside their industry (i.e., low redundancy) introduce products that are significantly more innovative than firms that form ventures with organizations within their industry (i.e., high redundancy).

Thus, the effects of redundancy on creativity appear somewhat mixed. However, previous studies that focus on the negative influence of horizontal collaboration on innovative activity have not fully accounted for the fact that innovation in horizontal alliances is likely to be diminished by competitors' low degrees of relational embeddedness (see Figure 1). We believe that when the effects of relational embeddedness are removed, knowledge redundancy should have a positive effect on information utilization.

Building on research by both marketing and organizational scholars, we suggest that redundant knowledge enhances innovation by providing a shared base of tacit understanding, similar organizational routines, and common beliefs that serve as building blocks for innovation

(Dougherty 1992; Hutt, Reingen, and Rochetto 1988). As Powell and Brantley (1992, p. 368) note, "Typically, innovation builds on existing know-how." The conception of innovation as a process of building from existing stores of knowledge and expertise underlies Cohen and Levinthal's (1990) well-known concept of absorptive capacity, which suggests that existing knowledge structures enhance a firm's ability to use new information. More recently, Madhavan and Grover (1998) note that information redundancy enhances innovation by capitalizing on the absorptive capacity of organizational actors. Likewise, Hutt, Reingen, and Rochetto (1988) find that shared knowledge structures increase an organization's level of creative new product initiatives.

Collectively, this literature suggests that knowledge redundancy in the form of similar new product development capabilities will have a positive effect on information utilization in the form of new product/process creativity. At times, however, alliance members may engage in innovation that fails to build on existing competencies. For example, "competency-destroying innovations" (see Tushman and Anderson 1986) may require firms to develop new skills and capabilities. In these cases, firms may intentionally seek out alliance partners that possess nonredundant knowledge structures. However, these conditions do not necessarily negate the importance of shared knowledge structures and common skills. Indeed, shared knowledge structures are likely to provide a basis for effective communications and actions even in these more uncertain environments. For example, the innovative benefits of shared knowledge structures is demonstrated in research that shows that radical innovation is effectively diffused through know-how exchange among industry competitors (Allen 1983).

In addition to its positive effect on new product/process creativity, we suggest that redundancy should also enhance information utilization in the form of new product development speed. Specifically, we believe that the presence of shared knowledge structures and similar capabilities has a positive effect on a firm's ability to absorb, incorporate, and transform acquired knowledge into new products or processes in a timely manner. Although the strength-of-ties literature is largely silent on the effects of redundancy on speed of action, new product development researchers broadly suggest that the presence of shared knowledge and similar capabilities should enhance the speed of new product development because this redundancy lowers the need for planning and coordination among new product alliance members.

Although planning is an essential component of the new product development process, it tends to have a negative relationship with the speed of product introduction (Dickson 1992; Stalk 1988). According to McDonough and Barczak (1991), technological familiarity facilitates the speed of product development by easing decision making and reducing the dangers of the "not invented here" syndrome. Likewise, Griffin (1993a, p. 9) notes that diversity of technical expertise is negatively related to speed of new product development and observes that "As the number of different technical inputs to projects increases, stronger coordination across groups is required." Thus, a high degree of redundancy among alliance participants should enable firms to spend less time planning and coordinating their activities and thus be better able to introduce new products quickly. In summary, we predict the following:

H₆: Knowledge redundancy will be positively related to information utilization in new product alliances in the form of (a) new product creativity, (b) new process creativity, and (c) new product development speed.

Method

Sample and Procedure

The sampling frame for this study is U.S. firms that have recently participated in new product alliances. Historically, new product alliances among U.S. companies have been limited by a federal antitrust policy that has been described as largely "hostile toward R&D collaboration among industrial firms" (Mowery 1998, p. 38). However, starting in the mid-1980s, new product alliances blossomed following the passage of the National Cooperative Research Act (NCRA) of 1984. One of the principal intents of the NCRA was to increase information sharing and cooperative R&D activity among industry rivals by decreasing the threat of antitrust prosecution (U.S. House 1984). Although the NCRA was primarily focused on enhancing cooperation among competitors, this act has also fostered several alliances among channel members.

In accordance with the NCRA, new product alliance participants may file written notification of their alliance with the U.S. Attorney General to minimize the threat of antitrust prosecution. These filings are published in the *Federal Register* and provide information about the formation date, identity and location of the parties, and basic purpose of each alliance. Although new to marketing, *Federal Register* filings have served as the sampling frame for several studies of new product alliances (e.g., Aldrich and Sasaki 1995; Bolton 1993; Link 1996; Scott 1988; Vonortas 1997). We examined all the alliances filed in the *Federal Register* from January 1, 1989, to March 15, 1995.

During this time period, 242 new product alliances were filed in the *Federal Register*. After omitting alliances that either were deemed too large for respondents to evaluate (i.e., more than 12 participants) or consisted solely of firms that were already included in a prior alliance, we had a sample of 153 alliances, which represent the relevant population for our sampling frame. Within each alliance, we identified between one and six firms for inclusion in our sample. If an alliance had six or fewer participants, we included all members in our sampling frame. For alliances containing more than six participants, we used a random selection procedure. Because prior research suggests that international alliances may be systematically different from domestic alliances (e.g., Harrigan 1985; Kogut and Singh 1988), we included only firms that were either U.S. companies or domestic divisions of multinational corporations. To maximize the diversity of organizations included in this study, firms that belonged to multiple alliances were sampled only once. These procedures resulted in 380 firms for inclusion in our study.

The next stage of the sampling procedure involved finding the name of a key informant. As detailed by Campbell (1955), the key informant approach enables researchers to obtain information about a group (i.e., a firm) by collecting data from selected people within that group who are highly

knowledgeable about the phenomena under study. The key informant approach has been successfully employed in several studies of interorganizational relationships (e.g., Lusch and Brown 1996; Morgan and Hunt 1994; Stump and Heide 1996). As in other studies in this domain (e.g., Bolton 1993; Link and Bauer 1989; Robertson and Gatignon 1998), our targeted key informants were vice presidents of R&D within each firm. Vice presidents of R&D are ideal respondents because of their high levels of knowledge about the firm, its strategic environment, and its new product alliances (Link and Bauer 1989).

Before mailing questionnaires, we attempted to precontact each key informant by telephone to (1) assess the informant's ability to serve as a key informant by asking if he or she was knowledgeable about the alliance in question, (2) obtain cooperation, and (3) verify the informant's mailing address. In the majority of cases, we talked directly with a key informant. This process eliminated 39 firms (across six alliances) in which we could not reach or identify a knowledgeable executive. Therefore, the population for our final sampling frame consisted of 341 (380 - 39) firms. Each informant was mailed a cover letter, a one-page summary description of their new product alliance, a survey, and a postage-paid reply envelope. As an incentive to participate, informants were told they would be provided with a customized summary report of the study results. Three weeks after this initial mailing, we telephoned nonrespondents, and we sent a handwritten postcard one week later. Informants who did not reply within six weeks were mailed a second set of survey materials.

The surveys for eight firms were returned as undeliverable, and another 33 firms replied that they were willing to participate in this study but did not have enough knowledge about their alliance to provide useful information. This left an effective sampling frame of 300 firms (across 147 alliances), of which 106 usable surveys were returned, for a 35% response rate. These 106 surveys represent 70 different alliances (for a 48% response rate at the alliance level). This sample size and response rate compare favorably with similar studies of this population (e.g., Bolton 1993; Chen 1997; Littler, Leverick, and Bruce 1995; Sivadas and Dwyer 2000). As Armstrong and Overton (1977) recommend, potential nonresponse bias was assessed through an extrapolation method of comparing early with late respondents. No significant differences in either mean scores or variances were found for any key constructs between early (i.e., before second mailing) and late (i.e., after second mailing) respondents. Only 12 (11%) of our responses were from firms involved in two-party alliances, and the average respondent was involved in an alliance with 5.4 other participants. Thus, these responses capture the multifirm aspect of new product alliance activity.

As a validity check, respondents provided information regarding their position, the number of years they had worked for their firm, and their level of familiarity with the alliance in question. Results indicate that the sampling approach was quite successful in identifying key informants. Respondents were highly knowledgeable about their firm's involvement in the new product alliance (5.8 on a seven-point scale) and had worked for their firm for an average of 14.8 years. Two-thirds (66%) were presidents or vice presidents of their firm.

Measurement

Measure development began with field interviews and an early pretest version of the survey among product development personnel at IBM. These early interviews helped develop the measurement scales and were instrumental in crafting a pretest survey that was mailed to key informants in 50 firms (of which 23 responded) who had participated in new product alliances from March 16, 1995, to October 31, 1996. Respondents were asked for their suggestions for improving the survey instrument. All the scales used in the pretest were examined for internal consistency, unidimensionality, and content validity. This analysis revealed that the survey instrument was generally sound; however, a few items appeared in need of modification and were revised. The final survey contained measures of the key constructs and a set of control variables. The items in these key measures are detailed in the Appendix and the intercorrelations, reliability, and descriptive statistics are provided in Table 1.

Alliance composition. We consider alliance composition to be the nature of the relationship among alliance participants. To capture this relationship, we listed the names of all organizations participating in the alliance and asked respondents to classify each collaborator as a customer, a supplier, a competitor, or other (adapted from Littler, Leverick, and Bruce 1995). On the basis of these classifications, we calculated the percentage of competitors in each alliance as an indicant of the degree of horizontal collaboration. The mean percentage of alliance participants classified as competitors by each respondent was 37%. In terms of the distribution of our sample, 35.8% of responses were from alliances composed solely of channel members, 24.5% of the responses were from alliances in which 1%–49% of the participants were competitors, and 39.6% of the responses were from alliances in which 50%–100% of the participants were competitors. This distribution is consistent with the composition of alliances found in prior studies in this domain (e.g., Robertson and Gatignon 1998; Vonortas 1997) and provides a wide array of alliance types in which to examine our conceptual framework.

Relational embeddedness. In the extant strength-of-ties literature, embeddedness typically is derived by an estimation of the frequency of contact (typically using a single item) between social actors (see Granovetter 1982; Krackhardt 1992). However, as noted by Frenzen and Nakamoto (1993, p. 369, italics in original), “frequency of contact reflects the *opportunity* rather than the motivation to transmit.” Recognizing the limitations of this type of revealed measures of embeddedness, both Krackhardt (1992) and McEvily and Zaheer (1999) call for measures that capture social actors’ motivation to engage in information exchange. We sought to answer these calls by obtaining a direct assessment of relational embeddedness through a multi-item measure of its underlying components.

Using related work in the relational exchange literature as a guide (e.g., Dwyer, Schurr, and Oh 1987; Heide and John 1988; Lusch and Brown 1996), we view embedded ties as evolving in a temporal fashion, in which both prior dealings and anticipated future interactions exert an influence on the pattern of relations among organizational actors. In addition,

our measure taps the degree of reciprocal services and mutual closeness among social actors, because prior research suggests that these two constructs are the best indicants of embedded ties (e.g., Marsden and Campbell 1984; Mathews et al. 1998). Therefore, we developed a four-item, Likert-type scale that asked respondents to assess their firms’ degree of reciprocity and closeness with fellow alliance participants. This measure demonstrates acceptable reliability ($\alpha = .76$).

Knowledge redundancy. Network researchers typically assess redundancy by examining the degree of overlap in the network contacts of social actors (e.g., Burt 1987, 1992). Although this measure is rich in analytical properties, it provides only an indirect assessment of shared knowledge and skills. Therefore, we decided to assess knowledge redundancy more directly by developing a four-item semantic differential scale that asked respondents to evaluate the degree of similarity in new product development skills, knowledge, and resources of one of their fellow alliance participants (selected at random by the researchers). We adopted this single-firm approach because we believed that respondents would have difficulty responding to a more global (i.e., alliance-level) measure of knowledge redundancy.

In the vast majority of cases (91%), firms for which competitors accounted for half or more of their fellow participants evaluated competitors, and firms for which channel members accounted for the majority of their fellow participants evaluated channel members. In addition, there is no significant difference in the mean level of redundancy reported for two-party alliances (3.52) versus multiparty alliances (3.65). Therefore, although our measure only assesses a firm’s degree of redundancy with a single alliance participant, we believe that this measure is indicative of the degree of redundancy among alliance participants in general. Our knowledge redundancy scale was developed on the basis of the descriptions of capability similarity discussed in the writings of Best (1990), Richardson (1972), and Teece (1992) and is similar to the measure of technological linkage employed by Olk (1997). This measure displays good reliability ($\alpha = .85$).

Amount of new product-related information acquired. Drawing on research in both cognitive and organization science (Anderson 1983; Kogut and Zander 1992), we investigate two different forms of new product-related information. First, we examine product-related information, such as a product’s underlying components, features, and specifications. Second, because new product alliance activity often involves process innovation, we also examine process-related information, which is the techniques and procedures used to develop new products. We measured the amount of new product-related information acquired using a new ten-item, seven-point Likert-type scale that asked informants to rate the amount of new product-related information their firm acquired from fellow alliance participants. Our measure contained five items that assess product information (i.e., facts and findings) and five items that assess process information (i.e., techniques and tasks). Each of these two forms of information acquisition demonstrates a high degree of internal consistency (product information acquisition $\alpha = .89$, process information acquisition $\alpha = .92$).

TABLE 1
Key Measure Statistics

Measure	Mean	Standard Deviation	a	b	c	d	e	f	g	h	i	j	k	l	m	n
a. Alliance composition	.37	.37	(n.a.)													
b. Relational embeddedness	4.16	1.22	-.21	(.76)												
c. Knowledge redundancy	3.63	1.66	.48	-.06	(.85)											
d. Product information acquisition	3.45	1.44	-.43	.47	-.28	(.89)										
e. Process information acquisition	2.98	1.41	-.27	.33	-.22	.66	(.92)									
f. New product creativity	5.29	1.30	-.36	.29	-.08	.38	.26	(.96)								
g. New process creativity	4.81	1.38	-.12	.10	.02	.31	.33	.65	(.96)							
h. Product development speed	4.01	1.03	.19	.38	.24	.23	.29	.12	.27	(.81)						
i. Number of firms	6.42	2.68	.34	-.02	.18	-.26	-.10	-.37	-.07	.13	(n.a.)					
j. Relationship history	2.67	1.50	-.20	.36	-.08	.30	.16	.14	.03	.20	-.21	(n.a.)				
k. Stage of development	4.83	1.30	-.09	.01	-.01	.13	.00	.34	.35	.11	-.26	.17	(.77)			
l. Skill-based objectives	5.28	1.31	-.42	.14	-.29	.36	.21	.49	.42	.17	-.16	.06	.35	(.72)		
m. Cost-based objectives	5.16	1.41	.10	.18	.11	.03	.07	.15	.15	.26	.01	.05	.14	.32	(.71)	
n. Alliance scope	1.74	.44	-.02	-.09	-.10	-.06	.04	-.09	-.10	-.14	.04	-.08	-.11	-.01	-.08	(n.a.)

Notes: The coefficient alpha for each measure is on the diagonal, and the intercorrelations among the measures are on the off-diagonal. Correlations $\geq \pm .19$ are significantly different from zero at $p \leq .05$; correlations $\geq \pm .25$ are significantly different from zero at $p \leq .01$. n.a. = not applicable.

New product/process creativity. Our measure of new product/process creativity is adapted from Moorman's (1995) new product creativity scale. Because firms can develop innovation in both products and processes, our measure consisted of two separate scales: (1) an assessment of the degree of creativity of the product itself and (2) the degree of creativity in the processes designed to manufacture the product. Each of these two measures employed seven items with a seven-point Likert-type scale. Both new product and new process creativity demonstrate a high degree of reliability, as each had an alpha of .96.

New product development speed. To measure product development speed, we used a five-item, seven-point semantic differential scale. Scale items asked informants to rate the speed of development associated with the new products generated from their alliance participation. These items focus on how fast the firm has been able to develop new products or processes compared with the firm's norms and expectations. This measure, which borrows from the work of Griffin (1993a, b) and McDonough and Barczak (1991), displays good reliability ($\alpha = .81$).

Control variables. These variables were designed to control for individual firm differences and features of new product alliances that might serve as potential confounds or alternative explanations for our hypotheses about the relationship between tie-strength characteristics and new product outcomes. These control variables fall outside our theoretical focus on tie-strength characteristics but have been shown to influence interfirm cooperation in previous studies that use alternative conceptual foundations.

At the firm level, we control for relationship history between the focal firm and its fellow alliance participants, because a history of prior dealings has been shown to enhance interorganizational cooperation (Morgan and Hunt 1994; Smith and Barclay 1997). To assess the extent to which the focal firm participated in prior alliances with each of the other alliance participants, we used a single item with a seven-point scale ranging from "few relationships" to "many relationships." We then calculated the average score among all alliance partners to form an aggregate measure of relationship history. We also control for the type of objective a firm is trying to accomplish, because prior research suggests that firms enter alliances as a means of either reducing costs or enhancing skills (Hladik 1988; Sakakibara 1997; Vonortas 1997). As a measure of these objectives, we asked informants to rate the importance of four objectives that focus on cost-based goals (such as reducing the costs associated with product development, $\alpha = .71$) and four objectives that focus on skill-based goals (such as keeping abreast of changing technologies, $\alpha = .72$).

In addition to these firm-level variables, we also control for three alliance-level variables. First, because a broad base of research demonstrates that it is easier to achieve coordination in small groups than large ones (Day 1990; Heil and Robertson 1991; Pfeffer and Salancik 1978), we control for the number of firms by counting the number of participants in each alliance as listed in the *Federal Register*. Second, as the level and nature of interfirm interaction is likely to vary depending on the stage of development of alliance projects (Garud 1994; Link and Bauer 1989), we control for the stage

of development of product innovation. As a measure of this construct, we asked informants to assess retrospectively the stage of product development at the time of alliance formation using a five-item scale based on the work of Garud (1994), Link and Bauer (1989), and Tushman and Anderson (1986). This measure displayed adequate reliability ($\alpha = .77$). Third, because multiple-project alliances may differ systematically from single-project alliances, we control for alliance scope (i.e., whether the alliance was a short-term, single-project venture or a long-term, multiple-project venture) by having two doctoral students classify each alliance as involving either single or multiple projects on the basis of the statement of alliance objective contained in the *Federal Register*. Interrater agreement level among the coders was 85%, and all discrepancies were resolved through a discussion between the coders and one of the authors.

Measure purification. Our key measures were purified through a process that examined their internal consistency by means of coefficient alpha and their unidimensionality and discriminant validity by means of a series of confirmatory factor analysis models using LISREL 8 (Jöreskog and Sörbom 1993). The sets of measures were selected from theoretically similar subsets, which permitted joint examination of maximally similar latent constructs. These sets consisted of the three types of information utilization (i.e., new product creativity, new process creativity, and product development speed), two types of information acquisition (i.e., product information and process information), and two dimensions of tie strength (i.e., relational embeddedness and knowledge redundancy). As Campbell and Fiske (1959) note, this type of grouping of maximally similar constructs provides a stringent test of discriminant validity.

We also chose this submodel approach because all the observed variables could not be included in a single model without violating the five-to-one ratio of sample size to parameter estimates as recommended by Bentler and Chou (1988). This type of submodel analysis has been employed in several previous studies (e.g., Fisher, Maltz, and Jaworski 1997; Moorman 1995; Moorman and Miner 1997). In general, these submodels have fit indices close to or above recommended levels (information utilization model: $\chi^2_{(149)} = 377$, comparative fit index [CFI] = .89, root mean square residual [RMR] = .07; information acquisition model: $\chi^2_{(34)} = 111$, CFI = .90, RMR = .09; strength-of-ties model: $\chi^2_{(19)} = 14$, CFI = .97, RMR = .03), and each observed variable had significant ($p \leq .01$) factor loadings associated with its theorized latent construct.

To assess the discriminant validity between the latent constructs, we ran each submodel twice; in the first run, we freely estimated the correlation between the latent constructs, and in the second run, we constrained the correlation to unity (Anderson and Gerbing 1988). For the information utilization model (which contained three constructs), we constrained the correlation between product and process creativity. For each of the models investigated, the chi-square values for the unconstrained models were significantly lower than the chi-square values for the constrained models (information utilization model: $\Delta\chi^2_{(1)} = 494$, $p \leq .0001$; information acquisition model: $\Delta\chi^2_{(1)} = 141$, $p \leq .0001$; strength-of-ties model: $\Delta\chi^2_{(1)} = 130$, $p \leq .0001$), providing evidence of discriminant validity.

Results

Tie Strength and Alliance Composition

We examined the relationship between tie strength and alliance composition by conducting a one-way analysis of variance (ANOVA) (with a Scheffé test of multiple contrasts) in which we specified three conditions of alliance composition (i.e., 0% horizontal, 1%–49% horizontal, 50%–100% horizontal) as the criterion variable. Although we conceptualize and measure alliance composition as a continuous variable (i.e., percentage of participants classified as competitors), we treat alliance composition in a categorical manner for inclusion into an ANOVA format (similar results are obtained when alliance composition is used in a continuous manner in a correlation analysis; see Table 1). As predictor variables, we included relational embeddedness (H_1) and knowledge redundancy (H_2). As hypothesized, we find that relational embeddedness is negatively related to the degree of horizontal alliance composition ($F_{(2, 101)} = 5.0, p \leq .01$), as firms in purely vertical alliances have a higher level of embeddedness ($\mu = 4.64$) than firms in alliances dominated by competitors ($\mu = 3.81$). Thus, H_1 is supported. We also find that knowledge redundancy is positively related to the degree of horizontal alliance composition ($F_{(2, 101)} = 13.6, p \leq .001$), as firms in alliances dominated by competitors have a higher level of redundancy ($\mu = 4.54$) than both firms in alliances dominated by channel members ($\mu = 3.38$) and firms in purely vertical alliances ($\mu = 2.82$). Thus, H_2 is supported.

The Effects of Embeddedness and Redundancy on Information Acquisition and Information Utilization

We tested the effects of relational embeddedness and knowledge redundancy on information acquisition (H_3 and H_4) and information utilization (H_5 and H_6), through a multivariate general linear regression model (GLM) for purposes of statistical efficiency. Product information acquisition, process information acquisition, product creativity, process creativity, and speed of product development were the dependent variables; relational embeddedness and knowledge redundancy were the predictor variables; and relationship history, number of firms in the alliance, stage of development, skill-based objectives, cost-based objectives, alliance scope, and alliance composition (i.e., percentage of alliance participants classified as competitors) were control variables. We included alliance composition as a control variable to help determine the effects of redundancy and embeddedness independent of their relationship to the composition of a given alliance. In contrast to our previous hypotheses (H_1 and H_2), in this GLM regression analysis, we are interested in the direct effects of tie-strength characteristics (rather than the direct effect of alliance composition) on new product outcomes.

Multivariate tests reveal that both knowledge redundancy (Wilks' Lambda = .62, $F = 8.2, p \leq .0001$) and relational embeddedness (Wilks' Lambda = .76, $F = 4.5, p \leq .001$) are significantly related to our five dependent variables. In addition, both knowledge redundancy ($E^2 = .24$) and relational embeddedness ($E^2 = .36$) have large effect sizes. Among our control variables, only skill-based objectives have a signifi-

cant multivariate relationship (at $p \leq .05$) to our five dependent variables (Wilks' Lambda = .70, $F = 6.1, p \leq .0001$). Because of these significant multivariate effects for our two key predictor variables, we explored the individual regression models for each of our five dependent variables.

As reported in Table 2, relational embeddedness and knowledge redundancy have differential effects on information acquisition. Specifically, although relational embeddedness is strongly and positively related to the acquisition of product information ($B = .42, t = 3.51, p \leq .001$), it is only marginally related to the acquisition of process information ($B = .24, t = 1.86, p \leq .07$). Conversely, although knowledge redundancy is negatively related to the acquisition of process information ($B = -.22, t = -2.11, p \leq .04$), it is unrelated to the acquisition of product information ($B = -.11, t = -1.17, p \leq .25$). Thus, both H_3 and H_4 receive partial support, because relational embeddedness appears to enhance the acquisition of product information whereas knowledge redundancy appears to diminish the acquisition of process information.

As reported in Table 2, both relational embeddedness and knowledge redundancy have significant, positive effects on two of our three measures of information utilization. Specifically, relational embeddedness is positively related to both new product creativity ($B = .33, t = 3.15, p \leq .002$) and speed of new product development ($B = .34, t = 3.90, p \leq .0001$) but is unrelated to new process creativity ($B = .13, t = .97, p \leq .34$). Likewise, knowledge redundancy is positively related to both new product creativity ($B = .19, t = 2.23, p \leq .03$) and speed of new product development ($B = .15, t = 2.10, p \leq .04$) but is unrelated to new process creativity ($B = .12, t = 1.13, p \leq .26$). Thus, the hypothesized effect of relational embeddedness on information utilization is generally supported, because closer relational ties appear to enhance both new product creativity (H_{5a}) and speed of new product development (H_{5c}). Similarly, the hypothesized effects of knowledge redundancy on information utilization are generally supported, because overlapping skills and knowledge appear to enhance both new product creativity (H_{6a}) and speed of new product development (H_{6c}).

Discussion

In recent years, both marketing scholars (e.g., Sheth and Sisodia 1999; Wind and Mahajan 1997) and marketing professionals (see Gupta and Wilemon 1996) have expressed a considerable degree of interest in horizontal forms of cooperation in general and new product alliances in particular. A topic of concern to both groups is the issue of how to achieve cooperation among competing firms. As recently noted by McEvily and Zaheer (1999, p. 1154), "The balance between interfirm cooperation and competition, while a popular idea, warrants greater research attention." Our study directly addresses these concerns about the tension between cooperation and competition by showing that horizontal alliances differ from vertical ones in both structure and motivation. In addition, we show how these different alliance characteristics affect interfirm cooperation through both the acquisition of information from alliance participants and the use of this information to develop new prod-

TABLE 2
Regression Analysis of Relational Embeddedness and Knowledge Redundancy on New Product Outcomes

Key Predictor Variables	Product Information Acquisition		Process Information Acquisition		New Product Creativity		New Process Creativity		New Product Development Speed	
	B	t-Score	B	t-Score	B	t-Score	B	t-Score	B	t-Score
Relational embeddedness	.42	3.51***	.24	1.86*	.33	3.15**	.13	.97	.34	3.90***
Knowledge redundancy	-.11	-1.17	-.22	-2.11**	.19	2.23**	.12	1.13	.15	2.10**
Control Variables										
Number of firms	-.03	-.62	.02	.28	-.13	-2.73***	.04	.64	.07	1.87*
Relationship history	.12	1.27	.12	1.18	-.04	-.43	-.04	-.34	.12	1.70*
Stage of development	-.01	-.07	-.05	-.41	.17	1.64*	.27	2.17**	.04	.51
Skill-based objectives	.30	2.24**	.09	.63	.43	3.64***	.47	3.22***	.28	2.82***
Cost-based objectives	-.15	-1.46	-.06	-.53	-.05	-.52	-.06	-.50	-.01	-.14
Alliance scope	.02	.06	.41	1.23	-.02	-.09	-.12	-.37	-.11	-.49
Alliance composition	-.30	-.66	-.17	-.36	-.33	-.92	.38	.77	1.03	3.16**
R ² (adjusted)	.38 (.31)		.22 (.13)		.46 (.40)		.27 (.18)		.40 (.34)	

*Significant at $p \leq .10$.

**Significant at $p \leq .05$.

***Significant at $p \leq .01$.

ucts and processes. Thus, our study provides a first step in the direction toward understanding how to achieve and sustain cooperation among competitors compared with channel members. In this final section, we highlight the key implications of our findings, discuss potential limitations, and identify future research directions.

Theoretical and Substantive Implications

Tie strength and alliance composition. As suggested by a growing number of interorganizational researchers (e.g., Achrol 1997; Sheth and Sisodia 1999; Sivadas and Dwyer 2000), relations among competitors are qualitatively different from relations among channel members. Our results support this view by showing that participants in horizontal alliances possess both higher levels of knowledge redundancy and lower levels of relational embeddedness compared with vertical alliance participants. In effect, competitor-centered alliances can be thought of as networks dense in overlapping knowledge but sparse in relational norms. This combination of dense knowledge and sparse relations runs counter to the traditional conceptualization offered in the strength-of-ties literature. Thus, although individual actors may display both high levels of redundancy and high levels of embeddedness (i.e., close friends), this combination seems unlikely among interorganizational actors. This finding is important because it questions the existing notion that weak ties serve as important bridges through which information is transmitted (e.g., Frenzen and Nakamoto 1993; Granovetter 1973). In an interorganizational context, strong ties (i.e., channel members) are more likely to serve this bridging function than weak ties (i.e., competitors) because of their higher level of relational embeddedness and lower level of knowledge redundancy.

As a result, the challenges facing managers in horizontal alliances appear to be quite different (and much stiffer) than the challenges facing their counterparts in vertical alliances. Specifically, managers seeking to develop new products through alliances with competing firms face the dual challenge of cooperating with firms that can provide relatively little complementary knowledge and are reluctant to share their knowledge. This may be an important reason that horizontal alliances are found to be less stable than vertical ones (Park and Russo 1996). In summary, it appears that despite their collaboration as alliance participants, horizontally related firms have difficulty balancing the tension between cooperation and competition (see McEvily and Zaheer 1999).

One possible solution for minimizing tension between horizontal alliance participants may be to establish stronger informal linkages among competitors through such activities as trade show meetings, informal know-how transfer among engineers, and active membership in trade associations. As noted by Lee and Lee (1992), the vast majority of cooperative R&D activity is informal in nature and occurs through these types of mechanisms. For example, engineers often engage in informal know-how trading activity through impromptu meetings at conferences or trade association meetings. Likewise, manufacturers often solicit informal advice from channel members when designing a new product. Thus, formal new product alliances may be more successful when they develop as an extension of these informal processes.

Relational embeddedness, knowledge redundancy, and information acquisition. As expected, our results show that both relational embeddedness and knowledge redundancy play an important role in determining the amount of new product-related information a firm acquires from its fellow alliance participants. However, our results also suggest that the impact of these two features of tie strength varies depending on the type of information considered. Specifically, embeddedness appears to influence the amount of product information a firm acquires, whereas redundancy appears to influence the amount of process information a firm acquires.

The differential effects for relational embeddedness on product versus process information suggest that information transfer among alliance participants is more than a passive diffusion process. Thus, the nature of the relationship between alliance participants plays an important role in regulating the flow of information. As Frenzen and Nakamoto (1993, p. 363) note, "When transmitters are allowed to behave as gatekeepers, the flow of word-of-mouth information can be greatly disrupted." In a new product alliance context, participants appear to guard their gates carefully to ensure that valuable product-related information is not transferred to partners with whom they share low levels of embeddedness because of fears of having this information opportunistically exploited (see Williamson 1985). This finding is congruent with a recent study by Macdonald (1995), which finds that interfirm cooperation is hampered by many senior managers' reluctance to release product-related information, because they commonly view it as a commodity to be hoarded. Such concerns seem less salient for process information, as this type of technology is more tacit and less accessible through reverse engineering (Teece 1998).

Our finding that redundancy has a negative influence on the acquisition of process information but is unrelated to the acquisition of product information may have important implications for researchers concerned about the role of structure versus motivation among social actors. In his initial conceptualization, Granovetter (1973, p. 1371) suggests that weak ties provide key information benefits because of their structural network characteristics (i.e., low degree of knowledge redundancy). Therefore, he argues for "the primacy of structure over motivation" in terms of the relationship between tie strength and information flow. Since then, the issue of the information-related value of structure versus motivation (Frenzen and Nakamoto 1993) has been hotly debated by strength-of-ties researchers. However, these researchers have paid little attention to the type of information flowing between social actors. Our findings offer a conceptual refinement by distinguishing between information about techniques and skills and information about facts and findings, as well as an empirical contribution by finding that the structural aspects of interorganizational ties are more important for acquiring information about processes than products. This finding may be due to the likelihood that competing firms are working on similar technologies independently (Allen 1983) and thus have less need to acquire process-related information from each other.

Relational embeddedness, knowledge redundancy, and information utilization. As described thus far, the portrait of horizontal new product alliances appears rather bleak. We

have found that compared with vertical alliance participants, horizontal alliance participants have lower levels of relational embeddedness and higher levels of knowledge redundancy and that this combination is associated with lower levels of information acquisition. Therefore, it may seem surprising that despite these challenges, many firms choose to partner with competitors rather than channel members (Hladik 1988). For example, 40% (42 of 106) of the firms in our sample were engaged in an alliance in which half or more of the participants were competitors.

To date, existing explanations for horizontal collaboration have centered on economic efficiency, such as the desire for competitors to develop common industry standards or lower the collective costs associated with new product development (e.g., Sakikabara 1997; Vonortas 1997). Our findings suggest an alternative explanation. Specifically, although efficiency concerns may be valid, horizontal new product alliances also appear to enjoy benefits of new product development effectiveness in the form of higher levels of new product creativity and faster speed of development due to the synergy created by the redundancy of their product development-related knowledge, skills, and capabilities (see Olk 1997; Sivadas and Dwyer 2000). Thus, our findings offer a novel, information utilization-based explanation for the popularity of horizontal alliance activity. These findings also offer an alternative view of the strength of weak ties (Granovetter 1973). Traditionally, weak ties are viewed as advantageous because weakly connected actors share a low degree of knowledge redundancy, which enhances information acquisition. In contrast, our findings suggest that in an interorganizational context, weak ties may be advantageous because a high degree of knowledge redundancy among competing firms enhances information utilization.

In contrast to the information utilization benefits of redundancy (as well as embeddedness) for both new product development speed and new product creativity, this aspect of tie strength has little effect on new process creativity. Traditional economic thought suggests that compared with product innovations, process innovations are more likely to be internally generated as by-products of production (Klepper 1996). Therefore, if process innovation is merely a secondary outcome of product innovation, the structural and motivational aspects of a new product alliance may be relatively unimportant for the development of new processes. Although the exact nature of the relationship between alliance characteristics and new process development is hard to determine from a single study, our results support traditional economic thought and suggest that the tie strength has a larger impact on the development of new products than new processes. As seen in Table 1, this assertion is supported by the respondents' indications that their new products were significantly more creative than their new processes (product creativity = 5.29, process creativity = 4.81; $t = 4.14$, $p \leq .001$).

Potential Limitations

Some researchers have expressed concern about organizational studies that employ the view of only a single informant (e.g., Phillips 1981). Although our study uses a single-informant approach, we believe that this approach is

warranted for several reasons. First, because our research objective focuses on obtaining global measures of new product-related activities rather than an aggregation of individual perceptions of these activities, the use of a single key informant seems appropriate. Second, as recommended by Campbell (1955), these informants were carefully selected for their unique expertise (which was verified through validity checks). Finally, as noted by Griffin (1993a, p. 120), for most new product development studies, the estimates provided by individual informants "are surprisingly robust—they usually fall within 5%–10% of each other."

A related limitation pertains to our use of subjective managerial perceptions rather than more objective new product-related outcomes. Although objective outcome measures may be desirable, they are difficult to acquire and even harder to interpret (Griffin 1993a). As Smith, Carroll, and Ashford (1995, p. 17) note, subjective measures of managerial perceptions are appropriate for studies of interorganizational collaboration, because "many of the benefits of cooperation ... can be defined in noneconomic terms." Furthermore, Dess and Robinson (1984) show that managerial perceptions are generally consistent with objective measures of performance. Finally, objective measures may also be problematic, because they usually require higher level of measurement aggregation, which often leads to higher levels of respondent uncertainty and greater rates of survey error (Hu, Toh, and Lee 1996).

It should also be noted that our sample is composed of firms that have voluntarily filed their alliance with the U.S. Department of Justice in order to seek the protection of the NCRA. Thus, data obtained from these respondents could reflect a self-selection bias. Specifically, participants concerned about antitrust prosecution may be more likely to file under the NCRA. Given these antitrust concerns, these firms may be wary about sharing sensitive information with their fellow participants. This wariness may have influenced our findings about the effects of tie strength on information acquisition. However, we believe that the possibility of such contamination is remote, because our findings suggest that highly competitor-centered alliances account for only a small portion of all NCRA filings. In addition, because the NCRA provides many benefits and filing is cheap and easy, any firm engaged in new product alliance activity has a strong incentive to register under the NCRA. Nevertheless, given the diversity of collaborative activity in general, there are likely to be several new product alliances not filed under the NCRA for various reasons. Unfortunately, other than the NCRA filings, there is no systematic data source of U.S. firms engaged in new product alliance activity (Hemphill 1997).

As a final limitation, we focus our analysis on the relationship between alliance composition and tie-strength dimensions (by ANOVA) and then assess the impact of these dimensions on new product outcomes (by GLM regression). Using a strength-of-ties perspective, we view relational embeddedness and knowledge redundancy as simply correlates (rather than consequences) of alliances with varying composition (i.e., horizontal versus vertical). Therefore, the precise causal linkage among alliance composition, tie-strength dimensions, and new product outcomes remains to be determined. As a means of clarifying the causal sequence

among these variables, alternative conceptual models should be tested. For example, one such model could examine the moderating influence of embeddedness and redundancy on the relationship between alliance composition and new product outcomes. In addition to alternative conceptualizations, future research efforts should consider alternative (and finer grained) measures of alliance composition, because our classification focuses on the percentage of competitors in a given alliance and ignores possible distinctions between buyers and suppliers. Thus, although our findings generally support our hypotheses, these limitations suggest possible boundary conditions for our results.

Future Research Issues

We encourage other scholars to use our research as a starting point to investigate the interorganizational dimension of new product development. Many marketing and management scholars note that a firm's survivability and growth is highly dependent on its ability to develop innovative new products (e.g., Dickson 1992; Zander and Kogut 1995). Because of the critical importance of new product development for both individual firms and the U.S. economy, marketing scholars need to adopt a broader perspective on product development issues and examine the role of new product alliances and other types of interfirm cooperation as a source of new product innovations. For example, researchers interested in intraorganizational new product teams (e.g., Walker and Ruekert 1987) may wish to examine the applicability of their concepts and findings to the interorganizational product development teams that populate new product alliances.

We also encourage marketing orientation scholars to investigate the relationship between alliance participation and market orientation. The market orientation literature indicates that intraorganizational information exchange is a key component of a market orientation (Kohli and Jaworski 1990; Slater and Narver 1995). In addition, market-oriented firms may also engage in a high degree of interorganizational information exchange. Therefore, researchers could explore the relationship among alliance participation, information exchange, and market orientation through a longitudinal study that tracks alliance participants from initial alliance formation to dissolution. As part of this longitudinal study, researchers could explore the impact of informational exchange activities on managerial perceptions of competitors and customers.

Finally, we encourage research on the broader societal and consumer implications of new product alliance activity. As sanctioned by the NCRA, the U.S. Department of Justice views new product alliances as a means of encouraging innovation and enhancing the competitiveness of U.S. industry (Harris and Mowery 1990; Hemphill 1997). However, many scholars and public policy officials remain deeply concerned about the potential anticompetitive effect of collaborative R&D (Link 1996; Wright 1986). This concern seems somewhat warranted, because prior studies have found that new product alliances are disproportionately composed of large firms making R&D investments in existing lines of product development (Scott 1988; Vonortas 1997). As this debate unfolds, some researchers (e.g., Petit and Tolwinski 1999; Sakakibara 1997; Wright 1986) claim that alliances among competitors are especially problematic from a public policy

perspective because of the risks of collusion and underinvestment in R&D. Our findings suggest that alliances among competitors may actually enhance innovation, because their high degree of knowledge redundancy appears to lead to products that are both more innovative and more quickly introduced to the marketplace. However, these results are preliminary, and further research is needed to understand more fully the complex relationship among social welfare, economic efficiency, and interfirm cooperation.

Appendix Key Measures

Amount of New Product–Related Information Acquired (new measure; seven-point Likert scale)

Please rate the *amount* of the following types of *information* that your firm has acquired from the other participants in this venture:

Product Information Acquisition

1. Information about venture participants' R&D projects.
2. Research findings related to the development of new products.
3. Information about key product specifications.
4. Information about end-user requirements.
5. Information about competitors' technology.

Process Information Acquisition

1. Information about new manufacturing processes.
2. Insights into new ways to approach product development.
3. Information about new ways of combining manufacturing activities.
4. Insights about key tasks involved in the production process.
5. Insights into new ways to streamline existing manufacturing processes.

New Product/Process Creativity (adapted from Moorman 1995; seven-point semantic differential scale)

Product Creativity

In regard to *new product creativity*, please rate the degree to which the new *products* generated by your firm's participation in this venture are or are expected to be

1. Very ordinary for our industry—very novel for our industry.
2. *Not* challenging to existing ideas in our industry—challenging to existing ideas in our industry.
3. *Not* offering new ideas to our industry—offering new ideas to our industry.
4. *Not* creative—creative.
5. Uninteresting—interesting.
6. *Not* capable of generating ideas for other products—capable of generating ideas for other products.
7. *Not* promoting fresh thinking—promoting fresh thinking.

Process Creativity

In regard to *new process creativity*, please rate the degree to which the *processes* used to manufacture the new products

generated by your firm's participation in this venture are or are expected to be

1. Very ordinary for our industry—very novel for our industry.
2. *Not* challenging to existing ideas in our industry—challenging to existing ideas in our industry.
3. *Not* offering new ideas to our industry—offering new ideas to our industry.
4. *Not* creative—creative.
5. *Uninteresting*—interesting.
6. *Not* capable of generating ideas for other products—capable of generating ideas for other products.
7. *Not* promoting fresh thinking—promoting fresh thinking.

New Product Development Speed (adapted from Griffin 1993a, b and McDonough and Barczak 1991; seven-point semantic differential scale)

In regard to the *speed of development*, please rate the degree to which the new products or processes generated by your firm's participation in this venture are or are expected to be

1. Far behind our time goals—far ahead of our time goals.
2. Slower than the industry norm—faster than the industry norm.
3. Much slower than we expected—much faster than we expected.
4. Far behind where we would be had we gone it alone—far ahead of where we would be had we gone it alone.
5. Slower than our typical product development time—faster than our typical product development time.

Relational Embeddedness (new measure; seven-point Likert scale)

Please rate the degree to which the following items accurately describe the nature of your firm's overall relationship with the other organizations participating in the cooperative research venture:

1. We feel indebted to our collaborators for what they have done for us.
2. Our engineers share close social relations with the engineers from collaborating organizations in this venture.
3. Our relationship with our collaborators can be defined as "mutually gratifying."
4. We expect that we will be working with our collaborators far into the future.

Knowledge Redundancy (new measure; seven-point semantic differential scale)

Please rate the degree to which the participant listed below compares to your firm in general:

1. Produces very different products—produces very similar products.
2. Has complementary new product development skills—has overlapping new product development skills.
3. Their engineers have different knowledge from ours—their engineers have the same type of knowledge as ours.
4. Has very different resources—has very similar resources.

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