BUYING HIGH TECH PRODUCTS:
AN EMBEDDEDNESS PERSPECTIVE

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Buying High Tech Products:

An Embeddedness Perspective

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Buying High Tech Products: An Embeddedness Perspective

Abstract

Prior research on technology-intensive (TI) markets makes abstraction of the social context in which transactions take place. In contrast with this prior literature, the authors show that buyer-vendor transactions in TI markets are relationally and structurally embedded in an interfirm network. Their main premise is that buyers in TI markets prefer vendors with whom they can share a strong tie, and that in turn buyers want these vendors to share strong ties with their component manufacturers. This is an important addition to TI literature and to the on-going debate on the strength of ties in the sociology, management and marketing literatures. The authors also specifically consider how characteristics focal to TI markets, such as the know-how buyers possess or the pace of technological change they perceive, affect the extent to which buying behavior is relationally and structurally embedded. An empirical test in the computer network market shows good support for the developed theory.

Introduction

Technology-intensive (TI) markets are the main drivers of the growth of our economy and impose unique demands on market participants (Glazer 1991). More in particular, organizational buying behavior in TI markets yields unique challenges to marketing knowledge (Heide and Weiss 1995; Weiss and Heide 1993). Although this is widely recognized, research on technology-intensive markets is scarce. Extant theory is concentrated heavily in the game-theoretic modeling tradition (John, Weiss and Dutta 1999) and is clearly under-socialized.

In contrast with this under-socialized view of TI markets, this paper shows that an important aspect of TI markets is that (1) the expected tie between buyer and vendor, and (2) the current ties between vendor and component manufacturers determine a vendor's attractiveness to buyers. In line with economic sociology, we say that *organizational buying behavior in TI markets is* ***embedded***.

In embedded markets, purposive economic action is embedded in systems of social relations, both in time and structure (Granovetter 1985). Recently, a growing research stream on embeddedness has begun to develop in marketing (Frenzen and Davis 1990; Murry and Heide 1998; Rindfleisch and Moorman 2001; Wathne, Biong and Heide 2001), in management (Ahuja 2000; Gulati and Gargiulo 1999; Hansen 1999; Powell, Koput and Smith-Doerr 1996; Rowley, Behrens and Krackhardt 2000) and in sociology (DiMaggio and Louch 1998; Granovetter 1973 and 1985; Raub and Weesie 1990; Romo and Schwartz 1995; Uzzi 1997).

If *history* or *future expectations* of the relationship influence the actor's present and future behavior or status, we say that the actor's behavior or status is **relationally**

embedded (Gulati 1998). Buyer behavior is relationally embedded when the relationship the buyer expects to have with his vendor will affect his preferences to buy from that vendor. In marketing literature, relational embeddedness has received scattered attention since its introduction by Bonoma and Zaltman (1978). The resulting literature on relational embeddedness shows similarities with paradigms such as the political economy paradigm (Achrol, Reve and Stern 1983; Arndt 1983; Dwyer and Welsh 1985; Stern and Reve 1980) and the relationship marketing paradigm (Anderson and Weitz 1989; Dwyer, Schurr and Oh 1987; Levitt 1983). More specifically, prior marketing literature examined relational embeddedness in consumers' purchasing behavior (Frenzen and Davis 1990), channels (Murry and Heide 1998; Wathne, Biong and Heide 2001), and horizontal alliances (Rindfleisch and Moorman 2001).

If the *network structure* influences the actor's present and future behavior or status, we say that the actor's behavior or status is **structurally embedded** (Cohen, Robinson and Edwards 1967). Buyer behavior is structurally embedded when the relationships between the vendor and component manufacturers affect a buyer's preferences for that vendor. Surprisingly, structural embeddedness received far less attention than relational embeddedness (Anderson, Håkansson and Johanson 1994). To the best of our knowledge, no prior research in marketing has integrated relational and structural embeddedness in a single theoretical framework.

But why are TI markets both relationally and structurally embedded? TI markets are knowledge-intensive environments. Knowledge turns monolithic products into systems, composed of distinct components often manufactured by a set of different component manufacturers (John, Weiss and Dutta 1999). At the same time, knowledge

bases in TI markets have a high turnover rate, since rapid technological change makes present knowledge bases obsolete (Capon and Glazer 1987). As a result, knowledge transfer in interfirm networks is a key objective for companies in TI markets, for both vendors and buyers (Glazer 1991; John, Weiss and Dutta 1999). Prior literature has emphasized the role of embeddedness in knowledge transfer (Gulati 1998; Hansen 1999).

The focal debate in the embeddedness literature is on the optimality of strong versus weak ties. The **strength of a tie** is the frequency and closeness with which two organizations interact (Granovetter 1973; Hansen 1999). The mainstream thought embeddedness literature seems to bear is that *weak ties are preferable to strong ties in complex environments* (Granovetter 1973; Rowley, Behrens and Krackhardt 2000). In contrast, our study argues and shows that buyers prefer strong ties to weak ties in TI markets, which are complex environments by definition.

The central premise of our study is that *buyers prefer strong ties for the focal relationship with their vendor as well as for the third ties this vendor has with component manufacturers*. This central premise is grounded in the importance of knowledge transfer in buyer-vendor relationships in TI markets. We also examine how factors that are focal to technology literature, such as the buyers' know-how and the perceived pace of technological change affect our strength of ties argument. Consequently, this paper makes the following contributions:

(1) We argue and show that TI markets are embedded. We also examine how factors that are focal to TI markets, such as the know-how buyers possess and the pace of technological change they perceive, influence the effects of embeddedness.

(2) We combine relational and structural embeddedness, while most prior research in marketing only studied relational embeddedness.

(3) We show that buyers in TI markets prefer strong focal and third ties, while prior research in management and sociology has especially emphasized the benefits of weak ties.

This study also has important managerial implications for vendors in TI markets. We show that vendors should look beyond the focal dyad with buyers. They should develop a comprehensive network perspective that includes the nature of their relationships with component manufacturers. We also show that vendors should try to develop strong ties with their customers as well as with component manufacturers. In this manner, they add the most value to buyers in that they optimize knowledge transfer to the buyer. Our study also has implications towards vendors' targeting and positioning decisions. We show that depending upon buyers' know-how and the pace of technological change they perceive, buyers will have different preferences towards the relational and structural embeddedness of the vendor.

The outline of our paper is as follows. The following section develops the conceptual background of the study and the research hypotheses. The third section presents the research design, the methods employed to gather and analyze the data, and the results of the data analysis. The fourth section discusses the empirical findings, the limitations of our study, and the implications towards future research and managerial practice.

Conceptual Background

The predominant role of knowledge transfer in TI markets effectively transforms buyer-seller exchanges into transactions for knowledge (John, Weiss and Dutta 1999; Teece 1988). Considerations on knowledge transfer thus determine buying behavior and attitudes to a large extent. The way in which an actor is embedded in a larger network will determine his success in managing such knowledge transfer (Hansen 1999).

Several authors have also raised knowledge *search* as an important construct in assessing a firm's embeddedness in a network (Hansen 1999; Rowley, Behrens and Krackhardt 2000). Through search, companies can locate and identify attractive knowledge bases. Once the firm has located and identified attractive knowledge bases it can target knowledge transfer in a later stage (Hansen 1999). Although we recognize that this can be a useful activity for a vendor in his own right, knowledge search by the vendor has no immediate benefits to the buyer. This conforms to the premise that knowledge search has no value for a single transaction, unless it is immediately tied to knowledge transfer in that transaction itself (Granovetter 1973).[1] This reasoning further underlines the focal role of knowledge transfer in exchanges in TI markets.

Prior literature argues that embeddedness plays a key role in understanding knowledge and information flows between organizations (Burt 1992; Granovetter 1985). The study of the role of embeddedness in knowledge transfer considers *tie strength* to be the key construct (Granovetter 1973; Hansen 1999; Rindfleisch and Moorman 2001). We

[1] In this respect, note that we focus upon the preferences a buyer develops towards a particular vendor, rather than the inclusion of that vendor in a consideration set (also see Heide and Weiss 1995).

build upon theories on interfirm knowledge transfer to combine relational and structural embeddedness in a comprehensive theory.

Further, we argue that the extent to which buying behavior is relationally and structurally embedded is contingent upon three main factors. First, a buyer's *direct access* to knowledge bases that reside with component manufacturers makes indirect knowledge transfer through the vendor more beneficial. If the buyer has little or no direct access to such knowledge bases, the vendor performs the role of go-between, and thus spans a structural hole in the buyer's network (Burt 1992). The fact that the vendor spans a structural hole in the buyer's network alters the benefits from knowledge transfer.

Second, a buyer's *know-how* determines his absorptive capacity, or his ability to recognize, assimilate and apply new knowledge (Cohen and Levinthal 1990). Buyers with sufficient know-how benefit more from knowledge transfer than buyers that lack know-how. Thus the buyer's level of know-how affects his preference for the embeddedness of a vendor.

Third, also the *pace of technological change* a buyer perceives will affect the benefits the buyer derives from the knowledge transfer in the network. Rapid technological change makes information more time-sensitive (Bourgeois and Eisenhardt 1988). This has two predominant effects. On the one hand, it will necessitate speedier and more frequent knowledge transfer to stay abreast of technological change. On the other hand, a higher pace of technological change will reduce the value of the knowledge transferred in view of its rapid obsolescence.

In sum, we expect that a buyer's direct access to knowledge bases, his current know-how, and his perceived pace of technological change alter his preferences towards the relational and structural embeddedness of a vendor.

Relational Embeddedness

Relational embeddedness, as measured by the strength of the focal buyer-vendor tie is a focal determinant of buying behavior in TI markets, in view of its role in knowledge transfer. In TI markets, knowledge is often highly complex (John, Weiss and Dutta 1999). Tie strength is especially important when it concerns the transfer of such complex knowledge, while knowledge that is not complex can easily be transferred regardless of the strength of the tie (Polanyi 1966).

Knowledge complexity has two dimensions, that is, the extent to which knowledge is tacit and the extent to which knowledge is dependent (Hansen 1999). In TI markets, knowledge is often both tacit (John, Weiss and Dutta 1999) and dependent (Teece 1986).

Tacit knowledge is knowledge "that cannot be explicated fully even by an expert" (Polanyi 1966). Tacit knowledge thus has a low level of codifiability (Winter 1987). Exchange parties may find it difficult to contract over the transfer of tacit knowledge before that transfer has actually occurred. By definition, contracts on tacit knowledge cannot be written since the knowledge to be transferred cannot be codified. This raises the possibility that the exchange partner behaves opportunistically and does not fully deliver his end of the bargain. Dutta and Weiss (1997) show that firms structure their relations in specific ways to overcome these tradability problems.

The second dimension of knowledge complexity is whether the knowledge is independent or rather an element of a set of interdependent components (Teece 1986).

We have argued before that monolithic products get transformed into systems in TI markets (John, Weiss and Dutta 1999). This implies interdependence of knowledge in TI markets. Terminals in a computer network function in conjunction with communication devices, with other terminals and with the server. Hence, decisions regarding terminals have to be based on knowledge concerning communication devices and the server.

In case knowledge is more tacit and dependent, knowledge transfer requires more frequent interaction (Hansen 1999). Such interaction results in relationship-specific heuristics (Uzzi 1997). These heuristics in turn facilitate the process of assimilating complex knowledge for the buyer (Polanyi 1966).

The closeness of the interaction determines the willingness of the vendor to spend more effort in accurately articulating the tacit knowledge (Granovetter 1982). It also makes the vendor more available to assist the buyer in assimilating the interdependent knowledge components residing with component manufacturers. In line with these theoretical arguments, we expect that buyers prefer a strong focal tie with their vendor to a weak focal tie.

This is in line with previous research by Hansen (1999) and Uzzi (1997). Hansen (1999) finds that new product development teams that have strong ties with other organizational subunits are more effective if knowledge is complex. Uzzi (1997) finds that there is more exchange of tacit knowledge in close relationships as compared to arm's length transactions.

H1: Buyers in TI markets prefer a strong focal tie to a weak focal tie with their vendor.

Structural Embeddedness

The buyer will not only decide on the strength of the focal tie with a vendor. A vendor's attractiveness to buyers is also a function of the strength of third ties, that is, the strength of the vendor's ties to component manufacturers (Anderson, Håkansson and Johanson 1994). Knowledge bases and other resources in TI markets often reside in different firms (Kogut 2000; Teece 1992). Third ties to component manufacturers can provide a valuable access to these different knowledge bases in an industry (Anderson, Håkansson and Johanson 1994).

Successfully accessing these knowledge bases in TI markets goes beyond merely retaining a large number of third ties. Indeed, firms must be able to effectively transfer tacit and dependent knowledge across these ties (Powell, Koput and Smith-Doerr 1996). If the vendor has strong third ties, the buyer will find it easier to mobilize tacit and dependent knowledge present in the entire network, compared to a situation in which these ties are weak. Component manufacturers will be more willing (Granovetter 1982), and able, through relation-specific heuristics (Uzzi 1997), to share knowledge with the vendor. The buyer will therefore mobilize the industry's knowledge sources more easily through the vendor if the vendor has strong ties with component manufacturers.

In sum, strong third ties are beneficial to the buyer since they indirectly enlarge the accessible base of tacit and dependent knowledge. This idea is consistent with previous research. Gulati and Gargiulo (1999) and Gulati, Nohria and Zaheer (2000) contend that strong third ties provide a firm with a unique opportunity to tap into an industry's resources.

We hypothesize:

H2: Buyers in TI markets prefer strong third ties between vendor and component manufacturers to weak third ties between vendor and component manufacturers.

In addition, we may expect a buyer's preference for third tie strength to interact with focal tie strength. While it is common to prior marketing literature on buying behavior to isolate dyadic interaction from the surrounding relationships, we argue that the relationship between buyer and vendor serves as an indirect link with knowledge bases that reside with component manufacturers.

Vendors in knowledge-intensive environments become more attractive as they occupy a more central role in the interfirm network (Gulati and Gargiulo 1999). More specifically vendors' ability to assimilate fine-grained information from component manufacturers enhances their attractiveness towards buyers. As argued before, in TI markets such transfer requires strong third ties. However, a vendor's third ties and their resources determine what is achieved in the focal relationship between buyer and vendor (Anderson, Håkansson and Johanson 1994). Vendors' access to the knowledge bases of component manufacturers makes a strong focal tie with such vendors more attractive to the buyer.

We hypothesize:

H3: Buyers in TI markets prefer a stronger focal tie when third ties are strong, compared to when third ties are weak.

Direct access

We argued that the buyer benefits, through knowledge transfer, from a strong focal tie with the vendor and strong third ties between the vendor and component manufacturers. The buyer may have *direct* access to the knowledge bases of component

manufacturers, in addition to the indirect access he has through the vendor. Direct access to the knowledge bases of component manufacturers refers to the number of strong ties the buyer has with component manufacturers (Ahuja 2000). The number of strong ties with component manufacturers will affect a buyer's preference for a strong focal tie and for strong third ties.

If the buyer lacks direct access to the knowledge bases of component manufacturers, then there is a *structural hole* between buyer and component manufacturers (Burt 1992). In this case, the vendor that fills the structural hole performs the structural role of go-between, indirectly linking the two through third ties. This provides the vendor with brokerage opportunities, in that he derives information and control benefits from his structural position (Burt 1992). Information benefits encompass *more* access to different information flows and *early* access to new information (Burt 1992 and 1997; Hargadon and Sutton 1997). Control benefits imply that the vendor has a say in whose interests are served and can play demands of buyer and component manufacturers against one another (Burt 1997). These information and control benefits of the vendor allow the vendor to claim a larger part of the quasi-rents of the transaction.

Socialization through close relationships serves as a hedge against potential opportunistic exploitation of information and control benefits (Rowley, Behrens and Krackhardt 2000; Walker, Kogut and Shan 1997). Firms in close relationships can deploy tactics that promote goal convergence, which makes them less vulnerable to potential opportunism (Wathne and Heide 1999).

As such, socialization may reduce the vendor's tendency to distort information and to play demands of buyer and component manufacturers against one another.

Therefore, buyers that lack direct access may prefer a stronger focal tie, as they are more susceptible to the vendor's opportunistic behavior.

H4a: The less direct access to component manufacturers buyers in TI markets have, the more they prefer a strong focal tie.

Under hypothesis 2, we argued that buyers prefer strong third ties to be able to access knowledge bases that reside with the component manufacturers. However, in case buyers do not have direct access to these knowledge bases, strong third ties bear two risks.

First, when a buyer has no direct access, the knowledge from component manufacturers that he indirectly receives through the vendor is not verifiable. At the same time, the vendor has an incentive to manipulate and even 'bias' information to the buyer (Burt 1997). By manipulating the knowledge he transfers from component manufacturers to the buyer, he can better exploit his position as broker (Burt 1997). Thus, the accuracy of the knowledge that the buyer accesses through third ties is uncertain if the buyer is unable to verify this knowledge directly.

Specifically in the computer network market, Violino and Caldwell (1998) mention the objective and truthful representation of information by computer network vendors as a primary concern among buyers. Feldman and March (1981) emphasize precision and reliability of information as focal determinants of its value. The unreliability and potential imprecision of the knowledge transferred constrain the benefits a buyer derives from indirect knowledge transfer through third ties, and subsequently his preference for strong third ties.

Second, vendors that link otherwise unconnected buyers and component manufacturers have more control over whose interests will be served in the transaction at hand (Afuah 2000; Burt 1997). If the vendor maintains close relationships with component manufacturers, there is a higher possibility that vendor and component manufacturers would collude against the buyer. Such behavior would impede accurate knowledge transfer to the buyer, which would reduce the benefits that result from strong third ties. Lack of direct access to component manufacturers may therefore lower a buyer's preference for strong third ties. Hence, we hypothesize:

H4b: The less direct access to component manufacturers buyers in TI markets have, the less they prefer strong third ties.

Know-How

Know-how is a prime asset in TI markets (Glazer 1991). Know-how refers to scientific knowledge applied to useful purposes (Quinn, Baruch and Zien 1997). The know-how buyers possess will affect the benefits they receive from strong focal and third ties.

First of all, a firm's know-how determines its absorptive capacity, that is, the ability to recognize, assimilate and apply new knowledge (Cohen and Levinthal 1994). The more knowledgeable buyers are, the better they can assimilate new knowledge (Cohen and Levinthal 1990). Prior know-how increases both the ability to memorize new knowledge and the ability to use new knowledge. The main reason is that assimilation of new knowledge occurs in processes of associative learning (Bower and Hilgard 1981). Therefore, more knowledgeable buyers will be more able to assimilate the (complex) knowledge transfer gained through stronger ties, focal as well as third ties.

In addition, more knowledgeable buyers will have a stronger motivation to acquire new knowledge through strong focal and third ties. More knowledgeable buyers have stronger feedback effects from acquiring new knowledge. These positive feedback effects enhance the increasing returns on the knowledge transfer achieved through strong ties (Arthur 1990). Strong third ties also provide an organization with a sense of belonging to a larger information-processing network, which is imperative to knowledgeable buyers in TI markets (Glazer 1991). In sum, we hypothesize:

H5: The more know-how buyers in TI markets have, the more they prefer (a) a strong focal tie and (b) strong third ties.

Pace of Technological Change

Knowledge bases in technology-intensive markets are subject to frequent change (John, Weiss and Dutta 1999). The pace of technological change refers to the rate at which computer networks and their features are changing (Weiss and Heide 1993).

Essential to the pace of technological change is that it creates uncertainty (Aldrich 1979). Rapid technological change makes knowledge more time-sensitive. It determines the extent to which knowledge in a given period looses its value in subsequent periods (Glazer and Weiss 1993; Moorman and Miner 1997). This has two effects. First, a rapid pace of change may destroy a buyer's competences (Tushman and Nelson 1990). This enhances the value of knowledge transfer for the buyer, who needs to cope with the rapid obsolescence of his own knowledge base. Second, as knowledge grows obsolete more quickly, speedy transfer of knowledge is imperative (Weiss and Heide 1993). The knowledge gained today is of less value tomorrow.

As we have argued before, strong ties enhance speedy knowledge transfer. In view of the higher motivation related to a stronger tie, buyers are able to access more knowledge at an earlier time (Uzzi 1997). Note that this is consistent with previous technology literature. For instance, Heide and Weiss (1995) find that in turbulent environments, buyers are more likely to choose existing vendors – with whom they have stronger ties by definition – over new vendors.

In sum, we hypothesize:

H6: The more rapid buyers in TI markets perceive the pace of technological change to be, the more they prefer (a) a strong focal tie and (b) strong third ties.

We also argued before that buyers are solely dependent on the vendor for accurate information when they do not have direct access to component manufacturers. This dependency leads to control and information benefits which the vendor may exploit to the disadvantage of the buyer (Burt 1992). We hypothesized that the buyer may react by seeking a stronger focal tie (H4a) with his vendor, while seeking weaker third ties with component manufacturers (H4b), as compared to situations in which the buyer has direct access to component manufacturers.

A rapid pace of technological change will strengthen the effects hypothesized in H4a and H4b. At the level of the focal tie, the lack of direct access creates an opportunity for a vendor to exploit his information and control benefits. Actions that the vendor undertakes to this end may slow down a buyer's reaction to technological changes (Mintzberg, Raisinghani and Theoret 1976). Reaction speed to technological change is a major determinant of success in turbulent environments (Bourgeois and Eisenhardt 1988).

Hence, we expect the negative relationship between direct access and preference for a strong focal tie to grow more negative when pace of technological change is higher.

At the level of the third ties, we argued that vendor and component manufacturers may collude more easily against the buyer through strong third ties in case the buyer has no direct access. A rapid pace of technological change will further enable such collusion. High volatility makes future outcomes unpredictable and in that sense creates problems in writing contracts. In essence, contracts will always be incomplete in important respects in turbulent markets (Klein, Frazier and Roth 1990). For this reason, we expect that the positive relationship between direct access and preference for strong third ties is stronger when pace of technological change is high.

An additional argument towards both focal and third ties relates to the accuracy of knowledge provided by the vendor. As we argued before, lack of direct access may entice opportunistic behavior by the vendor in the sense that he might distort or bias knowledge. The vendor's opportunities to distort or bias knowledge grow larger in technologically volatile environments. A rapid pace of technological change makes it difficult for a buyer to evaluate information (Sutton, Eisenhardt and Jucker 1986). Direct access to component manufacturers may bring relief for the buyer, as this second source of knowledge will help in evaluating the knowledge provided by the vendor. In sum, we hypothesize:

H7: The more rapid buyers in TI markets perceive the pace of technological change to be,
(a) the stronger is the negative effect of direct access on the buyer's preference for a strong focal tie, and
(b) the stronger is the positive effect of direct access on the buyer's preference for strong third ties.

Other variables

In our model we included three other variables that are related to embeddedness. However, since their effects are theoretically straightforward, we did not develop any formal hypotheses. These variables are the valence of the focal and third ties and the number of third ties.

Valence

Valence in interfirm exchanges refers to a continuum from cooperative (positive valence) to competitive (negative valence), in accordance with Wish (1976) and Iacobucci and Ostrom (1996). We can best describe negative valence as the intrinsic motivation of exchange parties to behave opportunistically. Positive valence refers to the absence of this motivation due to the presence of trust between the exchange parties.

Trust enhances the effectiveness of cooperation in interfirm exchanges (Bucklin and Sengupta 1993). Prior studies have provided ample evidence of increased failure probability when exchange parties are competitors in other markets (Park & Russo 1996). Cooperation between competitors often results in learning races that hamper effective knowledge transfer (Baum, Calabrese and Silverman 2000). On the basis of this literature, we expect that buyers will be less able to source knowledge from the vendor and from his component manufacturers if focal and third ties are negative in valence, as compared to a situation in which these ties are positive in valence. Thus, buyers will prefer a focal tie and third ties that are positive in valence to a focal tie and third ties that are negative in valence.

Number of third ties

In prior studies, researchers have been unable to disentangle the number of third ties and the strength of third ties (for examples see Hansen 1999; Rowley, Behrens and

Krackhardt 2000). Although strong third ties require more time investment, this does not necessarily imply that vendors with strong third ties have less third ties than vendors with weak third ties. Avoiding the potentially confounding effect of the number of third ties and the strength of third ties is of prime importance for a clear understanding of the underlying theory. Joining both constructs into one and the same construct obscures a clear theory underlying the strength-of-ties phenomenon.

As argued above, third ties provide vendors with access to knowledge bases that reside with component manufacturers. The more third ties the vendor has, the more opportunities he has to diversify his knowledge on the market of components. Therefore, we expect that buyers prefer a vendor with many third ties to a vendor with few third ties.

Methodology

The next subsection discusses the research design. The second subsection presents the data collection. The third subsection discusses the development of the questionnaire. The fourth subsection describes the measures we used in this study. The final subsection discusses the method we used to test our hypotheses and presents our findings.

Research design

We tested the hypotheses described in the previous section with a conjoint design. We preferred a conjoint design to several alternative research designs – of which a retrospective field study is the most obvious – for distinct reasons.

First, buyers may have difficulties in identifying weak third ties, since by definition parties with weak ties are only connected to a limited extent (Granovetter 1973). A research design in which we would ask the buyer to characterize a vendor's

third ties would suffer from a bias favoring strong third ties. Such bias would invalidate the research design as a test for the developed theory on structural embeddedness.

Second, the nature of relationships changes over time. Actors may perceive relationships differently at different times (Anderson, Håkansson and Johanson 1994). We want to assess the influence of ex ante relationship perceptions on buyers' preferences. A retrospective study – in which we would ask respondents ex post about their relationship perceptions and their according preferences – would introduce severe biases.

Third, pre-tests showed that respondents found the conjoint tasks to be very realistic. Customers are regularly approached by vendors and are used to make assessments of a vendor's characteristics. Our conjoint task was designed to describe the situation in which a buyer is being approached by a vendor and must develop its preferences based upon the embeddedness of that vendor.

In sum, we assessed a conjoint experiment as the most appropriate research design. Organizational researchers have emphasized the usefulness of such experimental methods before (Dutta and John 1995; Sutcliffe and Zaheer 1998), conjoint analysis in particular (Murry and Heide 1998; Wathne, Biong and Heide 2001).

Sampling and data collection

The sampling frame for this study was a database containing detailed information on officially registered companies. We randomly selected 1750 medium-sized firms from four different industries based on the industry code.

In a second stage, we contacted these firms by telephone, for four reasons: to (1) check if the firm met our selection criteria; (2) identify a key informant within a selected firm; (3) request participation; and (4) check the mailing address. We only selected

respondent firms that either recently bought a computer network or that would be interested in buying one. We imposed selection criteria on the key respondent within the company, that is, the key respondent had to be (1) experienced and knowledgeable on the phenomenon under study; and (2) able and willing to participate (Campbell 1955).

The final sample consisted of 745 (43%) firms that met our selection criteria. All key informants received a questionnaire consisting of the conjoint experiment and additional questions. We provided several incentives to enhance the response rate. First, we included a letter supporting the study, signed by the director of a large association for medium-sized and small enterprises. Second, we promised to deliver a benchmark instrument to respondents, which allowed them to compare their IT-investment policy with the policies of their competitors. Third, we promised to donate $5 to charity – cancer research – for each completed questionnaire. Fourth, we mailed reminders, containing a second copy of the questionnaire, three weeks after we sent out the original questionnaire.

Of the 745 firms we contacted, 189 returned completed questionnaires, for a response rate of 25.4%. This response rate compares favorably with response rates previously reported in the literature in this field of research. We deleted the questionnaires of eight respondents since they did not meet our key informant selection criteria, in that they were inexperienced and not knowledgeable on the decision under study. We deleted twenty additional questionnaires since they provided incomplete information on focal theoretical variables. Table 1 describes our sample in some more detail.

To assess the possibility of non-response bias in our data, we compared early and late respondents following the procedures suggested by Armstrong and Overton (1977).

We defined "early" respondents as respondents that returned the questionnaire before we sent out the reminder. We defined "late" respondents as respondents that returned the questionnaire after we sent out the reminder. We found no differences between "early" and "late" respondents on firm characteristics such as size, know-how, profitability, and revenues. Defining the first 75% of our respondents as "early" and the last 25% as "late" also did not yield significant differences between "early" and "late" respondents. Thus, non-response bias in our data does not seem to be a substantial problem.

Development of questionnaire

We developed a questionnaire that included sixteen full profile conjoint tasks of five factors with two levels each. The conjoint design was an orthogonal half fraction of a 2^5 full factorial design that allowed for estimation of all main effects and two-way interaction effects (p. 42, Louviere 1988). In the conjoint task, we asked respondents to rate their preferences for a vendor characterized by the manipulated attributes on a 7-point scale going from very low preference to very high preference. We preferred ratings over rankings or choices since they are more time efficient for respondents and easier to administer through mail (Green and Srinivasan 1978). The use of ratings is also fairly common in marketing research (Leigh, MacKay and Summers 1984).

Evaluating five factors in a full profile scenario is within the boundaries of a respondent's cognitive ability (Green and Srinivasan 1978). By restricting the number of levels to two for each factor, we avoided an important problem in conjoint – the number-of-attribute-levels problem (Currim, Weinberg and Wittink 1981; Wittink, Krishnamurthi and Reibstein 1989). The pretests showed that respondents did not suffer from cognitive or task overload when confronted with sixteen full profile scenarios.

The questionnaire also included other measurement scales on constructs such as direct access, know-how, and pace of technological change.

To initially develop the conjoint scenarios and scales in the questionnaire, we consulted the academic and management literature. We conducted on-site interviews with three vendors, three customers and three component manufacturers. Each interview lasted about two hours. We also visited approximately 75 websites of vendors. Using this procedure we were able to develop realistic conjoint profiles, in the terminology of the respondent.

We pre-tested the questionnaire in personal interviews with five customers. On the basis of these interviews we slightly revised the conjoint scenarios. We also provided a clearer explanation of the conjoint factors employed. In this stage, we also decided to provide respondents with an example profile. We adopted minor changes in the measurement scales.

In a third stage, we conducted a pilot study. We mailed 400 questionnaires and received 35 completed questionnaires without any additional response-enhancing incentives. The pilot study generally confirmed the validity of our measures and indicated support for our initial hypotheses. Based on the pilot study, we fine-tuned scale measures. We also further clarified the conjoint experiment. Finally, as mentioned before, we developed several incentives to increase the response rate.

Measures

This section contains the conjoint factors and the measures for the non-manipulated variables. The five factors that constituted the conjoint task are presented in Table 2. The five factors are the structural and relational embeddedness variables identified in the theory section. Note that in line with industry terminology, we refer to

computer network vendors as system integrators and to component manufacturers as hardware and software manufacturers.

The strength of the focal tie factor (STR1) varied in terms of whether the system integrator would cooperate very or less intensively and frequently with the buyer (Hansen 1999). The valence of the focal tie factor (VAL1) varied in terms of whether the relationship of the system integrator with the buyer would be rather cooperative or rather competitive (Wish 1976; Iacobucci and Ostrom 1996). The strength of third ties factor (STR2) varied in terms of whether the system integrator cooperates very or less intensively and frequently with hardware and software manufacturers. The valence of third ties factor (VAL2) varied in terms of whether the system integrator has a rather cooperative or rather competitive relationship with hardware and software manufacturers. The number of third ties factor (NR) varied in terms of whether the system integrator has relationships with a large or a small number of hardware and software manufacturers.

A complete list of the scales used to measure the non-experimental factors is presented in the Appendix. It concerns direct access, pace of technological change, and know-how. Our measurement for direct access (ACCESS) relied on previous research by Ahuja (2000). The measure is the number of strong ties a buyer has with hardware and software manufacturers. Our measurement for pace of technological change (PACE) relied on previous research by Heide and Weiss (1995). This scale measures buyer's perceptions of the extent to which particular dimensions of the computer network market, such as workstations, servers, operating system, and application software were changing. The reliability of this scale (alpha = 0.90) is high (Nunnally 1978). Our measurement for know-how (KNOWHOW) relied on previous research by Ohanian (1990) and Netemeyer

and Bearden (1992). This scale measures the extent to which a buyer is knowledgeable, competent, expert, trained and experienced on computer networks. The reliability of this scale (alpha = 0.75) is satisfactory (Nunnally 1978).

Test of Hypotheses

To test our hypotheses, we developed an ordered probit model. Preference ratings are closer to ordinal- than interval-scaled measures (Steenkamp and Wittink 1994; Wittink, Krishnamurthi and Reibstein 1989). Therefore, we considered it more appropriate to model buyers' preferences using an ordered probit structure, which accounts for the ordered nature of preference ratings (Greene 2000).

We used an effects coding scheme to represent the two levels of the five factors (see Table 2). We coded the first level as +1 and the second level as -1. We defined two-way interactions by multiplicative cross-product terms between relevant factors (Green and DeSarbo 1979). We regressed the three-way interaction term of direct access, technological pace and tie strength on its three main variables and three two-way interaction terms. We inserted the corresponding residual series in the ordered probit models to measure the impact of the three-way interaction effects. By adopting this procedure, we are certain that the variance explained by the three-way interaction terms is unrelated to the individual main effects and two-way interactions.

The likelihood ratio statistic of the model shows high fit (LR-stat: 759.17). This chi-squared distributed statistic with 18 degrees of freedom is highly significant (prob. < 0.0000001). Thus, the model explains sufficient variance overall to justify examining the individual effects.

The results are presented in Table 3, where we abstain from the estimation results of the threshold parameters. We find that buyers significantly prefer vendors with a

strong focal tie and strong third ties to vendors with weak ties (β_{STR1} = 0.338, $p < 0.01$; β_{STR2} = 0.194, $p < 0.01$). This supports H1 and H2.

As hypothesized under H3, we find a significant and positive interaction effect between focal tie strength and third tie strength ($\beta_{STR1*STR2}$ = 0.043, $p < 0.05$).

The interaction of direct access and tie strength is significant and negative at the level of the focal tie ($\beta_{STR1*ACC}$ = -0.033, $p < 0.05$), while it is significant but positive at the level of the third ties ($\beta_{STR2*ACC}$ = 0.028, $p < 0.05$). This supports our prediction that buyers who lack direct access to component manufacturers prefer to have a stronger tie with the vendor, while they prefer weaker third ties (H4), as compared to buyers who have such direct access.

The interaction of a buyer's know-how and tie strength is significant and positive at the level of the focal tie ($\beta_{STR1*KNOWHOW}$ = 0.069, $p < 0.01$), but insignificant at the level of the third ties ($\beta_{STR2*KNOWHOW}$ = 0.014, $p = 0.52$). The results thus only partially support our hypotheses under H5.

Contrary to our predictions under H6, we find no support for the existence of an interaction effect between pace of technological change and tie strength ($\beta_{STR1*PACE}$ = 0.013, $p = 0.53$; $\beta_{STR2*PACE}$ = -0.032, $p = 0.13$).

We do find a significant and negative three-way interaction effect between direct access, pace of technological change, and focal tie strength as hypothesized under H7a ($\beta_{STR1*ACCESS*PACE}$ = -0.028, $p < 0.1$). We find a significant and positive three-way interaction effect between direct access, pace of technological change, and third tie strength as hypothesized under H7b ($\beta_{STR2*ACCESS*PACE}$ = 0.033, $p < 0.05$). The pace of

technological change does not seem to have a direct effect on tie strength, but rather it strengthens the interaction effects of direct access with tie strength.

Regarding the effects of valence and number of third ties, we found the effects we expected. We found buyers to prefer a relationship with their vendor that is positive in valence ($\beta_{VAL1} = 0.419$, $p < 0.01$). We also found that buyers prefer the vendor to have relationships with component manufacturers that are positive in valence ($\beta_{VAL2} = 0.146$, $p < 0.01$). Finally, we found that buyers prefer vendors with many third ties to component manufacturers to vendors with few third ties to component manufacturers ($\beta_{NR} = 0.084$, $p < 0.01$).

Note that we included the other variables depicted in Table 3 for control purposes.

Discussion

Theoretical implications

Our results lead to four main theoretical conclusions. First, TI markets are embedded. We found that the expected buyer-vendor interaction and the network structure the vendor is embedded in, affect a buyer's preferences towards a particular vendor. More specifically, we found that expectations on the strength and valence of buyer-vendor interaction significantly influence a buyer's preferences for a vendor. We also found that a vendor's network structure, as measured by the strength, valence and number of third ties a vendor has with component manufacturers, significantly influences a buyer's preference for a vendor. These findings support our notion that TI markets are embedded and thus that many theories on TI markets are under-socialized.

Second, we highlighted the importance of *structural embeddedness* as complementary to *relational embeddedness.* The significant effects of third tie variables

on buyers' preferences are a clear indication that studying buyer-vendor interaction merely dyadically leads to an incomplete understanding of the embeddedness of relationships. We also found that the strength of third ties interacts with the strength of the focal tie (H3). This means that studies that isolate relational embeddedness from structural embeddedness may not only provide an incomplete picture, but may also suffer from omitted variable bias.

Third, we found that buyers prefer strong to weak focal and third ties (H1 and H2). This finding contrasts with recent management literature that posits that suppliers may benefit from weak ties to their partners in turbulent and knowledge-intensive environments. Granovetter (1973) argued that weak ties connect an actor with nonredundant knowledge bases, which lead to the belief that in turbulent and knowledge-intensive markets weak ties outperform strong ties (Rowley, Behrens and Krackhardt 2000). From the perspective of a buyer in TI markets, weak ties do not provide access to knowledge since the buyer is not able to source complex knowledge through such weak ties (Hansen 1999). Although weak ties may eventually transform into strong ones, this process takes much time (Hansen 1999). The potential transformation of weak into strong ties thus may be of limited value to a buyer deciding on an individual purchase. Thus, buyers are not likely to derive any value from weak ties.

Fourth, although buyers in our sample prefer strong to weak focal and third ties at all times, we did find that a buyer's direct access and know-how, together with the pace of technological change he perceives, affect a buyer's preferred tie strength.

We found that a buyer that lacks direct access prefers a stronger focal tie with the vendor and weaker third ties of the vendor with component manufacturers, compared to a

buyer that has direct access to component manufacturers (H4). These results support our theoretical argument that is grounded in structural holes theory.

We also found that buyers with more know-how prefer a stronger focal tie with the vendor, compared to buyers with less know-how (H5a). This finding supports our argument that buyers with more know-how have the absorptive capacity needed for successfully assimilating new knowledge and are more eager to access new knowledge bases in the industry. We did not find support for the hypothesis that they would also have a higher preference for strong third ties (H5b).

Somewhat surprisingly, we found no support for our hypotheses that buyers perceiving a higher pace of technological change would prefer a stronger focal (H6a) and stronger third ties (H6b), compared to buyers who perceived a lower pace of technological change. This is surprising in view of prior literature that emphasizes the link between the pace of technological change and the need for new information (Tushman and Nelson 1990; Weiss and Heide 1993). However, in addition to the effects we hypothesized, contrary effects may be at play. In high velocity environments, firms benefit from more comprehensive knowledge (Bourgeois and Eisenhardt 1988). Too strong ties, however, may endanger the comprehensiveness of the knowledge the buyer receives (Uzzi 1997). Therefore, a paradoxical picture emerges. On the one hand, buyers prefer rapid access to new knowledge, for which strong ties are beneficial. On the other hand, strong ties may endanger the comprehensiveness of the knowledge received. These two effects may cancel out. However, further research is needed to understand these unexpected results.

Finally, we find support for the three-way interaction we hypothesized between direct access, pace of technological change and tie strength (H7). Buyers that lack direct access to component manufacturers prefer a strong focal tie and weak third ties, and these effects are strengthened under conditions of a high pace of technological change. Under high pace of technological change, reaction speed is more important, the future is less predictable and knowledge accuracy is more difficult to assess, enhancing the risk for the vendor's opportunistic behavior.

Managerial Implications

The present study has many relevant managerial implications. Recognizing that social factors influence buying behavior in TI markets and acting accordingly may significantly alter a firm's performance. More specifically, our study has the following implications for vendors in TI markets.

First, vendors should look beyond the dyad with the buyer and should develop strong ties with component manufacturers. We find that a vendor with strong ties to component manufacturers will have more success in attracting buyers, as compared to a vendor with weak ties to component manufacturers. Vendors should also emphasize their strong third ties in their communication.

We find that the network structure of a vendor influences the relationship a customer is seeking. Buyers will prefer stronger ties with vendors that have strong ties with component manufacturers. Therefore, vendors that invest more in the development of strong ties with component manufacturers will find buyers more willing to develop a strong focal tie.

Second, our findings regarding the interaction effects we hypothesized, help a company in making its targeting decisions. For instance, a company with weak third ties

may better target buyers that have little direct access to component manufacturers. Buyers with little direct access have no way of verifying the accuracy and truthfulness of the vendors' knowledge, and they may feel as if the vendor and component manufacturers collude against him. Such buyers may prefer a vendor with somewhat weaker third ties. In case the buyer has no direct access, vendors also need to prove their good intentions by other means, such as maintaining close interaction with the buyer or possibly building a reputation as a trustworthy exchange partner. For buyers that perceive the pace of technological change to be high, the effect of direct access becomes even more substantial.

Third, weak third ties require less time investment as compared to strong third ties, and therefore vendors may need to consider a trade-off between many weak or few strong third ties. Our results show that buyers care more about third tie strength than about the number of third ties. Thus, from a commercial perspective, it may be better for a vendor to develop a few strong third ties rather than many weak third ties if he is faced with such a trade-off.

Limitations and Future Research Directions

The results and implications drawn from this study should be viewed in the light of the research method employed. The research method we chose to test the developed theory suffers from several limitations.

Prior research has argued that experiments suffer from a lack of external validity. Do respondents' preferences in an experimental setting reflect their company's attitudes and behavior in real-life settings? We have several indications that our data may not suffer substantially from a lack of external validity. First, our pre-tests revealed that respondents regarded the conjoint task to be very realistic.

Second, we also explored the external validity of our data using additional information provided by respondents. 73 of our respondents named the computer network vendor they recently contracted. We visited each of these vendors' websites and registered whether they explicitly communicated their relationships with component manufacturers (1) on their homepage, (2) in their company description, or (3) in a direct link from the homepage. We studied whether this communication of third ties was associated with the importance the corresponding respondents attached to third tie characteristics in the experimental condition. We found that this association was significant ($p < 0.05$) and positive. Though exploratory, these results make us confident that our experimental study may not substantially suffer from a lack of external validity. Anyhow, we feel that the literature may benefit from a field study on this phenomenon. However, researchers embarking upon such research effort should consider the potential problems – as we mentioned earlier – related to such endeavor.

Another limitation of our study is that we focus on buying behavior in one single market. We would welcome research on high tech products other than computer networks that may generalize our findings.

Overall, the embeddedness of TI markets remains challenging. Although our study undoubtedly suffers from shortcomings, we hope that the least we have achieved is generating interest in this particular area of research. We also hope that future research will further our knowledge on this phenomenon.

Table 1:

Sample Characteristics

Average turn-over 1999 (in USD)	30,820,000 [645,000 ; 730,000,000]
Average profit 1999 (in USD)	2,105,000 [- 975,000 ; 36,000,000]
Average number of employees	118 [3 ; 485]
Average number of employees in IT	7 [0 ; 110]
Yearly investment in computer network	90,773 [0 ; 1,590,000]
% of respondents in industrial services	50
% of respondents in food production	10
% of respondents in machine production	20
% of respondents in transport	20

Table 2:

Conjoint attributes and levels

1. Focal tie strength (STR1)	+1:	This system integrator will cooperate very intensively and very frequently with your company.
	-1:	This system integrator will cooperate less intensively and less frequently with your company.
2. Focal tie valence (VAL1)	+1:	Your company's relationship with this system integrator will be rather cooperative.
	-1:	Your company's relationship with this system integrator will be rather competitive.
3. Third tie strength (STR2)	+1:	This system integrator cooperates very intensively and very frequently with his hardware and software manufacturers.
	-1:	This system integrator cooperates less intensively and less frequently with his hardware and software manufacturers.
4. Third tie valence (VAL2)	+1:	This system integrator's relationships with hardware and software manufacturers are rather cooperative.
	-1:	This system integrator's relationships with hardware and software manufacturers are rather competitive.
5. Number of third ties (NR)	+1:	This system integrator cooperates with a large number of hardware and software manufacturers.
	-1:	This system integrator cooperates with a small number of hardware and software manufacturers.

Table 3:

Results of Ordered Probit Model

Variable	Estimated Coefficient	Std Error	Expected Sign	Hypothesis
STR1	.338***	.025	+	H1
STR2	.194***	.025	+	H2
STR1*STR2	.043**	.020	+	H3
STR1*ACCESS	-.033**	.014	-	H4a
STR2*ACCESS	.028**	.014	+	H4b
STR1*KNOWHOW	.069***	.021	+	H5a
STR2*KNOWHOW	.014	.021	+	H5b
STR1*PACE	.013	.021	+	H6a
STR2*PACE	-.032	.021	+	H6b
STR1*ACCESS*PACE	-.028*	.017	-	H7a
STR2*ACCESS*PACE	.033**	.017	+	H7b
VAL1	.419***	.021	+	Other
VAL2	.146***	.020	+	Other
NR	.084***	.020	+	Other
KNOWHOW	-.029	.021		Control
ACCESS	.020	.015		Control
PACE	.037	.026		Control
ACCESS*PACE	.004	.017		Control

*** : $p < 0.01$
** : $p < 0.05$
* : $p < 0.1$

APPENDIX:

Scale Measures

Direct access to component manufacturers

With how many hardware and software component manufacturers does your company have weekly contact?

Know-How on computer network (Cronbach Alpha 0.90)

We measured this construct using a seven-point scale consisting of five items. Concerning the ***characteristics of computer networks***, would you consider your company to be (1) not at all knowledgeable – very knowledgeable; (2) not at all competent – very competent; (3) not at all expert – highly expert; (4) not at all trained – very well trained; (5) not at all experienced – very experienced.

Pace of technological change (Cronbach Alpha 0.75)

We measured this construct on a seven-point scale consisting of five items. We anchored the scale by *No changes taking place* and *Frequent changes taking place* (Heide and Weiss 1995):

1. The nature of workstations for computer networks.
2. The nature of servers for computer networks.
3. The nature of Network Operating Systems.
4. The nature of application software.
5. The nature of network technology in general.

References

Achrol, Ravi S., Torger Reve & Louis W. Stern (1983), "The Environment of Marketing Channel Dyads: a Framework for Comparative Analysis," Journal of Marketing, 47 (Fall), 55-67.

Afuah, Allan (2000), "How Much Do Your Co-opetitors' Capabilities Matter in the Face of Technological Change?," Strategic Management Journal, 21 (Special Issue), 387-404.

Ahuja, Gautam (2000), "Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study," Administrative Science Quarterly, 45 (September), 425-455.

Aldrich, Howard A. (1979), Organizations and Environments. Englewood Cliffs, NJ: Prentice-Hall Inc.

Anderson, Erin & Barton Weitz (1989), "Determinants of Continuity in Conventional Industrial Channel Dyads," Marketing Science, 8(4), 310-323.

Anderson, James C., Håkan Håkansson & Jan Johanson (1994), "Dyadic Business Relationships within a Business Network Context," Journal of Marketing, 58(October), 1-15.

Armstrong, J. Scott and Terry S. Overton (1977), "Estimating Non-response Bias in Mail Surveys," Journal of Marketing Research, 16 (August), 396-400.

Arndt, Johan (1983), "The Political Economy Paradigm: Foundation for Theory Building in Marketing," Journal of Marketing, 47(Fall), 44-54.

Arthur, W. Brian (1990), "Positive Feedback in the Economy," Scientific American, 262 (Feb), 92-99.

Baum, Joel A.C. and Christine Oliver (1992), "Institutional Embeddedness and the Dynamics of Organizational Populations," American Sociological Review, 57(August), 540-559.

----, Tony Calabrese and Brian S. Silverman (2000), "Don't Go It Alone: Alliance Network Composition and Startups' Performance in Canadian Biotechnology," Strategic Management Journal, 21 (Special Issue), 267-294

Bonoma, Thomas G. and Gerald Zaltman (1978), Organizational Buying Behavior. Chicago: American Marketing Association.

Bourgeois, L.J. and Kathleen M. Eisenhardt (1988), "Strategic Decision Processes in High Velocity Environments: Four Cases in the Microcomputer Industry," Management Science, 34 (7), 816-835.

Bower, Gordon H. and Ernest R. Hilgard (1981), Theories of Learning. Englewood Cliffs, NJ: Prentice-Hall.

Bucklin, Louis P. & Sanjit Sengupta (1993), "Organizing Successful Co-Marketing Alliances," Journal of Marketing, 57 (April), 32-46.

Burt, Ronald. S. (1992), Structural Holes – The Social Structure of Competition. Harvard University Press.

---- (1997), "The Contingent Value of Social Capital," Administrative Science Quarterly, 42(2), 339-365.

Campbell, Donald T. (1955), "The Informant in Quantitative Research," American Journal of Sociology, 60 (January), 339-342.

Capon, Noel and Rashi Glazer (1987), "Marketing and Technology: A Strategic Coalignment," Journal of Marketing, 51 (July), 1-14.

Cohen, Arthur M., Ernest L. Robinson and Jack L. Edwards (1967), "Experiments in Organizational Embeddedness," Administrative Science Quarterly, 14 (June), 208-221.

Cohen, Wesley M. and Daniel A. Levinthal (1990), "Absorptive Capacity: A New Perspective on Learning and Innovation," Administrative Science Quarterly, 35 (1), 128-152.

---- and ---- (1994), "Fortune Favors the Prepared Firm," Management Science, 40 (2), 227-251.

Currim, Imran S., Charles W. Weinberg and Dick R. Wittink (1981), "Design of Subscription Programs for a Performing Arts Series," Journal of Consumer Research, 8 (June), 67-75.

DiMaggio, Paul and Hugh Louch (1998), "Socially Embedded Consumer Transactions: For What Kind of Purchases Do People Most Often Use Networks?," American Sociological Review, 63 (October), 619-637.

Dutta, Shantanu and George John (1995), "Combining Lab Experiments and Industry Data in Transaction Cost Analysis: The Case of Competition as a Safeguard," Journal of Law, Economics and Organization, 11 (1), 189-204.

---- and Allen M. Weiss (1997), "The Relationship Between a Firm's Level of Technological Innovativeness and its Patterns of Partnership Agreements," Management Science, 43 (3), 343-356.

Dwyer, F. Robert & M. Ann Welsh (1985), "Environmental Relationships of the Internal Political Economy of Marketing Channels," Journal of Marketing Research, 22(Nov), 425-440.

----, Paul H. Schurr and Sejo Oh (1987), "Developing Buyer-Seller Relationships," Journal of Marketing, 51(April), 11-27.

Feldman, Martha S. and James.G. March (1981), "Information in Organizations as Signal and Symbol," Administrative Science Quarterly, 26(2), 171-186.

Frenzen, Jonathan K. & Harry L. Davis (1990), "Purchasing Behavior in Embedded Markets," Journal of Consumer Research, 17(1), 1-12.

Glazer, Rashi (1991), "Marketing in an Information-Intensive Environment: Strategic Implications of Knowledge as an Asset," Journal of Marketing, 55 (October), 1-19.

---- and Allen M. Weiss (1993), "Marketing in Turbulent Environments: Decision Processes and the Time-Sensitivity of Information," Journal of Marketing Research, 30 (November), 509-521.

Granovetter, Mark (1973), "The Strength of Weak Ties," American Journal of Sociology, 78 (May), 1360-1380.

---- (1982), "The Strength of Weak Ties: A Network Theory Revisited," in: Social Structure and Network Analysis, P.V. Marsden and N. Lin, eds., Beverly Hills, CA: Sage.

---- (1985), "Economic Action and Social Structure: the Problem of Embeddedness," American Journal of Sociology, 91(3), 481-510.

Green, Paul E. and Wayne S. DeSarbo (1979), "Componential Segmentation in the Analysis of Consumer Tradeoffs," Journal of Marketing, 43 (Fall), 83-91.

---- and V. Srinivasan (1978), "Conjoint Analysis in Consumer Behavior: Issues and Outlook," Journal of Consumer Research, 5 (September), 103-123.

Greene, William H. (2000), Econometric Analysis, New Jersey: Prentice-Hall.

Gulati, Ranjay (1998), "Alliances and Networks," Strategic Management Journal, 19, 293-317.

---- and Martin Gargiulo (1999), "Where Do Interorganizational Networks Come From?," American Journal of Sociology, 104 (March), 1439-1493.

----, Nitin Nohria and Akbar Zaheer (2000), "Strategic Networks," Strategic Management Journal, 21 (March), 203-215.

Hansen, Morton T. (1999), "The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge across Organization Subunits," Administrative Science Quarterly, 44(1), 82-111.

Hargadon, Andrew and Robert I. Sutton (1997), "Technology Brokering and Innovation in a Product Development Firm," Administrative Science Quarterly, 42 (December), 716-749.

Heide, Jan B. and Allen M. Weiss (1995), "Vendor Consideration and Switching Behavior for Buyers in High-Technology Markets," Journal of Marketing, 59 (July), 30-43.

Iacobucci, Dawn and Amy Ostrom (1996), "Commercial and Interpersonal Relationships: Using the Structure of Interpersonal Relationships to Understand Individual-to-Individual, Individual-to-Firm, and Firm-to-Firm Relationships in Commerce," International Journal of Research In Marketing, 13, 53-72.

John, George, Allen M. Weiss and Shantanu Dutta (1999), "Marketing in Technology-Intensive Markets: Toward a Conceptual Framework," Journal of Marketing, 63 (Special Issue), 78-91.

Klein, Saul, Gary L. Frazier and Victor J. Roth (1990), "A Transaction Cost Analysis Model of Channel Integration in International Markets," Journal of Marketing Research, 27 (May), 196-208.

Kogut, Bruce (2000), "The Network as Knowledge: Generative Rules and The Emergence of Structure," Strategic Management Journal, 21, 405-425.

Leigh, Thomas W., David B. MacKay and John O. Summers (1984), "Reliability and Validity of Conjoint Analysis and Self-Explicated Weights: A Comparison," Journal of Marketing Research, 21 (November), 456-462.

Levitt, Theodore (1983), The Marketing Imagination. New York: The Free Press.

Louviere, Jordan J. (1988), Analyzing Decision Making: Metric Conjoint Analysis. Sage University Paper series on Quantitative Applications in the Social Sciences, Beverly Hills: Sage Publications.

Mintzberg, Henry, D. Raisinghani and A. Theoret (1976), "The Structure of "Unstructured" Decision Processes," Administrative Science Quarterly, 21, 246-275.

Moorman, Christine and Anne S. Miner (1997), "The Impact of Organizational Memory on New Product Performance and Creativity," Journal of Marketing Research, 34(February), 91-106.

Murry, John P., Jr. & Jan B. Heide (1998), "Managing Promotion Program Participation within Manufacturer-Retailer Relationships," Journal of Marketing, 62 (January), 58-68.

Netemeyer, Richard G. and William O. Bearden (1992), "A Comparative Analysis of two Models of Behavioral Intention," Journal of the Academy of Marketing Science, 20 (Winter), 49-59.

Nunnally, Jum C. (1978), Psychometric Theory, 2nd ed. New York: Mc Graw Hill Book Company.

Ohanian, Roobina (1990), "Construction and Validation of a Scale to Measure Celebrity," Journal of Advertising, 19 (3), 39-52.

Park, Seung Ho and Michael V. Russo (1996), "When Competition Eclipses Cooperation: An Event History Analysis of Joint Venture Failure," Management Science, 42 (June), 875-890.

Polanyi, Michael (1966). The Tacit Dimension. New York: Anchor Day Books.

Powell, Walter W., Kenneth W. Koput & Laurel Smith-Doerr (1996), "Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology," Administrative Science Quarterly, 41(1), 116-145.

Quinn, James Brian, Jordan J. Baruch and Karen Anne Zien (1997), Innovation Explosion. New York: The Free Press.

Raub, Werner & Jeroen Weesie (1990), "Reputation and Efficiency in Social Interactions: An Example of Network Effects," American Journal of Sociology, 96(3), 626-654.

Rindfleisch, Aric and Christine Moorman (2001), "The Acquisition and Utilization of Information in New Product Alliances: A Strength-of-Ties Perspective," Journal of Marketing, 65 (April), 1-18.

Romo, Frank P. & Michael Schwartz (1995), "The Structural Embeddedness of Business Decisions: The Migration of Manufacturing Plants in New York State, 1960 to 1985," American Sociological Review, 60 (December), 874-907.

Rowley, Tim, Dean Behrens and David Krackhardt (2000), "Redundant Governance Structures: An Analysis of Structural and Relational Embeddedness in the Steel and Semiconductor Industries," Strategic Management Journal, 21, 369-386.

Steenkamp, Jan-Benedict E.M. and Dick R. Wittink (1994), "The Metric Quality of Full-Profile Judgments and the Number-of-Attribute-Levels Effect in Conjoint Analysis," International Journal of Research in Marketing, 11, 275-286.

Stern, Louis W. & Torger Reve (1980), “Distribution Channels as Political Economies: A Framework for Comparative Analysis,” Journal of Marketing, 44(Summer), 52-64.

Sutcliffe, Kathleen M. and Akbar Zaheer (1998), “Uncertainty in the Transaction Environment: An Empirical Test,” Strategic Management Journal, 19(1), 1-23.

Sutton, Robert, Kathleen Eisenhardt and James Jucker (1986), “Managing Organizational Decline: Lessons from Atari,” Organizational Dynamics, 14 (Spring), 17-29.

Teece, David J. (1986), “Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy,” Research Policy, 15 (December), 285-305.

---- (1988), “Capturing Value from Technological Innovation: Integration, Strategic Partnering, and Licensing Decisions,” Interfaces, 18 (May), 46-61.

---- (1992), “Competition, Cooperation, and Innovation: Organizational Arrangements for Regimes of Rapid Technological Progress,” Journal of Economic Behavior and Organization, 18 (June), 1-25.

Tushman, Michael L. and Richard R. Nelson (1990), “Introduction: Technology, Organizations and Innovations,” Administrative Science Quarterly, 35, 1-8.

Uzzi, Brian (1997), “Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness,” Administrative Science Quarterly, 42(1), 35-67.

Violino, Bob and Bruce Caldwell (1998), “Analyzing the Integrators,” Informationweek, 709 (November), 45-69.

Walker, Gordon, Bruce Kogut and Weijian Shan (1997), “Social Capital, Structural Holes and the Formation of an Industry Network,” Organization Science, 8 (March), 109-125.

Wathne, Kenneth H. and Jan B. Heide (2000), “Opportunism in Interfirm Relationships: Forms, Outcomes and Solutions,” Journal of Marketing, 64 (October), 36-51.

----, Harald Biong and Jan B. Heide (2001), “Choice of Supplier in "Embedded" Markets: Relationship and Marketing Program Effects,” Journal of Marketing, 65 (April), 54-66.

Weiss, Allen M. and Jan B. Heide (1993), “The Nature of Organizational Search in High Technology Markets,” Journal of Marketing Research, 30 (May), 220-233.

Winter, Sydney (1987), “Knowledge and Competence as Strategic Assets,” in The Competitive Challenge, David J. Teece, ed. Cambridge, MA: Ballinger.

Wish, M. (1976), “Comparisons among Multidimensional Structures of Interpersonal Relations,” Multivariate Behavioral Research, July, 297-324.

Wittink Dick R., Lakshman Krishnamurthi, and David J. Reibstein (1989), “The Effect of Differences in the Number of Attribute Levels on Conjoint Results,” Marketing Letters, 1 (2), 113-123.

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