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# Divisive Faultlines and the Unplanned Dissolutions of Multipartner Alliances

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Received wisdom suggests that multipartner alliances are relatively unstable because of their complexity and the increased potential for free riding. Nonetheless, multipartner alliances do benefit from built-in stabilizing third-party ties that mitigate opportunism and conflict between partner pairs. Previous empirical research on multipartner alliance stability has been inconclusive. We shed some light on these inconsistencies by recognizing that within multipartner alliances, schisms can occur not only between a pair of partners but also between subgroups of partners that are divided by faultlines. We suggest that divisive faultlines can form between subgroups of partners within a multipartner alliance as a function of their prior experience with one another. When a subgroup of alliance partners has relatively strong ties to each other and weak ties to other partners, destabilizing factions can develop that hamper reciprocity among the partners. Using a longitudinal analysis of 59 multipartner alliances, we found that, in general, faultlines (as modeled by the dispersion of tie strength within multipartner alliances) increase the hazard of unplanned dissolutions. We also found that multipartner alliances comprising a mix of centrally and peripherally positioned partners within the industry network were less apt to suffer the effects of divisive faultlines. We suggest that this is due to the greater opportunity costs of dissolution and the presence of relatively high-status partners who can act as peacekeepers and coordinators of their lower-status partners.

*Keywords:* interorganizational relations; multipartner alliance; embeddedness; faultlines

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## Introduction

Alliances between firms play a critical role in achieving technological and economic objectives. Whereas the simplest alliances involve two partners, multipartner alliances can be particularly effective for completing large-scale development projects requiring the coordination and resources of multiple firms (Beamish and Kachra 2004). A multipartner alliance is a single cooperative agreement involving three or more firms bounded by a unifying goal and governed by a single overarching contract (Das and Teng 2002a, Lavie et al. 2007, Li et al. 2012). Such structures are distinct from alliance networks comprising relatively autonomous dyadic ties established through independent contracts for a diverse array of goals. Various characteristics of alliance networks, and firms' positions within these networks, have been found to influence alliance formation and their stability (e.g., Gulati and Gargiulo 1999, Gulati et al. 2012, Polidoro et al. 2011, Rosenkopf and Padula 2008). However, individual alliances in an alliance network can form and dissolve relatively independent of each other, compared with the more tightly coupled and interdependent ties that compose a multipartner alliance. Because firms in a multipartner alliance are bound together by

one overriding contract and goal, and they depend on each other's contributions to achieve alliance objectives, a schism between *any* two partners in a multipartner alliance jeopardizes the entire alliance and may lead to the dissolution of all the ties within the alliance.

Notwithstanding their potentially tenuous nature, multipartner alliances remain popular. Studies have reported that 30%–50% of all alliances have three or more partners (e.g., Garcia-Canal et al. 2003, Makino et al. 2007). The use of multipartner alliances is particularly widespread in high-technology industries. For example, companies including Google, T-Mobile, Qualcomm, and Motorola joined forces to develop the first truly open and comprehensive platform for mobile devices, altering the competitive landscape in the telecommunication equipment industry (Helft and Markoff 2007).

Multipartner alliances differ substantially from two-partner alliances in their social exchange processes (Das and Teng 2002a). In contrast to the direct reciprocity found in two-partner alliances, successful multipartner alliances often require indirect reciprocity where obligations to individual partners are generalized to the entire group. For example, in a three-partner alliance consisting of Firms A, B, and C, any quid pro quo benefits

due to Firm A for providing resources to Firm B may need to come from Firm C. Because of the complexity associated with organizing multiple member firms toward a common goal, and the need for indirect reciprocity, multipartner alliances have greater coordination and monitoring challenges compared with two-partner alliances (Garcia-Canal et al. 2003, Li et al. 2012, Zeng and Chen 2003). Since the effectiveness of formal contracts is thought to be limited, broad-based trust across all partners may be particularly important to keep partners from free riding on the others (Zeng and Chen 2003). Because of their complexity and unique challenges, received wisdom within the alliance literature is that multipartner alliances are inherently less stable than two-partner alliances (e.g., Beamish and Kachra 2004, Garcia-Canal et al. 2003). Some empirical evidence supports this notion (Dussauge et al. 2000).

However, insights from social network theory suggest that having multiple partners in an alliance may *enhance* stability. A distinctive feature of multipartner alliances is that they have built-in third-party ties linked to every pair of partners. Common third parties can monitor partner behavior, deter opportunistic behavior, resolve conflicts between other partners, promote trust, and prevent destabilizing schisms from occurring (Gulati 1998). Third parties within multipartner alliances may be particularly motivated to resolve conflicts that jeopardize an alliance in which they have a direct stake (Rosenkopf and Padula 2008). Some empirical evidence supports the notion that multipartner alliances are particularly stable (Park and Russo 1996).

Because there is a lack of theoretical and empirical clarity regarding the stability of multipartner alliances— alliance structures that are prevalent and distinct from both alliance networks and two-partner alliances— additional insight is needed. We provide nuance on the subject of multipartner alliance stability by recognizing that within multipartner alliances, schisms can occur between not only a dyad of partners but also *subgroups* of partners that are divided by faultlines. These are divisions that form within groups when subgroups of members share particularly cohesive ties to each other based on common experiences and identity (Lau and Murnighan 1998). Faultlines within groups of individuals, modeled using such attributes as gender, ethnicity, and common outside affiliations, are shown to increase conflict and hamper group performance (Li and Hambrick 2005). Similarly, we suggest that divisive faultlines can form between subgroups of partners within a multipartner alliance as a function of their prior experience with each other. When some alliance partners have relatively strong ties to each other because of prior relationships, and weak ties to other partners, they have the potential to coalesce and rely on familiar norms and routines established during their prior relationships. This reliance on old ways can come at the expense of

establishing the broad-based routines and trust across all partners in the alliance needed for indirect reciprocity and generalized social exchange (Das and Teng 2002a).

We investigated this proposition using a sample of multipartner technology alliances in the global telecommunication equipment industry. Consistent with our argument, we found that faultlines, as modeled by the dispersion of tie strength within multipartner alliances, increased the rate of unplanned dissolution. However, we also found that multipartner alliances comprising firms that varied in their network centrality within the broader industry alliance network were somewhat resilient to the destabilizing influence of tie strength dispersion. We suggest this resiliency results from the greater opportunity costs of dissolution as a result of relatively distinct knowledge being contributed, and the presence of relatively high-status partners who can act as peacekeepers and coordinators.

Our study contributes to both the alliance and network literatures. Multipartner alliances have been integrated into larger industry network studies where the dyads that comprise multipartner alliances are accounted for when modeling alliance networks (e.g., Gulati et al. 2012). However, studies where the level of analysis is the alliance and the alliances being studied comprise multiple partners are rare (e.g., Li et al. 2012). Research on alliance networks has shown how relational (i.e., strong ties), structural (i.e., third-party ties), and positional (i.e., network centrality) embeddedness influence alliance dynamics (e.g., Ahuja et al. 2009, Gulati et al. 2012, Polidoro et al. 2011). Despite the notion that multipartner alliances are dense clusters of firms that exhibit network characteristics (Rosenkopf and Padula 2008), fundamental network concepts have not been used to explore their stability. To our knowledge, this study is the first to consider how the configurations of alliance partner embeddedness influence multipartner alliance stability. Such a dearth may stem from the conceptual and empirical complexities inherent in the study of multipartner alliances. Any fine-grained analysis of relational embeddedness in multipartner alliances requires a complete collaborative history of all those involved. Consequently, scholars have tended to focus on dyadic relationships and the networks derived from them (Ahuja 2000, Gulati 1995b, Gulati and Gargiulo 1999, Gulati et al. 2000, Polidoro et al. 2011, Stuart 2000, Xia 2011), or they have controlled for the differences between two-partner and multipartner alliances using a simple dummy variable (e.g., Dussauge et al. 2000) or count of partners (e.g., Garcia-Canal 1996).

In their recent review of faultline literature, Thatcher and Patel (2012) proposed that firm-level faultlines be explored. We do so by extending faultline research from groups of individuals (Lau and Murnighan 1998, 2005; Li and Hambrick 2005) to groups of firms, integrating insights from this literature with those from social

embeddedness research. Strategy scholars have a proclivity for adapting individual-level concepts such as absorptive capacity (Cohen and Levinthal 1990), learning (Argyris and Schon 1978), and relational ties (Gulati 1995b) to the firm level. Our conception of faultlines within multipartner alliances as a function of the dispersion of partners' tie strength expands on the notion that firms are capable of developing trusting and cohesive relationships (Gulati 1995a). To the extent that firms can forge strong ties, divisive faultlines resulting from the configuration of those ties are also plausible.

Extant research has emphasized the benefits of strong ties between firms in terms of mitigating risks of opportunism, reducing contracting costs, and promoting relational stability (e.g., Uzzi 1996, Zaheer and Venkatraman 1995). Our research suggests that there is a dark side to strong relationships between firms when such cohesive ties within multipartner alliances engender divisive faultlines that impede generalized social exchange. Our work explores the interplay between partners' centrality within the broader alliance network and their tie strength as it pertains to multipartner alliances. Consistent with prior work (Polidoro et al. 2011), we find that the different types of embeddedness (i.e., strong ties, network centrality) are not merely additive or mutually reinforcing, but rather influence the stability of multipartner alliances in more complex ways than what would be expected based on dyadic relationship studies.

Our unfolding story and empirical results are consistent with a recent framework suggesting how inertia, exogenous pressures, agency, and opportunity influence network evolution (Ahuja et al. 2012). First, inertial forces drove firms in our sample to become highly embedded in a subset of partners with whom they feel comfortable and familiar. Exogenous pressures from technological and regulatory changes within the telecommunications equipment industry in the early 1990s rendered existing collaborative networks inadequate for addressing new demands. Agency and opportunity cajoled incumbent firms to form multipartner alliances with sometimes unfamiliar partners, creating links between central and peripheral firms. However, the long-term influence of multipartner alliances on industry networks depend on their stability.

Finally, our research responds to calls for the development of methodologies and measures to more effectively assess the influence of clusters on larger sparsely connected network structures (Rosenkopf and Padula 2008). The concepts and measures we have used can be applied to other mesolevel network structures such as clusters and multilateral agreements.

We begin by reviewing the literature on the formation and stability of multipartner alliances. We then develop the notion of divisive faultlines within multipartner alliances, based on the dispersion in relational tie strength and how dispersion in partner positional embeddedness can alter the influence of such faultlines.

## Review of Multipartner Alliance Formation and Their Stability

Multipartner technology alliances are formed to bring together the diverse resources needed for the novel recombination of knowledge. Such alliances have the potential to earn greater returns than two-partner alliances, because larger pools of diverse resources can lead to the development of particularly unique products and services that are difficult to imitate (Beamish and Kachra 2004). However, fully leveraging these large pools of resources requires the development of generalized social exchange and indirect reciprocity among the partners. With generalized social exchange, there is often not a one-to-one correspondence between what any two partners in a multipartner alliance give to and receive from each other (Das and Teng 2002a). Partner A can contribute a resource to partner B without necessarily obliging partner B to directly reciprocate. Instead, partner B fulfills its obligation by contributing in roughly equivalent value to some other partner in the future (Bearman 1997). In other words, partner A's contribution to partner B may eventually be reciprocated by partner C. Thus, exchange is generalized to the alliance and not individual partners. However, just when such a reciprocal payment will occur may be uncertain and often comes with no explicit guarantee of reciprocation (Takahashi 2000).

Partners involved in generalized exchange have an incentive to free ride to reduce their costs of cooperation or avoid wasting their contribution if others do not cooperate. Because of the particularly complex exchange processes in multipartner alliances, free riding can be difficult to detect (Takahashi 2000, Zeng and Chen 2003). When such a practice is detected, establishing sanctions against those identified is challenging because once the alliance is established, no partner may be excluded from realizing some of the benefits regardless of their contribution (Zeng and Chen 2003). Thus, for generalized exchange to function properly without free riding, there needs to be broad-based trust among all the partners. Not only must partner A trust partner B to adequately contribute to partner C, it must trust partner C to reciprocate benefits to itself. Without trust, indirect reciprocity breaks down, making it difficult to fully exploit larger pools of resources that typify multipartner alliances. When this occurs, the value of multipartner alliances decrease, and the likelihood of their dissolution is enhanced.

Despite the inherent incentives to free ride, studies exploring the influence of having multiple partners on alliance stability and performance have been mixed. Consistent with the notion that multipartner alliances are intrinsically unstable, Dussauge et al. (2000) found in their sample of more than 200 manufacturing alliances that those involving more than two partners were more likely to dissolve. However, Beamish and Kachra (2004)

found in a large sample of Japanese alliances that the number of partners generally had little influence on outcomes. Contrary to their expectations and the belief that multipartner alliances are relatively complex and unstable, Park and Russo (1996) found that the duration of electronics alliances in their sample actually *increased* with the number of partners.

Three or more partners in an alliance may indeed enhance stability. Multipartner alliances provide a context where trust and cooperation may be promoted because multiple members can mutually monitor each other's behavior and mediate conflict that occurs between members (Rosenkopf and Padula 2008). A key attribute of multipartner alliances is the stabilizing third-party ties built into their structure. Such alliances are by definition structurally saturated (all partners are connected to all other partners) and comprise triads. A three-party alliance comprises one triad, a four-party alliance comprises four triads, and so forth. Thus, each dyad within a multipartner alliance is embedded within at least one triad and stabilized by the conflict resolution capabilities of third parties (Simmel 1950). Third-party ties within sparsely connected industry networks have been found to enhance the stability of two-partner alliances (Polidoro et al. 2011). Third parties within multipartner alliances are likely to be even more effective at resolving internal conflict and stabilizing relationships for two reasons. First, a conflict between two partners will be relatively transparent to other members of the same alliance. Second, third parties within a multipartner alliance are likely to be highly motivated to resolve any conflict that could jeopardize the alliance in which they have a direct and sizable stake. As third parties monitor and stabilize the various dyadic relationships within multipartner alliances, free riding is held in check and norms of indirect reciprocity develop. Resources will flow more freely between partners when they can trust that indirect reciprocity will occur, enabling the alliance to reach its potential for creating value.

Such informal governance within multipartner alliances can make them particularly well suited for centrally positioned firms within an industry network who wish to safely partner with peripherally positioned and less familiar firms that possess valuable resources (Rosenkopf and Padula 2008). As a rule, firms that are highly central in the industry network as the result of maintaining a broad array of alliances tend to ally with other firms that are centrally positioned because their quality and reliability are well established (Chung et al. 2000, Gulati and Gargiulo 1999, Podolny 1994). Although the benefits of partnering with other central firms are genuine, over time, knowledge among highly interdependent and centrally positioned partners can become redundant and hamper firm performance (Ahuja et al. 2009, Uzzi 1997). Thus, despite their general propensities to play it safe (Gulati 1995b,

Podolny 1994), centrally positioned firms must often partner with peripheral firms to break out of the redundancy trap and renew their capabilities.

The respective capabilities and desires of central and peripheral firms can drive them together. Firms that are central to the overall industry network can use their connections to identify peripheral firms with valuable information (Ahuja et al. 2009). Those firms that are peripheral may be interested in allying with central firms to enhance their own status (Rosenkopf and Padula 2008). Nonetheless, forming alliances with peripherally positioned and untested firms remains a relatively risky proposition for centrally positioned firms. Rosenkopf and Padula (2008) observed that many of the multipartner alliances in their study comprised a mixture of partners in terms of their positional embeddedness in the industry network. Some were centrally positioned, whereas others were peripherally positioned. Although they did not observe the outcomes of these mixed alliances, they surmised that there may be safety in numbers. Because multipartner alliances are structurally saturated with built-in stabilizing third-party ties, they can be used by centrally positioned firms to buffer the risk of reaching out to unfamiliar partners who have valuable knowledge.

In summary, multipartner alliances have the potential to create substantial value by bringing together large pools of diverse resources. Fully exploiting such potential depends on generalized social exchange processes that require broad-based trust and norms of indirect reciprocity among all partners. Although multipartner alliances are thought to be inherently unstable because of their complexity and incentives to free ride, their built-in third-party ties can also mitigate schisms from occurring, thereby enabling trust and norms of reciprocity to evolve. All multipartner alliances are structurally saturated and enjoy the potential benefits of third-party ties. Within a particular multipartner alliance, the number of internal third-party ties does not vary across the firm pairs. What does vary is the strength of ties between the various partners within an alliance, as well as the configuration of tie strength across multipartner alliances.

Tie strength variability within an alliance has implications for its stability. Destabilizing schisms within multipartner alliances can occur not only between dyads of firms, but between subgroups as well. These higher-level schisms are more likely when particularly cohesive subgroups resulting from strong ties create divisive faultlines, which can hamper the development of the broad-based trust necessary for generalized social exchange.

### **Tie Strength Dispersion Within Multipartner Alliances**

Individuals generally prefer to interact with those with whom they have trusting and cohesive relationships,

without fear of being taken advantage of (Granovetter 1985). However, within larger groups, such cohesiveness can also lead to divisive faultlines. Members may have varying levels of trust and kinship toward each another. Faultlines occur when particularly cohesive subgroups exist within a larger group (Lau and Murnighan 1998), and in-group/out-group factionalism creates mistrust and animosity within the larger group (Pearce 1997). Those who coalesce as an in-group tend to identify more with their subgroup than with the larger group (Polzer et al. 2006). Factions that operate outside the formal structure of the group can advance their interests by threatening to withdraw pooled resources and manipulating governance decisions (Ariño and de la Torre 1998, Brass and Burkhardt 1993). The mere potential for adverse influence by a faction can cause a loss of trust by those who are not part of the faction. Whether perceived or real, such factions diminish the overall sense of fairness and equity among the members (Li and Hambrick 2005, Polzer et al. 2006).

Past research has proxied potentially divisive faultlines by observing the distribution of shared attributes among individual members of a group (Lau and Murnighan 2005, Li and Hambrick 2005). Those of the same gender, ethnicity, or age group may form a cohesive subgroup because, as a function of their common attributes, they are likely to have had similar experiences in their lives and can more closely identify with each other (Lau and Murnighan 1998). Similarities in background tend to elicit trust and create cohesive bonds (Brewer and Brown 1998). If every individual (or none) within a group shares the same attributes in question (e.g., similar age), faultlines and subgroup factions are unlikely to form. Instead, it is moderate diversity within a group of individuals that provide a basis for divisions that may adversely affect group dynamics (Lau and Murnighan 1998). Lau and Murnighan (2005) found that members of subgroups based on gender and ethnicity tended to be biased when assessing the contributions, behavior, and trustworthiness within their subgroups compared with those outside of them. Li and Hambrick (2005) explored faultlines based on age, tenure, gender, and ethnicity within joint venture management groups and found that strong faultlines increased conflict between subgroups, leading to poor performance.

Thus *differences* in the extent to which members have shared experiences are the basis for faultline formation. These experiences can be shared indirectly (e.g., those in similar age or ethnic cohorts are likely to have similar life experiences) such that demographic groupings can be used to proxy differences in shared experiences within the group. Experiences may also be shared *directly* through a history of interaction. As partners prove themselves to be trustworthy and honest over the course of previous direct interactions, they develop

strong relational ties such that they identify with one another's needs, preferences, and priorities (Lewicki and Bunker 1996). However, similar to the effects of subgroups based on demographic attributes, particularly strong ties among individuals based on a history of prior interactions can divide a larger group into subgroups and lead to counterproductive dynamics.

Strong ties based on past interactions can form between firms as well. Sociologists have long pointed to numerous examples of preferential and stable bilateral trading relationships to show that firms bond with other firms when they repeatedly interact (e.g., Piore and Sabel 1984). Close personal ties may develop between individuals at collaborating firms, putting pressure on each firm to meet the expectations of the other (Macaulay 1963). As firms engage over time, and interpersonal ties grow stronger, trust develops between firms (Gulati 1995a, Ring and Van de Ven 1994). Over the course of multiple relationships, expectations of reciprocity develop, reducing concerns over equity and fairness, and encouraging partners to share information, further strengthening their bond. Communication patterns between firms become routine and norms develop for resolving conflicts (Dyer and Singh 1998, Zollo et al. 2002). The cohesiveness that results from prior relationships between two firms transcends the specific managers involved in the prior relationships. Although there may be turnover in management, new managers are socialized in terms of what to expect from firm partners (Gulati and Nickerson 2008). Thus, even if individual managers at partner firms have not interacted directly before, the prior ties between their respective firms provide a basis for goodwill between them (Gulati 1998). In essence, being affiliated with firms that have interacted in the past affords a salient common attribute for otherwise disparate individuals that can lead to a sense of solidarity.

To the extent that pairs of partner firms develop strong ties from prior interactions, faultlines can develop within multipartner alliances as a function of the differences in tie strength across partner pairs. Potentially divisive faultlines form when some firms in a multipartner alliance share strong ties with each other but not with others. Under such conditions, pockets of highly cohesive partners (i.e., in-groups) form, as well as partners relegated to out-groups. In contrast, if a multipartner alliance comprises firms where tie strength is either uniformly high (i.e., every firm has worked extensively with each other in the past) or uniformly low (i.e., all firms are complete strangers), there is little potential for divisive faultlines based on differences in tie strength. The potential for divisive faultlines occurs only when tie strength is nonuniform across the multiple dyads.

Similar to individuals who make up cohesive subgroups within a larger group, the managers from partner firms who make up particularly cohesive subgroups within a multipartner alliance may identify more with

the subgroup than the alliance. Norms of exchange and communication routines established during prior relationships may persist at the expense of establishing inclusive norms that involve all partner firms and managers. Multipartner alliances are particularly susceptible to faultlines and factions in the early stages of their existence when members are trying to gauge each other and the task at hand (Lau and Murnighan 1998). During times of uncertainty, managers from member firms may seek security with other managers whose firms share a history of collaboration and preexisting norms. Cohesiveness beyond the subgroup may become constrained, leading to mistrust and a sense of inequity between those in and outside of the subgroup.

Such sentiments among the managers and personnel representing their respective firms can have dire consequences for alliance stability. When faultlines reduce solidarity and impede the development of broad-based trust in the alliance, they decrease the viability of generalized exchange. The failure to develop norms of generalized social exchange and indirect reciprocity in a multipartner alliance compromises its potential value. Unmet performance expectations and mistrust can fuel conflict among partners, influencing their decisions regarding the future of the alliance (Li and Hambrick 2005). When partners perceive the collaborative potential to go unfulfilled and that collaborative activities are not fair, they reduce their commitment to the alliance or dissolve it altogether (Ariño and de la Torre 1998).

The potential for faultlines within a multipartner alliance is greater when the strength of the various dyadic ties within the alliance is particularly dispersed. Thus, we expect increasing tie strength dispersion to hamper the stability of multipartner alliances and promote their unplanned dissolution.

*HYPOTHESIS 1. The greater the dispersion of tie strength within a multipartner alliance, the greater the hazard of unplanned dissolution.*

### **Positional Embeddedness Dispersion Within Multipartner Alliances**

Although faultlines within multipartner alliances provide a basis for subgroup factions and internal conflict, whether these faultlines lead to schisms and dissolution will depend in part on the opportunity costs of dissolving and the presence of relatively high-status partners who can act as peacekeepers and strong coordinators.

In general, conflicts between parties, whether individuals, groups, or nations, are likely to be resolved when there are substantial costs to all parties with escalating them (Deutsch 1994, Greig 2001). Das and Kumar (2009) suggested that alliance partners are particularly resilient to internal conflict when potential economic benefits from maintaining cooperation are substantial, or if alliance dissolution will adversely affect

the reputation of those involved. Under such conditions, the indiscretions of partner firms are often overlooked.

Accordingly, when there are particularly high opportunity costs for the various partner firms in dissolving a multipartner alliance, managers are likely to tolerate or cope with potentially divisive faultlines. The economic opportunity costs from dissolving technology development multipartner alliances may vary depending on the composition of partners. Creative and economically valuable recombinatorial opportunities are at a peak when there is a diverse array of knowledge to draw on (Rosenkopf and Almeida 2003). Centrally positioned firms in the industry network often create alliances with those on the periphery to gain access to new knowledge and combat knowledge redundancy that occurs when centrally positioned firms interact only with each other (Gulati and Gargiulo 1999). Multipartner alliances that include a mixture of centrally and peripherally positioned firms within the industry network can create pools of particularly diverse knowledge with high recombinatorial potential. All else being equal, the value creation opportunities from multipartner alliances comprising a mix of partners exhibiting highly dispersed positional embeddedness within the industry network will be substantial. There are also reputation-based opportunity costs of dissolution. The reputations of firms peripherally positioned within the industry network may be enhanced by affiliating with high-status firms that are centrally positioned (Podolny 1994). Managers of peripherally positioned firms within multipartner alliances that also include centrally positioned partners will be reluctant to destabilize an alliance that benefits them through connections to high-status firms.

In contrast, recombinatorial opportunities from alliances comprising primarily centrally positioned firms are relatively limited because information and resources within these alliances are less diverse than those found within alliances involving both centrally and peripherally positioned firms. When word of failure spreads to those they are connected with, the reputations of centrally positioned partners may be harmed by alliance dissolution. However, their relative prominence also enables them to attract other partner firms to form alternative alliances to the one in question. Thus the opportunity costs of dissolving multipartner alliances comprising primarily centrally positioned firms is somewhat limited. The opportunity costs of dissolving alliances comprising only peripheral partners will also be limited. There is little opportunity for the peripheral partners to enhance their prestige by maintaining ties to high-status firms when there are no centrally positioned partners involved. In addition, the sparse connectivity among peripherally positioned firms reduces reputation-based opportunity costs, since information regarding uncooperative partner behavior is not diffused so readily among potential partners.

Conflict within a group of partnering firms can also be resolved through the efforts of a strong lead partner.<sup>1</sup> When a set of firms has a common purpose, and one firm dominates in terms of resources and status, that firm often becomes the *hub firm*, providing the governance and discipline necessary for the group to achieve its goals (Provan et al. 2007). Such lead partners are likely to emerge in multipartner alliances with members that are highly dispersed in terms of positional embeddedness. Under these conditions, some partners will be of relatively higher status than the remaining partners because of their centrality within the broader industry network. Such partners can reduce conflict in two ways. First, they can be particularly effective third-party peacekeepers in conflicts involving deferential lower-status partners. Second, they can assume the role of central coordinators among lower-status partners, solving problems as they arise before conflict festers.

In sum, the high opportunity costs of dissolution and lead partner governance associated with multipartner alliances with members that are highly dispersed in their positional embeddedness may be able to mitigate destabilizing internal conflict. Such mitigation will be particularly valuable when there are faultlines. When conflict from faultlines occurs, partners examine the costs and benefits of dissolution. In such make-or-break situations, a stabilizing “reset” moment is more likely to occur when the opportunity cost of dissolution is high and there is a strong lead partner that can foster peace. When multipartner alliance memberships are concentrated in their positional embeddedness, neither a high opportunity cost for dissolution nor a relatively high-status peacekeeper will exist to dampen instability because of faultlines. Thus, the destabilizing effects of faultlines as a result of tie strength dispersion will be particularly pronounced when there is little dispersion in the positional embeddedness of the alliance membership and less so when members are highly dispersed in their positional embeddedness.

**HYPOTHESIS 2.** *The greater the dispersion in positional embeddedness across partners in a multipartner alliance, the weaker the influence of tie strength dispersion on the hazard of an unplanned dissolution.*

## Methods

### Sample and Data

Our research setting was the global telecommunications equipment industry. Firms in this industry produce and market hardware and software that enable the transmission, switching, and reception of voice, images, and data over short and long distances using digital, analog, wire line, and wireless technology. This industry was chosen based on the significant changes in technology and competition it had experienced over the past three decades,

resulting in a growing number of technology alliances involving incumbent firms (Amesse et al. 2004), particularly those with more than two partners.

Many practical considerations guided the construction of our sample. Since we employ a longitudinal design, collaboration data from multiple data sources were compiled for the 1982–1997 time period. Our sample period was then limited to 1987–1997 to minimize left censoring. The sample frame of potential partners covered only public companies to ensure the availability and reliability of archival data. We further limited the sample frame to the industry’s top-selling firms, which offer more complete and accurate alliance data than smaller firms (Gulati 1995b). To minimize survivor bias, the top firms in the industry at the beginning of the study period were used rather than those who dominated the industry at the end, since mergers, restructurings, and failures had taken place throughout the study period (Amesse et al. 2004). To compute our measures of tie strength, we followed prescriptions for establishing network boundaries in empirical research (Laumann et al. 1983) and restricted the network to firms and alliances that centered on the telecom industry, similar to criteria used in recent alliance network research (Phelps 2010, Schilling and Phelps 2007). These restrictions produced a sample of 104 potential partner firms involved.

We used several sources for the alliance data. Specifically, data on our sample firms were collected using the Securities Data Company (SDC) joint venture and alliance database along with systematic archival research on annual reports, 10-K and 20-F filings, *Moody’s Industrial Manual* and *Moody’s International Manual*, and three electronic databases: Factiva, Lexis-Nexis, and Dialog. We recorded only collaborations that could be confirmed by multiple sources. During our period of study, the 104 sample firms initiated 7,978 alliances, including two-partner and multipartner alliances. Of the 7,987 alliances, 1,089 were multipartner alliances (13.63%). Of these, 95 involved three or more of the 104 sample telecommunications firms we had initially identified. However, we had to further limit our sample of multipartner alliances to those exclusively comprising our panel firms because we needed the complete alliance history for every participant in each of the multipartner alliances in our final sample to compute tie strength measures. Fifty-nine multipartner alliances involving 46 sample firms that operated during 1987–1997 matched this stringent criterion.

Using a panel design, we observed our sample multipartner alliances and their partner firms over time. The unit of observation was the multipartner alliance-year. Data were collected on an annual basis so that records for every technology alliance maintained by the sample firms existed at the end of each sample year. All network embeddedness variables in this study were calculated based on a panel of networks anchored



by 104 panel firms, which formed (two-partner and multipartner) 7,978 alliances between 1982 and 1996. To assess prior ties and compute our measures associated with tie strength and positional embeddedness for a given year, we considered all alliances (two-partner and multipartner) formed in the previous five years. Consequently, we collected alliance data for each firm beginning in 1982 and researched each sample multipartner alliance to identify its date of dissolution or continuation through 1997.

The final panel comprised 59 multipartner alliances and 251 alliance-year observations. We counted 25 terminations during the observation period. Since five of these were planned, 20 multipartner alliances (or 34% of our sample) experienced a failure event. On average, each alliance was at risk of dissolution for 4.25 years. Sample alliances ranged from 3 to 10 member firms, with an average size of 4.13.

### Measurement: Dependent Variable

*Multipartner Alliance Dissolution<sub>kt</sub>*. The dependent variable in our study was the hazard of an unplanned alliance dissolution. Such dissolutions often reflect problematic collaborations (Polidoro et al. 2011). The operationalization of alliance dissolution required a two-step process. First, we needed to systematically identify the date of dissolution, or continuance for each alliance, by the end of the sample period (1997), and second, we had to determine whether a dissolution event was planned or unplanned. To determine the dissolution date, we followed the procedure implemented by Ahuja (2000) and contacted company personnel to identify dissolution dates, which proved useful in identifying the status (termination or ongoing) of joint ventures. We obtained information for nearly all the joint ventures regarding the month of a venture's termination and whether it still existed at the end of the sample period. Where the termination date of a joint venture was unavailable, we assumed dissolution to have occurred the year after the last documentation or the year after announcement, whichever was later. For non-joint venture alliances, dissolution was based on specified tenure mentioned in archival sources or an announcement of dissolution in either archival sources or by a company contact. In the absence of specific dissolution data, an alliance was assumed to exist through the end of the final year for which there was documentation or end of year it was founded, whichever came later. Statistical tests for differences in mean duration between alliances with dissolution announcements and those with assumed dissolution dates yielded no significant differences, supporting the validity of this approach.

Since our theoretical arguments linked alliance dissolution events to collaborative difficulty, the circumstances prompting the end of a collaborative agreement

were of interest (Makino et al. 2007, Polidoro et al. 2011). To distinguish unplanned from planned dissolution events, we conducted in-depth media searches and cross-referenced evidence from (a) SDC deal-text statements, (b) press releases taken from company websites, and (c) news stories published in such electronic databases as Factiva and LexisNexis. Where detailed information about a dissolution event could not be found, and no tenure was specified in the alliance announcement, we assumed the termination was unplanned. This procedure yielded 20 unplanned dissolutions, 5 planned dissolution events where collaborations ended as a result of changes in the external environment (e.g., product markets and technologies) or project completion (e.g., a successful product launch), and 34 multipartner alliances that existed beyond our window of study. Examples of the archival evidence used to determine whether dissolution was planned or unplanned are provided in Appendix A. The average duration of multipartner alliances that experienced unplanned dissolution was 2.45 years, with a standard deviation of 2.33 years.

We measured multipartner alliance dissolution using a time-varying dummy variable set to 0 for every time period  $t$  in which alliance  $k$  existed at the end of the year and 1 otherwise. An alliance with a planned breakup was designated in our data set as censored.

### Measurement: Explanatory Variables

*Tie Strength Dispersion<sub>kt-1</sub>*. Li and Hambrick (2005, p. 797) noted that the “measurement of faultlines is daunting.” Previous research has dealt with this difficulty by relying on contrived contexts. For example, Lau and Murnighan (2005) used a randomized block experimental design to create clearly defined faultlines within groups of individuals. Perhaps most analogous to our context is the work done by Gibson and Vermeulen (2003) on subgroup strength within teams of individuals. They first assessed the overlap between pairs of individuals in terms of various demographic dimensions and then computed the dispersion in the overlap across the different pairs on a team. In a similar fashion, we consider the tie strength between pairs of firms within a multipartner alliance and compute the dispersion in tie strength.

To assess *tie strength dispersion* within each multipartner alliance  $k$  in year  $t - 1$ , we counted the number of prior ties formed by each dyad in the multipartner alliance for the year  $t - 1$ . A prior tie is defined as direct contact between a pair of firms through either a two-partner or multipartner alliance (Gulati 1995b). Following prior alliance research, we used a five-year moving window (i.e.,  $t - 6$  to  $t - 1$ ) to identify prior ties (Gulati and Gargiulo 1999). This practice implies that only relationships formed in the previous five years affect current behavior. We weighted each prior tie based on the

scope of activities that occurred in the prior alliance. Weights ranged from 1 to 4 depending on the count of the following activities: technology codevelopment, production, marketing, and technology licensing. We then computed tie strength variance across multiple dyads within each sample multipartner alliance for each year. Variance is essentially a measure of dispersion. A value of 0 indicates that tie strength is equal across all partner pairs. Higher values of variance indicate that tie strength within a multipartner alliance is concentrated among a subset of partner pairs. A logarithmic transformation was used to enhance the normality of this measure.<sup>2</sup> Other potential measures of dispersion such as the Herfindahl index are essentially functions of the measure of variance but may be highly biased in relatively small samples such as our alliance partner pairs.<sup>3</sup>

*Positional Embeddedness Dispersion*<sub>kt-1</sub>. Network researchers have used a variety of centrality measures to assess a firm's position in an industry network structure. Whereas many studies have used Bonacich's (1987) eigenvector centrality (e.g., Polidoro et al. 2011, Rosenkopf and Padula 2008), we use degree centrality to measure a firm's positional embeddedness (e.g., Gulati et al. 2012). Because eigenvector centrality quantifies the extent to which central nodes are connected to other central nodes, the measure becomes relatively unstable and highly vulnerable to sampling effects (Costenbader and Valente 2003). This suggests that eigenvector centrality is best suited to networks with clearly defined boundaries and membership. Despite our best data collection efforts, we acknowledge the likelihood of gaps in our alliance network and fuzzy boundaries with respect to neighboring industries. Under these conditions, degree centrality represents a robust measure for distinguishing between central and peripheral firms in the network (Wasserman and Faust 1994).

We measured the degree centrality for all sample firms based on collaborative activities in the five years preceding the formation of each sample multipartner alliance. To capture the extent to which a firm enjoys information benefits related to alternative partnering opportunities outside the focal multipartner alliance, to compute its degree centrality, we exclude any partners connected through the focal multipartner alliance. We used the panel of alliance networks constructed for each year from 1982 to 1996 to calculate the number of collaborative ties over the last five years each partner had with firms outside the focal multipartner alliance. We then calculated the variance in positional embeddedness among the partner firms within each multipartner alliance. A logarithmic transformation was used to enhance the normality of this measure.

### Control Variables

To limit alternative explanations and isolate the marginal effects of explanatory variables, we controlled for several alliance-level characteristics.

*Average Tie Strength*<sub>kt-1</sub>. Prior research suggests that strong cohesive ties between partners enhance the stability of two-partner alliances by reducing opportunism and coordination costs (Gulati and Singh 1998). Based on received wisdom (Greve et al. 2010, Kogut 1989), we assume that cohesive and trusting relationships between any two firms in a multipartner alliance can also have a stabilizing effect on the entire alliance. Dense networks of generally strong ties between alliance members are thought to generate a collective cohesiveness that leads to inclusive reciprocity norms, as well as limiting self-serving behaviors (Oh et al. 2004). Consistent with the work of Reagans and Zuckerman (2001), we conceptualize the density and resulting cohesiveness of a multipartner alliance in terms of the average tie strength across all possible partner pair relationships within the alliance. To measure the *average tie strength* within a multipartner alliance, we computed the average tie strength of multipartner alliance  $k$  in year  $t - 1$  as the scope-weighted count of alliances formed between all dyads of partners in the alliance in the previous five years divided by the number of possible dyads. Since each dyad could have collaborated in several alliances over the past five years, values exceeding unity were common.

*Average Positional Embeddedness*<sub>kt-1</sub>. Firms that occupy central positions in an industry network are believed to benefit from superior access to valuable information (Gulati and Gargiulo 1999). When potential partner firms are collectively more central, they gain more reliable information about one another at the time of alliance formation, which may lead to better partner selection (Gulati 1995b) and greater alliance stability (Polidoro et al. 2011). As before, we based our measure on the number of collaborative ties each partner had with firms outside the focal multipartner alliance over the last five years. We then calculated the mean of partner centralities to obtain an alliance-level average positional embeddedness (Polidoro et al. 2011).

*Knowledge Dispersion*<sub>kt-1</sub>. Disparity in the level of innovative or technological capability among partners could affect the stability of an alliance. Collaborative relationships may become strained by asymmetric resource dependency when partners cannot equitably contribute technological resources (Das and Teng 2002b, Park and Ungson 1997). Several management researchers have used patent counts as an indicator of corporate technological capabilities (Jaffe 1986, Mowery et al. 1996, Silverman 1999). Researchers argue that organizational knowledge depreciates over time because (1) products or processes can change, rendering some knowledge obsolete; (2) organizational records may become lost or difficult to access; and (3) when organizational turnover occurs, employees leave and take their knowledge with them (Argote 1999). In response to the

potential decay of technological competencies and consistent with past alliance research, we considered only patents received in the last five years to reflect a firm's current innovative capability (Stuart 1998). For every period we calculated the inequality of firm innovativeness within each multipartner alliance using the logarithm of the variance. Higher values indicate greater inequality.

*Number of Partners<sub>k</sub>*. The number of partners in an alliance can increase coordination costs, monitoring costs, and managerial complexity (Gulati and Singh 1998). Alternatively, the greater the number of partners, the greater the number of potentially stabilizing third-party ties associated with each partner pair. Thus we control for the count of partners in each alliance.

*Joint Venture Governance<sub>k</sub>*. Research has shown that equity joint ventures can provide superior coordination and conflict resolution mechanisms to address the complexity of multipartner alliances (Garcia-Canal et al. 2003), suggesting that the equity joint venture structure increases multipartner alliance stability. The choice of joint venture governance is correlated with tie strength between partners (Gulati and Singh 1998) whose effect on stability may be confounded with that of using joint venture governance. We controlled for *joint venture governance* using a dummy variable set to 1 if the alliance was governed by an equity joint venture and 0 otherwise.

*Geographic Diversity<sub>k</sub>*. Diversity in nationality across partners in an alliance can increase communication and coordination costs (Parkhe 1993), decreasing stability. We control for the number of distinct nations in which the partners in alliance *k* are headquartered.

*Market Overlap<sub>k</sub>*. Alliances are more likely to fail when partners are also competitors (Park and Russo 1996). We control for the influence of competition in multipartner alliance *k* by counting the number of dyads in which both firms share the same four-digit Standard Industrial Classification (SIC) code.

*Prior Partnership Dissolutions<sub>k</sub>*. The dissolution of prior alliances involving members of a focal multipartner alliance may influence its stability. For every alliance-year, we counted the number of dyadic dissolution events partners in the focal multipartner alliance had experienced with each other in the prior five years. Of the 59 multipartner alliances in our sample, 54 had members that had between one and four prior dissolutions events with each other.

*Task Complexity<sub>k</sub>*. To control for differences in task complexity on alliance stability, we added dummy variables to account for the fixed effects of the presence of the following activities: technology codevelopment, manufacturing, marketing, and technology licensing.

*Industry Classification<sub>k</sub>*. Although all firms in our sample were leading firms in the telecom industry, a closer inspection of alliance deal texts suggested that sample alliances operated across five related industry segments—communication equipment, computers and office equipment, consumer electronics, electronic components and accessories, and data processing and information services. We controlled for these differences at the three-digit SIC level using dummy variables.

### Potential Endogeneity

Our study of unplanned dissolution events among multipartner alliances is necessarily limited to sets of firms who chose to participate in a multipartner alliance. However, firms do not choose to form multipartner alliances at random. Thus our coefficient estimates could be potentially biased as a result of systematic managerial selection processes that are related to both our core theoretical variables (i.e., *tie strength dispersion* and *tie strength dispersion × positional embeddedness dispersion*). If it appears that managers do not systematically take into account our variables of interest when determining whether or not to form a multipartner alliance, confidence that self-selection is not biasing our coefficients of interest in our survival models increases.

With the exception of one recent study focusing on the new venture participation in multilateral research and development alliances (Li 2013), there has been no systematic study of multiparty alliance formation, let alone one that takes into account faultlines between subgroups of partners. Thus, we used our sample to develop a model of multipartner alliance formation to compare those multipartner alliances that actually formed to potential multipartner alliances that did not. Since generating all possible permutations of potential multipartner alliances of varying sizes involving the 46 firms that were involved in our sample of multipartner alliances would have been prohibitively complex, we used a matched pair design matching on formation year and alliance size (number of partners). To construct the control sample of multipartner alliances that could have formed but did not, we needed to construct a risk set of firms that could have formed multipartner alliances but did not. For a particular year in our sample, we considered sample firms that were involved in at least one alliance to be eligible for participation in a multipartner alliance. From this risk set of firms, we randomly selected *n* firms into an unrealized multipartner alliance to match the same number of firms in a realized multipartner alliance. For example, if a multipartner alliance was formed in year *t* by three firms, we randomly selected three firms from the risk set of firms for the same year to form a matching unrealized multipartner alliance. Consistent with King and Zeng (2001) and Hansen and Løvås (2004), for each multipartner alliance formed in each year *t*, it was matched with two

**Table 1 Descriptive Statistics and Pearson Correlations for Multipartner Alliance Formation**

Variable	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8
1 Alliance formation	0.33	0.47	0.00	1.00	—							
2 Tie strength dispersion	1.28	1.29	0.00	4.96	0.43	—						
3 Average tie strength	2.33	3.39	0.00	15.23	0.39	0.41	—					
4 Average positional embeddedness	62.95	37.10	6.33	202.25	0.45	0.53	0.70	—				
5 Positional embeddedness dispersion	7.01	1.52	2.17	9.66	0.14	0.32	0.12	0.54	—			
6 Knowledge dispersion	13.74	2.78	-9.21	16.71	0.27	0.30	0.23	0.39	0.41	—		
7 Number of partners	4.17	1.72	3.00	10.00	0.00	0.12	0.01	0.00	0.08	0.15	—	
8 Geographic diversity	2.63	0.94	1.00	6.00	-0.41	-0.20	-0.29	-0.12	0.00	-0.02	0.51	—
9 Market overlap	0.80	1.14	0.00	7.00	-0.10	0.10	-0.07	0.00	0.08	0.04	0.57	0.4

Notes.  $N = 177$ . Correlations with absolute value greater than 0.15 are significant at the 0.05 level.

randomly constructed unrealized multipartner alliances. These unrealized multipartner alliances constitute the control sample. Thus, the overall sample used to assess the likelihood of alliance formation was 177: 59 formed alliances plus 118 unformed.

Table 1 provides correlations and descriptive statistics for all variables used to assess the likelihood of multipartner alliance formation. Model 3 in Table 2 provides our full rare events logistic regression model predicting the likelihood of alliance formation. In our analysis,

neither *tie strength dispersion* nor its interaction with *positional embeddedness dispersion* was found to significantly influence the formation of multipartner alliances. Thus our variables of interest appear to be randomly distributed across the treatment group (formed multipartner alliances) and control group (potential alliances that did not form). Although insignificant findings should not be overemphasized, they provide an initial indication that the coefficients of interest in a survival model are not biased as a result of self-selection bias.

**Table 2 Rare Event Logit Estimates on the Likelihood of Multipartner Alliance Formation**

Variable	Alliance formation		
	Model 1	Model 2	Model 3
<i>Tie strength dispersion</i>		-0.37 (0.28)	-0.44 (0.30)
<i>Tie strength dispersion</i> × <i>Positional embeddedness dispersion</i>			0.12 (0.19)
<i>Average tie strength</i>	0.15 (0.13)	0.29 (0.19)	0.27 (0.19)
<i>Average positional embeddedness</i>	0.04* (0.02)	0.04* (0.02)	0.04** (0.01)
<i>Positional embeddedness dispersion</i>	-0.08 (0.22)	-0.07 (0.21)	-0.15 (0.22)
<i>Knowledge dispersion</i>	0.11 (0.13)	0.1 (0.12)	0.12 (0.14)
<i>Number of partners</i>	0.30 (0.20)	0.32 (0.20)	0.32 (0.20)
<i>Geographic diversity</i>	-1.75*** (0.44)	-1.78** (0.44)	-1.78** (0.43)
<i>Market overlap</i>	0.00 (0.26)	0.06 (0.26)	0.05 (0.26)
<i>Fixed year effect</i>	Yes	Yes	Yes
<i>Fixed industry effect</i>			
Constant	-2.09*	-1.85	-2.18
Log pseudolikelihood	-54.47	53.24	-53.03
Observations	177	177	177
Degree of freedom	16	17	18
Likelihood ratio test $\chi^2(1)$		2.46	0.42
Prob > $\chi^2$		0.12	0.51
Akaike information criterion	140.94	140.48	142.06

Notes. Two-tailed tests were used for all variables. Robust, heteroskedasticity-adjusted standard errors are in parentheses.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

There are reasons as to why firms in our sample would not take these core theoretical variables into consideration when forming multipartner alliances. First, managers may simply not have been cognizant of the performance implications of the variables we are exploring. The use of multipartner alliances was relatively novel at the time of the study (1987–1997). The diffusion of administrative innovations such as multipartner alliances and the understanding of when to use them take time (Teece 1980). Early in a diffusion cycle, when decision makers are not fully aware of the performance consequences of their choices, characteristics of interest are likely to be randomly distributed (Armour and Teece 1978). Under such conditions, empirical settings are more akin to a natural experiment, and sample selection bias will be minimal (e.g., Park and Steensma 2012). Managers were likely unaware of tie strength and positional embeddedness dispersion and its potential influence on survival. To the extent that they may have been aware, the opportunity to access diverse resources from unfamiliar partners using multipartner alliances may have overridden any concerns.

Although we found little evidence that our primary results of interest are biased by sample self-selection, we took additional steps to account for the effects of unobserved heterogeneity on our dissolution models as described in our tests of robustness.

### Model Specifications, Estimation, and Results

To test our core hypothesis, we employed survival analysis techniques. We chose a parametric approach to estimate the baseline hazard function (i.e., the rate at which alliances dissolve when all covariates equal zero). Parametric survival functions allow for the baseline hazard to

vary as a function of alliance duration (Dussauge et al. 2000, Park and Russo 1996). The Weibull distribution was used to accommodate a monotonic effect of time (Polidoro et al. 2011). We then estimated the effects of covariates as exponentially multiplicative increases or decreases in the baseline hazard rate.

To account for potential autocorrelation caused by unobserved alliance effects that are stable over time, we clustered observations by alliance and reported clustered standard errors that were robust in terms of both arbitrary heteroskedasticity and intragroup correlation (Rogers 1993). To control for such unobserved systematic period effects such as industry conditions, which may influence alliance stability, year dummies were included in all models. We lagged the dependent variable by one year, facilitating causal inferences by establishing temporal precedence, which reduced concerns of reverse causality as well as avoiding simultaneity.

Table 3 provides correlations and descriptive statistics for all variables used to assess the likelihood of unplanned dissolution. Table 4 provides the results of our survival analysis. All models included year and industry segment dummy variables. Conservative two-tailed tests were used to assess the significance of all coefficients. Model 1 includes our control variables, Model 2 introduces *tie strength dispersion*, and Model 3 adds the interaction between *tie strength dispersion* and *positional embeddedness dispersion*.

Hypothesis 1 proposes a positive relationship between *tie strength dispersion* and the likelihood of *unplanned dissolution*. In Model 2, the effect of *tie strength dispersion* was positive and highly significant ( $\beta = 1.41$ ,  $p < 0.05$ ). A positive coefficient suggests an increased probability of multipartner alliance dissolution. Thus, we find support for the general destabilizing effect of *tie strength dispersion*. Hypothesis 1 is supported. Based on these empirical results with all other covariates set to 0, a one-standard-deviation increase of *tie strength dispersion* (Model 2) resulted in a more than fivefold increase in the risk of an unplanned multipartner alliance dissolution occurring four years after formation.

Hypothesis 2 suggests that the relationship between *tie strength dispersion* and the likelihood of *unplanned dissolution* will be relatively weaker when multipartner alliances comprise partners that are highly dispersed in terms of positional embeddedness. In Model 3, the effect of *tie strength dispersion*  $\times$  *positional embeddedness dispersion* was negative and significant ( $p < 0.05$ ). To gain further insight into the nature of this moderating effect, we plotted the survival functions for multipartner alliances characterized by high and low levels of tie strength dispersion and positional embeddedness dispersion, while holding all other covariates constant at their mean values. Figure 1, panels (a) and (b), reveals that there is a stronger positive relationship between *tie strength dispersion* and *unplanned dissolution* when

**Table 3** Descriptive Statistics and Pearson Correlations for Multipartner Alliance Dissolution

Variable	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1 Unplanned dissolution	0.08	0.27	0.00	1.00	—														
2 Tie strength dispersion	2.22	1.18	0.00	4.94	-0.02	—													
3 Average tie strength	7.57	4.87	0.00	20.88	-0.13	0.38	—												
4 Average positional embeddedness	100.77	42.89	12.00	214.50	-0.10	0.44	0.56	—											
5 Positional embeddedness dispersion	7.91	1.36	2.63	10.02	0.01	0.31	0.13	0.37	—										
6 Knowledge dispersion	15.05	1.07	10.14	16.74	0.03	0.26	0.18	0.22	0.30	—									
7 Number of partners	4.13	1.70	3.00	10.00	0.08	0.10	-0.06	-0.08	-0.09	0.18	—								
8 Joint venture governance	0.16	0.30	0.00	1.00	-0.01	0.07	-0.10	0.04	0.28	0.19	0.2	—							
9 Geographic diversity	1.71	0.77	1.00	3.00	0.03	0.30	-0.04	0.19	0.35	-0.01	-0.13	-0.09	—						
10 Market overlap	0.66	1.03	0.00	4.00	-0.03	0.14	0.00	-0.06	0.22	-0.28	0.06	-0.11	0.26	—					
11 Prior partnership dissolutions	1.41	1.27	0	4	0.01	0.11	0.19	0.28	-0.04	0.36	0.4	0.04	-0.32	-0.25	1				
12 Licensing agreement	0.31	0.47	0	1	-0.07	0.39	0.3	0.33	0.33	0.13	-0.13	-0.11	0.33	0.07	-0.28	1			
13 Manufacturing agreement	0.08	0.28	0	1	0.02	-0.07	-0.11	-0.15	0.13	0.05	-0.18	0.18	0.24	0.34	-0.19	-0.05	1		
14 Marketing agreement	0.13	0.34	0	1	-0.03	0.18	0.08	0.04	0.21	-0.05	-0.11	0.22	0.18	0.19	-0.08	0.29	0.1	1	

Notes. N = 251 alliance-years. Correlations with an absolute value greater than 0.1 are significant at the 0.05 level.

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**Table 4 Weibull Regression Estimates of the Hazard of Unplanned Multipartner Alliance Dissolution**

Variable	Model 1	Model 2	Model 3	Model 4
<i>Tie strength dispersion</i>		1.41* (0.58)	2.28* (0.96)	2.28** (0.74)
<i>Tie strength dispersion</i> × <i>Positional embeddedness dispersion</i>			−1.12* (0.57)	−1.12* (0.50)
<i>Average tie strength</i>	−0.14 (0.16)	−0.45 (0.33)	−0.36 (0.27)	−0.36 (0.27)
<i>Average positional embeddedness</i>	0.02 (0.02)	0.02 (0.02)	0.02 (0.03)	0.02 (0.02)
<i>Positional embeddedness dispersion</i>	−0.18 (0.76)	−0.28 (0.97)	−0.95 (1.00)	−0.95 (0.70)
<i>Knowledge dispersion</i>	0.44 (0.48)	0.15 (0.51)	−0.30 (0.60)	−0.30 (0.49)
<i>Number of partners</i>	−0.20 (0.19)	−0.43 (0.33)	−0.76* (0.41)	−0.76* (0.34)
<i>Joint venture governance</i>	2.72† (1.40)	3.16* (1.60)	3.93* (1.73)	3.93** (1.39)
<i>Geographic diversity</i>	−1.06 (0.94)	−1.53 (1.11)	−1.79 (1.31)	−1.79* (0.83)
<i>Market overlap</i>	0.89 (0.64)	0.73 (0.63)	0.63 (0.53)	0.63 (0.65)
<i>Prior partnership dissolutions</i>	−0.68 (0.52)	−0.62 (0.59)	−0.54 (0.53)	−0.54 (0.49)
<i>Licensing agreement</i>	0.08 (1.21)	0.59 (1.47)	1.26 (1.41)	1.26 (1.07)
<i>Manufacturing agreement</i>	−0.40 (0.68)	0.07 (0.64)	−0.47 (0.52)	−0.47 (1.15)
<i>Marketing agreement</i>	3.43 (2.43)	3.48 (2.59)	4.53 (3.51)	4.53** (1.74)
<i>Fixed year effect</i>	Yes	Yes	Yes	Yes
<i>Fixed industry effect</i>	Yes	Yes	Yes	Yes
<i>Constant</i>	−18.62***	−22.20***	−24.35***	−24.35***
<i>ln(Weibull shape parameter ρ)</i>	1.62* (0.39)	1.77* (0.39)	1.93* (0.42)	1.93* (0.22)
<i>ln(Overdispersion parameter θ)</i>				−16.38
Log pseudolikelihood	−16.29	−13.01	−10.49	−10.49
Observations	251	251	251	251
Degree of freedom	25	26	27	27
Likelihood ratio test $\chi^2(1)$		6.57	5.04	
Prob. > $\chi^2$		0.01	0.02	
Akaike information criterion	82.59	78.02	74.98	

Notes. Two-tailed tests were used for all variables. Robust, heteroskedasticity-adjusted standard errors are in parentheses.

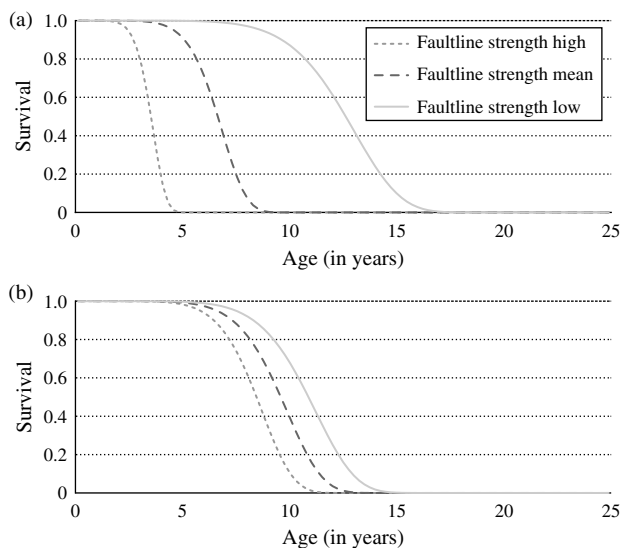
† $p < 0.1$ ; \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

*positional embeddedness dispersion* is low (−1 S.D.) as opposed to when it is high (+1 S.D.). For example, when *positional embeddedness dispersion* is low, a one-standard-deviation increase from the mean in *tie strength dispersion* reduced from 97.05% to 7.02% the probability of a multipartner alliance surviving to its eighth year without experiencing an *unplanned dissolution*. However, when *positional embeddedness dispersion* is high, a one-standard-deviation increase from the mean in *tie strength dispersion* only reduced the probability of a multipartner alliance surviving to its ninth year from 91.93% to 81.60%. Together, panels (a) and (b) of Figure 1 show multipartner alliances are particularly

vulnerable to faultlines when they comprise partners that occupy similar network positions.

Our results with regard to our control variables were also notable. After controlling for all other factors including *positional embeddedness* and its interaction with *positional embeddedness dispersion*, we find that *number of partners* increased stability (Table 4, Model 3). This result is consistent with the notion that, despite the added complexity, having more partners may provide an alliance structural stability through additional third-party ties. Our results also suggest that *joint venture governance* promotes the unplanned dissolution of multipartner alliances. A possible reason for this finding

**Figure 1** Effects of Faultline Strength on Multipartner Alliance Survival Under Conditions of Low (a) and High (b) Positional Embeddedness Dispersion



could be that strict formal controls associated with joint venture governance negatively affect the flexibility needed by multiple partners to create a stable evolutionary path for the alliance through mutual adaptation (Ariño and de la Torre 1998).

### Robustness and Alternative Specifications

We examined the robustness of our results in various ways. Although our explanatory variables did not affect alliance formation (Table 2, Model 3), endogeneity resulting from selection processes remains a possible threat. The standard solution for selection bias is to estimate a selection parameter from the full set of all possible alliances (actual and hypothetical) and then include this parameter in the restricted sample of those that actually formed and were at risk of an unplanned dissolution (Heckman 1976). Unfortunately, we found this technique a poor fit for addressing selection issues in our specific context because of (1) the intractable number of possible multipartner alliances that could have formed and (2) the normality assumptions associated with a Heckman correction in a two-stage model, which are problematic in nonlinear models such as survival analyses (Boehmke et al. 2006, Prieger 2002).

One means of addressing the problem of unobserved heterogeneity is to expand the survival model to include an unobserved random proportionality factor, creating so-called frailty models. Frailty models are used to identify an excessive degree of unexplained variability as a result of misspecification or omitted covariates, also known as overdispersion. In Table 4, Model 4, we measured the presence of overdispersion by adding a gamma distributed<sup>4</sup> latent multiplicative effect to the hazard function specified in Model 3. The frailty parameter  $\theta$  is not statistically significant, nor does the likelihood-ratio

test comparing the frailty models to the standard suggest that unobserved heterogeneity is present. In addition, there were no substantial changes in our coefficients.

Another empirical strategy for contending with endogeneity in nonlinear models is the use of flexible parametric selection (FPS) models (Prieger 2002). FPS models are not constrained to a particular functional form, and the use of a bivariate exponential distribution to bind selection and duration equations together allows for duration dependence to assume the form of the Weibull distribution (Boehmke et al. 2006). We estimated simultaneous duration-selection models using the DURSEL program in STATA. The results show that faultline strength and its multiplicative effect with positional embeddedness dispersion were not significant in the selection model, but they significantly influence multipartner alliance duration, further reducing endogeneity concerns with respect to our theoretical variables. We provide the detailed model estimates in Appendix B and Table B.1, along with an explanation of the FPS model.

Our results were robust using a nonparametric specification employed in previous studies (Dhanaraj and Beamish 2004, Hennart et al. 1998, Kogut 1989, Park and Russo 1996, Xia 2011). When we recomputed our original tie strength measures using a four-year window instead of a five-year window, our results remained robust. They were also robust when we computed tie strength based on unweighted counts of prior ties. Finally, we considered whether the influence of tie strength dispersion on instability depends on the number of partners. To assess whether the deleterious effects of tie strength dispersion are stronger in larger alliances, we tested for the interaction effect of *tie strength dispersion*  $\times$  *number of partners*. We found a positive, albeit marginally significant ( $p < 0.1$ ), effect. Future research may want to explore further this possibility.

### Discussion and Conclusion

Received wisdom within the alliance literature is that multipartner alliances are inherently unstable because of their complexity and the increased potential for free riding, yet empirical evidence regarding their stability has been mixed. Insights from social network theory suggest that multipartner alliances benefit from built-in stabilizing third-party ties, which can mitigate opportunism and conflict between partners. Nonetheless, within multipartner alliances, schisms may also occur between subgroups of partners. Despite the notion that multipartner alliances are dense clusters of firms that exhibit network characteristics (Rosenkopf and Padula 2008), fundamental network concepts have not been used to explore their stability. This study considers how configurations of partner embeddedness influence multipartner stability.

Within our sample, those multipartner alliances that had highly dispersed tie strength across partner pairs

were generally more likely to dissolve than those exhibiting less variability in tie strength. We suggest that when subgroups of alliance partners share relatively strong ties to each other, but weak ties with other partners, in-group and out-group factionalism may occur, creating mistrust and conflict within the alliance.

Those who coalesce as an in-group identify more with their subgroup than with the larger group. Such factions can hamper the development of the broad-based trust and indirect reciprocity norms that are necessary if multipartner alliances are to meet partner expectations and fully exploit their potential to create value. Unmet performance expectations will generate further mistrust and conflict, and they could potentially lead to the dissolution of the alliance.

However, we also found that when multipartner alliances involved a mix of centrally and peripherally positioned partners within the industry network, they were more resilient to the effects of divisive faultlines. This resiliency may be due to the high opportunity costs of dissolution for the partners in these alliances. The potential value from combining relatively distinctive knowledge provided by partners positioned in different parts of the alliance network, and the opportunity for peripherally positioned firms to gain prestige by partnering with central firms, provides strong incentive to tolerate internal factions. Moreover, strong lead partners are likely to emerge in multipartner alliances with members that are highly dispersed in their positions within the broader alliance network. Relatively high-status partners can be particularly effective third-party peacekeepers and coordinators of deferential lower-status partners.

The results of this study have implications for a number of research threads. Alliance studies have demonstrated that prior ties may influence the formation, evolution, governance, and outcomes of two-partner alliances (Ahuja 2000, Gulati 1995b, Gulati and Gargiulo 1999, Gulati et al. 2000, Stuart 2000). However, multipartner alliances differ from two-partner alliances in terms of their internal structure, exchange processes, and reciprocity expectations. To our knowledge, this is the first study to specifically examine the factors that influence multipartner alliance stability. Moreover, we employ concepts (e.g., faultlines) and measures that are uniquely applicable to multipartner alliances where a distribution in tie strength across partner pairs is possible.

Nonetheless, these findings from our study complement those from studies on two-partner alliances and alliance networks. In their study of alliances in the global liner shipping industry, Greve et al. (2010) found that, contrary to their expectations, the presence of particularly cohesive members in a multipartner alliance would increase the likelihood of their withdrawal from the alliance. They pointed to a potential dark side to embeddedness, an idea they argued needs to be developed further. Similarly, we also find that particularly

cohesive subgroups within multipartner alliances hamper stability. We elaborate more fully on the notion of a dark side to embeddedness by considering the occurrence of faultlines within multipartner alliances. Polidoro et al. (2011) found that having more common third parties connected to the two alliance partners in a two-partner alliance reduced the likelihood of the alliance dissolving. After accounting for their configurations in tie strength and positional embeddedness, we found that multipartner alliances that had a greater number of partners were in fact more stable. One explanation is that because of the number of members, larger alliances offer more stabilizing third-party ties internal to the alliance than do smaller alliances.

Contrary to their expectations, Polidoro et al. (2011) also found that two-partner alliances where the partners had higher levels of combined centrality were more likely to dissolve when these firms had prior direct ties. Greve et al. (2013) suggested that given viable alternative partnering options outside of their current alliances, firms are more likely to withdraw from their current alliances. Similarly, we found that multipartner alliances comprising primarily centrally positioned partners were more likely to dissolve when there were faultlines resulting from particularly strong ties among a subgroup of partners. We argue that multipartner alliances comprising partners with an extensive number of alternative options as a result of their network positions are particularly susceptible to falling victim to destabilizing faultlines. Overall, different types of embeddedness appear to exert substantially different types of influence on alliance stability.

Our theory and results highlight an additional counterproductive aspect of overembeddedness to that described by Uzzi (1996) in his study on alliance networks. Firms within sparsely connected industry networks may become overembedded in a subset of partners with whom they feel comfortable and familiar, forgoing productive exchange opportunities with firms with whom they are less embedded. We extend this notion to smaller, fully saturated networks such as multipartner alliances. When a subset of partners within a multipartner alliance is highly embedded (i.e., strong ties) compared with other partners, factions can form to the detriment of the entire alliance. In a paradoxical fashion, firms may try to prevent becoming overembedded in their industry network by engaging unfamiliar and untested partners within multipartner alliances, which provide informal control and safety in numbers. However, the extent to which multipartner alliances endure overembeddedness depends on their configurations of strong ties. In essence, the same factors that may encourage multipartner alliance formation (i.e., embedded firms safely partnering with unfamiliar firms) may also lead to its demise (via faultlines).



In contrast to the unambiguously stabilizing influence commonly associated with strong ties in dyadic alliance research, our study suggests that in multilateral collaborative contexts, strong ties may have a destabilizing effect. When cohesive ties within multipartner alliances result in divisive faultlines, they can impede the development of generalized social exchange norms. Thus, strong ties can impede collective action in situations where norms of generalized exchange are critical to collaborative success. Therefore, the influence of tie strength on the collaborative stability in general depends on the relative importance of preferential (dyadic) exchange and generalized (collective) exchange processes in specific networks and alliances. Gaining a better understanding of the dark side to strong ties could increase the explanatory power of the social embeddedness framework for complex collaborations involving more than two partners. Our study provides a theoretical foundation for future research on multipartner collaboration at various levels of analysis (Rowley et al. 2000, Uzzi 1996).

Our study introduces faultlines as a mechanism that can influence the structural trajectory of the industry network by jeopardizing the stability of ties within multipartner alliances. When stable multipartner alliances contain bridging relationships linking partners from previously disconnected regions of the network, they disproportionately influence the overall network structure by increasing the overall connectivity and clustering in the network. However, when they unexpectedly dissolve, the connectivity and clustering in the network is significantly reduced. Our study informs network dynamics research by demonstrating how inertia, opportunity, exogenous pressures, and agency as fundamental drivers of tie formation and dissolution affect mesolevel structures in interorganizational networks.

Finally, this study has implications for managers involved in or contemplating multipartner alliances. Our theory and results suggest that when establishing a multipartner alliance, the collaborative history of all potential partners should be taken into account. Managers should not rely solely on the stabilizing effect of common third parties in multipartner alliances but instead closely examine the disparity in tie strength between the various partners and the potential for faultlines. Any alliance where extensive collaborative histories create strong ties between certain partners and not others face limited long-term viability compared with those that offer a more uniform level of tie strength. Firms interested in forming multipartner alliances that feature highly disparate tie strengths may wish to mandate team-building mechanisms, which can offset the tendency for cohesive partners to coalesce or rely on preexisting norms that do not include all members.

### Limitations and Future Research

Although promising, the results and contributions offered by this study are not without limitation. Rather than using

a finer-grained measure, we relied on unplanned dissolution to measure stability. Although fine-grained data on changes in multipartner alliance governance such as shifts in division of equity (Blodgett 1992) and alteration of contractual agreements (Reuer and Arino 2002, Young-Ybarra and Wiersma 1999) may allow for a better representation of alliance stability, the lack of available archival data on our sample's changes in governance precluded their use. Despite such limitations, we believe our measure of alliance stability is valid, since alliance dissolution is a recognized indicator of collaborative stability (Kogut 1989) and because any misclassification of termination events led to conservative tests of our hypotheses. Such a measure of alliance stability is consistent with the research on the stability of two-partner joint ventures (Polidoro et al. 2011).

Other limitations concern the nature of our sample. Because our sample frame consisted of large firms and we used a nonrandom sampling process, our results may not generalize beyond the population of multipartner telecom alliances. And because our sample was based on horizontal technology alliances where coordination and governance hazards were exacerbated (Gulati and Singh 1998), alliances employing vertical relationships as in manufacturing or marketing may not reflect the same dynamics. Additional evidence based on larger random samples and data on different types of multipartner collaborations are needed to externally validate these results. Despite our best efforts to address potential sample selection concerns, the numerous selection steps (focus on realized multipartner alliances, publicly announced, encompassing only publicly traded telecom firms) make it difficult to fully rule out the possibility of selection biases. Although our empirical results are consistent with the notion of destabilizing faultlines, in-depth case studies would enrich our understanding of such processes and their effects on multipartner alliance stability.

Despite these concerns, we believe the results will lead to interesting avenues for future research. Little is known about the consequences of multipartner alliances on firm-level outcomes. Although our study focuses on alliance stability, we did not focus on which partner(s) chose to exit a multipartner alliance. A study by Lavie et al. (2007) used a competitive dynamics framework to examine the link between firm performance and entry/exit decisions. In contrast, our theoretical argument suggests that multipartner alliance outcomes depend partly on the distribution of tie strength among partners in that alliance. Following this logic, when relative strangers enter multipartner alliances with a subgroup of cohesive partners, they will exit earlier than initially planned, decreasing derivable benefits of the alliance. Testing this theoretical logic with detailed data should allow for a better understanding of the relationship between multipartner alliance and individual partner performance.

An overall understanding of the benefits and detriments of strong ties within multipartner alliances remains incomplete. Future studies should investigate those conditions where tie strength dispersion offers a stabilizing effect, perhaps buffering the consequences of an imbalance in the distribution of power. Multipartner technology alliances frequently emerge when relevant technological knowledge about a new product or service is dispersed among many firms, leading to a power structure based on partners' technological resource positions, embedded in a network of social relations. We argue that subgroups of highly embedded partners are more likely to form coalitions operating outside formal legitimated structures to advance their agenda through concerted actions (Brass and Burkhardt 1993). Investigating how tie strength dispersion within a multipartner alliance can moderate the influence of formal power distribution on stability and other outcomes would make for an interesting extension of our findings. The theoretical perspective advanced in this study may inform future research on the dynamics within larger strategic alliance structures in high-technology settings. Prominent and economically consequential examples include patent pools and standard setting consortia.

### Conclusion

We integrate network and faultline concepts and suggest that particularly cohesive subgroups within a multipartner alliance may be detrimental to its stability. When faultlines impede the development of broad-based trust and norms of indirect reciprocity across all partners, the potential for multipartner alliances to create value is hampered. To the extent that tie strength dispersion leads to divisive faultlines (applicable only to multiparty structures), the evolutionary path of the entire collaborative network is affected. Multipartner alliances are particularly popular and prevalent in high-growth industries such as telecommunications, aerospace, and software. Thus there is good reason to develop a more granular understanding of what determines their performance and success.

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### Appendix A. Examples of Archival Evidence Related to Assessing the Dissolution of Multipartner Alliances

Dissolution event	Participants	Dissolution context
Unplanned	Motorola Inc., Apple Computer Inc., International Business Machines (IBM) Corp.	IBM Corp. entered into a strategic alliance with Apple Computer Inc. and Motorola Inc. to jointly develop a new computer hardware system. The hardware prototypes were expected to be manufactured during 1995 and on the market in 1996. The collaboration was dissolved when IBM and Apple Computer announced on November 17, 1995, plans to scrap their Kaleida Labs software joint venture. Almost from the start, engineers had haggled over job responsibilities, and board members were distracted by more important jobs. Conceived in 1991 as part of a grand alliance meant to put giant Microsoft in its place, the venture gained only a handful of customers for its ScriptX multimedia programming language. (Source: Hammonds 1995)
	Hitachi Ltd., NTT Corp., NEC Corp., Oki Electric Industry Co. Ltd., Matsushita Electric Industrial Co. Ltd., Fujitsu Ltd., Toshiba Corp., Sharp Corp., Mitsubishi Electric Corp.	Japan's fifth-generation computer, a highly anticipated project that took 11 years to develop, failed to work properly, thus causing plans for a logical computer to come to a halt. Consequently, the project came to a quiet close. After the dissolution, the Institute for New Generation Computer Technology (ICOT) software was offered free of charge to all comers, but no other institute offered to take the technology further. "ICOT's programs will run only on custom-built computers, and none of the companies that built the parallel interface machine modules plans to put such machines into production." (Source: Cross 1992)
	Oki Electric Industry Co. Ltd., Toshiba Corp., Fujitsu Ltd., NEC Corp., Hitachi Ltd., Mitsubishi Electric Corp.	The collapse of the Open Systems Interconnection (OSI) project in 1996 severely damaged the reputation and legitimacy of the organizations involved, especially ISO. The worst part was that OSI's backers took too long to recognize and accommodate the dominance of the TCP/IP protocol suite. The financial damage done to Japan and Europe (where Internet deployment was delayed by years) is difficult to estimate. (Source: Walrand and Varaiya 2000)
Planned	Compression Labs Inc., Reliance Electric Co., Philips	"Reliance Comm/Tec and three partners have been jointly developing video-on-demand solutions for nearly a year. In the latest demonstration, the blockbuster film <i>The Firm</i> was delivered in compressed digital video format by Reliance Comm/Tec, Compression Labs, On-Demand Technologies, and Philips Consumer Electronics. It was brought to the small screen by transporting Motion Picture Experts Group signals through a coaxial network by Reliance Comm/Tec's integrated multimedia access platform, from On-Demand Technologies' RAIS digital video service to a Philips 31-inch TV set." (Source: Philips Business Information 1994)

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## Appendix B. Robustness Test with Concurrent Estimation of Selection and Duration Models

We used an FPS model to address sample selection (Prieger 2002). FPS models are not constrained to a particular functional form, and the use of a bivariate exponential distribution to bind selection and duration equations together allows for duration dependence to assume the form of the Weibull distribution (Boehmke et al. 2006). At first, this analytical technique appeared uniquely suited to our empirical context because it parallels the Heckman approach and would be consistent with our finding that the baseline hazard increases over time. However, the results of the simultaneous duration-selection technique calculated using the DURSEL program in STATA in Table B.1 should be interpreted with caution because the duration-selection technique only allows for time-invariant covariates. This raises theoretical and analytical issues.

First, our study is based on the premise that multipartner alliances are at risk of experiencing an unplanned dissolution as a function of factors that change over time. This is consistent with our theoretical focus on the collaborative dynamics affecting multipartner alliance stability as a function of varying tie strength within the alliance. Second, by shifting from a dynamic to a static interpretation, we move analytically from a panel design describing year-to-year variation in our theoretical variables to an exclusive focus on the formation

**Table B.1 Full Information Maximum Likelihood Duration with Selection Model**

Variables	Alliance formation	Alliance duration
	Model 1	Model 2
<i>Tie strength dispersion</i>	-0.18 (0.23)	-1.64*** (0.31)
<i>Tie strength dispersion × Positional embeddedness dispersion</i>	-0.01 (0.02)	0.16*** (0.04)
<i>Average tie strength</i>	1.32* (0.60)	-0.10*** (0.02)
<i>Average positional embeddedness</i>	0.00 (0.01)	-0.00 (0.00)
<i>Positional embeddedness dispersion</i>	-0.18 (0.15)	0.10* (0.05)
<i>Knowledge dispersion</i>	0.25 (0.11)	0.21*** (0.04)
<i>Number of partners</i>	0.08 (0.12)	-0.09* (0.04)
<i>Joint venture governance</i>		-0.38 (0.74)
<i>Geographic diversity</i>	-0.63* (0.24)	-0.44 (0.82)
<i>Fixed year effect</i>	No	No
<i>Fixed industry effect</i>		No
<i>Constant</i>	-2.62*	-0.22
<i>ln(Weibull shape parameter <math>\rho</math>)</i>		1.81*
<i>Rho (error correlation)</i>		0.24**
<i>Log pseudolikelihood</i>		-43.88
<i>Observations (uncensored)</i>		84 (25)

Note. Two-tailed tests were used for hypothesized variables and controls.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

and termination events. Whereas the estimates in the selection model derive from the conditions preceding the formation of the 59 observed multipartner alliances, the corresponding duration model is estimated based only on the conditions preceding the 25 observed termination events. In other words, this model did not take into account observations that were censored because of a termination event *not* occurring. This results in a dramatic reduction of our data support for model estimation and hypothesis testing (i.e., 84 relevant observations for both selection and duration models).

This reduced sample size did not support the complexity of our original model specification, and we could only compute estimations for simplified models. Because of the sample size, the results for some controls appeared rather sensitive to specification changes. Despite this rather tenuous analytical environment, model results related to our theoretical proposition were consistent with our findings in alternative approaches. Positive coefficients in the selection model indicate factors that increase the probability of multipartner alliance formation, whereas positive coefficients in the duration model increase the duration and thus reduce the likelihood of an unplanned dissolution event. Despite the caution that is warranted in the interpretation of these results, three observations merit attention.

First, tie strength dispersion and its multiplicative effect with positional embeddedness dispersion do not seem to affect the formation but increase the likelihood of an unplanned dissolution event, further reducing concerns that the observed effects of our theoretical variables are artifacts of selection bias.

Second, average tie strength has a positive effect on multipartner alliance formation but a negative effect on multipartner alliance duration. This result is consistent with the notion that high levels of relational embeddedness among partners represent an attractive force during partner selection that can turn into a collaborative liability as the alliance evolves.

Finally, the correlation between error terms in the selection and duration models is significant. This suggests that, in this simplified specification, the selection model indeed removed bias from the duration model estimates.

## Endnotes

<sup>1</sup>We thank an anonymous reviewer for suggesting this line of thinking.

<sup>2</sup>Prior to the logarithmic transformation, we added 1 to all values of tie strength variance such that the natural log of multipartner alliances with zero variance was defined.

<sup>3</sup>Herfindahl index =  $(1/N) + N \times (\text{variance})$ , where  $N$  is equal to the size of the sample. Adjustments for sample size are particularly appropriate for measuring concentration of market share within an industry, where  $N$  is equal to the number of industry participants.

<sup>4</sup>Results were also robust to frailty models using an inverse Gaussian distribution.

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