Social Networks, the *Tertius Iungens* Orientation, and Involvement in Innovation

David Obstfeld
University of California, Irvine

This study examines the microprocesses in the social networks of those involved in organizational innovation and their strategic behavioral orientation toward connecting people in their social network by either introducing disconnected individuals or facilitating new coordination between connected individuals. This *tertius iungens* (or "third who joins") strategic orientation, contrasts with the *tertius gaudens* orientation emphasized in structural holes theory, which concerns the advantage of a broker who can play people off against one another for his or her own benefit. Results of a multimethod study of networks and innovation in an engineering division of an automotive manufacturer show that a *tertius iungens* orientation, dense social networks, and diverse social knowledge predict involvement in innovation. Implications of the study for innovation and social networks, as well as for social skill and agency within firms are presented.•

How exactly do individuals in organizations engage in innovation activities? Is it a function of the social networks in which they are embedded, individual intentional actions or agency, or some combination of these? Despite extensive research into a process so crucial to firm growth and competitiveness (Schumpeter, 1942; Van de Ven, 1986; Tushman and Moore, 1988; Jelinek and Schoonhoven, 1990), key questions about the social nature of the innovation process remain unanswered.

Organizational innovation is often a process of creating new social connections between people, and the ideas and resources they carry, so as to produce novel combinations. Recent treatments of innovation follow Schumpeter (1934) in viewing innovation as emerging from the active combination of people, knowledge, and resources (Kogut and Zander, 1992; Brown and Duguid, 1991; Henderson and Clark, 1990; Dougherty, 1992; Hargadon, 2003). While Schumpeter (1934: 81) emphasized the innovation process (and not the innovator), characterizing innovation as a "type of conduct" occurring both within and outside organizations, the fundamental social mechanics of innovative combination remain underspecified.

If combination is the key to innovation, then social network activity may be an important predictor of people's involvement in innovation. The early social networks literature examined the connection between social networks and innovation quite explicitly. Studies using a social network approach to innovation and product development (e.g., Allen, 1977; Tushman, 1978; Tushman and Scanlan, 1981) determined that strategically positioned individuals facilitate information dissemination which in turn facilitates innovation. Allen (1977) found that individuals with more informal contacts outside the organization, or "gatekeepers," were critical for importing novel information and linking the organization with its environment. These gatekeepers effectively serve as the primary link to external sources of information and technology (Katz and Tushman, 1981). These advantageously situated individuals facilitate information flow from a fixed position in a static social network. This work illuminated the passive role of social networks in transmitting the information crucial to

0001-8392/05/5001-0100/$3.00.

•

I thank my doctoral committee: Wayne Baker (chair), Michael Cohen, Mark Mizruchi, Kathleen Sutcliffe, and Karl Weick. I also thank Paul Adler, Chris Ansell, Rick Bagozzi, Christine Beckman, Steve Borgatti, Miguel Guilarte, Joann Horai, Brad Killaly, Ajay Mehra, Rodney Lacey, Cal Morrill, Simon Rodan, Lynn Shore, Anand Swaminathan, Marc Ventresca, and Ezra Zuckerman for helpful comments on previous drafts. I am grateful to Dan Brass and three anonymous reviewers for their excellent advice and comments. Thanks also to Linda Johnson for her editorial insight and support. An earlier version of this paper won the University of Michigan's Likert Award.

innovation but neglected the active role that individuals can play to link different parties and advocate for innovation. In a similar sense, Granovetter's (1973) pioneering work on weak ties examined bridges as conduits of information and resources but not the activity of joining people on opposite sides of those bridges. Ibarra (1993a) suggested a more dynamic network perspective, finding that network centrality provided a broader basis for mobilizing support for cross-boundary innovation.

A more recent debate on social capital has recognized the contrasting benefits of dense and sparse networks. Different social network positions pose different opportunities and problems for two key aspects of combinatorial innovation: new ideas and the coordinated action to implement those ideas. Sparse networks rich in structural holes, featuring the absence of connections among those in the network (Burt, 1992), present both an opportunity structure for generating new ideas and an action problem. Dense networks, conversely, reduce the obstacles to initiating coordinated action necessary to implement innovation but pose greater obstacles to the generation of new ideas.

The opportunity structure that social networks with structural holes present for good ideas has been well developed theoretically and empirically (e.g., Burt, 1992, 2004). Networks with an abundance of structural holes, by situating people at the confluence of different social domains, create opportunities for the novel combination and recombination of ideas. These same networks, however, pose a problem for acting on such ideas. Structural holes pose an action problem because the dispersed, unconnected people found around structural holes are inherently more difficult to mobilize or coordinate, especially around novel ideas. People surrounding structural holes have different interests, unique perspectives, and employ different language. The action problem may often overwhelm whatever information advantage structural holes afford. The nature of the action problem is suggested by Burt's (2004) finding that while structural holes led to good ideas, there was no evidence that those ideas led to implementation efforts, let alone implementation success.

Dense networks, in contrast, have an opportunity structure conducive to initial mobilization but one that hinders the generation of new ideas. Networks that are dense and cohesive are conducive to mobilized action because interests and perspectives are prealigned or normatively constrained, and the language and trust necessary to mobilize those interests are more readily available (Granovetter, 2005). Dense networks may present an obstacle to later efforts to mobilize beyond the initial densely linked group, but such efforts would still benefit from the alignment of the original dense cluster. Dense networks present the optimal conditions for the exchange of the complex information necessary for innovation in complex organizations (Uzzi, 1997; Hansen, 1999) but present an idea problem because of the redundancy of information circulating within the network (Granovetter, 1973).

The action problem associated with structural holes and the idea problem associated with dense networks raises a fundamental question about the true antecedents of innovation in the broad array of settings in which innovation necessarily involves the combination of people and ideas. The action problem surrounding networks with structural holes and the idea problem with dense networks does not mean that coordinated action cannot occur in sparse networks or that new ideas cannot occur in dense networks. Similarly, good ideas do not necessarily occur in sparse networks, and coordinated action is not automatic in dense networks. This paper focuses on the action problem, beginning with the assumption that social network structure is a source but not the only source of the coordinated action that produces innovation. Neither the advantages associated with structural holes (good ideas) nor dense networks (reduced barriers to mobilization) fully account for the actual joining activity necessary for innovation to occur. Innovation involves a joining of people in both sparse and dense networks to produce the coordinated action that leads to innovation. This joining activity is captured in the idea of the *tertius iungens* strategic orientation.

THEORY AND HYPOTHESES

The *Tertius Iungens* Strategic Orientation

Tertius iungens (YUNG-gains) is based on the Latin verb "iungo" which means to join, unite, or connect. In early Latin, it means literally to yoke, harness, or mate and serves as the root of such modern words as junction, conjugal, and yoga. In one context it is used in the phrase "to throw a bridge over a river." In later Latin, it seems to be used in a more metaphorical sense, "to unite" or "to form" (as in a friendship.) Cicero used the term "iungere amicitiam cum aliquot," that is, "to form a friendship or alliance with another." Correspondingly, the *tertius iungens* orientation is a strategic, behavioral orientation toward connecting people in one's social network by either introducing disconnected individuals or facilitating new coordination between connected individuals. Such activity is central to the combinative activity at the root of innovation.

The emphasis here on combination, and in particular the joining of people, contrasts with the strategic separation among parties emphasized in Simmel's (1950) concept of the *tertius gaudens*. Simmel (1950: 154–162) argued that the introduction of a third party fundamentally alters the social dynamics of dyadic ties. Simmel (1950) called one particular triad type the *tertius gaudens,* or "the third who enjoys," based on the inherent benefit of a position between two disconnected parties. These two parties, because of their unfamiliarity with each other, can be manipulated to the third party's benefit. Simmel's use of the *tertius gaudens* concept, then, refers to an active separation of the two parties tied to the third.

The *tertius gaudens* concept has a central role in structural holes theory (e.g., Burt, 1992, 2000) in the social networks literature. A structural hole exists between two acquaintances in an individual's network if the acquaintances share a tie with the individual but are not connected to each other. Structural holes theory suggests that unique ties to other individuals or firms provide superior access to information and greater opportunities to exercise control. Burt (1992) drew on Simmel's concept of *tertius gaudens* to explain the social activity that occurs around structural holes. He argued that social networks rich in structural holes present opportunities for using a *tertius gaudens* strategy, by which an actor positioned between two disconnected parties can manipulate or exploit those parties to the actor's benefit. Burt argued that low-density egocentric social networks rich in structural holes present opportunities for advantage through the *tertius gaudens* strategy. While developing the importance of active separation, Burt also addressed a broader set of triadic-based behaviors (e.g., moving knowledge and information between disconnected parties and even introducing parties) that have come to be associated with the *tertius gaudens* idea. My reference to the *tertius gaudens*, however, is restricted to the active separation suggested in Simmel's original usage.

Baker and Obstfeld (1999) suggested that the *tertius gaudens* explains only one entrepreneurial strategy, which they termed a disunion strategy, and suggested an alternative, "union," or what I call here a *tertius iungens* strategy. In this case, ego closes the gap between disconnected others by bringing them together. This alternative dynamic corresponds with the first of Simmel's triad types, overlooked by Burt, the third party who acts as a mediator, or "non-partisan," to create or preserve group unity: "The non-partisan either produces the concord of two colliding parties, whereby he withdraws after making the effort of creating direct contact between the unconnected or quarreling elements; or he functions as an arbiter who balances, as it were, their contradictory claims against one another and eliminates what is incompatible in them" (Simmel, 1950: 146–147).

Simmel's mediator, or "non-partisan," offers an alternative to the *tertius gaudens* that merits further examination and development. Much of Simmel's above description of the non-partisan, for example, assumes adversarial tension, with references to "colliding parties," "quarreling," "contradictory claims," or incompatibility. Such adversarial tension, however, characterizes only one set of conditions that might surround the joining that the *tertius iungens* may instigate. Much *tertius iungens* activity may involve coordination without adversarial tension and competing claims. Parties may be indifferent to one another's interests, oblivious to other potentially commensurate interests, or even share common interests without being tied together for the purposes of a given project. Simmel's reference to "unconnected" elements therefore also bears closer scrutiny. Innovations form around projects that represent combinations of people, ideas, and resources. Parties may be previously unconnected in the sense of being completely unacquainted with one another or, alternatively, may have previous strong or weak ties along a variety of dimensions but be unconnected in relation to a given project or initiative. The absence of coordination between previously tied individuals may arise from cognitive gaps (Baker, 2000: 142) that arise from incomplete interpersonal knowledge. This suggests that *tertius iungens* actors may operate within sparse networks or dense networks of already related nodes unmobilized for a specific effort or initiative.

Specification of the *tertius iungens* orientation is at variance with social network perspectives that emphasize how structure determines action. A strict structuralist position assumes that specification of a network implies the pursuit of the opportunities afforded by such a network and discounts individual differences (e.g., Mayhew, 1980). Others suggest that such individual differences help determine the value of various social networks (Emirbayer and Goodwin, 1994; Mehra, Kilduff, and Brass, 2001) and offer an account of agency that factors in both social structure and individual differences. This more moderate position considers social network variables together with individual differences (e.g., Brass and Burkhardt, 1993; Ibarra, 1993a, 1993b; Galaskiewicz and Wasserman, 1994; Kilduff and Krackhardt, 1994; Marsden and Friedkin, 1994; Mehra, Kilduff, and Brass, 2001). This line of work suggests that structure affords opportunities but is not the only antecedent of action and that characteristics of nodes as well as networks are important in the consideration of such action. Further, innovative action is therefore likely to be a function not only of the network but also of the strategic orientation of the node toward action.

The use of the term "orientation" suggests a construct of medium specificity between a highly specific attitude (e.g., toward a task) and a more general personality trait (Frese and Fay, 2001). A "strategic orientation" refers to the preferred means for approaching problems in a social context (Higgins, 1998; Levine, Higgins, and Choi, 2000). Following Simmel's conception of the non-partisan, *tertius iungens* activity is a strategic orientation by which actors bring forth such combinations and recombinations.

Attending to underlying strategic orientations like the *tertius iungens* clarifies the multidimensional nature of brokerage. Brokers may engage in four brokering strategies: (1) coordinate action or information between distant parties who have no immediate prospect for direct introduction or connection, (2) actively maintain and exploit the separation between parties, (3) introduce or facilitate preexisting ties between parties such that the coordinative role of the *tertius iungens* subsequently recedes in importance (brief *iungens*), and (4) introduce or facilitate interaction between parties while maintaining an essential coordinative role over time (sustained *iungens*). In the first two strategies, separation is maintained. The *tertius iungens* orientation refers to the latter two strategies.

In this brokerage typology, Fernandez and Gould's (1994: 1457) conception of brokerage that ". . . does not permit the endpoints of the brokerage relation to be directly connected" is consistent with the first strategy. Marsden's (1982: 202) definition of brokerage—a mechanism "by which actors facilitate transactions between other actors lacking access to or trust in one another"—tended to emphasize the first two brokerage strategies. Despite his emphasis on the *tertius gaudens* logic of action, Burt (1997) addressed *tertius iungens* behavior as well, describing, for example, entrepreneurial managers who identify opportunities to add value within an organization and who join people together to develop these opportunities. The concept of technology brokering

(Hargadon and Sutton, 1997; Hargadon, 2002) emphasizes both the first brokerage strategy and the *tertius iungens* orientation, whereas DiMaggio's (1992) treatment of how Paul Sachs connected the museum, university, and finance worlds to help create the Museum of Modern Art is most consistent with the second *tertius iungens* strategy.

For the purposes of this study, I collapse the two *tertius iungens* categories into a more general category of *tertius iungens* activity to capture the combinatorial action likely associated with innovation within the firm. *Tertius gaudens* activity (i.e., active separation), though a potent brokerage strategy that may lead to creative ideas, does not foster the combinatorial action necessary to much innovation. Given a relevant structural hole, *tertius gaudens* profits by maintaining separation among alters, whereas *tertius iungens* closes it to coordinate action. Given a closed triad, *tertius gaudens* drives a wedge between the two alters, whereas *tertius iungens* introduces new projects around which the alters can collaborate.

Independent of preexisting social network structure, the *tertius iungens* strategy identifies the mobilization activity essential to many forms of innovation. A *tertius iungens* strategy, then, is a behavioral orientation that emphasizes creating or facilitating ties among people in one's social network. Individuals who are active in introducing dissimilar others and facilitating action among previously tied alters (or people in one's social network) will be more involved in the combinative activity that leads to innovation.

Hypothesis 1: The greater an individual's *tertius iungens* orientation, the greater his or her involvement in innovation.

Social Network Structure

As noted earlier, recent work on social networks and innovation at the individual and firm level follows the lines of a more general debate about the merits of two different conceptualizations of social capital (Baker and Obstfeld, 1999; Burt, 2000; Putnam, 2000; Adler and Kwon, 2002). One conceptualization stresses the benefits of "closed," dense, or cohesive networks (e.g., Coleman, 1988), including cooperation, trust, and the potential to build knowledge through intensive, repeated interactions and exchange of ideas (e.g., Ahuja, 2000). The other emphasizes structural holes, unique ties to other individuals or firms that provide superior access to information and greater opportunities to exercise control (Burt, 1992, 1997). According to structural holes theory, networks full of structural holes, by exposing an actor to novel communities, diverse experiences, unique resources, varying preferences, and multiple thought worlds, provide superior opportunities. The information advantage Burt associated with networks with structural holes roughly corresponds to the advantageous position occupied by the gatekeepers in the earlier social networks/innovation literature to the extent that both imply boundary positions. As noted earlier, structural holes also present brokers with a control advantage derived from the leverage they have over the individuals they connect. Consistent with the *tertius gaudens* logic, Burt suggested that separation between structurally equivalent alters provides ego with the maximal opportunity to play alters against one another and thus to benefit.

An opposing position in the social capital debate recognizes the advantages of dense networks. This position is consistent with a growing body of work recognizing the importance of dense networks for certain types of knowledge work. The advantages of dense social networks, and the more frequent communication and strong ties they usually entail, include trust, norms of cooperation, and more effective exchange of complex knowledge, all of which are crucial to the coordinated action necessary for sustained innovation efforts. With respect to trust, for example, Uzzi (1997: 43) found in embedded ties "a predilection to assume the best when interpreting another's motives and actions." With respect to norms, Coleman (1988) suggested that network closure provides the basis for sanctioning that can effectively constrain action to serve the collective good. Finally, dense networks tend to be the locus of shared knowledge (Arrow, 1974; Kogut and Zander, 1992; Nahapiet and Ghoshal, 1998), language, and style, which facilitates communication.

Research results with respect to the effects on innovation of the distinction between dense and sparse networks are limited and mixed (Rodan and Galunic, 2004). Structural holes, for example, facilitated the technology brokering role that the product design firm IDEO used to develop innovative products (Hargadon and Sutton, 1997; Hargadon, 2002). In Rodan and Galunic's (2004) recent study, network sparseness was only a marginally significant predictor of innovation, but the interaction of sparseness and knowledge heterogeneity was significant. Other research based on tie strength, however, suggests the importance of dense networks in innovation and innovation-related tasks such as knowledge transfer. Uzzi (1997) and Hansen (1999) identified the fine-grained information transfer of tacit knowledge as a function of stronger, embedded ties. Both authors inferred a connection between such ties and dense social networks, an inference for which there is some precedent (Granovetter, 1973; Reagans and McEvily, 2003). Such knowledge sharing, whether along strong ties or in dense networks, is likely to involve not only technical knowledge but knowledge about the social and political context in which innovations are conceived and pursued over time.

Despite the advantages to moving knowledge inside the firm rather than across firm boundaries (Kogut and Zander, 1992), exchanging, integrating, and creating knowledge can be extraordinarily difficult (Dougherty, 1992; Carlile, 2002). When the primary innovation activity becomes more concerned with creating and mobilizing support for innovation based on the sustained development of more complex forms of knowledge, rather than the simple transfer of information, dense networks would appear to become particularly important. The communities of practice literature (Brown and Duguid, 1991, 2001; Lave and Wenger, 1991; Wenger, 1998) has examined the knowledge sharing and creation benefits of dense, informally constituted networks of shared practice. In this sense, a dense network is also "premobilized" in that it presents less inherent conflict between those who must agree to support the innovation. Podolny and Baron (1997) found that structural holes in the information networks they studied led to promotions but found the opposite effect if those structural holes occurred in the individual's buy-in network, the network most similar to that required to garner support for an innovation. Thus I hypothesize the following relationship between structural holes and innovation:

Hypothesis 2: The fewer the number of structural holes (i.e., the higher the density) in an individual's social network, the greater his or her involvement in innovation.

Knowledge

Consistent with Schumpeter's perspective on combination, the organizational and strategy literature have emphasized the combination and recombination of knowledge. In this view, a firm's capacity to integrate knowledge represents a critical competitive advantage (Kogut and Zander, 1992; Grant, 1996; Spender, 1996; Nahapiet and Ghoshal, 1998; Okhuysen and Eisenhardt, 2002; Hargadon, 2003). Individual stocks of knowledge, therefore, are critical to the combinatory process of innovation. Social network approaches recognize the importance of structural knowledge conduits but often assume that the social network serves as a proxy for individual knowledge without exploring the potentially complex relationship between the social network and individual knowledge (Rodan and Galunic, 2004). Social network theories that stress the advantages of structural holes or gatekeepers, for example, tend to emphasize access to new information and overlook the individual accumulation of technical and social knowledge that make its application to innovation possible. This preexisting individual stock of knowledge makes possible an absorptive capacity, which Cohen and Levinthal (1990: 128) defined as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends." They argued that such a capacity is a function of a firm's level of prior related knowledge. While presenting absorptive capacity as a firm-level construct, Cohen and Levinthal grounded the construct in research suggesting that individual learning is cumulative and that a depth and diversity of knowledge enables the individual to assimilate and apply knowledge from a broad number of areas. An accumulated stock of individual knowledge, then, is important to innovation both as a resource to draw upon directly as well as the basis for assimilating new knowledge.

The concept of absorptive capacity stresses the importance of prior related technical knowledge as a basis for successful innovation and research and development. Although technical knowledge is essential to any innovation effort, complex, technically oriented organizations place demands on their participants for depth and familiarity with newer technologies and practices in their functional area of expertise, and situated theories of knowledge suggest that knowledge occurs in intertwined technical and social realms (Lave and Wenger, 1991). A person with a rich stock of social knowledge—knowledge of the organization's culture, along with the nature, history, and preferences of different personnel and departments—would be in a good position to introduce innovations. Extensive social knowledge about the personnel and differing styles of critical departments across the organization resulting from informal ties and potentially shared design experience contribute critically to cross-boundary innovation efforts. Social knowledge is related to the accurate cognition of informal networks, which Krackhardt (1990) found was a base of power. Rodan and Galunic (2004) found that knowledge heterogeneity was a significant predictor of both overall managerial performance and innovation performance. Thus, other things being equal, individuals with more in-depth technical and more diverse social knowledge are more likely to be involved in innovation efforts.

Hypothesis 3a: The greater an individual's technical knowledge in his or her functional area of expertise, the greater his or her involvement in innovation.

Hypothesis 3b: The greater an individual's social knowledge across all relevant functions, the greater his or her involvement in innovation.

METHODS

Site and Participants

I tested the hypotheses with a study of employees involved in automotive design. The design of an automobile is roughly a five-year process that begins with establishing a general styling theme and the key design features of the car. From there, engineers and the designers who assist them begin to rough out and refine various parts while coordinating their design with those responsible for adjacent parts in the design through continual discussions and meetings in a variety of cross-functional teams. Engineers and the designers responsible for the digital design of parts in three-dimensional space continually develop designs that are assembled digitally and in successive rounds of building prototypes to determine compatibility. It is routine for an engineer to be responsible for one or more parts while serving on multiple teams that monitor the emerging vehicle's performance, cost, weight, and schedule. It is well understood that compromise and coordination are more difficult the further the overall design moves toward production, as the work associated with changing part designs that reflect hundreds of hours of design and testing increases. In such a setting, a *tertius iungens* orientation is likely to be important to the success of an innovation.

NewCar (a pseudonym) is an engineering division of a major Detroit automotive manufacturer with over 1,000 employees, 440 of whom were dedicated to the design of a new vehicle, which I will refer to as the G5. The core automotive design work for the G5 was carried out by five engineering units—Powertrain, Electric, Interior, Chassis, and Body—and was coordinated by two other engineering groups responsible for program management and the integration of different design contributions. The engineers and designers from NewCar frequently worked with representatives from Styling (responsible for the aesthetic appearance of the car), Marketing, Operations, Manufacturing, and numerous external suppliers to which various parts of the engineering work had been outsourced. A NewCar engineering executive and the G5 program manager served as the main sponsors for the study. I conducted a survey approximately three years into the G5's five-year design process, a point at which the G5's design was nearly complete.

The survey was administered in two parts. The first part asked respondents about their involvement with innovation during the design process and measured their *tertius iungens* orientation; the second part collected respondents' social network data. The first part of the survey was distributed over the internal company e-mail system to all 440 professional-level employees (engineers, designers, and managers) working on the G5. Completion of the entire survey entered respondents into a lottery for prizes that served as an incentive. Several weeks before the distribution of the survey, the G5 program manager sent an e-mail to the entire division describing the survey and encouraging employees to participate. The program manager e-mailed two reminders to complete the survey. The survey and reminders indicated that the purpose of the study was "to better understand the social dynamics of the product development process."

A total of 182 respondents returned the survey via company e-mail. In return, each received a pass code to enter a Web site on the company's intranet to complete the social network portion of the survey. This latter portion of the survey was completed by 152 people, for a total response rate of 35 percent. An independent samples T test indicated no difference in education, rank, or years in the company between respondents and nonrespondents to the second part of the survey. Of the respondents, 128 were male, 24 were female.

Ethnographic study. I conducted field observations of NewCar's innovation efforts before, during, and after the survey administration, in part to augment the quantitative analysis. The first phase of ethnographic observation was conducted over a 12-month period that concluded several months prior to the survey administration. I maintained active contact with the organization for another year during the preparation and administration of the survey study. Field observation averaged four days a week for the first nine months and four days a month for the last 15 months. Each day of observation yielded 5–50 pages of handwritten field notes that I usually wrote up within 24 hours after leaving the field. I supplemented these with 112 taped and transcribed interviews. I routinely collected meeting minutes, prints of CAD/CAM designs, and informal sketches as part of the data-gathering effort.

Measures

In creating the survey, I initially identified 81 innovations involved in the design process, which I reduced to a list of 73. The list of 73 innovations was established by (1) interviewing 26 "middle managers" from each of the G5's seven departments to determine the significant changes to product and process in their area since the inception of the G5, a three-year period; (2) conducting informal discussions and examining patent application lists, and (3) subjecting the initial list of 81 innovations developed in steps 1 and 2 to review and approval by the G5 program manager and senior managers in each of the six other NewCar engineering areas. This process established a final list of 73 innovations, all of which were new or a major modification to what previously existed and were implemented. Table 1 provides some examples of the product and process innovations involved in the G5's design.

Dependent variable. I measured innovation involvement by respondents' highest level of participation in a change to the G5 product or process, using Ibarra's (1989, 1993a) scale of five categories of innovation involvement, with the following item:

> Check 1 if you, along with or in conjunction with others, were the initiator of the innovation—that is, if its introduction and use was in large portion your idea. This is the number to check if the innovation would not have happened without you. (It is expected that '1's will be very rare.) Check 2 if you were not the initiator but played a major role in the development of the innovation as a whole. This is the number to check if you played an important role in shaping the innovation—it would not exist in its present form without your contribution. Check 3 if you were associated with the development of the innovation in a more limited capacity, for example, providing advice to the initiator on specific aspects of the innovation. This is the number to check if you played a minor role in bringing the innovation to the organization. Check 4 if you know about the innovation but had nothing to do with it. Check 5 if the innovation is not applicable to your work and is one you know nothing about.

Respondents were asked to evaluate their level of involvement in each of the 73 innovations. A respondent's innovation involvement reflected the highest level of involvement reported across all 73 innovations. If an individual reported that he or she was an initiator for one or more of the 73 inno-

Table 1

Examples of G5 Innovations*

Product innovations

1. Battery tray acid retention and drainage troughs.
2. Double boot on manual shifter to enhance NVH characteristics.
3. Reversible, low-current, rear washer switch.
4. Seat mounting of seat belt (vs. outboard floor anchor).
5. Shell-molded, three-piece plastic intake manifold.
6. Fastenerless air induction system mounting.
7. Air conditioner pressure transducer for better AC fan and idle speed control.
8. Clutch interlock defeat.

Process innovations

9. Introduction of customized computer application for e-mail, issues tracking, virtual data, team management, etc.
10. Introduction of product development manager (PDM) software.
11. Slow-build/fast-build prototype process.
12. Three-dimensional computer-assisted animation of door function combining geometric and behavior design domains.
13. Creation of a prototype parts management group and process.
14. Robotic quarter glass installation without encapsulation or other locating mechanisms.
15. Design and development of connectivity model creation process linking electrical schematics to three-dimensional design tool.

*Some minor wording changes have been made to preserve the anonymity of the organization.

vations, then he or she was designated as an initiator. This approach stresses the highest level of involvement in any innovation rather than counting the number of innovations pursued because innovations varied widely with respect to the amounts of time they involved. The measure thus emphasizes comparable levels of engagement. I reversed the coding of the innovation involvement so that factors that contributed to innovation involvement would display a positive regression coefficient.

I used reviews by 49 experts to validate initiator and major-role self-reports of innovation involvement. I created a listing of all those self-reporting either an initiator or major role for a given innovation and asked each expert—a person familiar with the innovation in question—to assign participants to one of four levels of involvement: "Initiator," "Major Role," "Minor Role," or "No Involvement or No Knowledge of Individual's Involvement." I used these expert evaluations to review and change initiator and major-role self-report innovation involvement, as appropriate, according to predetermined criteria. For example, I did not change a particular level of self-reported innovation involvement when it was confirmed by at least one other report of involvement at an equal or higher level.

Of the 83 respondents who reported either an initiator or major role as the highest level of innovation involvement, I left 60 respondents' level unchanged, moved 20 respondents down a level of involvement, moved three respondents up a level, and eliminated two individuals from the study due to the size of the discrepancy (two levels) between the self-report and expert responses. I left seven initiator or major-role self-reports unchanged due to the unavailability of expert reports.

Independent Variables

Tertius iungens orientation. I created a 7-point *tertius iungens* orientation scale to capture a predisposition to bring people together in collaboration, including introducing disconnected others and forging stronger ties between others who may already have ties with one another. The six-item scale contained the following items: (1) I introduce people to each other who might have a common strategic work interest; (2) I will try to describe an issue in a way that will appeal to a diverse set of interests; (3) I see opportunities for collaboration between people; (4) I point out the common ground shared by people who have different perspectives on an issue; (5) I introduce two people when I think they might benefit from becoming acquainted; and (6) I forge connections between different people dealing with a particular issue. I tested the scale on a group of 55 professionals from several organizations prior to using it at NewCar. In this pretest, the scale had a reliability (Cronbach alpha) of .85. In the final study, it had a reliability of .88.

To further test the discriminant validity of the *tertius iungens* construct, I conducted a confirmatory factor analysis (CFA) comparing the structure of the *tertius iungens* scale to individualism collectivism (Erez and Earley, 1987; Triandis et al., 1988; Wagner, 1995), the integrating and compromising styles of handling conflict (Rahim and Manger, 1995), proactive personality (Bateman and Crant, 1993), and the Big Five personality dimensions (Saucier, 1994). I collected new data from 130 fully employed MBA students to conduct the comparison with eight of the scales and used existing data to compare the *tertius iungens* scale with the individualism-collectivism scale. In all analyses, the phi matrix showed minimal interscale correlation. The highest observed inter-item correlation was 0.52, between the *tertius iungens* and proactive personality scales, in effect accounting for only 25 percent of shared variance.

Finally, I conducted two additional statistical tests to examine the discriminant validity between the *tertius iungens* scale and proactive personality using the methods proposed by Bagozzi, Yi, and Phillips (1991). The first examined the phi coefficient plus or minus two times the standard error. According to Bagozzi, Yi, and Phillips (1991), the criteria for discriminant validation are established if this range does not include the value of one. If the range includes the value of one, this would suggest that the two constructs share considerable overlapping information. The resulting computation provided an interval of .36 to .68, thereby indicating there is no significant overlap between the two constructs. The results were the same when I used the same test to compare the *tertius iungens* scale and all the other scales.

I conducted a second test to compare the *tertius iungens* scale and the proactive personality scale based on the commonly referenced chi-square difference test (Bagozzi, Yi, and Phillips, 1991; Raykov and Marcoulides, 2000) in which two models are evaluated. Two chi-square tests were compared. In the first, the observed phi coefficient of .52 was considered, and in the second, the phi value was set to one, indicating complete overlap between the two constructs. A nonsignificant increase in the chi-square would indicate that the two factors are overlapping. A significant increase in the chi-square for the one-factor model would indicate that a major deterioration of model fit occurred when these two factors were set at one. The results indicate a significant chi-square increase, suggesting that the *tertius iungens* scale and proactive personality had discriminant validity.

Structural holes. Consistent with Burt (1992), I used an egocentric social network survey instrument to derive a single list of people with whom the respondent had ties. The name-generator questions asked respondents to identify persons with whom they had different kinds of relations, including those with whom they discussed important matters, with whom they communicated to get work done, who were influential in getting new projects approved, with whom they socialized informally, and to whom they turned for advice. I combined responses from these questions into one summary network and recorded a tie in this network if the respondent indicated that a tie existed between his or her alters for any of the above relations.

To measure tie strength (Granovetter, 1973) between the respondent and each alter, I asked, "How strong of a connection do you have with X?" with possible responses of

"Strong," "Somewhat strong," "Somewhat weak," "Weak," and "I prefer to avoid this person." To assess ties between alters, I asked, "How connected are X and Y?" with similar response options, plus the option "Strangers or not acquainted," to indicate when alters had no relationship. I designated a tie to exist between alters if any relationship was indicated other than "prefer to avoid this person." I designated a tie between alters as absent if the respondent provided the "strangers" or "prefer to avoid each other" response.

I used two measures of structural holes, density and Burt's (1992) measure of constraint. The density measure reflects the level of cohesion necessary for coordinated action. Density, or the ratio of existing ties between those in a subject's network out of all possible ties, is often seen as a general proxy for structural holes (e.g., Podolny and Baron, 1997) and is particularly relevant for the innovation-related dependent variable, as the density of ties may reflect the sustained cooperation necessary for innovation efforts to succeed. The constraint measure captures the extent of an individual's dependence on the others in his or her network as well as his or her access to novel, non-redundant information (Burt, 1992). The constraint measure is meant to identify the social network positions that confer the greatest information and control advantages. Low constraint corresponds with larger numbers of structural holes. Constraint is a function of the existence of direct ties between ego i and alter j and of the extent to which j has other ties q that are in i's network as well. The formula for constraint is:

$$c_{ij} = \left(p_{ij} + \sum_{q \neq i \neq j}^{Q} p_{iq}p_{qj}\right)^2$$

where p_{ij} is the proportion of the total relational strength that ego devotes to a given alter in proportion to the sum of relational strengths of all other of ego's alter ties, and $\Sigma p_{iq}p_{qj}$ captures the degree of triadic closure between i, j, and third parties q (Reagans, Zuckerman, and McEvily, 2004.) Both density and constraint were calculated in UCINET (Borgatti, Everett, and Freeman, 2002).

Knowledge. Four measures captured the extent of an individual's knowledge. First, technical knowledge was measured with a question that emphasized familiarity with the respondent's area of functional expertise, following Kaplan's (1993) suggestion that familiarity and comfort are strongly associated with the experience of tacitly held knowledge: "In general, how comfortable are you addressing the more advanced technical issues associated with the following areas?" for each of ten technical areas (i.e., Body, Chassis, Electric, Interior, Powertrain, Vehicle Development, Program Management, Marketing, Manufacturing, and Purchasing), with the technical knowledge measure referring only to the response to the technical area in which they were based (1 = "not comfortable at all" and 7 = "very comfortable").

Second, social knowledge was defined as broad access to current and often unofficial information about the activity in various areas surrounding the G5's development. That access served as a conduit for unfiltered intelligence about individual and departmental issues and interests and suggested an appreciation of the social and political dynamics that surround innovation efforts. Social knowledge was measured by the respondent's response to the question, "In general, how easy would it be for you to get candid, 'behind-the-scenes' input regarding G5 issues concerning the following areas?" for each of the ten technical areas indicated above (1 = "not comfortable at all" and 7 = "very comfortable"). These ten responses formed a social knowledge scale with a reliability (Cronbach alpha) of .88.

Third, time in the firm influences technical and social knowledge (Hitt et al., 2001). This takes the form of familiarity with the organization's culture and language, insight into other individual and group preferences, and instincts about how to advocate for innovation. In this respect, years in the firm appears to reflect both accumulated technical and social knowledge. Therefore, I used the number of years employed by NewCar as a third measure of accumulated technical and social knowledge.

Formal education served as a fourth measure of an individual's stock of knowledge. Given the importance of engineering to the automotive context in which the survey was administered, I broke education levels into a binary scale: those with a master's degree in an engineering or engineering-related area received a 1 and all others, a 0. Formal education was an important consideration at NewCar. First, company policy prevented promotion past a fairly low professional rank without an undergraduate degree. Second, advanced degrees conferred an enhanced status beyond the associated formal knowledge. These issues make education different from the other measures of knowledge proposed here.

Control Variables

Years in firm dummy variable. Several participants in the survey (18 out of 152, or 12 percent) indicated a length of time in the firm of less than one year. Because of the greatly reduced potential for these individuals to contribute substantively to a majority of the innovations, which were typically initiated two or three years before the survey administration, these respondents had the potential to distort the time in the firm measure. To control for this effect, I created a dummy variable, coded 1 for respondents with less than a year in the firm and 0 for all other respondents.

Organizational rank. Consistent with the innovation literature (e.g., Ibarra, 1993a), I expected senior managers to be very influential in innovation processes due at least in part to the authority associated with their formal position. Because certain innovations could occur simply by virtue of the formal authority vested in more senior-ranking individuals, I controlled for rank. I asked NewCar employees to provide their formal grade level and connected these to a corresponding 6-point numerical scale. The highest rank on this numerical scale corresponded to an executive engineer in charge of an entire department, such as Chassis, as it related to the G5. People who held this rank had considerable tenure and influence in the organization. Levels 4 and 5 represented middle managers' jobs. Level 3 positions were both professional and managerial. Levels 1 and 2 corresponded with frontline professional positions. I had to determine a rank equivalent for the substantial number of contract workers who worked full time for NewCar but were technically employed by an outside firm. In this study, 34 percent of the respondents were contractors. The G5 program manager indicated that the contractors' rank was widely considered to be equivalent to the second increment of the 6-point scale. The measure of rank incorporated all contractors at this level.

Number of alters. Because the density measure does not reflect the size of the respondent's network, I added an additional independent variable, the number of people in the respondent's network, to control for the impact of network size in the model containing the density variable.

Data Analysis

I used an ordered logit model to estimate the probability of involvement in innovation. Ordered logit models are used to estimate the relationship between an ordinal dependent variable and a set of independent variables. An ordinal variable is a variable that is categorical and ordered. The categorical, ordered dependent variable used in this study had five response levels (i.e., initiator, major role, minor role, know about the innovation, or did not know anything about the innovation). A multinomial logit model is appropriate for categorical dependent variables more generally, but such a model does not capture the information inherent in the ordering of the dependent variable. Ordinary regression has the potential to produce different and potentially misleading results according to the numerical values assigned to the different ordinal response levels. An ordered logit model makes use of the ordered nature of the response levels without being influenced by the numerical values used for the dependent variable.

In an ordered logit, an underlying probability score is estimated as a linear function of a set of independent variables and a set of cut points. The probability of observing outcome i corresponds to the probability that the estimated linear function, plus random error, is within the range of the cut points estimated for the outcome:

$$\Pr(\text{outcome}_j = i) = \Pr(\kappa_{i-1} < k\beta_1 x_{lj} + k\beta_2 x_{2j} \ldots + \beta_k x_{kj} + u_j \leq \kappa_i)$$

where u_j is assumed to be logistically distributed in the ordered logit. In either case, one estimates the coefficients $\beta_1, \beta_2, \ldots, \beta_k$ together with the cut points $\kappa_1, \kappa_2, \ldots, \kappa_{k-1}$, where k is the number of possible outcomes. κ_0 is taken as $-\infty$ and κ_I is taken as $+\infty$.

RESULTS

Table 2 presents means, standard deviations, and correlations among the variables included in the regression. Of 152 respondents, 22.4 percent were coded as an initiator, 23 per-

Table 2

Means, Standard Deviations, and Correlations among Variables

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9
1. Innovation involvement	2.51	1.06	—								
2. Density	.55	.20	.201	—							
3. Constraint	.32	.10	.038	.473	—						
4. Number of alters	13.24	3.74	.046	−.178	−.822	—					
5. *Tertius iungens* orientation	4.73	.93	.330	−.029	−.035	.032	—				
6. Social knowledge	4.36	1.27	.363	−.131	−.182	.197	.341	—			
7. Technical knowledge	6.14	1.35	.227	.119	−.009	.075	.206	.160	—		
8. Years in firm	7.10	7.55	.418	.191	.075	−.014	.196	.123	.145	—	
9. Education	.24	.43	.116	−.061	−.067	−.007	.007	.019	.090	.025	—
10. Organizational rank	2.15	.87	.355	.180	.057	−.007	.175	.025	.039	.488	.117

cent were coded as having a major role, 36.8 percent were coded as having a minor role, 16.4 percent were coded as recognizing at least one innovation, and 1.3 percent did not recognize any of the innovations. Table 3 reports regression results. Tests of significance shown in the table are one-tailed for directional predictions and two-tailed otherwise. Model 1 presents the results using density as the social network measure. Model 2 substitutes constraint for density as a measure of structural holes. In both models, the *tertius iungens* orientation variable is a significant predictor of innovation involvement, confirming hypothesis 1.

The *tertius iungens* orientation was repeatedly demonstrated by the NewCar program manager, a senior G5 manager

Table 3

Ordered Logit Coefficients Predicting Innovation Involvement (N = 152)

Variable	Model 1 (with density)	Model 2 (with constraint)
Social network		
Density	1.954••	—
	(.850)	
Number of alters	−0.005	—
	(.043)	
Constraint	—	2.078
		(1.609)
Tertius iungens orientation	0.324•	0.314•
	(0.183)	(0.182)
Knowledge		
Social knowledge	0.562•••	0.535•••
	(0.142)	(0.140)
Technical knowledge	0.088	0.108
	(0.121)	(0.119)
Years in firm	0.061•	0.063••
	(0.026)	(0.026)
Years in firm (dummy variable)	0.930•	0.939•
	(0.532)	(0.531)
Education	0.619•	0.584
	(0.371)	(0.371)
Organizational rank	0.424•	0.487•
	(0.215)	(0.213)
Chi-square	71.701•••	67.725•••
D.f.	(9)	(8)
Nagelkerke R^2	.401	.383

• $p < .05$; •• $p < .01$; ••• $p < .001$.

known for his innovativeness. He revealed how he strategically orchestrated and altered social networks:

> [My boss] came back from that course at IBM [all excited] about these network ideas . . . gatekeepers and what-not. I said, "Ed, I create these networks." That's half the battle. Half the battle is creating the networks. I've created the networks between functional specialists and my staff. I created the drivetrain and chassis [connection]. . . . Getting Pat engaged in the process. [The network] is different now.

The program manager's *tertius iungens* orientation was salient over a four-month period, when I observed him successfully advocate for the creation of an entirely new unit charged with coordinating part suppliers, design engineers, and prototype "builds"—a substantial innovation to NewCar's design process. His efforts involved an initial phase of coordinating three already tied senior executives, two within the division and one outside, whose support he needed for the new unit to go forward, followed by the enlistment and subsequent introduction of a manager and five front-line employees who would staff an entrepreneurial team charged with developing and executing the new process. The program manager subsequently introduced that new team's manager and team members to critical stakeholders, as he did his other program management staff.

Another six-month set of field observations concerned the efforts of a grassroots, informal network of seven individuals advocating for a major corporate-wide reengineering of the prototyping process, an effort entirely outside of top management's agenda and consequently one that was hidden in its initial phases. Of particular note here were the repeated microsocial *tertius iungens* joining activities necessary to make this effort progress at multiple levels. The group initiated scores of *tertius iungens* introductions that can be grouped into three major *tertius iungens* cycles targeting successively broader or higher-ranking audiences. The first cycle involved a design engineer, Brian, who mobilized a network of individuals interested in pursuing innovations in engineering and operating processes. A second cycle involved convening a much larger officially sanctioned three-day gathering to consider the viability of reengineering the prototype process. The third and final cycle involved the core team's convening a senior tier of executives to whom they would present their recommendations. Each of these cycles was built around a multitude of *tertius iungens* joinings.

Tertius iungens activity was also salient in product design issues. Over a five-month period, for example, I observed the successful advocacy for an innovative rubber seal located below the manual shifter console (Obstfeld, 2005b)—the first of its kind at NewCar. The effort was the direct consequence of one engineer's initiating a series of meetings between different clusters of contractors and NewCar functional groups to establish the viability of the innovation and another engineer's introducing a new supplier with unique manufacturing capabilities to the design effort. The final stage of this successful effort depended on the *tertius iungens* activity of two designers, who used a series of digital cross-sectional images cutting through the three-dimensional representations of the design subassembly to coordinate and ultimately forge a consensus on a number of design issues that made the implementation of the innovation possible.

These three examples illustrate the social action that surrounds the move to connect people on a structural level. The theoretical framework for *tertius iungens* activity emphasizes a triadic joining of alters in the pursuit of an innovation that, as Simmel pointed out in discussing the non-partisan, is often an active political process at the microsocial level. To be successful, the *tertius* needs to identify the parties to be joined and establish a basis on which each alter would participate in the joining effort. The logic for joining might be presented to both parties simultaneously or might involve appeals tailored to each alter before the introduction or on an ongoing basis as the project unfolds. Field observations also confirmed that nearly all innovation efforts on the G5 involved *tertius iungens* activity of some sort. In the rare case in which an individual came up with an insight on his or her own, the complex, interdependent nature of the design process necessitated coordinating and joining multiple interests to implement that idea.

Hypothesis 2 predicted that density, or the absence of structural holes, would predict involvement in innovation. As shown in model 1 in table 3, density is significantly related to innovation involvement, supporting hypothesis 2. In model 2, constraint was only marginally significant ($p < .10$).

My ethnographic data also illustrated why dense social networks were important in a variety of G5 innovation efforts. In the program manager's efforts to create a new prototype-building team and process, he first coordinated the support of previously related executive engineers who had to work together on other product design issues. In the second stage, he brought together a manager and several front-line staff, many of whom had established ties. In the second innovation effort described above, although the core group looking to radically alter the corporation's prototyping procurement process spanned six divisions and ranged in rank from front-line professionals to senior managers, five of its core members were previously acquainted and had collaborated sporadically over several years and in some cases decades. Brian re-mobilized the preexisting, cross-departmental network of engineers who had periodically worked and socialized together but whose day-to-day contact was unpredictable. Reflecting on the process before the senior executive presentation, Carl, a member of the core group indicated:

> . . . you have the same people. Brian, myself, Hill, Nelson, Rogers . . . I mean, we were all the team that started it. We've been talking about it to each other and in different changing networks for five, six years now. So basically, we all finally got together, formed this little team. That spurred the [business reengineering effort]. We had the [business reengineering meeting] so everybody bought into what the team wanted and now the team's gotten back together to come up with a real process.

Preexisting ties also surrounded the next two stages of mobilization. The 35 attendees to the three-day reengineering meeting in many cases had already known one another to varying degrees due to their prior association with the prototyping process but had been brought together specifically for the initiative the core team spearheaded. The senior executives who were convened for the core team's subsequent senior-executive-level pitch also knew one another but were strategically selected to establish the joint approval that would allow the core team to go forward with a more detailed proposal.

Three of the four measures associated with knowledge (hypothesis 3) are significant predictors of innovation involvement in the direction hypothesized. Hypothesis 3b is confirmed with social knowledge serving as a highly significant predictor of innovation involvement. In addition, as expected, years in the firm is a significant predictor of innovation involvement and, based on the dummy variable, those with more than one year in the firm have a marginally significant greater probability of being involved with innovation. Also as expected, the higher the education level, the greater is the involvement in innovation. Technical knowledge and innovation involvement are not significantly related.

Ethnographic data showed that the importance of social knowledge concerned how that diverse, behind-the-scenes information aided efforts to marshal support for various initiatives. Participants in these innovation efforts routinely went through repeated discussions concerning the key stakeholders that needed to be linked to an ongoing effort or attracted to a new one. In the following exchange, the program manager (PM) discussed with another manager, Ken, the creation of a meeting to gain support around a key technology initiative:

PM: Parker wants everyone to put their [cards] on the table, drink some Courvoisier, roll some doobies. Jackson wants to be more directive. You don't want one and a half hours of meat, you want a half hour of meat and lots of discussion. . . . I won't let Jackson sandbag us. Morgan will be looking at the ceiling. Sanders will be asleep. Hughes will be [playing with] his moustache. . . . You and Jackson and Parker will be engaged. We need Jack there. We need to do some skeet shooting. Put up the slide . . . "Pull! Bam! Bam! Bam!" [*The PM mimes the shooting of a rifle.*] Talk for 15 minutes and "Pull!" [*The PM again mimes the shooting of a rifle.*]

Ken: The big five. [*Ken thinks five key senior managers need to be invited to the meeting.*]

PM: Sure.

Ken: Steve Sanders.

PM: Sure. My boss.

Ken: Why?

PM: He owns the process.

Though social knowledge was measured at the individual level, the above vignette also shows how individual social knowledge is often supplemented by an interactively generated shared awareness of who knows what.

The core team described above, pursuing the reengineering of the corporate-wide prototype-building process, continually marshaled social intelligence about how to proceed, what stakeholders to appeal to, and who to invite to various of their meetings. The people invited to the reengineering meeting, for example, were carefully selected attendees judged to be receptive to the initiative and who would provide a broad base of support and legitimacy. In a critical meeting, the team took considerable time to determine who should be invited:

Max: We need engineers, we have none yet.

Brian: I can get you all kind of engineers.

Terry: Forward-thinking people like [us]?

Brian: Forward-thinking body guys in Division 1 or Division 2.

Rogers: We need more engineering types from corporate.

Brian: I walked into Hill [a senior manager in the core team] and asked about guys "like us" at corporate and he just shook his head. We can try to get Victor Collins. I can give you Division 1 or Division 2. Division 1, Howard Esterbrook, a smart, smart guy. Division 2, Stanley Gould. . . .

Someone: You have got to have Eatmon there. You either have to channel him or kill him. No one knows the system like Eatmon but it comes with his dark side. . . .

Brian: You know who would jump on this in a moment? Curtis Wald.

Finally, organizational rank is significant in table 3, suggesting that the authority associated with higher organizational rank alone is responsible for innovation involvement and is therefore an important control. Network size in model 1 is not significant.

DISCUSSION AND CONCLUSION

The findings provide strong evidence that a *tertius iungens* orientation, social knowledge, and social network density are independent predictors of innovation involvement within the firm. With the *tertius iungens* and social knowledge measures, structural accounts of innovative action are incorporated and expanded on to specify the social action associated with those who initiate and implement combinative innovation. My field observations suggest more concretely how *tertius iungens* activity and social knowledge interweave in dense networks as innovation efforts unfold.

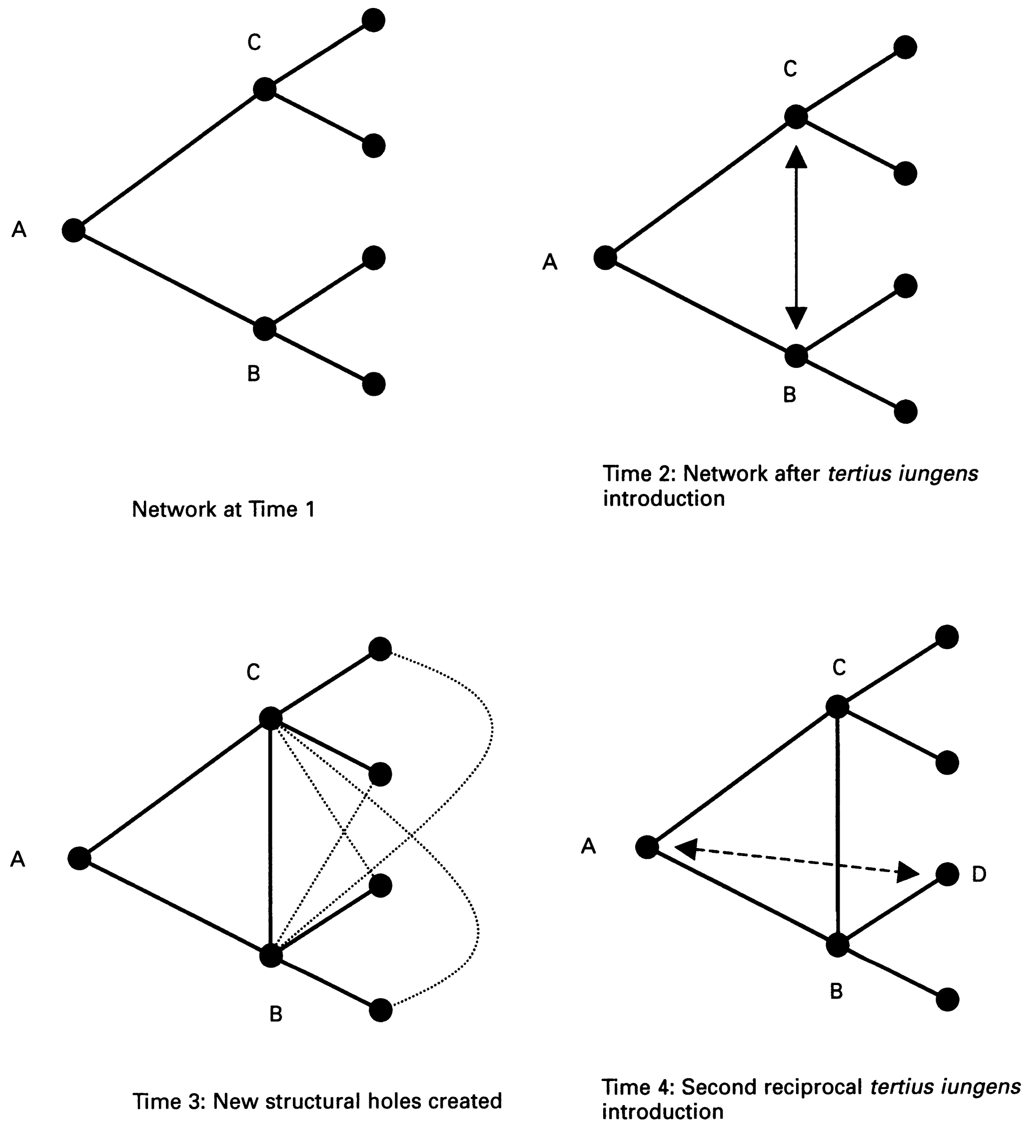
In his work on the triad, Simmel (1950: 154) pointed out two roles for the *tertius:* serving "as a means to the ends of the group" (*tertius iungens)* or using the interaction "for his own purposes" (*tertius gaudens*). Structural holes theory develops the particulars of *tertius gaudens* dynamics in a conception of social organization built around competition and stressing a set of dependent variables that are outcomes of those competitions (e.g., promotions and profit). The language of structural holes theory is often a language of competition, control, relative advantage, and manipulation. Burt (1992: 33) indicated, for example, that the *tertius* may choose to move "accurate, ambiguous, or distorted information" between contacts.

While the *tertius* certainly entertains the option of distorting information, according to Simmel (1950: 147), the non-partisan may also organize information to justify reconciliation "not only in the obvious elimination of misunderstandings or in appeals to good will" but by showing "each part the claims and arguments of the other [and] thus lose the tone of subjective passion which usually provokes the same tone on the part of the adversary." While recognizing the important insights that structural holes theory has provided, it is important to recognize alternative social network mechanisms corresponding to critical corporate processes such as innovation that revolve around more explicitly coordinative action. The *tertius gaudens* and *tertius iungens* orientation, taken together, offer a broader rendering of social network mechanisms and a fuller account of organizational processes and outcomes.

A fundamental premise of structural holes theory is the advantage that ego gains from disconnected alters, an advantage that ego forgoes when he or she introduces those alters, the essential element in the *tertius iungens* orientation. Put differently, networks with structural holes confer a control that the *tertius* sacrifices when he or she connects people through casual introduction or as a part of a more thoughtfully orchestrated project. The *tertius iungens* strategy, however, is not necessarily self-sacrificing or disinterested, because it may create advantages, but of a more indirect type. The *tertius iungens* introduction, while forfeiting the control of a *gaudens* approach, may be generative in indirect ways, as shown in figure 1. At time 1, A has a structural hole between B and C. The introduction of B and C closes the hole (time 2) but may have a second-order generativity of creating structural holes for B and C (at time 3) that may indirectly benefit A. Such an introduction (at time 2) may initiate other virtuous cycles. B, having benefited from the introduction to C, may also take the reciprocal step of introducing A to new node D (time 4). If ego's alters provide such reciprocal introductions of ego to new people, they extend the reach of ego's network, thereby generating new structural holes. Additionally, while newly tied B and C are no longer in a position to be leveraged against one another, they are now in a position to cooperate to support ego as well. The *tertius iungens* logic suggests a different form of action reminiscent of the cooperative strategies found in game theory. The introduction of alters constitutes a loss of control and a certain vulnerability to the subsequent collusion of alters, but along with the potential for longer-term generativity and coordination.

Introductions of alters close holes in A's original network, but such closure may actually constitute the reaping of network potential that may otherwise go unrealized. The action of the *tertius iungens* is not that of cultivating the preexisting competition of structurally equivalent alters but of facilitating, locating, and even forging coordinated action between disparate network members. The commensurability necessary for such action may be ready at hand, in the sense of coordinating predetermined constellations of actors with a shared need and ability to collaborate. Alternatively, the actors to be

Figure 1. How *tertius iungens* activity creates structural holes.



joined, the interests to be shared, the terms of exchange, or even the currency of the pay-off may not be readily apparent. The activity of the *tertius iungens* is most challenging when the nature and prospects for projects are uncertain and the relevant actors to engage are not apparent. In these cases, identifying the different actors to engage and the appeals that will resonate with those actors are the subject of considerable skill, quite discrete from the structure of the social network itself.

Given the potential generativity of triadic introductions, *tertius iungens* activity does not necessarily increase an actor's network density as a consequence, painting the actors who pursue them into dense network corners. This may not occur, first, because, as noted, *tertius iungens* activity generates a social momentum that creates new ties and consequently new structural holes. Introductions may close existing holes but because they also change network structure, they may lead to subsequent introductions that foster the creation of new structural holes. Second, actors who engage in the triadic activity of joining often also engage in a related dyadic activity of forming new ties. For both these reasons, *tertius iungens* activity is dynamic without necessarily driving ego networks toward increasing density.

The greater statistical significance of social network density, as compared with constraint, suggests that the choice of a dependent variable may influence the relevance of the social network measure. While the density measure reflects a level of cohesion necessary for coordinated action, the constraint measure is meant to capture the extent of an individual's dependence on others in his or her network as well as his or her access to novel, non-redundant information (Burt, 1992). As Burt (1992: 54) indicated, "Contact j constrains your entrepreneurial opportunities to the extent that: (a) you've made a large investment of time and energy to reach j, and (b) j is surrounded by few structural holes with which you could negotiate to get a favorable return on investment." Correspondingly, Burt's constraint measure consists of two components, one concerning the proportion of the total relational strength that ego devotes to a given alter in proportion to the sum of relational strengths of all other of ego's alter ties and a second component that is a function of triadic closure (Reagans, Zuckerman, and McEvily, 2004). Despite the strong correlation between constraint and density (.473, $p < .01$, two-tailed test), the constraint measure's failure to correlate with innovation involvement and its limited capacity to predict innovation involvement, compared with density, suggests that its blended emphasis on relative dependence and closure does not correspond with the conditions under which innovation involvement occurred at NewCar.[1]

The importance of dense networks to innovation involvement needs further study. In this study, the importance of density may reflect the types of incremental innovations characteristic of the large-scale automotive design process. None of the innovations in this study qualifies as a radical innovation, and many constituted solutions to well-structured problems. The radical ideas that precede radical innovations may result from the novel information available in sparse (non-dense) networks. NewCar's dense networks may mitigate the potential for radical innovation but facilitate the daunting task of integration and implementation associated with any automotive design process (Gabbay and Zuckerman, 1998). Networks rich in structural holes and the novel information they generate may be more valuable and predictive of innovation in entrepreneurial environments involving more boundary crossing and less intensive sustained collaboration and information exchange. The dense networks found at NewCar may be as strongly predictive of the absence of radical innovation as they are of incremental innovation.

The significance of two direct effects, density and the *tertius iungens* orientation, taken together depict a form of innovative action emphasizing coordination among preexisting ties that is quite distinct from the control and leverage upon which the constraint measure is based. If innovation involves

1
The constraint measure does have a moderate correlation with social knowledge, the most significant independent variable in the study. The constraint measure, however, fails to predict innovation with or without the social knowledge measure in the ordered logit.

marshalling support around new ideas, the incremental, shared nature of NewCar innovation suggests more marshalling than newness is necessary for innovation efforts to proceed. The fact that neither social network measure correlates significantly with the *tertius iungens* orientation suggests that social network structure may create a context for selective coordination but does not explicitly determine it. This low correlation also suggests that *tertius iungens* activity does not necessarily lead to network density. The decoupling of social networks from mechanisms of agency and brokerage suggests a variety of approaches to advocating innovation.

Finally, there are important opportunities for exploring the relationships between network structure and innovation and mobility. Burt (2004) found that structural holes led to good ideas but no evidence that those ideas led to implementation efforts. People discussed good ideas to display competence and to entertain but not necessarily to change business practices. Future work could explore the extent to which structural holes lead to good ideas that appeal to senior management (the evaluators of ideas in Burt's study) without precipitating innovative action. In one scenario, promotions may result from structural holes via the good ideas they spawn without contributing to innovation or implementation.

The strong significance of the social knowledge measure suggests that diverse, behind-the-scenes information and awareness of who knows what is important because it provides a basis for enlistment, translation, and coordination. This suggests a connection between social knowledge and the concept of transactive memory (Wegner, 1987; Liang, Moreland, and Argote, 1995). The social knowledge finding also indicates the importance of considering knowledge independent of social networks, rather than using structural holes as a proxy for knowledge access (Rodan and Galunic, 2004). Consistent with Burt's argument that information benefits accrue to social networks high in structural holes, the constraint measure was negatively correlated with social knowledge (–.182, $p < .05$, two-tailed test). Despite this correlation, social knowledge, independent of the social network and in the highly technical engineering context of the study, was the strongest predictor of innovation involvement.

My field observations suggest that it was not only the possession of knowledge but the ability to articulate, or make social and technical knowledge more explicit, usable, and relevant to the situation at hand, that determined the success of innovation efforts (Obstfeld, 2005a). Field observations indicate that innovators made use of a toolkit of articulation devices (e.g., metaphors, analogies, stories, informal sketches, humor, and perspective taking) through which they articulated knowledge in a number of domains (product, process, relational, political, and organizational culture). Further study can examine whether such articulation devices provide the means by which brokers establish a common ground around which alters converge to collaborate on a project or course of action. If so, the articulation process may be one means by which *tertius iungens* brokers drive collaborative action and knowledge creation (Nonaka and Takeuchi, 1995).

The *tertius iungens* orientation and social knowledge constitute a set of agency-related factors that complement social structure (e.g., social networks) as predictors of social action. The innovations in this study display a moderate degree of the "maneuverability, inventiveness, and reflective choice" that Emirbayer and Mische (1998: 964) associated with agency and underscore the collective action that underpins successful innovation efforts within the firm. By using both social networks and the social processes that surround them, this study presents a model of action that addresses the need to integrate structure and agency (Emirbayer and Goodwin, 1994; Emirbayer and Mische, 1998).

The *tertius iungens* may be a foundation for what Fligstein (2001: 106) called social skill, or the ability to induce cooperation in others, which he asserted is critical to the "emergence, stability, and transformation of many kinds of local orders." The pursuit of *tertius iungens* strategies as an element of social skill is supported by the following observation of the G5 program manager:

> How many move networks proactively? Tony Nelson, Jim Williams, Charlie Collins. You're not so naïve as to think that everyone knows about this stuff? Most people spend their entire lives coming to understand functional [responsibilities]. They operate within that and a couple of other relationships. . . . getting the job done faster. Few recognizing there's some ways to get things done.

Different contexts may dictate the need for dense or sparse networks for innovation but require *tertius iungens* skill as a constant. While examining social action in a more micro context than Fligstein's institutional perspective, this study shares the same microsocial level of analysis from which change or stability emerges. The connection between strategic orientations and social skill, as well as their link to more macro processes such as institutional entrepreneurship (DiMaggio, 1988), remains to be investigated. Further, greater attention to different strategic orientations and network content may provide a better understanding of the micromechanisms of network formation on multiple levels of analysis.

The study of *tertius iungens* activity has other implications for markets and collective action that extend through and beyond innovative action. One logical extension of *tertius gaudens*, as Simmel pointed out, is market activity and the way buyers can play merchants off one another for the best price. Another function of markets, however, is to enable buyers and sellers to find one another, at root a *tertius iungens* function (Baker and Obstfeld, 1999; Khurana, 2002; Pollock, Porac, and Wade, 2004). Similarly, the creation of markets or alliances where none previously existed ought to be understood as *tertius iungens* activity. A grasp of markets as constituted by both *gaudens* and *iungens* activity captures a substantial amount of market activity that an exclusively competitive framework overlooks.

The *tertius iungens* may also specify the root of collective action. Granovetter (1973) speculated that the failure of the Italian community of Boston's West End to form an organization to fight urban renewal despite its cohesiveness (Gans, 1962) might have been due to a lack of bridging weak ties that would have knitted the community together in opposition. A subsequent exchange between Granovetter and Gans (Gans, 1974; Granovetter, 1974) also considered the West Enders' reluctance to engage in political activities and the absence of influential activists, "hop-skip" people (Jacobs, 1961), that might have brought together disparate parts of the community. The West Enders' failure to mobilize may also have involved the lack of a more subtle community-wide propensity to introduce disconnected alters and facilitate ties that would have allowed collective action to proceed. West Enders may have lacked a distribution of the *tertius iungens* skill for knitting together the collective action projects necessary to resist the urban planners. If innovation is understood as a form of collective action, the very same mechanics are often at work in organizations (Obstfeld, 2005c). Many of the NewCar innovation advocates described above were shaped by a cultural tradition that had selectively spawned and supported *tertius iungens* behavior for decades. Organizations that want to foster such behavior may consider the extent to which such *tertius iungens* behavior is permitted, cultivated, and passed tacitly from one employee cohort to the next.

This study has certain limitations necessitating further research. The dependent variable, innovation involvement, only identifies successfully implemented innovations and thus leaves unanswered whether the dependent variable captures involvement in innovation only or a more generic level of involvement common to a variety of innovation and non-innovation activities. The measure also does not capture the differential impact of innovations or the potential for individuals to be involved in more than one innovation. The study also has limited longitudinal data in the form of ethnographic observations only; the individual-level and survey data are from one point in time. It is assumed, for example, that individual social networks and social knowledge preceded innovation involvement, and the ethnographic data support this assumption, but there is no way to rule out that these independent variables may have been altered as a consequence of prior innovation-related activity. Further, ego-network data gathering presents an opportunity to use a statistical sampling measure across a broad population and systemically capture network ties outside of a given organizational community, but it brings with it certain problems. Alter-alter network ties are based on respondents' impressions of the relationships between third parties and are subject to systematic bias (Krackhardt and Kilduff, 1999). Other social network data collection approaches provide more accurate information. Relatedly, egocentric measures that focus only on direct connections between alters are incomplete indicators of the bridging associated with structural holes because such measures fail to capture whether alters actually belong to different clusters or social circles (Reagans, Zuckerman, and McEvily, 2004). In addition, the ego-network approach here combined all networks into one, when other approaches might have allowed for comparison between different constituent types of networks (e.g., buy-in versus informational networks). The measure of technical knowledge relies on a single self-report item, and multiple items would have been preferable. Finally, this study focuses on innovation involvement and, in so doing, does not capture the effects of the independent variables on other activities associated with job or team performance (Welbourne, Johnson, and Erez, 1998). It therefore does not provide a full picture of the role of innovation in the context of these other activities.

This study contributes to social network theory by identifying the *tertius iungens* mechanism as a fundamental pattern of action that accounts for innovation involvement independent of network density. The study also suggests a strong link between social network density and innovation in some within-firm contexts. As Law and Callon (1988: 284) suggested, "Engineers are not just people who sit in drawing offices and design machines, they are also, willy nilly, social activists." The *tertius iungens* orientation suggests one form this social activism might take. The model of innovation involvement proffered—social networks, the *tertius iungens* orientation, and the use of social knowledge—is suggestive of the mechanics that lead to organizational and institutional change as well.

REFERENCES

Adler, P., and S.-W. Kwon
2002 "Social capital: Prospects for a new concept." Academy of Management Review, 27: 17–40.

Ahuja, G.
2000 "Collaboration networks, structural holes, and innovation: A longitudinal study." Administrative Science Quarterly, 45: 425–455.

Allen, T. J.
1977 Managing the Flow of Technology. Cambridge, MA: MIT Press.

Arrow, K.
1974 The Limits of Organization. New York: Norton.

Bagozzi, R. P., Y. Yi, and L. W. Phillips
1991 "Assessing construct validity in organizational research." Administrative Science Quarterly, 36: 421–458.

Baker, W. E.
2000 Achieving Success Through Social Capital: Tapping Hidden Resources in Your Personal and Business Networks. San Francisco: Jossey-Bass.

Baker, W. E., and D. Obstfeld
1999 "Social capital by design: Structures, strategies, and institutional context." In R. T. Leenders and S. M. Gabbay (eds.), Corporate Social Capital and Liability: 89–105. Boston: Kluwer Academic.

Bateman, T. S., and J. M. Crant
1993 "The proactive component of organizational behavior: A measure and correlates." Journal of Organizational Behavior, 14: 103–118.

Borgatti, S. P., M. G. Everett, and L. C. Freeman
2002 UCINET for Windows: Software for Social Network Analysis. Natick, MA: Analytic Technologies.

Brass, D. J., and M. E. Burkhardt
1993 "Potential power and power use: An investigation of structure and behavior." Academy of Management Journal, 36: 441–470.

Brown, J. S., and P. Duguid
1991 "Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation." Organization Science, 2: 40–57.
2001 "Knowledge and organization: A social-practice perspective." Organization Science, 12: 198–213.

Burt, R. S.
1992 Structural Holes: The Social Structure of Competition. Cambridge, MA: Harvard University Press.
1997 "The contingent value of social capital." Administrative Science Quarterly, 42: 339–365.
2000 "The network structure of social capital." In R. I. Sutton and B. M. Staw (eds.), Research in Organizational Behavior, 22: 345–423. New York: Elsevier/JAI.
2004 "Structural holes and good ideas." American Journal of Sociology, 110: 349–399.

Carlile, P. R.
2002 "A pragmatic view of knowledge and boundaries: Boundary objects in new product development." Organization Science, 13: 442–455.

Cohen, W. M., and D. A. Levinthal
1990 "Absorptive capacity: A new perspective on learning and innovation." Administrative Science Quarterly, 35: 128–152.

Coleman, J. S.
1988 "Social capital in the creation of human capital." American Journal of Sociology, 94: S95–S120.
1988 "Interest and agency in institutional theory." In L. G. Zucker (ed.), Research on Institutional Patterns: Environment and Culture: 3–21. Cambridge, MA: Ballinger.

DiMaggio, P. J.
1992 "Nadel's paradox revisited: Relational and cultural aspects of organizational structure." In N. Nohria and R. G. Eccles (eds.), Networks and Organizations: Structure, Form, and Action: 118–142. Boston: Harvard Business School Press.

Dougherty, D.
1992 "Interpretive barriers to successful product innovation in large firms." Organization Science, 3: 179–202.

Emirbayer M., and J. Goodwin
1994 "Network analysis, culture, and the problem of agency." American Journal of Sociology, 99: 1411–1454.

Emirbayer M., and A. Mische
1998 "What is agency?" American Journal of Sociology, 103: 962–1023.

Erez, M., and P. C. Earley
1987 "Comparative analysis of goal setting strategies across cultures." Journal of Applied Psychology, 72: 658–665.

Fernandez, R. M., and R. V. Gould
1994 "A dilemma of state power: Brokerage and influence in the national health policy domain." American Journal of Sociology, 99: 1455–1491.

Fligstein, N.
2001 "Social skill and the theory of fields." Sociological Theory, 19: 105–125.

Frese, M., and D. Fay
2001 "Personal initiative: An active performance concept for work in the 21st century." In B. M. Staw and R. I. Sutton (eds.), Research in Organizational Behavior, 23: 133–187. New York: Elsevier/JAI.

Gabbay, S. M., and E. W. Zuckerman
1998 "Social capital and opportunity in corporate R&D: The contingent effect of contact density on mobility expectations." Social Science Research, 27: 189–217.

Galaskiewicz, J., and S. Wasserman
1994 "Introduction: Advances in social and behavioral sciences from social network analysis." In S. Wasserman and J. Galaskiewicz (eds.), Advances in Social Network Analysis: xi–xvii. Thousand Oaks, CA: Sage.

Gans, H. J.
1962 The Urban Villagers. New York: Free Press.
1974 "Gans on Granovetter's 'Strength of weak ties.'" American Journal of Sociology, 20: 524–526; 529–531.

Granovetter, M.
1973 "The strength of weak ties." American Journal of Sociology, 78: 1360–1379.
1974 "Granovetter replies to Gans." American Journal of Sociology, 20: 527–529.
2005 "The impact of social structure on economic outcomes." Journal of Economic Perspectives, 19: 33–50.

Grant, R. M.
1996 "Toward a knowledge-based theory of the firm." Strategic Management Journal, 17: 109–122.

Hansen, M. T.
1999 "The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits." Administrative Science Quarterly, 44: 82–111.

Hargadon, A.
2002 "Brokering knowledge: Learning and innovation." In R. I. Sutton and B. M. Staw (eds.), Research in Organizational Behavior, 24: 41–85. New York: Elsevier/JAI.
2003 How Breakthroughs Happen: The Surprising Truth about How Companies Innovate. Boston: Harvard Business School Press.

Hargadon, A., and R. I. Sutton
1997 "Technology brokering and innovation in a product development firm." Administrative Science Quarterly, 42: 716–749.

Henderson, R., and K. B. Clark
1990 "Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms." Administrative Science Quarterly, 35: 9–30.

Hernes, R.
1998 "Real virtuality." In P. Hedstrom and R. Swedberg (eds.), Social Mechanisms: An Analytical Approach to Social Theory: 74–101. Cambridge: Cambridge University Press.

Higgins, T.
1998 "Promotion and prevention: Regulatory focus as a motivational principle." In M. P. Zanna (ed.), Advances In Experimental Social Psychology, 30: 1–46. San Diego: Academic Press.

Hitt, M. A., L. Bierman, K. Shimizu, and R. Kochhar
2001 "Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective." Academy of Management Journal, 44: 13–28.

Howell, J. M., and C. A. Higgins
1990 "Champions of technological innovation." Administrative Science Quarterly, 35: 317–341.

Ibarra, H.
1989 "Centrality and innovativeness: Effects of social network position on innovation involvement." Unpublished Ph.D. thesis, Yale University.
1993a "Network centrality, power, and innovation involvement: Determinants of technical and administrative roles." Academy of Management Journal, 36: 471–501.
1993b "Personal networks of women and minorities in management: A conceptual framework." Academy of Management Review, 18: 56–87.

Jacobs, J.
1961 Death and Life of Great American Cities. New York: Random House.

Jelinek, M., and C. B. Schoonhoven
1990 The Innovation Marathon. San Francisco: Jossey-Bass.

Kaplan, A. W.
1993 "Generating interest in solar power: Familiarity and photovoltaic adoption among electric utility managers." Unpublished Ph.D. thesis, University of North Carolina at Chapel Hill.

Katz, R., and M. L. Tushman
1981 "An investigation into the managerial roles and career paths of gatekeepers and project supervisors in a major R&D facility." R&D Management, 11: 103–110.

Khurana, R.
2002 "Market triads: A theoretical and empirical analysis of market intermediation." Journal for the Theory of Social Behavior, 32: 239–262.

Kilduff, M., and D. Krackhardt
1994 "Bringing the individual back in: A structural analysis of the internal market for reputation in organizations." Academy of Management Journal, 37: 87–108.

Kogut, B., and U. Zander
1992 "Knowledge of the firm, combinative capabilities, and the replication of technology." Organization Science, 3: 383–397.

Krackhardt, D.
1990 "Assessing the political landscape: Structure, cognition, and power in organizations." Administrative Science Quarterly, 35: 342–369.

Krackhardt, D., and M. Kilduff
1999 "Whether close or far: Social distance effects on perceived balance in friendship networks." Journal of Personality and Social Psychology, 76: 770–782.

Lave, J., and E. Wenger
1991 Situated Learning: Legitimate Peripheral Participation. Cambridge: Cambridge University Press.

Law, J., and M. Callon
1988 "Engineering and sociology in a military aircraft project: A network analysis of technological change." Social Problems, 35: 284–297.

Levine, J. M., E. T. Higgins, and H.-S. Choi
2000 "Development of strategic orientations in groups." Organizational Behavior and Human Decision Processes, 82: 88–101.

Liang, D., R. Moreland, and L. Argote
1995 "Group versus individual training and group performance: The mediating role of transactive memory." Personality and Social Psychology Bulletin, 21: 384–393.

Marsden, P. V.
1982 "Brokerage behavior in restricted exchange networks." In P. V. Marsden and N. Lin (eds.), Social Structure and Network Analysis: 201–218. Beverly Hills, CA: Sage.

Marsden, P. V., and N. E. Friedkin
1994 "Network studies of social influence." In S. Wasserman and J. Galaskiewicz (eds.), Advances in Social Network Analysis: 3–25. Thousand Oaks, CA: Sage.

Mayhew, B.
1980 "Structuralism versus individualism: I—Shadowboxing in the dark." Social Forces, 59: 335–375.

Mehra, A., M. Kilduff, and D. J. Brass
2001 "The social networks of high and low self-monitors: Implications for workplace performance." Administrative Science Quarterly, 46: 121–146.

Nahapiet, J., and S. Ghoshal
1998 "Social capital, intellectual capital, and the organizational advantage." Academy of Management Review, 23: 242–266.

Nonaka, I., and H. Takeuchi
1995 The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. New York: Oxford University Press.

Obstfeld, D.
2005a "Saying more and less of what we know: Knowledge articulation and the social processes of knowledge creation and innovation." Working paper, Graduate School of Management, University of California, Irvine.
2005b "Projects and routines: Toward a less-routine theory of organizing." Working paper, Graduate School of Management, University of California, Irvine.
2005c "Engineering knowledge: Innovation and knowledge creation as collective action." Working paper, Graduate School of Management, University of California, Irvine.

Okhuysen, G., and K. Eisenhardt
2002 "Integrating knowledge in groups: How formal interventions enable flexibility." Organization Science, 13: 370–383.

Podolny, J. M., and J. N. Baron
1997 "Resources and relationships: Social networks and mobility in the workplace." American Sociological Review, 62: 673–693.

Pollock, T. G., J. F. Porac, and J. B. Wade
2004 "Constructing deal networks: Brokers as network 'architects' in the U.S. IPO market and other examples." Academy of Management Review, 29: 50–72.

Putnam, R.
2000 Bowling Alone: The Collapse and Revival of American Community. New York: Simon and Schuster.

Rahim, M. A., and N. R. Manger
1995 "Confirmatory factor analysis of the styles of handling interpersonal conflict: First-order factor model and its invariance across groups." Journal of Applied Psychology, 80: 122–132.

Raykov, T., and G. A. Marcoulides
2000 A First Course in Structural Equation Modeling. Mahwah, NJ: Erlbaum.

Reagans R., and B. McEvily
2003 "Network structure and knowledge transfer: The effects of cohesion and range." Administrative Science Quarterly, 48: 240–267.

Reagans, R., E. W. Zuckerman, and B. McEvily
2004 "Two holes in one?: Information and control in the analysis of structural advantage." Working paper, Columbia Business School, Columbia University.

Rodan S., and C. Galunic
2004 "More than network structure: How knowledge heterogeneity influences managerial performance and innovativeness." Strategic Management Journal, 25: 541–562.

Saucier, G.
1994 "Mini-markers: A brief version of Goldberg's unipolar Big-Five markers." Journal of Personality Assessment, 63: 506–516.

Schumpeter, J. A.
1934 Theory of Economic Development, Cambridge, MA: Harvard University Press.
1942 Capitalism, Socialism, and Democracy. New York: Harper and Row.

Simmel, G.
1950 The Sociology of Georg Simmel. Trans. by K. H. Wolff. Glencoe, IL: Free Press.

Spender, J. C.
1996 "Making knowledge the basis of a dynamic theory of the firm." Strategic Management Journal, 17: 45–62.

Triandis, H. C., R. Bontempo, M. Villareal, M. Asai, and N. Lucca
1988 "Individualism and collectivism: Cross-cultural perspectives on self-ingroup relationships." Journal of Personality and Social Psychology, 54: 323–338.

Tushman, M. L.
1978 "Special boundary roles in the innovation process." Administrative Science Quarterly, 22: 587–605.

Tushman, M. L., and W. L. Moore
1988 Readings in the Management of Innovation. Cambridge, MA: Ballinger.

Tushman, M. L., and T. J. Scanlan
1981 "Boundary spanning individuals: Their role in information transfer and their antecedents." Academy of Management Journal, 24: 289–305.

Uzzi, B.
1997 "Social structure and competition in interfirm networks: The paradox of embeddedness." Administrative Science Quarterly, 42: 35–67.

Van de Ven, A. H.
1986 "Central problems in the management of innovation." Management Science, 32: 590–607.

Wagner, J. A., III
1995 "Studies of individualism-collectivism: Effects on cooperation in groups." Academy of Management Journal, 38: 152–172.

Wegner, D.
1987 "Transactive memory: A contemporary analysis of the group mind." In B. Mullen and G. R. Goethals (eds.), Theories of Group Behavior: 185–205. New York: Springer-Verlag.

Welbourne, T., D. Johnson, and A. Erez
1998 "The role-based performance scale: Validity analysis of a theory based measure." Academy of Management Journal, 41: 540–555.

Wenger, E.
1998 Communities of Practice. Cambridge: Cambridge University Press.