Social Origins of Good Ideas

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University of Chicago and Raytheon Company
Address: Graduate School of Business, University of Chicago, Chicago, IL 60637;
(773-702-0848; ron.burt@gsb.uchicago.edu; http://gsb.uchicago.edu/fac/ronald.burt)

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This paper is about social structure defining an advantage in creating good ideas, and people reproducing the social structure as they discuss their ideas. My hypothesis is that people who live in the intersection of social worlds are at higher risk of having good ideas. Qualifications come immediately to mind, but the gist of the hypothesis is familiar and makes intuitive sense: ways of thinking and behaving are more homogenous within than between groups, so people connected to otherwise segregated groups are more likely to be familiar with alternative ways of thinking and behaving — which gives them the option of selecting and synthesizing alternatives. I describe anecdotal and aggregate evidence consistent with the hypothesis, but my purpose in this paper is to study the hypothesis in finer detail at the level of individual managers, linking ideas with network measures of social capital known to be associated with manager performance. I use archival and survey data on 673 managers in the supply chain of a large American electronics company in 2001 to show how compensation, positive performance evaluations, promotions, and good ideas were disproportionately in the hands of managers rich in the social capital of brokering connections across structural holes. Managers whose networks more often spanned structural holes were more likely to express their ideas, less likely to have their ideas dismissed by senior management, and more likely to have their ideas evaluated as valuable. Having a good idea is distinct from doing something with it. Managers typically discussed their ideas with socially convenient authority, thus reproducing the social structure. Good ideas emerged from the intersection of social worlds, but spread in a way that would continue segregation between the worlds.

There are internal and external factors in the origins of good ideas. Internal factors are the more immediate: you encounter a good idea and attribute to its source intellectual ability, a fresh perspective, a productive way of thinking, a creative personality, or some other quality of the individual that enabled him or her to generate the good idea. Beyond the individual are external factors, qualities of the social context around the individual that constitute an advantage in generating good ideas. Some external factors are renovations of the internal. Age is a personal attribute negatively associated with creating good ideas in science (e.g., Stephan and Levin, 1992, for

review), but beyond the internal factors of youthful energy and skills is the social factor of a new generation less invested in the prevailing paradigm (Kuhn, 1962; bluntly phrased in Planck's, 1949:33, comment: "a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die"). Of course, the external exists in its own right. A magisterial example is Collins (1998) describing prominent philosophical ideas traced back to the social structure around the people who proposed the ideas.

This paper is about external factors. It is about social structure defining an advantage in creating good ideas, and people reproducing the social structure as they discuss their ideas. The sociological hypothesis argued here could be used to advantage in distinguishing cognitive structures prone to creativity, however that argument is for another paper. Here I focus on the social structures in which good ideas disproportionately occur.

The setting is illustrated in Figure 1. Dots are people or groups. Lines are relations. The dots and lines are a network sociogram. The sociogram in Figure 1 shows a bridge-and-cluster structure: people sharing a specialization are densely connected within a cluster, and clusters are integrated across the network by occasional bridge relations between clusters. I enlarged a segment in Figure 1 to highlight four clusters: A, B, and C are groups in the usual sense of cohesion indicated by relations more dense within than beyond the group (density table shows average relations within and between groups), and D is a cluster defined by structural equivalence rather than cohesion among its members (density table shows that people in cluster D have stronger relations with group C than with one another). Whatever the level of analysis — communities or nations in geographic clusters, people in project groups, or bits in a cognitive cluster — the bridge-and-cluster structure is found in a wide variety of circumstances (Watts and Strogatz, 1998). People specialize within clusters, build bridges to integrate across clusters. The setting is a generic division of labor familiar from Durkheim (1893), but focused on network structures within and between cluster specializations. Work on factors responsible for the emergence of such structures is illustrated in economics by Becker and Murphy (1992) on the incentives to integrate rather than specialize, and in sociology by Feld (1981) on the

social foci responsible for network clusters, building on Festinger, Schachter, and Back's (1950) analysis of location effects in network formation and Blau's (1977) work on the parameters of social structure.

An analytical implication of bridge-and-cluster structures is the two leadership roles illustrated by Robert and James in Figure 1. James illustrates the network principle of cohesion, or network closure. The people with whom James discusses work are densely connected with one another within the same cluster. James is positioned to better integrate people sharing the same specialization. Robert illustrates the network principle of brokerage. The people with whom Robert discusses work are disconnected from one another across multiple clusters. Robert is positioned to integrate across specializations.

——— Figure 1 About Here ———

Belief and behavioral implications of the analytical duality illustrated by Robert and James have been the subject of extensive work — for example, Merton (1948a) and Katz and Lazarsfeld (1955) on the diffusion of tastes through cosmopolitan "opinion leaders" whose relationships bridge the gaps between social worlds (cf. Burt, 1999), Milgram (1967; Travers and Milgram, 1969) on the "small world" phenomenon in which people at great geographic remove can communicate with one another through surprisingly few intermediaries because of bridges between social worlds (cf. Watts, 1999), Granovetter (1973) on the critical role that "weak ties" would play in information access and flow if bridge relationships were weak rather than strong relationships, Burt (1982, 1992) on the information access and control advantages created when networks span the "structural holes" between social groups, or Padgett and Ansell (1993) on the "robust action" made possible when networks span the structural holes between groups.

One can see a broad theme in this work: information, beliefs, and behaviors are more homogeneous within than between groups. Most people focus on activities inside their own group, which creates holes in the flow of information between groups, or more simply, structural holes. People with contacts in separate groups are in a position to broker the flow of information across structural holes. Brokerage is social capital in that brokers have a competitive advantage in creating value with projects

that integrate otherwise separate ways of thinking or behaving. Consistent with the social capital prediction, managers with networks that span structural holes tend to receive more positive performance evaluations, faster promotions, higher compensation, and participate in more successful teams (Burt, 2000, for review).

Brokerage opens up opportunities for people to create value, but the value only happens if people act on their opportunities. Beyond work reporting a correlation between brokerage and performance lies work on processes by which people harvest the value buried in structural holes. Having contacts in other groups can be an advantage in recognizing and implementing valuable projects, which then results in the observed correlation between brokerage and performance (e.g., Burt, 2002).

Processing and distributing information is the key to the association. Imagine four levels of brokerage by which a person could create value by spanning the structural hole between two groups: The simplest act of brokerage is to make people on both sides of the hole aware of interests and difficulties in the other group; so much conflict and confusion in organizations seems to result from misunderstandings of the constraints on colleagues in other groups. Transferring best practice is a higher level of brokerage. People familiar with activities in two groups are better able than people confined within either group to see how a belief or practice in one group could create value in the other, and to know how to translate the belief or practice into language digestible in the target group. A third level of brokerage is to draw analogy between groups ostensibly irrelevant to one another. Something about the way in which those people think or behave has implications for the value of operations in my group. This step can be difficult for people who have spent a long time inside one group. Such people often look for differences between themselves and others to justify their assertion that "our situation is different" so they can feel comfortable ignoring beliefs and behaviors different from their own. Differences can always be found if one wants to find them. The question is whether there are by analogy elements of belief or practice in one group that could have value in another. Synthesis is a fourth level of brokerage. People familiar with activities in two groups are more likely to see new beliefs or behaviors that combine elements from both groups.[1]

A conclusion across the stories one could tell about the relevance of these four levels to specific industries or organizations is that brokers are critical to learning and creativity. People whose networks span structural holes have early access to diverse, often contradictory, information and interpretations which gives them a competitive advantage in delivering good ideas. To be sure, ideas come over a variety of paths from a variety of sources (e.g., Von Hippel, 1988; Geroski and Mazzucato, 2002), but idea generation at some point involves a broker moving knowledge from this group to that or combining bits of knowledge across groups. People connected to groups beyond their own can expect to find themselves delivering valuable ideas, seeming to be gifted with creativity. This is not creativity born of deep intellectual ability. It is creativity as an import-export business. An idea mundane in one group can be a valuable insight in another. Value is defined by the idea recipient, not its source. An idea is no less valuable to its recipients because there are people elsewhere who do not value it. The certain path to feeling creative is to find a constituency more ignorant than yourself. This is a familiar phenomenon in academic work. We specialize in certain methods, theories, and topics. It is impossible to keep up with developments in all specialties. It would be inefficient if it were possible. We appreciate the visitor, familiar with developments in a distant speciality, who shows how those developments can add value to our own work. In sum, my hypothesis is that good ideas come disproportionately from people whose networks span structural holes.

ANECDOTAL EVIDENCE

Evidence for the hypothesis can be found in the opinions of prominent creatives. In an often-cited lecture on the influence of commerce on manners, Adam Smith (1766, 539) noted that; "When the mind is employed about a variety of objects it is some how expanded and enlarged." Swedberg (1990, 3) begins his book of interviews with leading academics working across the boundary between economics and sociology with John Stuart Mills' (1848, 581) opinion: "It is hardly possible to overrate the value . . . of placing human beings in contact with persons dissimilar to themselves, and with modes of thought and action unlike those with which they are familiar. . . . Such

communication has always been, and is peculiarly in the present age, one of the primary sources of progress." Jean-René Fourtou, former CEO of the French chemical giant Rhône-Poulenc, observed that his scientists were stimulated to their best ideas by people outside their own discipline. Fourtou emphasized le vide — literally, the emptiness; conceptually, what I have discussed as structural holes — as essential to creative work (Stewart, 1996, 165): "Le vide has a huge function in organizations. . . . Shock comes when different things meet. It's the interface that's interesting. . . . If you don't leave le vide, you have no unexpected things, no creation. There are two types of management. You can try to design for everything, or you can leave le vide and say, 'I don't know either; what do you think?'" Biochemist Alex Zaffaroni is an exemplar. A former subordinate is quoted in an INSEAD video case explaining Zaffaroni's value to his organization: ". . . he is reading and thinking very widely. He is totally unafraid of any new technology in any area of human creativity. He has wonderful contacts with people in many different areas, so he sees the bridges between otherwise disparate fields."[2]

Archives on historical figures describe brokerage and ideas in wider perspective. For example, Caro (1982, Chapter 15) describes Lyndon Johnson's creation of a Washington power base in 1933 from the "Little Congress," through which he brokered connections between journalists and prominent people in government. Dalzell (1987, Part I) describes Francis Lowell's role as broker in creating the American cotton industry. DiMaggio (1992, especially 129-130) describes Paul Sachs role as broker in establishing the Museum of Modern Art in New York; "Sachs could employ his talents precisely because his strong ties to sectors that had previously been only weakly connected — museums, universities, and finance — placed him at the center of structural holes that were critical to the art world of his time." Padgett and Ansell (1993) describe Cosimo de Medici's use of his contacts with opposing elite family factions to establish his Medicean political party in Renaissance Florence. McGuire and Granovetter (forthcoming) describe Samuel Insull's use of his network of contacts in finance, politics, and technology to shape the electric utility industry at the turn of the century (cf. Sediatis, 1998, especially 373-374, on the greater flexibility, adaptability, and volume of business in Russian commodity markets created by organizers who had

little previous contact with one another, and Granovetter, 2002, on polycentric networks facilitating economic cooperation).

In his panoramic analysis of the history of philosophy, Collins (1998) presents sociograms of the intergenerational social networks among philosophers to illustrate his argument that the philosophers of greatest repute tend to be personal rivals representing conflicting schools of thought for their generation (Collins, 1998, 76); "The famous names, and the semi-famous ones as well who hold the stage less long, are those persons situated at just those points where the networks heat up the emotional energy to the highest pitch. Creativity is the friction of the attention space at the moments when the structural blocks are grinding against one another the hardest."

AGGREGATE EVIDENCE

There is also evidence at the aggregate level of organizations. In particular, it has been popular to study the ways in which technological change affects social structure at the same time that social structure affects technological advance (e.g., Barley, 1990, 92-95, provides crisp illustration with network data). Electronics and biotechnology have been favored research sites, with Walter Powell (e.g., Powell and Brantley, 1992; Powell, Koput and Smith-Doerr, 1996; Powell et al., 1999; Koput and Powell, 2000) and Toby Stuart (Stuart, 1998; Stuart, Hoang and Hybels, 1999; Stuart and Podolny, 1999; Stuart and Robinson, 2000) prominent ports of entry into the work. More generally, Kogut (2000) builds on a series of studies (e.g., Shan, Walker and Kogut, 1994; Zander and Kogut, 1995; Kogut and Zander, 1996; Walker, Kogut and Shan, 1997) to propose a network theory of the firm in which value is derived from a firm's ability to create and lay claim to knowledge derived from its membership and participation in networks (cf. Nahapiet and Ghoshal 1998, on social capital and knowledge; Powell and Smith-Doerr, 1994, on information issues in the economic sociology of networks, especially with respect to interorganization networks). Structural holes are a correlate of organizational learning, often discussed in terms of an organization's ability to learn — what Cohen and Levinthal (1990, 128) describe as an organization's absorptive capacity: "the ability of a firm to recognize the value of

new, external information, assimilate it, and apply it to commercial ends," which can be studied in terms of industry factors that facilitate absorption (e.g., Cohen and Levinthal, 1990) and external networks that enhance an organization's absorptive capacity (e.g., Cockburn and Henderson, 1998; see Knoke, 2001, 362ff. for review).

Organizations with management and collaboration networks that more often bridge structural holes in their markets learn faster and are more productively creative. Sutton and Hargadon (1996) describe processes by which a firm, IDEO, used brainstorming to create product designs, and then clarify in Hargadon and Sutton (1997) the brokerage function served. The firm's employees work for clients in diverse industries. In the brainstorming sessions, technological solutions from one industry were used to solve client issues in other industries where the solutions are rare or unknown. The firm profited, in other words, from employee bridge relations through which they brokered the flow of technology between industries (cf. Allen and Cohen, 1969, on gatekeepers; Lazega and Pattison, 2001, on network management of the status auction). Fleming (2002) describes a similar process within Hewlett-Packard: policy was to move engineers between projects rather than having each project hire and fire individually. The result was that HP technologies were constantly being mixed in new combinations. As a senior engineer described the experience (Fleming, 2002:1073): "I had to work in a single field for only two or three years and then like magic it was a whole new field; a paradise for creativity."

Drawing comparisons across companies, McEvily and Zaheer (1999) report greater access to competitive ideas for small manufacturers with more non-redundant sources of advice beyond the firm (and McEvily and Marcus, 2002, show lower absorptive capacity when the sales network is concentrated in a single customer). Stuart and Podolny (1999) report a higher probability of innovation from semiconductor firms that establish alliances with firms outside their own technological area. Comparing the biotechnology districts in Minneapolis and Philadelphia, Llobrera, Meyer and Nammacher (2000) attribute the growth and adaptation of Philadelphia's district to its many overlapping but non-redundant networks around organizations in the district. Ahuja (2000) reports higher patent output for organizations that hold broker positions in the network of joint ventures or alliances at the top of their industry.

Baum, Calabrese and Silverman (2000) study Canadian companies in biotechnology for their growth in revenues, number of patents granted, and the extent to which a company had multiple kinds of alliance partners at start-up. Companies with a heterogeneous mix of alliance partners tended to enjoy faster revenue growth, and a dramatic advantage in obtaining patents. Koput and Powell (2000) report higher earnings and survival chances of biotechnology firms with more kinds of activities in alliances with more kinds of partner firms. Lofstrom (2000) asked scientists, physicians, and engineers how much they learned from their firm's participation in an alliance intended to develop or extend a medical device technology. Individuals with a more non-redundant contacts, especially contacts within their own firm, were more likely to report that they had "learned a great deal" in the alliance. Podolny (2001) describes venture-capital firms spanning structural holes by linking co-investors not otherwise investing together. Firms with a "deal-flow" network more often spanning structural holes more often invested in early product development — where the information benefits of spanning structural holes could be a competitive advantage in detecting potentially valuable ideas — and were more successful in developing their early-stage investments into profitable IPOs (cf. Beckman and Haunschild, 2002, on firms with more heterogeneous boards of directors paying lower premiums for acquisitions; Ruef, 2002, on the tendency for entrepreneurs "attempting to combine disparate ideas or routines" to discuss their venture with varied kinds of contacts; Shane and Cable, 2002, on early-stage investors using social networks to decide between ventures).

SUPPLY CHAIN IN A LARGE ELECTRONICS COMPANY

The cited work offers anecdotal and aggregate evidence consistent with the hypothesis that brokerage increases the chances of having a good idea. To study the hypothesis at the level of individual people proposing ideas, I draw on data describing 673 managers who ran the supply chain in 2001 for one of America's largest electronics companies. This is not a population that comes immediately to mind as a place to study creativity, but here, as in most walks of life, people vary in the quality of

their ideas. The study population was going through a leadership change (triggered by exogenous events). The incoming leadership thought that a web-based network analysis would be a quick way to become familiar with the current informal organization of leaders in the supply chain. Changes moving forward would be facilitated in some ways and inhibited in other ways by the current organization. Knowing the current organization would be important for thinking about, and communicating, future strategy.

Idea Data

Managers received an email message from the incoming leadership explaining the study and directing the recipient to a website containing a short questionnaire that asked for a brief description of the manager's best idea for improving supply chain operations: "From your perspective, what is the one thing that you would change to improve [the company's] supply chain management?" The box into which responses were typed held a maximum of 2000 characters. The survey elicited 455 ideas.

Any rating of the ideas from good to bad has to take a point of view. An idea deemed terrific within a group of specialists can be dismissed as trivial outside the specialty. I return to this issue in the analysis, when I can use the data to speak more articulately about alternative views, but the research design here was to defer to top management for evaluations of relative merit. I do not recommend this point of view for all studies, nor propose it as the best point of view. At the same time, the view from the top is an eminently reasonable frame of reference: Top management was the expert panel familiar with business operations. They were the people who would reward ideas proposed in day-to-day operations. They were the people whose careers would rise or fall with the value of the ideas they sponsored.

Two senior managers, one from each of the two largest business units, were asked to evaluate ideas. Both judges were prominent for their experience in running the supply chain for their respective businesses. Each judge was given a list of the ideas and the question: "How much value could be generated if the idea were well executed?" The five-point scale ranged from one defined as "low value or can't say," to a score of five defined as "value could be high."

The judges were under pressure from the incoming leadership to provide quality evaluations, but rating 455 ideas is a daunting task. It seemed likely that the judges would fatigue before rating all of the ideas. It also seemed likely that higher-quality ideas would come from more senior people because they had a broader view across the bureaucratic silos in the supply chain (illustrated below in Figures 2 and 3). To guard against unreliable evaluations of the better ideas, ideas were presented to the judges in random order within two categories: The first 48 ideas were a random order of responses from respondents in the three highest ranks (Vice President, Director, and Senior Manager). The subsequent 407 were a random order of ideas offered by managers in lower ranks.

As expected, ratings are lower for ideas later on the list (-3.5 t-test; 2.7 mean value for the first 50 ideas, 1.4 mean value for the last 50 ideas), and higher for the ideas from people in more senior ranks (6.9 t-test; 3.0 mean value of ideas from Directors and Vice Presidents, 2.5 for ideas from Senior Managers, and 1.8 for ideas from the less senior managers). The effects of respondent rank and judge fatigue are confounded in the ratings (since ideas from high-rank managers were listed before ideas from other managers), but the two factors do not need to be separated for the purposes of this paper so much as it is important to hold constant both job rank and an idea's sequential order of evaluation when predicting the value of ideas. This, and other bias issues, are discussed below in the analysis of association with brokerage.

———— Table 1 About Here ————

Table 1 lists four illustrative ideas (edited for grammar and spelling errors). The first two ideas, judged high-value, propose extending supply-chain operations into exogenous sources of inefficiency. Supply chain managers were often viewed by company engineers as administrative assistants who executed equipment orders. Engineers were deemed better informed about alternative vendors, so the decision between vendors was theirs to make. Often, however, equivalent vendors existed for a product but the local engineer had dealt with only one vendor in the past, which was the vendor written into the proposal. The first idea in Table 1 is to move supply chain operations into the proposal process so that the company could benefit from the scale economies of purchasing from preferred vendors before low-volume, high-price

equipment purchases get written into a contract. A related inefficiency was created in contracts with large subcontracts to vendors familiar to local engineers. The second idea in Table 1 is to move supply chain operations into subcontracts to control the sometimes high prices that contractors paid for supplies, which were then charged back to the company.

The bottom two ideas in Table 1 were judged low in value. Both judges gave a score of one to the third idea, which is a call for more consistency across geographic locations. The bit of strategic thinking missing in the idea is to focus on consistency as it creates value as opposed to consistency for its own sake. As stated, the third idea is a classic lament from bureaucrats — we need people to adhere more consistently to agreed-upon processes. The fourth idea in Table 1 has a tone of the bureaucrat's lament, but it offers substantive detail, in fact so much detail that it is difficult to judge the value of the idea. The respondent is down in the weeds with details about his SixSigma project and the computer systems utilized in the project. It is difficult to evaluate the value of this idea without knowing more about the specific project and computer systems. One of the two judges gave the idea a score of one, the minimum on the printed list of ideas given to the judges. The other judge dismissed the idea without rating it (scored as zero, resulting in the 0.5 average across judges): ". . . for ideas that were either too local in nature, incomprehensible, vague, or too whiny, I didn't rate them."

Background Data

Several control variables were taken from company personnel records. In addition to the organizational division and geographic site where a manager worked, there were five job ranks: The executive rank was composed of people with job titles of Director or Vice President. In descending order below them were Senior Managers, followed by Managers III, II, and I. People in the Manager I rank were often individual contributors, but they rarely dealt with blue-collar workers. Another rank below Manager I was the front-line management dealing with blue-collar workers.

Managers were assigned to one of two roles in the supply chain: Some purchased goods from external vendors. Others moved goods between groups within

the company. I include the role distinction because purchasing paid higher salary ($22,111 higher on average, 5.4 t-test) and could have affected a manager's ideas about supply chain since the job involved contact with people in other companies.

Education is reported because it is so integral to the concept of human capital, especially for a study such as this of ideas. A substantial number of the managers had gone to graduate school (25% Master's degrees and 3% Doctorates), but an equal number had less than a college degree (17% had some college, short of a Bachelor's degree, and 10% had a high-school education or less). I also looked at race (86% of the study population was white), gender (26% female), and marital status (78% married), but none was a statistically significant predictor or slope-adjustment in the analysis, so none of them is reported.

Judging from age and seniority, there was a great deal of work experience in the study population. The average manager was 50 years old and had worked 18 years in this company. Many managers had spent their whole career in the company. More had spent their whole career in the industry. Age turned out to be more strongly associated with performance and idea value, so I use age as the control for work experience.

Performance Data

Performance data were gathered to assess the construct validity of the network data ("Are high-performers more often the managers whose networks span structural holes?"), and to generalize the idea data ("Do high-value ideas come more often from the people deemed high-performers?"). Performance was reviewed annually by each manager's supervisor. Salary and evaluation data for this analysis come from company personnel records for the annual cycle six months before the website survey, and the subsequent cycle six months after the survey.

Salary measures an employee's accumulated performance in that next year's salary is typically an incremental addition to current salary. Salaries in this study population increased slightly in the second year (5.5% on average, 2.8% standard deviation, 0% minimum, 30% maximum), but relative salary did not change much between the years (.99 correlation between salaries in the two years, .96 partial

correlation with job rank and age held constant). I use the salary figure current at the time of the web-based survey (rather than combining salaries across the years) because salary is so highly correlated between the years and I have complete data on salary at the time of the survey (there was 5.2% turnover in managers between the two years and I have no second-year salary data for managers who left the firm).

Evaluations measure current performance in that the evaluations are more free than salary to increase or decrease from one year to the next.   In the annual cycle preceding the network survey, 17% of the managers were judged "poor," 55% were judged "good," and 28% were judged "outstanding." Under pressure from top management to identify more weak performers, the proportion of managers assigned to the "poor" category increased to 25% in the second year, with 53% judged "good" and the remaining 22% judged "outstanding." A manager's evaluation in the first year is a good predictor of his or her evaluation in the second year, however, there were improvements and reversals. Of the managers judged "poor" in the first year, most were judged "poor" in the second year though many rose to "good" (81% and 19% respectively, none rose to "outstanding"). Of those judged "outstanding" in the first year, the majority continued to be "outstanding" in the second year, but a large number dropped to "good" and a minority dropped to "poor" (63%, 31%, and 6% respectively). I focused on consistently high or low evaluations to define a summary measure of performance, assigning managers into three categories: continuously poor (13% of the managers were judged "poor" in both years), continuously outstanding (16% were judged "outstanding" in both years), versus everyone else in the middle (71%, of whom 97% were given the middling code of "good" for one or both of the years). The summary measure is strongly correlated with evaluations in each year (correlations of .84 and .83 for the first and second years respectively), but more clearly distinguishes extremes of poor and outstanding performance. Managers who left the firm before the second annual review cycle were assigned to a category based on their evaluation in the previous year.   Not surprisingly, exit was most likely for managers who received a "poor" evaluation in the previous year (13% exit for those judged "poor" versus 4% exit for everyone else).

Promotion measures company-rewarded performance. Fourteen percent of the managers continuing with the company in the second year were promoted to a higher job grade in the annual performance review. A few were promoted two job grades, but most were a single grade so I treat promotion as a dichotomy. Pay was sometimes a substitute for promotion, for example, if a person was doing a terrific job but had been promoted recently. Of the managers not promoted in the second year, 34% received an above-average salary increase. The percent by which a manager's salary increased is a continuous variable — salaries increased in the second year by an average of 5.5% over a range of zero to 30 percent — but the performance signal managers discuss is whether they received an above-average raise. Supervisors were given a budget sufficient to cover an average raise for each subordinate. The average was defined by headquarters and varied from one year to the next, so the average was a consistent benchmark against which managers could interpret individual pay increases. In sum, I have three promotion measures: In addition to increased job grade and percentage increase in salary, my summary measure is a dichotomy distinguishing the 42% of managers promoted or given an above-average salary increase.

Network Data

Network data were collected by the standard survey method of name generators and interpreters (e.g., Marsden, 1990). The web-based questionnaire contained two name generators. After managers typed in their idea, they were asked if they had discussed the idea with anyone. If yes, they were asked to provide the name of the person with whom they had had the most detailed discussion. Next they were asked: "More generally, who are the people with whom you most often discuss supply-chain issues?" Five response boxes were provided for names. The questionnaire then listed two name interpreters. The first asked for the number of years that the respondent had known each cited person. The second asked about the relative strength of connections among the cited contacts. To answer, the respondent was guided through a matrix in which the respondent's perceived connection between each pair of cited people was coded as "often," "sometimes," or "rarely" discussing supply-

chain issues with one another. There are multiple observations of relations between people cited by more than one survey respondent.

——— Table 2 About Here ———

The survey provides 5,010 observations of 4,138 relationships. About half were between managers in the study population (44%).   The other 56% linked managers with subordinates and contacts outside the supply chain. Table 2 lists five levels of connection distinguished in the survey. The presumption is that information was more likely to move through stronger connections. The levels of connection make intuitive sense from the survey response categories, but the scores come from loglinear analysis of the response data.[3]

Where multiple observations of a relationship are contradictory, I use the strongest reported value. For example, if one manager cited another as a frequent discussion partner, and there is a second observation in which a mutual colleague reported that the two managers "sometimes" discuss supply-chain issues, connection between the two managers is set to .86 because of the stronger connection implied by the direct citation.

Consistency is more typical than contradiction: Stronger relations were more likely to be cited by both managers involved, more likely to be reported by multiple respondents, and more likely to be reported between people perceived to often discuss supply-chain issues.[4] At the other extreme, managers perceived to "rarely" discuss supply-chain issues almost never cited one another.[5]

Years of acquaintance did not differentiate relationships. Discussion partners on average had known one another for a long time. Table 2 shows that discussion partners have known one another for about eight years on average (the "—" in two rows of Table 2 indicate no data; years is only known for relations with cited discussion partners).

The survey respondents named 1,072 different people as discussion partners, 480 of whom were supply-chain managers. The 592 other discussion partners were subordinates and contacts beyond the supply chain, most of whom were named by a single respondent (561 named by one respondent, 31 named by two). The 193 unnamed supply-chain managers were isolates in the discussion network. Surely, the

193 isolates had a circle of local contacts. They were talking to someone. All I know is that they were not cited as a discussion partner by any other supply-chain managers in the company.

——— Figure 2 About Here ———

Figure 2 contains summary results on the 480 managers who were an active part of the supply-chain discussion network. The sociogram displays managers with lines indicating discussion citations. Managers are close in the sociogram to the extent that they cited one another and had the same other people as discussion partners.[6] The 193 social isolates would be distributed around the periphery of the diagram, disconnected from anyone else in the network. The first column of the table in Figure 2 shows how isolation varied by job rank. No Vice President or Director was a social isolate. Two Senior Managers were isolates. The largest concentration of isolates was among first-rank managers, where it is easy to imagine a local circle of people cut off from colleagues elsewhere.

I use network constraint to measure brokerage. Network constraint is a summary measure that varies with three qualities of a network: size, density, and hierarchy; increasing with the extent to which a network is concentrated in redundant contacts (Burt, 1992:Chap. 2; 2000).[7] The constraint on a manager is high if the manager's discussion partners talked a lot to one another directly (dense network) or they shared information indirectly via a central contact (hierarchical network). More constrained networks spanned fewer structural holes, so performance and the value of a manager's ideas should have a negative association with network constraint. I measure the constraint on each manager with respect to the immediate network of discussion partners, comprised of anyone that the manager cited as a discussion partner and anyone who cited the manager.[8] Figure 1 contains three illustrative computations.[9]

The second column of the table in Figure 2 shows that managers had a handful of discussion contacts on average. The average varied with rank: Directors and Vice Presidents had an average of 12.6 contacts, versus an average of 3.4 for managers in the first rank. The average was a handful of discussion partners. Connection scores in Table 2 were used to define relations between a manager's contacts.

Figure 2 shows the higher network constraint around managers in the lower ranks, increasing from a mean of 29.8 points for Directors and Vice Presidents, up to an average of 73.6 points for managers in the first rank. The 193 social isolates were assumed to have their own local discussion partners and so given the constraint score, 100 points, of someone who had one discussion partner or a completely interconnected circle of discussion partners (and a control for the 193 social isolates is tested in the analysis below).

OPPORTUNITIES FOR BROKERAGE

The supply chain was rich in opportunities for brokerage. Supply-chain isolation from the rest of the company offered one category of structural holes to be spanned. Isolation is evident in the pattern of relations linking supply-chain managers with contacts outside the supply chain. Social leaders within the supply chain are indicated in Figure 2 by dense intersections of relations with other managers. In contrast, managers toward the periphery of the sociogram often have a single relationship back into the network (e.g., managers 409, 208, 499, 329, 444 at the top of Figure 2). That single tendril far from the center of the system is the pattern of a peripheral person; they are connected into the network, but only barely. That pattern characterizes connections outside the supply chain. Many people were named (592 outside, versus 480 inside the supply-chain), but almost all were named by a single respondent (95%). The few named by multiple respondents were cited twice. None were named by more than two respondents. In other words, no business leaders outside the supply chain were a focus of supply-chain discussion. The supply-chain managers primarily turned to one another — which was an opportunity for enterprising managers to build bridging ties out to the business units to better integrate supply-chain processes into production (e.g., the two high-value ideas listed in Table 1).

——— Figure 3 About Here ———

Second, there were structural holes between business units within the supply chain. The center of the sociogram in Figure 2 is corporate headquarters. Clusters of managers within business units radiate from the center like five spokes on a wheel.

The clusters appear in the sociogram to the southeast, south, southwest, northwest, and northeast. To make the clusters more apparent, I looked more closely at the top 89 senior people to see the core of the supply-chain network, drawn in Figure 3. Managers are close together in Figure 3 to the extent that they cited one another and had the same other people as discussion partners.[10] Shaded areas indicate business units. Managers not in a shaded area work at corporate headquarters. Discussion is concentrated within business units. There are 514 connections in the sociogram at the top of Figure 3: 321 between managers in the same business unit (62%), 178 with managers at headquarters (35%), and a meager 15 direct connections between managers in different business units (3%). To further highlight the concentration within divisions, I removed the headquarters managers. Connections to headquarters are bridges of a kind, but they are also a continuation of the bureaucratic structure up from each division. In contrast, direct discussion between mangers in separate divisions cuts across lines of corporate control. The sociogram at the bottom of Figure 3 — exactly the sociogram at the top, but with headquarters removed — is stark illustration of the fragile contact across business units. Again, the situation is rich with opportunities for an enterprising manager to discover and bring home best practice in other divisions, and by so doing, enhance coordination across the supply chain.

A third category of opportunities was at the level of individuals within the supply chain. Bridges and clusters can be seen in Figure 2 and Figure 3, but Watts and Strogatz (1998, and Watts, 1999) provide a useful metric for expressing the situation at a micro level. There is a bridge and cluster structure in a population to the extent that two conditions occur: relations are dense within clusters, and short path distances connect people across the clusters. Bridges make the short path distances possible (see Granovetter, 1973, especially pages 1373-1376 on a community's difficulty in coordinating across dense clusters in the absence of bridging relationships).

The table of summary results at the top of Figure 2 show that managers tended to be surrounded by a dense cluster of discussion partners. The second to the last column is the mean network constraint among a manager's cited discussion partners. The average across job ranks is a near-maximum 81.0, and the 70.2 average for the highest-rank managers is not much lower. To put this in more concrete terms,

consider network density: discussion partners were reported 52% of the time to "often" discuss supply chain issues with one another, and 80% were reported to at least "sometimes" discuss supply chain with one another. In other words, managers on average had a small clique within which they discussed supply-chain issues. As a frame of reference for these averages, Marsden (1987) reports an average density of 62% for a national probability sample of Americans citing about the same number of discussion partners, but half of the cited contacts were family so Marsden's density average would have been lower if contacts were limited to work. Burt (2000) reports a 27.9 average level of colleague network constraint for about a thousand senior managers drawn from five study populations. The senior managers were able to name a larger number of contacts than allowed in this study, so accurate comparison requires a control for network size. The constraint-size equation in the baseline data is $C = a(e^{bN})$, where N is the number of contacts in a manager's network, C is the projected level of network constraint for networks of size N, the estimated coefficients a and b are 48.7 and -.075 respectively. Estimating the equation for the supply-chain discussion network yields $68.4(e^{-.10N})$ for network constraint among cited discussion partners (second to last column in Figure 2) and $60.8(e^{-.12N})$ for constraint when the network is expanded to include people citing the manager (third column in Figure 2). The intercepts show high levels of network constraint in the supply chain. The standard error for the intercept is one point in both study-population equations, so test statistics are large for the 20-point difference between the baseline 48.7 level of constraint for five-contact networks versus the mean 68.4 constraint among discussion partners in the supply chain, or the mean 60.8 constraint in the broader networks including people who cited a manager.

Despite dense clustering within business units and around individual managers, the managers who had any connection with one another were connected by short path distances. Path distance is the minimum number of relationships required to connect two people. Path distance to direct contacts is one. Path distance to friends of direct contacts is two, and so on. Try tracing a path of indirect connections from one side to the other in the Figure 2 sociogram in Figure 2. Intermediaries add up quickly. A

computer search for the shortest paths between people shows that the longest path distance is 11 steps.

Average path distance is just 4.2 steps. Averages are listed by job rank in the last column of Figure 2 with minimum and maximum means in parentheses (for the 476 connected managers, which excludes the 4 managers in the two disconnected dyads in the lower-right corner of Figure 2). For example, Senior Managers on average required 3.7 steps to reach anyone in Figure 2 — that is one direct connection to a colleague, plus two intermediaries past the colleague, to reach anyone. The best-connected could reach everyone in 2.9 steps on average. The worst-connected required an average of 6.4 steps (putting aside the two Senior Managers who were social isolates). Average path distance varied with job rank: more senior people had shorter path distances across the supply chain (3.3 mean for Directors and Vice Presidents versus 4.6 mean for first-rank managers). This is to be expected since more senior people had more bridging relations, indicated by their lower levels of network constraint, so they could more often reach directly out of their own social cluster into others (mean path distance is correlated .57 with network constraint in Figure 2 and .55 for the 89 people in Figure 3).

The shorter path distances to more senior people means that senior people were more responsible for connections across the supply chain. A histogram of Figure 2 path distances peaks over the average of four steps. The distribution looks the same for the much smaller core network of 89 people at the top of Figure 3, except the distribution shifts one step to the left (average path distance drops from 4.2 steps in Figure 2 to 3.2 steps at the top of Figure 3). In other words, connections across the supply chain are primarily determined by path distances among the 89 people at the top of Figure 3. The excluded 191 lower-rank, less-connected managers in Figure 2 require one connection to access the core network, which then connects them across the supply chain. Within the core network, removing the headquarters managers increases average path distance by two steps (3.2 mean path distance at the top of Figure 3 is 5.2 for the sociogram at the bottom of Figure 3). Without the headquarters managers, communication across the business units would depend on getting to the few people who sit on the 15 relations at the bottom of Figure 3 that bridge business

units. In short, formal chains of command were integral to communication across the supply chain; illustrated by the critical role that headquarters played in shortening path distances across business units, and the tendency for managers to turn to a small clique of interconnected colleagues to discuss supply-chain issues. With respect to brokerage opportunities, a setting dependent on formal chains of command for communication is a setting rich in opportunities for managers to coordinate directly across the formal chains.

BROKERAGE AND PERFORMANCE

The opportunities for brokerage raise questions about manager incentives to broker. If managers had an incentive to coordinate across structural holes within and around the supply chain, why do so many brokerage opportunities still exist? It is easy to imagine the lack of incentive: The network structure just described would result from managers encouraged to a focus on their immediate assignments, relying on headquarters for strategic thinking about how to coordinate across the supply chain. In fact, such a view was crisply stated to me by a program manager describing how he ran his group: "I don't want my people even thinking about alternatives. They spend two weeks thinking about an alternative, only to learn that what we have is 90% as good. The result is that they wasted two weeks and I'm behind schedule. I get some complaints about stifling creativity, but all I want is to be good enough and on schedule." Combine this view with a premium on personal loyalty from subordinates, and it is easy to imagine an organization in which managers were rewarded for sticking to an interconnected circle of colleagues focused on their immediate tasks.

Despite views such as the one quoted, the company recognized and rewarded brokerage: Table 3 shows positive associations between brokerage and all three measures of employee performance. Managers who often discussed supply-chain issues with managers in other groups were better paid, received more positive job evaluations, and were more likely to be promoted. Company promotion and compensation policy encouraged individuals to think strategically about integrating across the supply chain

The association between brokerage and performance is described by the bottom five rows of Table 3: The "network constraint" row is the association for first-rank managers, then the next four rows are slope adjustments for stronger or weaker associations at each of the other ranks.   For example, Model III is an ordinal logit equation predicting the three-category annual performance evaluations (outstanding, good, poor). Performance evaluations did not vary systematically with any of the control variables except age: older managers were less likely to receive positive evaluations. Above and beyond the control variables, there is a statistically significant negative association with network constraint — the more interconnected a manager's discussion contacts, the less positive his or her annual performance evaluation (-.014 coefficient, .004 standard error in parentheses, for a -3.5 test statistic). All of the slope adjustments in the four bottom rows are smaller than their standard errors. In other words, there is a strong negative association between network constraint and performance evaluation at each job rank. Adding a dummy variable distinguishing the 193 social isolates does not add anything to the prediction (-1.6 test statistic), nor change the fact that age and network constraint are the only statistically significant predictors. The graph to the right in Figure 4 plots the aggregate association for a logit model predicting evaluations from age and network constraint, the two statistically significant predictors in Table 3. Few received a "poor" evaluation two years in a row, but the few who did were disproportionately managers surrounded by a circle of densely interconnected discussion partners. At the other extreme, being evaluated "outstanding" for both years was unlikely on average (p = .16), but a manager whose discussion network spanned numerous structural holes had twice those odds (p = .32 for C = .10).

A more intuitive, less robust, demonstration of the performance association with brokerage is to sort managers into three broad groups with respect to business units: non-brokers (312 managers in a group of densely interconnected discussion partners as indicated by above-average network constraint), local brokers (196 managers with discussion partners in other groups, but all within the manager's own business unit, e.g., persons 283, 504, 528 in Figure 3), and enterprise brokers (165 managers with discussion partners in other groups, some outside the manager's own business unit,

e.g., persons 9, 234, 402 in Figure 3). The hypothesis is that good ideas are borne of engaging alternative ways of thinking and behaving. Since variation is more likely between than within business units, enterprise brokers have the most of whatever brokerage provides, local brokers have less, non-brokers the least. Consistent with the hypothesis, the odds of being evaluated "outstanding" in the annual reviews before and after the survey drop from 24% of enterprise brokers, to 19% of local brokers, and 10% of non-brokers. The odds of being evaluated "poor" in both years double from 5% of enterprise brokers, to 10% of local brokers, and 19% of non-brokers. The two trends are nonrandom (33.5 chi-square with 4 d.f., P < .001), but they disappear when network constraint is held constant (-6.4 test statistic for network constraint, versus 0.3 and -0.1 for dummy variables distinguishing local and enterprise brokers respectively from non-brokers).[11] In other words, performance increases with the extent to which a manager's discussion partners come from otherwise disconnected groups, within or beyond the manager's own business unit.

——— Table 3 and Figure 4 About Here ———

Models I and II in Table 3 describe the more complex association between salary and brokerage. As a quantity that increases incrementally, salary is a measure of cumulative performance reflecting a variety of conditions in a manager's past. Job rank is an obvious control: The average salary of a first-rank manager was $31,099 less than the average salary of a manager in the third rank. Senior Managers, on average, had salaries $19,638 higher than a third-rank manager. Intercepts are not presented for Models I and II to protect salary confidentiality. Effects are expressed with respect to managers in the third rank as a reference group. Beyond job rank, managers played two assigned roles in the supply chain: Some purchased goods from external vendors. Others moved goods within the company. Those who dealt with external vendors had higher salaries, but the difference is statistically negligible when job rank and age are held constant. Education was not directly associated with salary, but managers were compensated for experience. Salary increased with age ($338 per year on average). People tend to spend their whole career within this industry, so years in the company were less correlated with salary than years of age (6.5 t-test for age in Table 3 versus 2.1 for years in the company).

To hold constant differences between business units, I regressed the residuals from job rank, job role, age, and education across dummy variables distinguishing fifteen business units. Salaries were significant low in the one unit for which supplies were largely commodity goods so supply-chain managers were not required to have technical expertise ("LowTech" in Table 3). Salaries were significantly high in four units where supply-chain managers had to deal with higher-end electronic equipment and components ("HighTech in Table 3).

I then took studentized residuals from salary regressed over the above control variables, and distributed them across a map of the United States to look for pockets of deviant salaries. Salaries were significantly higher in two high-cost urban areas. "Urban 1" and "Urban 2" in Table 3 are dummy variables distinguishing managers who live in the two identified urban areas.

The above control variables measuring job rank, role, age, education, business unit, and location account for 78.6% of salary variance across the 673 managers. The amount by which a manager's salary exceeds, or falls below, the salary expected from his or her rank, role, age, education, business unit, and location measures the company view of the manager's performance relative to peers.

That view is keyed to brokerage. The five rows at the bottom of Table 3 for Models I and II show no association with network constraint for managers in the first rank, nor for managers in the second rank. Note that the slope is increasing with job rank, showing a stronger salary association with brokerage as a manager becomes more the author of his or her own job, and success depends more on reading the organization to identify valuable projects and know who can be brought together to implement the projects (cf. Burt, 1997). Salary in Model I decreases for first-rank managers by $7 with a one-point increase in network constraint. The decrease is larger for managers in the second rank (add $19 to the $7), and larger still for managers in the third rank (add $47 to the $7). The statistically significant association is at the Senior-Manager and Executive ranks. The $214 additional decrement for Senior Managers is significantly more negative than the $7 for first-rank managers (2.9 t-test). The $681 additional decrement for Directors and Vice Presidents is more so

(5.5 t-test). Adding a dummy variable distinguishing the 193 social isolates does not add anything to the prediction (0.4 test statistic).

Model II is the same as Model I except it is estimated from the data on managers who had two or more discussion partners. It seemed likely, from the results of Model I, that the third rank of managers was a transition point after which managers enjoyed the salary benefits of brokerage. I looked through the third-rank managers to see where salary benefits were accumulating. Initially, I thought that seniority would be a key. Managers who had been in the third rank for a while could have been playing a Senior-Manager role and so perhaps compensated for that. The answer was more simple. Third-rank managers involved in the informal discussion network showed the salary benefits of brokerage. Model II shows the same pattern of salary correlates as Model I, except that the salary of third-rank managers is significantly correlated with network constraint.

The graph to the left in Figure 4 plots salary relative to peers against network constraint for the managers identified in Table 3 as eligible for the salary benefits of brokerage. The salary variable is the residual from predicting salary by the twelve control variables in Table 3 standardized to unit variance and zero mean (salary expected for a manger from his or her job rank, role, age, education, business unit, and geographic location). Salary relative to peers clearly decreases as network constraint increases (-.41 correlation, -5.6 test statistic, P < .001).

Model IV in Table 3 shows the brokerage association with promotion. The more interconnected a manager's discussion contacts last year, the lower the probability of being promoted or receiving an above-average pay increase this year (-.022 coefficient, -3.7 test statistic). The association is consistent across job ranks (negligible slope adjustments). The only significant control variable is again age. Holding age constant, the graph to the right in Figure 4 shows how the probability predicted by Model IV changes with the network constraint around a manager. The odds were good for being promoted, or receiving an above-average raise between the two years observed (42%). Figure 4 shows how the odds varied above and below average as a function of the manager's discussion network. Managers brokering connections across segregated groups had more than twice the odds of a promotion

or above-average salary increase (.42 average is .68 for C = 10) while managers limited their supply-chain discussion to a circle of densely interconnected colleagues had the least chance (p= .28 for C = 100). Adding a dummy variable distinguishing the 193 social isolates does not add to the prediction (-1.4 test statistic). The same conclusion holds if the logit model is used to predict promotion to a higher job rank (-3.4 z-score for network constraint), or a regression model is used to predict the percentage by which a manager's salary was increased in the second year (-3.2 t-test for network constraint).[12]

In sum, managers at all ranks whose networks spanned structural holes received more positive evaluations in their annual review, and were more likely to promoted or receive above-average salary increases. The result was that more senior managers had broader networks and their salaries varied with the extent to which they had a broader network. From the middle of the third rank and up, manager salary increased with the extent to which the manager's network spanned structural holes.

BROKERAGE AND GOOD IDEAS

Brokerage has its hypothesized association with good ideas. Model V in Table 4 predicts the value perceived in a manager's idea, and the left-hand graph in Figure 5 shows the nonlinear association with brokerage. The steepest drop in value happens with initial network constraint, in other words, when a manager first begins to rely on redundant discussion partners. Circles in the graph indicate ratings by one of the two judges averaged across five-point intervals of network constraint, and squares indicate pooled ratings from the other senior person evaluating ideas. Thin lines through their respective ratings differ in level, but both show the strong negative association with network constraint (t-tests of -5.8 and -3.9 for their 455 individual ratings, see Figure 5 box insert).

——— Table 4 and Figure 5 About Here ———

None of the control variables is associated with value when network constraint is held constant. Higher-rank managers were more often the source of valuable ideas, but the zero-order association with rank disappears when network constraint is held

constant (6.9 t-test for the direct association between rank and average value, but negligible rank effects in Model V). Evidently, rank was no substitute for knowledge. Even within the top ranks, senior people whose discussion partners were drawn from a small circle of densely interconnected people were likely to have weak ideas for improving supply-chain operations (-.43 correlation between idea value and network constraint for the Senior Managers, Directors, and Vice Presidents, -3.2 t-test).[13]

Surprisingly, human capital is also a secondary factor. There is no association with lessons learned over years of experience. Age has no direct association with value in Model V, and a graph of value across age (not presented) is a random scatter showing no linear, curvilinear, or episodic association (.04 correlation with age and a similarly negligible .02 correlation with years in the company). In contrast, education does have a zero-order association with idea value: Higher value is seen in ideas from managers with a college education (4.4 t-test) or a graduate degree (3.4 t-test). However, social capital has the more direct association: Value and network constraint have a strong negative association within levels of education (among managers with a college education, -6.5 t-test, or managers with a graduate degree, -4.5 t-test), and Model V shows no association between value and education when network constraint is held constant.[14]

The two bias effects in Model V are negligible. First, it seemed possible that value ratings would be higher for ideas offered with more explanation. Responses explaining ideas ranged from 13 to 1,897 characters (253 mean). However, there is no zero-order association with either judge's evaluation of value (.06 and -.07 correlations), nor in the Model V prediction (-0.8 t-test). Second, it seemed likely that judges would fatigue as they rated ideas so value would be lower for ideas later on the list presented to the judges. There is a negative zero-order association between value and sequential order (-3.5 t-test), but the association is negligible under the controls in Model V (-0.9 t-test for sequential order).[15]

Ideas Dismissed

Recall that the two senior managers judging value sometimes dismissed an idea without rating it. As one explained, ". . . for ideas that were either too local in nature,

incomprehensible, vague, or too whiny, I didn't rate them." Being dismissed was not a rare event. Almost three fourths of the ideas were dismissed by one or the other senior person evaluating ideas (71%). One in three ideas was dismissed by both judges (32%), which is the outcome predicted by Model VI in Table 4. The positive association between network constraint and being dismissed (3.5 test statistic) shows that managers in networks of densely interconnected discussion partners were less successful in communicating their idea to the senior managers judging value. Here again, the association with network constraint is nonlinear. The dashed line in the graph to the right in Figure 5 shows that the steepest increasing in the odds of being dismissed happens with initial network constraint, in other words, when a manager first begins to rely on redundant discussion partners.

 The control variables in Model VI are again interesting for their lack of association with dismissal. Job rank is more complicated here in that the first-rank managers have a statistically significant higher risk of being dismissed and mangers in the top ranks had none of their ideas dismissed (so dummy variables distinguishing Senior Managers and the two executive ranks had to be removed from the prediction). Age, education, and the other control variables had no association with dismissal.

Ideas Unexpressed

Among the managers not responding to the survey were 16 who entered their name in the survey website, then left before answering the question about their best idea for improving supply-chain operations. I have no way of knowing how many other potential respondents decided not to answer the survey after seeing the questions, but I do know which managers chose not to complete the survey. I estimated Model VII in Table 4 to see whether non-response is idea-related in the sense of having the same pattern of correlates as idea value and idea dismissal. Managers probably had various reasons for not responding to the survey, but the pattern of correlates predicting non-response in Model VII looks like the pattern in Model V predicting idea value, and the pattern in Model VI predicting idea dismissal: There is a strong association with network constraint and negligible associations with job rank, role, age, education, business unit, and location. The steep dashed line in Figure 5's right-hand

graph shows the dramatic association with network constraint. Managers with networks that spanned structural holes were likely to express an idea (.06 predicted probability of non-response for 10 points of network constraint), while those surrounded by densely interconnected discussion partners were extremely unlikely to express an idea (.78 predicted probability of non-response for 100 points of network constraint).

Ideas Discussed

Social structure is an accretion of conversations. At the same moment that good ideas emerge where bridge relations span holes in today's social structure, idea discussion shapes tomorrow's structure. Brokerage is again a correlate.

After explaining their best idea for improving supply-chain operations, managers were asked whether they had discussed the idea with anyone in the company. If yes, they were asked to name the person with whom they had their most detailed discussion. A substantial minority of the supply-chain managers were dead-ends in the sense of never discussing their best idea (31%). A few said that they had discussed their idea, but were ambiguous about the discussion partner (7%; e.g., "everyone I can get to listen," "various," "other managers in supply chain"). The majority named a specific person with whom they had discussed their idea (67%), and some went on to name two or more discussion partners (14%).

Who Discusses?

Brokerage is the key variable predicting idea discussion. Model VIII in Table 4 shows that regardless of job rank, age, education, business unit, or region, the people likely to discuss their idea were the people whose networks spanned structural holes.

Job rank would appear to matter (3.2 test statistic for association between job rank and idea discussion), but more senior people are more involved in bridging structural holes, and the negligible effects for job rank in Model VIII show that it is the bridging that is directly associated with idea discussion.

Idea value would appear to matter. Discussed ideas have higher value scores (3.1 t-test) and were less likely to be dismissed by the two senior managers evaluating

value — 27% of discussed ideas were dismissed versus 42% of the undiscussed ideas (8.7 chi-square, 1 d.f., P < .01, where dismissed is the dependent variable in Model VI). However, neither idea value (dependent variable for Model V), nor a dummy variable distinguishing ideas dismissed (dependent variable for Model VI), add anything to Model VIII (respective test statistics of 0.8 and -0.6).

Discussion has two statistically significant correlates in Model VIII: idea length and brokerage. The length of a manager's explanation makes sense in that a person sufficiently interested to type a long explanation of an idea is more likely to spend effort talking about the idea.[16] The pattern of correlates other than length looks like the pattern in the other Table 4 models. Managers with networks that spanned structural holes were more likely to have a good idea (Models V and VI), express their idea (Model VII), and discuss their idea with colleagues (Model VIII).

With Whom?

Further inference can be drawn from who a manager choses for idea discussion. As a baseline model, consider an inertia model of social convenience. Who is most likely to be cited by a manager putting no effort into spreading or building support for an idea? The more that John speaks to the people with whom I frequently speak, the more likely that John will be present in my conversations with colleagues. If I were to have a conversation with a colleague selected at random, John has a good chance of being that colleague.

In more formal terms, John is central in my discussion network: he is speaks often to the people with whom I often discuss my work. Centrality in this sense is measured by the network constraint posed by each of a manager's contacts. The more a contact is connected with others in a manager's network, the more severe the contact's constraint on the manager (footnote 7).

Figure 6 shows manager contacts sorted from most to least central. The first position contains the contact with whom the manager had the most mutual friends. This is the person most likely to be cited if social convenience determined who was selected for idea discussion. At the other extreme on the horizontal axis are the most distant contact. These are contacts with whom a manager had no mutual colleagues,

people in other business units, or people with whom the manager had the least experience).[17] I put aside the 662 contacts cited by managers who did not discuss their best idea (grey bars in Figure 6) because they are not at risk of being cited for idea discussion. At risk are the contacts of managers who did discuss their best idea (1,788 uncited in white, and the 340 cited in red).

Social convenience is prominent in the graph. Idea discussion is concentrated in colleagues at the center of a manager's network: 36% of the people cited for idea discussion were the most central in a manager's network, 25% were the second most central, and 13% where the third-most central. The number of citations decreases at further removes from the manager, but so does the number of contacts available to be cited. Model IX in Table 5 shows that the probability of being cited is statistically significant in the first three positions. On average, contacts with whom managers discussed their best idea posed 13.6 points of constraint versus 7.6 points for other contacts (9.2 test statistic).[18] The probability of a colleague being cited for idea discussion increases systematically with relative level of constraint (8.3 test statistic).[19]

——— Figure 6 and Table 5 About Here ———

History does not have a direct association with idea discussion. There is an incentive to discuss ideas with trusted colleagues because it can seem presumptuous to propose ideas and Figure 5 shows that there was a good chance of being dismissed or judged negatively by senior management. However, Model X in Table 5 shows no association between idea discussion and years of acquaintance. Colleagues known for a decade or more have a 13% chance of being cited for idea discussion, versus 18% for colleagues known less than a year. The probability does not vary from year to year of acquaintance (7.8 chi-square, 8 d.f., P = .46), other than a decrease for colleagues known for more than a decade (8.6 chi-square, 1 d.f., P = .003) which is negligible in Model X.

Hierarchy matters in several ways. For one thing, ideas were typically discussed within business units. In part, this is because most network contacts were inside the same business unit (91%), but holding constant their numbers, contacts inside the business unit were more likely to be cited as the person with whom managers had discussed their best idea (2.3 test statistic). Second, the probability of citation varied

with colleague rank. Managers were unlikely to say that they had discussed their best idea with colleagues below them in the corporate hierarchy, and were likely to cite people above them (respective test statistics of -4.5 and 5.1 in Model X, where the reference category is same rank). Third, immediate supervision mattered above and beyond relative rank. Holding rank constant, the boss was disproportionately cited as the person with whom managers had discussed their best idea (5.4 test statistic).

Chains of command can be ambiguous. The majority of managers excluded the boss from their discussion network (69%), and the managers most likely to exclude the boss were the managers isolated inside a closed circle of densely interconnected colleagues (-6.7 test statistic for the lower network constraint associated with the boss in the manager's discussion network). Just connecting with the authority structure was a form of brokerage in this study population.

Managers segregated from formal supervision were connected informally to the authority structure. They often built their discussion network around a person of higher rank, just not the person to whom they had been assigned. It is productive to make the familiar distinction between formal and informal supervision (e.g., Blau, 1955, or Podolny and Baron, 1997, for a treatment more explicit about network implications). A formal boss is the person to whom a manager reported in the organization chart. An informal boss is a person of rank who is central among the colleagues with whom the manager discusses work.

Let the "informal boss" be the most central person of higher rank in a manager's discussion network. John would be my informal boss if he holds a job rank higher than mine and speaks more often than anyone else with all of the people with whom I discuss my work. The decision rule I used with the supply-chain data was to look down the list of a manager's contacts, ranked in descending order of network constraint (Figure 6), and the first person who held a job rank higher than the manager was deemed the informal boss. Where two contacts posed equal constraint, the contact holding higher rank was deemed the informal boss. If the equal-constraint contacts were of equal job rank, they were both coded as informal boss.[20]

Informal supervision was prominent in two ways: First, informal bosses were the most likely target of idea discussion (9.3 test statistic in Model XI): 41% of the informal

bosses were cited as the person with whom a manager's best idea was discussed. The odds drop to 9% for other contacts. A second consideration is the shear number of managers involved: 56% of the managers had only an informal boss in their discussion network, and 31% had both an informal and formal boss (sometimes in the same person; 91 supervisors were both formal and informal boss). The remaining 13% had neither formal nor informal supervision in their discussion networks (i.e., there were no contacts of a higher job rank than the manager, and the formal boss was not part of the discussion network). Managers in the third category, found in every job rank, had small networks of densely interconnected discussion partners (5.7 test statistic for higher network constraint) and tended not to have discussed with colleagues their best idea for improving supply-chain operations (-3.5 test statistic).

In sum, idea discussion was targeted at socially convenient authority. The informal boss combines both: he or she is of higher rank, and is socially convenient by dint of being best connected to a manager's other discussion partners. Rank alone was insufficient. The formal boss is a factor — as long as he or she is active in the discussion network around a manager. However, two thirds of the managers did not include the immediate supervisor in their discussion network, so their formal bosses are not included in Table 5. If I add the excluded bosses to Model XI, the positive association between idea discussion and formal supervision disappears.[21] Further, holding formal and informal supervision constant in Model XI has eliminated the tendency in Model X for managers to cite higher-rank contacts for idea discussion. In other words, higher rank elicited idea discussion when it was socially convenient.

CONCLUSIONS

This paper was about the hypothesis that people who live in the intersection of social worlds are at higher risk of having good ideas. I reviewed previous work showing anecdotal and aggregate evidence to support the hypothesis, but my purpose was to study the hypothesis in finer detail at the level of individual managers, linking ideas with network measures of social capital known to be associated with performance.

I analyzed archival and survey data on 673 managers in the supply chain of a large American electronics company in 2001. The study population is well-suited to testing the hypothesized association between brokerage and good ideas: There were numerous opportunities for brokerage (Figure 2 and Figure 3), and managers were rewarded for brokerage in the sense that compensation, positive performance evaluations, and promotions were disproportionately in the hands of managers who brokered connections across structural holes (Figure 4).

Brokerage has the expected association with good ideas: Managers whose networks more often spanned structural holes were more likely to express their ideas, less likely to have their ideas dismissed by senior management, and more likely to have their ideas evaluated as valuable (Figure 5).

I infer a cycle of structural reproduction from the results. On the negative side, managers surrounded by densely interconnected discussion partners were likely to have their ideas dismissed by senior management, have their ideas seen as low-value if not dismissed, so they have learned not to express ideas. These managers can be expected to obey the maxim that a closed mouth gathers no feet, withdrawing into their local social world to wait for orders, thereby contributing to the continued segregation of groups in the supply chain (see Morrison and Milliken, 2002, on organizational silence and its correlates).

The positive side of the cycle rewards able managers, but serves the same end as the negative side of the cycle. Managers whose networks spanned structural holes were likely to express their ideas, likely to have their ideas engaged by senior management, and likely to have their ideas perceived as valuable. These managers can be expected to continue to propose ideas. But to what end? Although managers with discussion partners in other groups were positioned to spread good ideas across business units, the people they cited for idea discussion were overwhelmingly colleagues already close in their informal discussion network (Figure 6). It would appear that the distribution of good ideas was guided by social convenience, which is to say that ideas were not discussed to change business practice so much as they were discussed to display competence and entertain familiar colleagues.

This conclusion strains the limits of my data. I know the names of the people with whom managers had their most detailed discussion. I do not have a census of the people with whom managers discussed their idea. Managers could have had their most detailed discussion with socially convenient colleagues, then moved on to mobilize support in subsequent discussion with people beyond their own group. I think not because there are multiple indicators of inertia: from the tendency for managers at all ranks to cite a dense circle of colleagues for work discussion (81% density on average, Figure 2), to the segregation of work discussion from the formal authority structure (discussion network around 69% of the managers excluded their immediate supervisor, footnote 21). The point remains that I do not have a census of people with whom managers discussed their best idea.

As a check on my conclusion, I returned to the organization (ten months after collecting the data reported in the paper) to ask a favor of the long-time employee who had been promoted to run supply-chain operations for the company (not one of the original two judges who evaluated ideas). I presented a list of the top 100 ideas, with the names and business units of the people proposing the ideas, and asked: "To your knowledge, has the person mobilized support to implement the idea or made an effort to mobilize support for the idea?" The 100 included all ideas that either of the two judges had given a maximum-value rating, all ideas that the judges together gave a 3.5 or higher average rating, and all ideas proposed by senior managers, directors, or vice presidents. If any of the original ideas were acted upon, these 100 would be the most likely (it seemed too big a favor to ask for an update on all ideas in the original data).

The results corroborate the conclusion about social convenience. There is little evidence of managers acting on their ideas. Of the 100 listed managers and their ideas, 16 were perceived to have worked on mobilizing support for their idea. More important to this paper, the ideas on which action occurred are consistent with the conclusion about social convenience. A logistic model of the 100 ideas shows that action was more likely for more valuable ideas (2.6 test statistic), from managers with contacts in other groups (-3.1 test statistic for network constraint) who cited more distant contacts for idea discussion (2.9 test statistic for idea-discussion contact

centrality, Figure 6). People holding more senior rank were more likely to act on their idea, but the association disappears when network constraint is held constant (3.0 zero-order test statistic drops to 1.4) showing that action was less a function of rank than connections to other groups. With respect to Figure 6, the managers who acted on their idea rose above social convenience to discuss their idea with contacts beyond their closest collagues (average rank 5.5 in Figure 6). The managers not taking action cited much closer colleagues, as expected if social convenience determined their selection of discussion partners (2.4 rank in Figure 6; 3.5 test statistic for difference).

My summary conclusion is that good ideas emerged from the intersection of social worlds, but spread in a way that would continue segregation between the worlds. There was a brokerage advantage in producing ideas, and company systems were working correctly to reward brokers who produced good ideas, but the potential value for integrating operations across the company was dissipated in the distribution of ideas.

NOTES

[1]I ignore idea content across the four levels of brokerage in idea production. I have two reasons: data and traction. It would be difficult to accurately and reliably evaluate ideas across a foreign content domain. Below, I defer to senior management in the study population. Second, I have no tools that provide novel insights into idea content (relative to the network analysis tools that can pry open the link between ideas and social structure). The presumption in this paper, therefore, is that the content of ideas reflects the social structure in which they emerge. Vary the groups to which a person is attached and you vary the content of the person's ideas. I do not believe that this is entirely true, but my hypothesis is that there is some truth to it. The other extreme would be to ignore social structure to focus entirely on the organization of bits and bytes within an idea. Czernich and Heath (2001) provide an illustration. They describe the dot.com evolution of the idea that website value increases with its number of viewers. They describe analogies to other ideas, and recombinations of elements within the idea. Sociologists will recognize the sociolinguistics of ethnomethodology and the indexical nature of expressions in the analysis (e.g., Denzin, 1969; Hudson, 1980), but the familiar micro-level insights are used by Czernich and Heath to describe macro-level change in market rhetoric. The subject could be analyzed from the perspective of this paper. The brokerage hypothesis says that analogies and recombinations in the evolution of "eyeballs to websites" should have come from people with attachments to the separate groups focused on the elements across which analogies and combinations were made. Ideas can be studied from the inside or outside. This paper is about the latter.

[2]Also see Hatch (1999) on the importance of empty places to the integrated improvisation among jazz musicians playing together, and Giuffe (1999) on the greater attention given to photographers with careers in networks of sparsely connected photographers). Productive analogy can be drawn to Merton's (1948b) view of serendipity in science. Expanding on research's familiar passive role in testing theory, Merton discusses active roles that research can play in shaping theory, one of which is the serendipity pattern in which an "unanticipated, anomalous, and strategic datum" exerts pressure for initiating theory (p. 158). Serendipity must involve an unanticipated result (datum) inconsistent with established facts or the theory being tested, but the third attribute, strategic, is the key that distinguishes Merton's view. The strategic value of a research result lies in its implications for generalized theory, by which Merton (1948b, 159) refers to: "what the observer brings to the datum rather than to the datum itself." Research has strategic value when an observer sees how a finding has implications for what other people see as unrelated theory. The creative spark on which serendipity depends, in short, is to see bridges where others see holes.

[3]Quantitative scores for relationships are based on loglinear analysis of the survey network data (Burt and Guillarte, 1986). Here are loglinear test statistics for relations between cited contacts:

	rare	sometimes	often
No citation	8.5	3.3	-11.6
Yes-No	-1.6	-2.9	0.6
No-Yes	-2.5	2.4	5.8
Yes-Yes	-5.2	1.9	11.7

The three columns distinguish relations by the perceived strength of connection between a pair of cited contacts ("rarely," "sometimes," or "often" discussing supply-chain issues). The four rows distinguish relations by citations. The possibilities are that they did not cite one another, they cited one or the other only on the first name generator (discussed best idea), they cited one or the other only on the second name generator (frequently discuss supply-chain issues), or they cited one or the other on both name generators. The first row of the table shows that uncited relations were likely to be perceived as "rare" discussion (8.5 z-score) and extremely unlikely to be perceived as "often" (-11.6 z-score). The bottom two rows of the table show that people cited as frequent discussion partners were perceived as "often" discussing supply-chain issues with the respondent (5.8 and 11.7 z-scores). A one-dimensional

loglinear association model yields the following raw scores for the rows and columns: -.74, -.06, .45, and .65 for the rows, -.76, .15, and .64 for the columns. Normalizing raw scores to vary from zero (minimum connection) to one (maximum connection) yields the scores in Table 2.

[4]On the first point, note the increasing percent mutual in the middle column of Table 2. On the second point, note that the 11 relations observed twice in the first row of Table 2 are 2% of all relations in that row, which increases to the 287 relations observed two or more times in the bottom row, which constitute 21% of the bottom-row relations. On the third point, note the increasing percent often in the last column of Table 2 (and see the first row of loglinear results in the preceding footnote). Another way to see the pattern is to distinguish relations by the number of times they were reported in the survey, then describe the percent of relations cited as discussion partners:

	Once	Twice	Three or more
Rarely	3%	0%	no observations
Sometimes	12%	15%	100%
Often	18%	52%	77%

where the rows distinguish relations by colleague perceptions and the columns distinguish the number of times that the relationship was reported in the survey. For example, the first row contains 615 relations between people reported as "rarely" discussing supply-chain issues. Eight of the relations were reported twice and in none of the relations did one manager cite the other (0%). The other 607 were reported just once and in 16 of them one manager cited the other as a discussion partner (3%). The point illustrated is that cited discussion partners were unlikely to be reported as "rarely" discussing supply-chain issues. Direct citations between managers were more likely when the two managers were perceived to "sometimes" discuss supply-chain issues. Most "sometimes" relations were observed once, but seventy were reported two or three times (none more than three times). Direct citations were especially likely between managers perceived to "often" discuss supply-chain issues; 18% likely in relations reported once, 52% likely in relations reported twice, and 77% likely in relations reported three or more times (the category of "three or more" contains 28 relations reported as "often" by three respondents, 13 reported by four respondents, six reported by five respondents, one reported by six, and one reported by seven respondents).

[5]This is evident in the first row of loglinear results in footnote 3, the near-zero percent rare in all but the first row of the second to the last column in Table 2, or the table in the preceding footnote showing a lack of direct citations between people reported as "rarely" discussing supply-chain issues.

[6]To depict this large sociogram, I used computer software circulated under the name InFlow by an organization consultant, Valdis Krebs. Documentation on the software is minimal. My statement about how people are positioned in Figure 2 is based on conversation with the author. Further information on the software can be found at the author's URL (http://www.orgnet.com).

[7]The index begins with the extent to which manager i's network is directly or indirectly invested in the manager's relationship with contact j: $c_{ij} = (p_{ij} + \Sigma_q p_{iq} p_{qj})^2$, for $q \neq i,j$, where p_{ij} is the proportion of i's network time and energy invested in contact j, $p_{ij} = z_{ij} / \Sigma_q z_{iq}$, and variable z_{ij} measures the zero to one strength of connection between contacts i and j (footnote 3). The total in parentheses is the proportion of i's relations that are directly or indirectly invested in connection with contact j. The sum of squared proportions, $\Sigma_j c_{ij}$, is the network constraint index C. I multiply scores by 100 and report integer scores.

[8]I considered two alternative boundary definitions. One was to preserve asymmetry: Manager i would be in i's network only if i cites j. It seemed unwise to read the survey data this closely given the number of people who did not respond to the survey, the uneven availability of data between the center and periphery of the network (discussed in the text), and the small, ego-centric networks that would result (reported in Figure 2, average network size would drop from 5.0 to 2.9 and average network constraint would increase from 60.5 points to 81.0; see previous footnote for the network-constraint

index). Nevertheless, to check this alternative, I estimated the performance and idea regression models with network constraint computed from asymmetric citations. The results are weaker on average than those reported in the text (e.g., the -5.0 t-test reported in Table 4 for association between idea value and the log of network constraint is -2.7). A second alternative would be to expand the networks to include j in i's network if any other colleague perceive i and j as close. This seems reasonable since quantitative scores for the survey responses put a relation reported as "often" at about the same strength as a direct citation between two managers (see footnote 3). However, perceived relations require a mutual colleague to report them, so perceived relations only occur between contacts already cited (average network size would increase only slightly if "often" ties were used define contacts, to 6.1 contacts from the 5.0 average in Figure 2) and further connect people within clusters (so network constraint would increase slightly, to 66.2 points from the 60.5 average in Figure 2). Again as a check, I estimated the performance and idea regression models with network constraint computed from the broader definition of connections. The results are about the same on average as those reported in the text (e.g., the -5.0 t-test reported in Table 4 for association between idea value and the log of network constraint is -4.1).

[9]There are two points illustrated. One is the typical computation discussed in the text: person 2 illustrates the constraint of having few contacts, person 3 the constraint of densely connected contacts, and Robert illustrates the low constraint of having many contacts in separate groups. The second point illustrated is the upward bias in constraint created by my definition of network boundaries. Building on previous research, I compute constraint for the immediate discussion network around each manager. Alternatively, I could compute constraint to take into account the broader structure around a manager. Person 3 in Figure 2 illustrates the difference. Person 3 has four contacts: Robert, James, and two others. Equal proportions of 3's network time and energy are allocated to each contact ($p_{ij} = 1/4$). The indirect proportion for 3's tie with Robert is zero because Robert has no direct contact with the other people. The indirect proportion for 3's tie with the other three contacts is high because all three are connected ($S_q\ p_{iq}p_{qj}$ = .165). However, the three contacts have relationships not considered in this computation. James, for example, has four contacts beyond 3's network. Ignoring them makes 3's network look more constrained than it is. James could bring new information into 3's network even though he is strongly connected within the network. If contact ties beyond 3's network were taken into acount, the indirect proportions would be lower, so the network constraint on person 3 would drop to 40.2 from the 70.8 reported in Figure 2 ($.402 = [.25+0]^2 + [.25+.084]^2 + [.25+.091]^2 + [.25+.084]^2$). I don't take this as a problem because I want to be consistent with previous research using surveys and my research results compare performance and idea value between managers under higher versus lower levels of network constraint. The point of this note is merely that the absolute level of constraint reported here for each manager's network analyzed separately is higher that it would be if constraint were computed from the entire network across managers

[10]The sociogram in Figure 3 is based on a multidimensional scaling of path distances among the 89 senior people computed from their discussion citations with one another. The sociogram was draw with David Krackhardt's Krackplot software (available at http://www.sfu.ca/~insna/soft_inf.html), which made it easy to edit the multidimensional scaling to widen the spaces between people in different divisions.

[11]The same conclusion holds for Model V in Table 4 predicting the value of the manager's best idea for improving supply chain operations (-4.3 test statistic for network constraint, versus -1.1 and 0.9 for local and enterprise brokers), so I do not discuss with respect to Table 4 the intuitively appealing distinction between local and enterprise brokers.

[12]The many salary correlates in Models I and II that are negligible in Model IV lower the direct effect of network constraint in Model IV. Retaining only age and network constraint in the prediction yields about the same age effect (-6.2 test statistic), but the higher constraint effect in Figure 4 (-6.5 test statistic). The network-constraint association with percentage raise is similarly stronger when age alone is the control variable (-5.1 t-test versus -3.2 in the text), but the association with promotion alone is continues about the same (-3.0 test statistic versus -3.4 in the text).

[13]The lack of association with job rank has measurement interest. Jim Baron raised a question about tautology in Model V: The two senior people judging value are at the top of the corporate ladder,

so the ideas that they would find valuable are the ideas most relevant to their personal concerns with integrating across business units — which would be the ideas of managers who have discussion partners in other business units. Therefore, it would not be surprising to find this measure of value associated with brokerage. A generic response is to defer to the people in charge. The perceptions of the most senior managers guide the allocation of this company's resources to people and projects. What they see as value is what is valuable in this organization. The job-rank results offer another response. If there is an ego-centric bias in the perception of value by the two senior people judging value then ratings should increase with job rank because people of higher rank have job concerns more similar to the two most senior people. Judged value does increase with the job rank of the person proposing an idea, but the association disappears when network constraint is held constant. I do not think that the judges were impressed with ideas relevant to their own jobs so much as they were impressed with the extent to which an idea reflected alternative ways of thinking or behaving. A definitive answer to Baron's question, however, requires an experimental design in which idea value is judged under a mix of two factors: idea similarity to the concerns of the person judging value, and idea quality reflecting alternative ways of thinking and behaving.

[14]Another measure of individual ability shows the same lack of direct association with value: 114 people in the study population had graduated from the company's Strategic Leadership Program (SLP). I have the grade on a four-point scale that each received in the program. Managers whose networks span structural holes do well in the Strategic Leadership Program (-4.1 t-test for the association between SLP grade and network constraint), but the rated value of their idea for improving supply-chain operations is associated with their network, not their program performance (regressing value over SLP grade and network constraint yields a 0.3 t-test for SLP grade and -3.3 t-test for network constraint). I also have the grade on a 100-point scale that 59 people received on a conceptual examination administered during a special session of the SLP for key people in the supply chain, but examination grades are uncorrelated with idea value, SLP grade, and network constraint (.10, .17, and -.11 respectively).

[15]Chip Heath noted another possible rating bias. The two senior managers, familiar with their own operations, might recognize and over-praise an idea from one of their subordinates. Rivalry is a related possibility. The two judges ran the two largest supply-chain operations in the company, so competition between them was inevitable. Feelings of competition might result in lower ratings for ideas from the rival organization. Neither bias was statistically significant in the ratings. I regressed ratings from each judge over two dummy variables (with controls for the rank of the respondent proposing an idea and the sequential order in which an idea was evaluated). One dummy variable identified respondents in the judge's own division. The other dummy variable distinguished respondents in the other judge's division. The reference group was respondents in neither division. Ratings were biased in the expected direction, but negligibly so (0.9 t-test for positive evaluations of ideas within a judge's own division, -1.3 t-test for evaluations of ideas from the other judge's division).

[16]The brokerage effect in Model VIII is stable across three alternative variables measuring manager effort in mobilizing colleague interest in an idea. In an ordinal logit model predicting three categories of targeted discussion (no discussion, discussion with unknown colleague, discussion with named colleagues), there are no statistically significant associations with any of the control variables in Model VIII (including length of explanation, 1.8 test statistic), and there is the strong negative association with network constraint (-3.4 test statistic). The same is true for an ordinal logit model predicting three categories of discussion effort (no discussion, discussion with one named colleague, discussion with multiple colleague; -2.8 test statistic for brokerage), and an ordinal logit model distinguishing action from discussion (no discussion, discussion only, discussion and action where the third category contains the 16 managers distinguished in the Conclusion section for trying to mobilize support for their idea; -3.9 test statistic for brokerage).

[17]Of the 2,790 contacts, 1,991 could be ordered by network constraint. Where contacts posed the same level of constraint (for example, a network in which every contact discusses work frequently with every other contact), another 61 contacts could be ordered by putting colleagues in the manager's business unit ahead of contacts in other business units (there are so few because most discussion partners were in the same business unit). Another 443 contacts could be ordered by their years of

relationship with the manager, which left 295 contacts to be ordered at random within same level of network constraint, same business unit, and same years known to manager.

[18]The survey generated 2,790 contacts for the 455 managers proposing an idea for improving supply-chain operations. The contacts are discussion partners cited by the 455 managers, and people citing the managers as discussion partners. All test statistics computed from manager-contact relations have been adjusted for autocorrelation within manager networks (e.g., Kish and Frankel 1974). Network constraint is correlated across relations within a network (connection between two contacts increases the level of network constraint they each pose) so the autocorrelation adjustment is large (9.2 test statistic in the text is 12.7 without the autocorrelation adjustment). The adjustment is less substantial for best-idea discussion (e.g., the 5.3 test statistic in Table 5 for discussion with the boss is 5.9 without autocorrelation adjustment).

[19]I measured relative centrality as follows: Let Rc_{ij} be the network constraint that contact j poses for manager i relative to the maximum posed by any of the manager's contacts: $Rc_{ij} = c_{ij}/(\max q_j)$, where c_{ij} is network constraint defined in footnote 7. Rc_{ij} equals 1.0 for the contact posing the most severe constraint on manager i, whether the c_{ij} level of constraint is high or low. The 10.1 test statistic in the text is for a logit model predicting from Rc_{ij} which of a manager's contacts were cited for idea discussion: the probability of being cited increases sharply as relative constraint approches its maximum (3.18 intercept, 2.42 logit coefficient).

[20]There are alternative decision rules that would capture the idea of informal supervision. I tried some alternatives and obtained similar results, so I stayed with the simple rule in the text. One rule was to exclude the formal boss from being an informal boss (a manager could have a formal and an informal boss, but not in the same person; 9.3 test statistic in Model XI for informal boss becomes 9.4). Another rule was to limit informal bosses to the managers who had not included the formal boss in their discussion network (a manager could have a formal or informal boss in their discussion network, but not both; 9.3 test statistic for informal boss becomes 7.7). A third rule was to limit the control variable for higher-rank contacts such that the "higher-rank" variable in Table 5 equals zero if a higher-rank contact is either the formal or informal boss to the manager whose discussion is being predicted (9.3 test statistic for informal boss in Model XI becomes 9.5).

[21]I added a record to the Table 5 data for each of the 314 managers whose immediate supervisor was not in his or her discussion network. The record represented the manager's relationship with his or her formal boss. Going down the predictors in Model XI, the record contained zero for the first five predictors (since the formal boss was not among the manager's five most central contacts), one for the same business unit, zero for lower rank, one for higher rank, one for formal boss, and zero for informal boss (the immediate supervisor must not have been an informal boss because he or she had not been included in the manager's discussion network). I dropped the two statistically negligible years-known variables in Table 5. Estimating the model with all 2,442 observations (in place of the 2,128 in Table 5) shows that the formal boss, on average, was unlikely to be the person with whom managers discussed their best idea (0.5 test statistic versus 4.0 in Table 5). The most likely discussion partner is the informal boss (8.7 test statistic), and again the three most-central contacts are disproportionately likely to be cited for best-idea discussion (test statistics for the four most-central contacts are 2.4, 3.6, 2.2, and 0.5 respectively).

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Table 1. Four Illustrative Ideas, Two High-Value and Two Low-Value.

(4.5 value, 38 network constraint) Involve SCM in the proposal process. Most of the risk in supply chain is at the front end of the busines, where little involvement from the SCM community is found. Opportunities to improve our win rate through innovative SCM ideas and out-of-the-box procurement are often overlooked or missed altogether. For example, on a proposal with a plug number for material, SCM is oftentimes not considered. We could be utilizing our powerful processes to decrement that material cost substantially, thus creating a competitive advantage.

(4.5 value, 31 network constraint) We need to develop and train our SCM people in the Subcontracts area to manage our critical subcontractors. We need to institute a standard process for subcontract mangement and a training program to deploy this process within SCM across our locations. We also need to have sufficient experienced subcontracts people available to support the program offices in order to adequately manage the subcontract process.

(1.0 value, 72 network constraint) If you go thru all the training to unify a process then the whole supply chain regardles of location should be required to continue to use the process. We tend to train alot, but are not required to continue to use the process once it has been incorporated. Supply Chain has a lot of great processes, but they get lost after the initial training, or not everyone is required to follow the process, based on location. We need to continue to work with our counter parts to ensure that the processes are being followed. Where there is a lack of training, we must take the time to train our fellow team members so that it benefits us in the long run.

(0.5 value, 80 network constraint) My SixSigma Team was tasked with developing an easier method to get Budgets and Targets posted, by part number, so that the buyers would not waste time contacting individual SCMs. This process requires utilizing the Materials System and Buyer Web System. The team ran into several roadblocks, but we identified solutions to resolve those roadblocks. Some programming changes were required (none of which was extremely high cost). In addition, we tried to have all SCMs directed to get all of their contracts loaded into the system by a certain cut-off date. We went through three or four cut-off date delays for various reasons, and each time our team met the challenge. So much time went by, however, the programmers were all diverted to the new SAP system. Without the programming changes, meeting the initial goals of the team (making ALL budgets and targets available to the buyers) is no longer possible. Therefore, the one thing I would change is to implement the changes that my team came up with. This would make the buyer much more efficient, and less frustrated.

NOTE — SCM stands for supply-chain management or supply-chain manager.

Table 2. Connections in the Supply Chain

Strength of Connection between Two People and Survey Criterion for Connection	Total Number Relations	Mean Years Known	Percent Mutual Citations	Number of Times Reported in Survey			Percent Reported as:	
				One	Two	Three or More	"Rare"	"Often"
0.00 Neither person cited the other (includes colleagues saying that the two "rarely" discussed supply-chain issues).	580	—	0%	569	11	0	100.0%	0%
0.50 One cited the other only as someone with whom their best idea was discussed.	333	8.3	0.5%	318	12	3	0.6%	3.3%
0.65 Colleagues said the two "sometimes" discussed supply-chain issues (no direct citation between the two).	675	—	0%	636	34	5	1.5%	1.8%
0.86 One cited the other as someone with whom he or she frequently discussed supply-chain issues, but not as someone with whom the best idea was discussed.	1188	7.9	2.8%	984	130	74	0.8%	12.8%
1.00 Colleague(s) said the two people "often" discussed supply-chain issues, or one person cited the other both as someone with whom the best idea was discussed and supply-chain issues were frequently discussed.	1363	8.5	10.1%	1076	176	111	0.6%	72.9%
TOTAL (mean or frequency)	4138	8.1	2.2%	3583	363	193	14.8%	28.2%

Table 3. Predicting Performance

	I. Salary (n=673)		II. Salary (n=398)		III. Evaluation (n=673)		IV. Promotion (n=638)	
Manager 1	-31,099 (2,882) **		-35,707 (3,498) **		-.973 (.678)		.689 (.670)	
Manager 2	-16,652 (2,745) **		-19,892 (3,479) **		-.863 (.631)		1.165 (.648)	
Manager 3 (reference)	——		——		——		——	
Sr. Manager	19,638 (3,782) **		15,484 (4,143) **		.116 (.843)		-.635 (.885)	
Executive	65,394 (4,522) **		61,930 (4,835) **		.423 (1.01)		.221 (1.08)	
Purchasing	754 (1,351)		1,811 (1,884)		.410 (.313)		.478 (.345)	
Age	338 (52) **		300 (71) **		-.085 (.013) **		-.084 (.013) **	
Bachelor	1,610 (1,003)		200 (1,401)		-.211 (.237)		.118 (.240)	
Graduate	734 (864)		-451 (1,155)		-.208 (.203)		.182 (.204)	
HighTech	3,516 (880) **		3,150 (1,189) *		.087 (.209)		.162 (.210)	
LowTech	-6,927 (1,481) **		-6,607 (2,375) *		-.351 (.342)		-.409 (.378)	
Urban 1	3,613 (1,046) **		3,947 (1,456) **		.423 (.247)		-.152 (.252)	
Urban 2	5,049 (1,010) **		5,585 (1,427) *		-.564 (.238)		-.052 (.243)	
Network Constraint	-7 (25)		-1 (38)		-.014 (.004) **		-.022 (.006) **	
Mgr2 * Constraint	-19 (35)		-47 (58)		.004 (.008)		-.008 (.009)	
Mgr3 * Constraint	-47 (38)		-159 (59) *		-.007 (.009)		.003 (.009)	
SrMgr * Constraint	-214 (75) *		-216 (84) *		-.005 (.017)		.010 (.019)	
Executive * Constraint	-681 (124) **		-697 (132) **		-.011 (.028)		.024 (.030)	

NOTE — Coefficients in Models I and II are change in salary dollars with a unit increase in row variable (respectively .80 and .83 squared multiple correlations; network effect plotted in Figure 4). Coefficients in Model III predict three levels of evaluation for an ordinal logit model (114.8 chi-square with 17 d.f; network effects are plotted in Figure 4 holding age constant). Coefficients in Model IV are for a logit model predicting whether the employee was promoted in the year after the network survey or received an above average raise (100.5 chi-square with 17 d.f.; network effect is plotted in Figure 4 holding age constant). Standard errors are given in parentheses (* P < .05, ** P < .001).

Table 4. Predicting Best Idea

	V. Idea Value (n=455)		VI. Idea Dismissed (n=455)		VII. No Idea (n=673)		VIII. Discuss Idea (n=455)	
Intercept	4.082		-3.739		-9.689		5.328	
Manager 1	-.228	(.159)	.721	(.285) *	-.015	(.281)	-.300	(.290)
Manager 2	-.133	(.168)	.287	(.313)	-.054	(.283)	.067	(.319)
Manager 3 (reference)	——		——		——		——	
Sr. Manager	.042	(.276)	——		.401	(.458)	-.295	(.525)
Executive	.291	(.336)	——		.438	(.621)	.210	(.758)
Purchasing	.335	(.177)	-.715	(.513)	.399	(.322)	-.160	(.323)
Age	.004	(.008)	-.006	(.015)	-.012	(.012)	-.013	(.015)
Bachelor	.226	(.148)	-.472	(.266)	-.101	(.239)	-.019	(.267)
Graduate	.094	(.143)	-.367	(.289)	-.205	(.210)	.198	(.270)
HighTech	.086	(.138)	.071	(.260)	-.099	(.212)	-.151	(.251)
LowTech	.404	(.231)	-.595	(.465)	.697	(.372)	.338	(.451)
Urban 1	.004	(.183)	-.590	(.371)	.488	(.253)	.165	(.349)
Urban 2	.071	(.174)	-.277	(.332)	.323	(.243)	-.531	(.313)
Length of Idea	-.0002	(.0002)	-.0001	(.0005)	——		.0013	(.0006) *
Sequential Order	-.0005	(.0005)	.0011	(.0010)	——		-.0006	(.0010)
Network Constraint	-.694	(.144) **	.972	(.281) **	2.356	(.243) **	-.939	(.267) **

NOTE — Network constraint is the log of constraint in this table. Model V predicts idea value on a one-to-five scale (.15 squared multiple correlation; network effect plotted in Figure 5). Models VI to VIII are logit predictions of the idea being dismissed (64.6 chi-square with 13 d.f.; network effect plotted in Figure 5), no idea being expressed (177.2 chi-square with 13 d.f.; network effect plotted in Figure 5), and discussing the idea with a named colleague (35.2 chi-square with 15 d.f.). Standard errors are given in parentheses

Table 5. Predicting Contact Selected to Discuss Best Idea

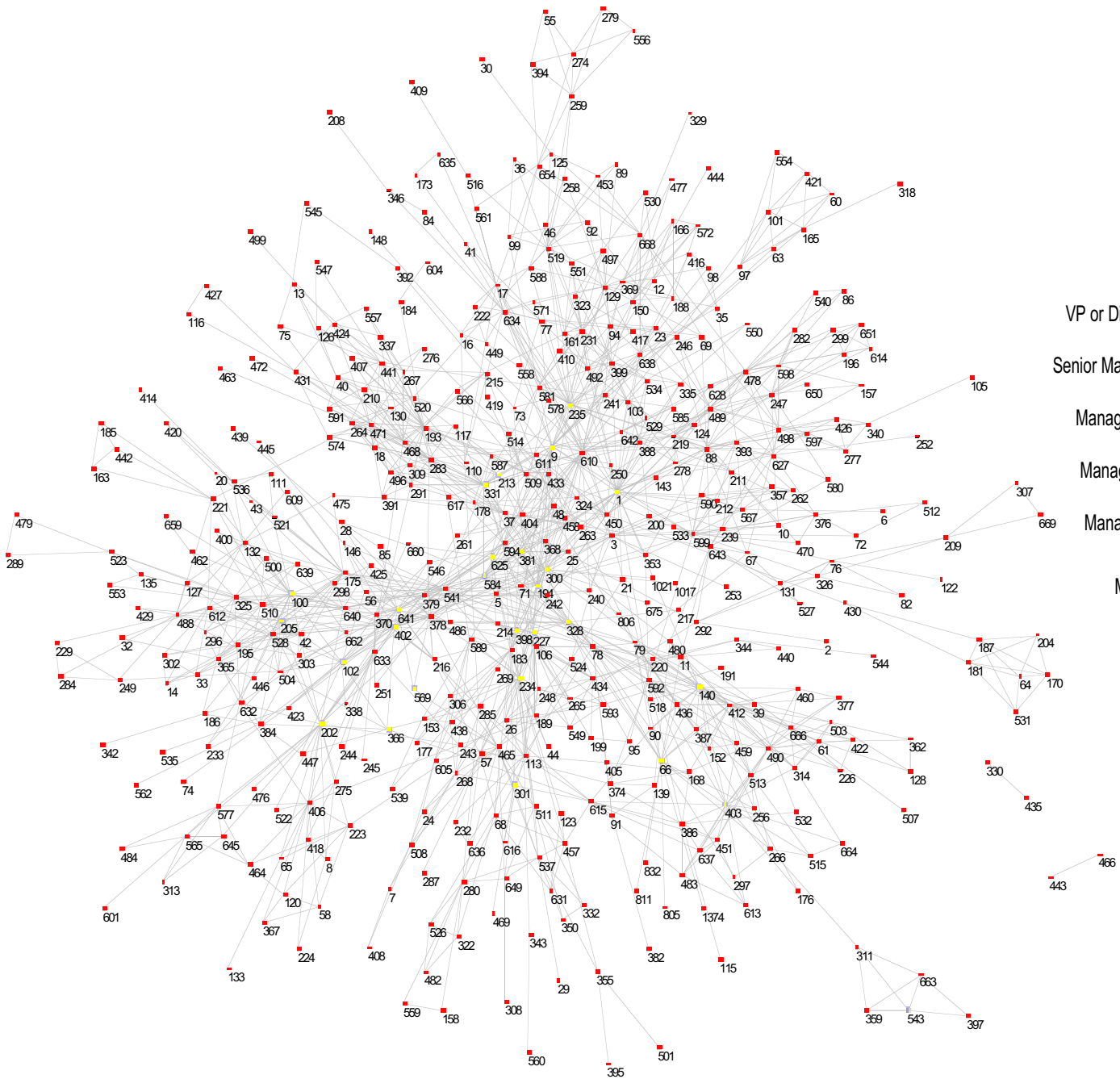|	IX. (n=2,128)		X. (n=2,128)		XI. (n=2,128)	
Intercept	-2.623		-2.829		-2.630	
Contact Most Central in Manager's Network	2.175	(.207)**	1.454	(.228)**	.453	(.290)
Second-most Central Contact	1.698	(.218)**	1.195	(.229)**	.859	(.245)**
Third-most Central Contact	.832	(.233)**	.331	(.252)	.291	(.259)
Fourth-most Central Contact	.119	(.283)	-.345	(.299)	-.390	(.321)
Fifth-most Central Contact	.199	(.281)	-.195	(.295)	-.115	(.297)
Years Manager Has Known Contact			-.036	(.021)	-.036	(.021)
Contact Known for a Decade or More			-.278	(.275)	-.232	(.289)
Contact in the Manager's Own Business Unit			.768	(.332)*	.664	(.334)*
Contact in Lower Job Rank			-1.445	(.321)**	-1.411	(.330)**
Contact in Higher Job Rank			.781	(.155)**	.006	(.184)
Formal Boss			1.373	(.253)**	1.154	(.293)**
Informal Boss					2.107	(.227)**

NOTE — These are logit equations predicting whom among a manager's contacts was selected to discuss the manager's best idea (169.4 chi-square with 5 d.f. for Model IX, 252.5 chi-square with 11 d.f. for Model X, 316.4 chi-square with 12 d.f. for Model XI). The first five predictors refer to the first five positions in the rank order displayed in Figure 6. Standard errors in parentheses are adjusted for autocorrelation between contacts attached to the same manager (* P < .05, ** P < .001).

Figure 1.
Social Order of Markets and Organizations, Specialization vs Integration

A

B

1

7

3

2

James

Robert

5

4

6

C & D

Density Table

85				Group A
5	25			Group B
0	1	100		Group C
0	0	29	0	Group D

Network Constraint ($C = \Sigma_j \, c_{ij} = \Sigma_j \, [p_{ij} + \Sigma_q \, p_{iq}p_{qj}]^2$, $i,j \neq q$)

person 2: $.265 = [1 \, / \, 3.5 + 0]^2 + [.5 \, / \, 3.5 + 0]^2 + [1 \, / \, 3.5 + 0]^2 + [1 \, / \, 3.5 + 0]^2$

person 3: $.402 = [.25+0]^2 + [.25+.084]^2 + [.25+.091]^2 + [.25+.084]^2$

Robert: $.148 = [.077+0]^2 + [.154+0]^2 + [.154+0]^2 + [.154+0]^2 + [.154+0]^2 + [.154+0]^2 + [.154+0]^2$
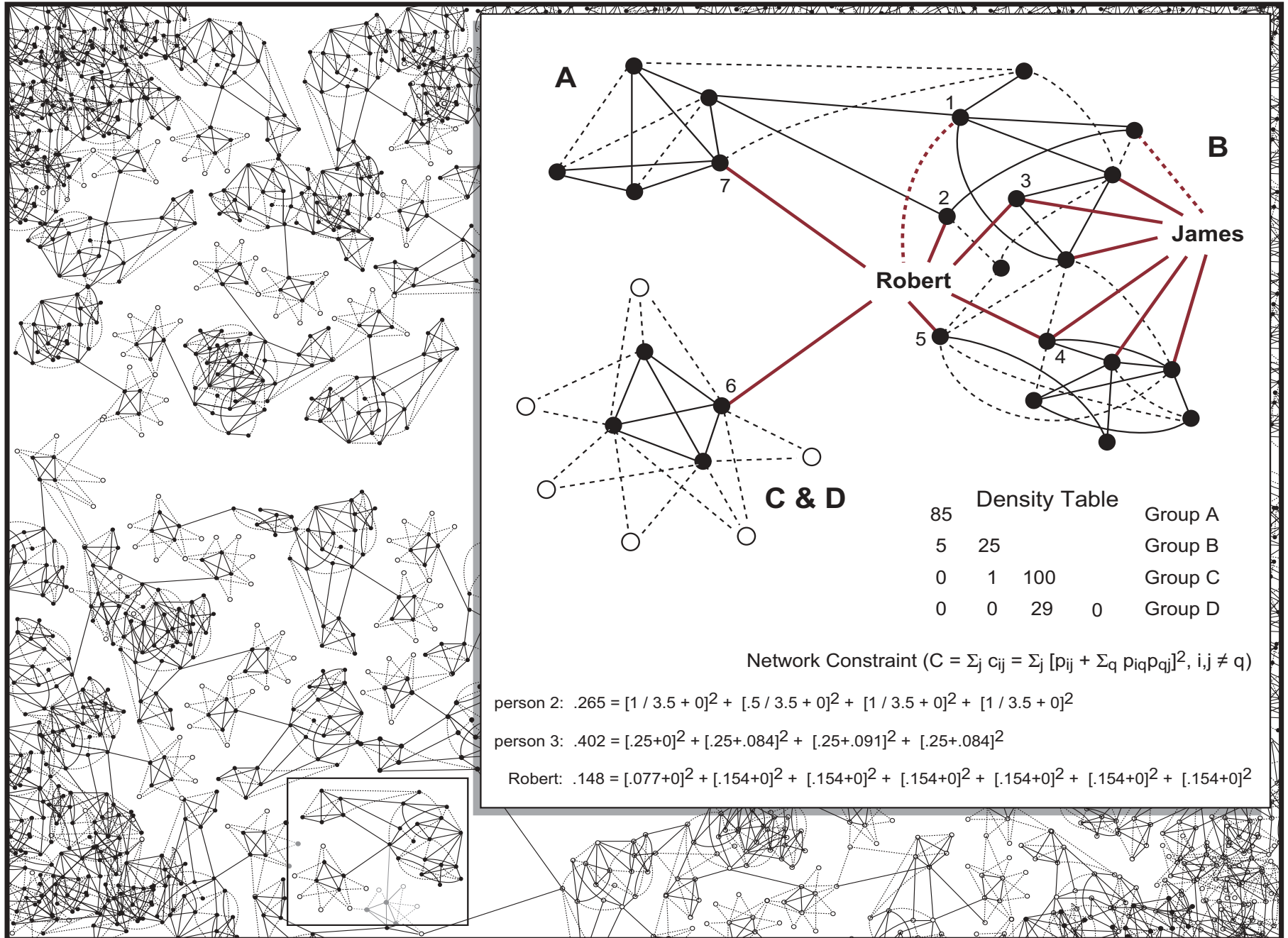
	Percent Social Isolates	Mean Network Size	Mean Network Constraint	Mean Number Cited as Discussion Partners	Mean Network Constraint Cited Discussn. Partners	Mean Path Distance (min-max) for the 476 connected managers in graph
VP or Director (25)	0%	12.6	29.8	4.9	70.2	3.3 (2.7-4.2)
Senior Manager (41)	5%	8.5	37.3	3.8	78.1	3.7 (2.9-6.4)
Manager III (121)	11%	6.4	50.2	3.7	77.9	4.0 (3.0-6.4)
Manager II (199)	27%	4.1	65.0	2.8	83.1	4.3 (2.8-6.4)
Manager I (287)	44%	3.4	73.6	2.4	83.4	4.6 (3.4-7.4)
Mean (673)	29%	5.0	60.5	2.9	81.0	4.2 (2.7-7.4)

Figure 2. Supply-Chain Discussion Network

(excludes 193 social isolates)

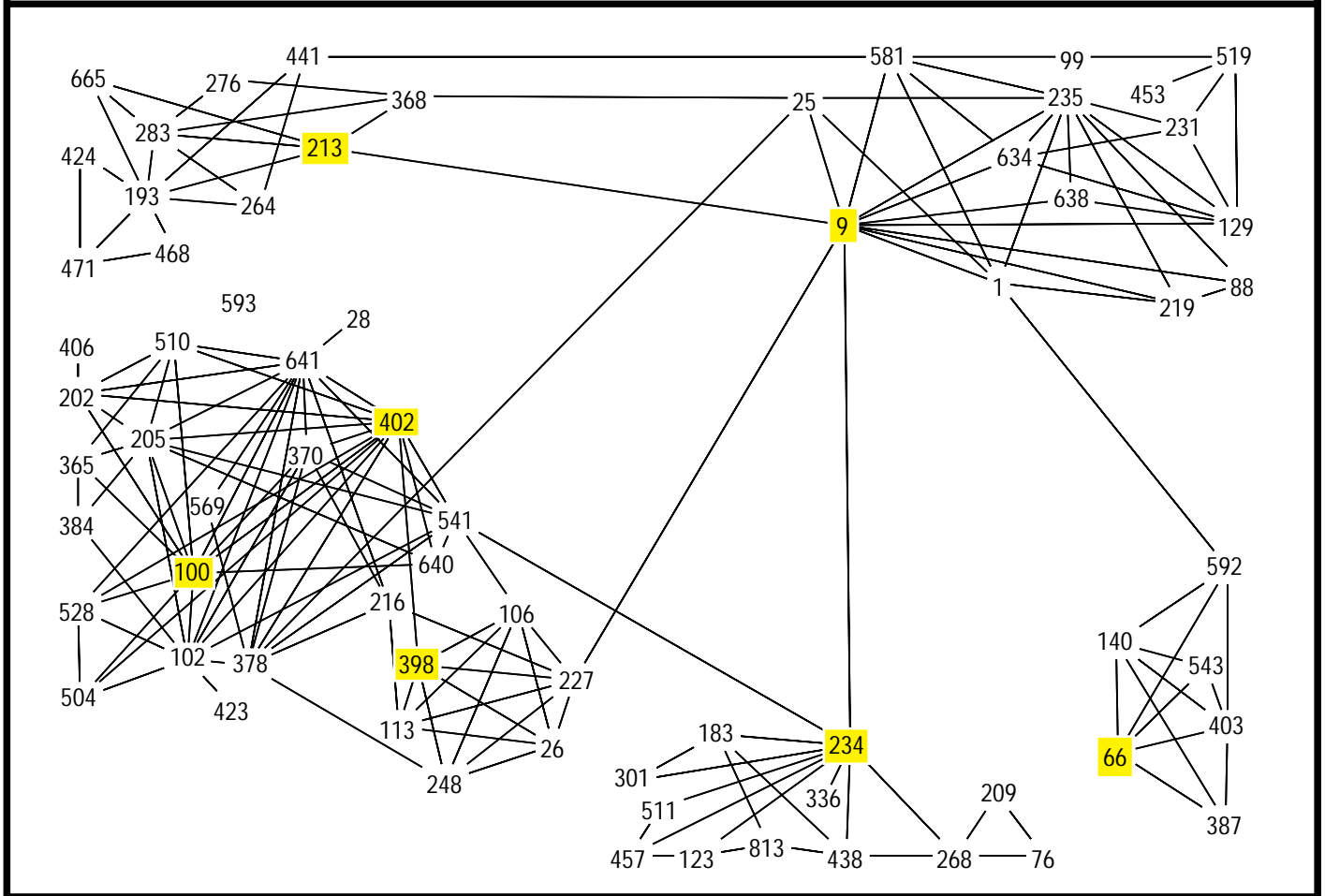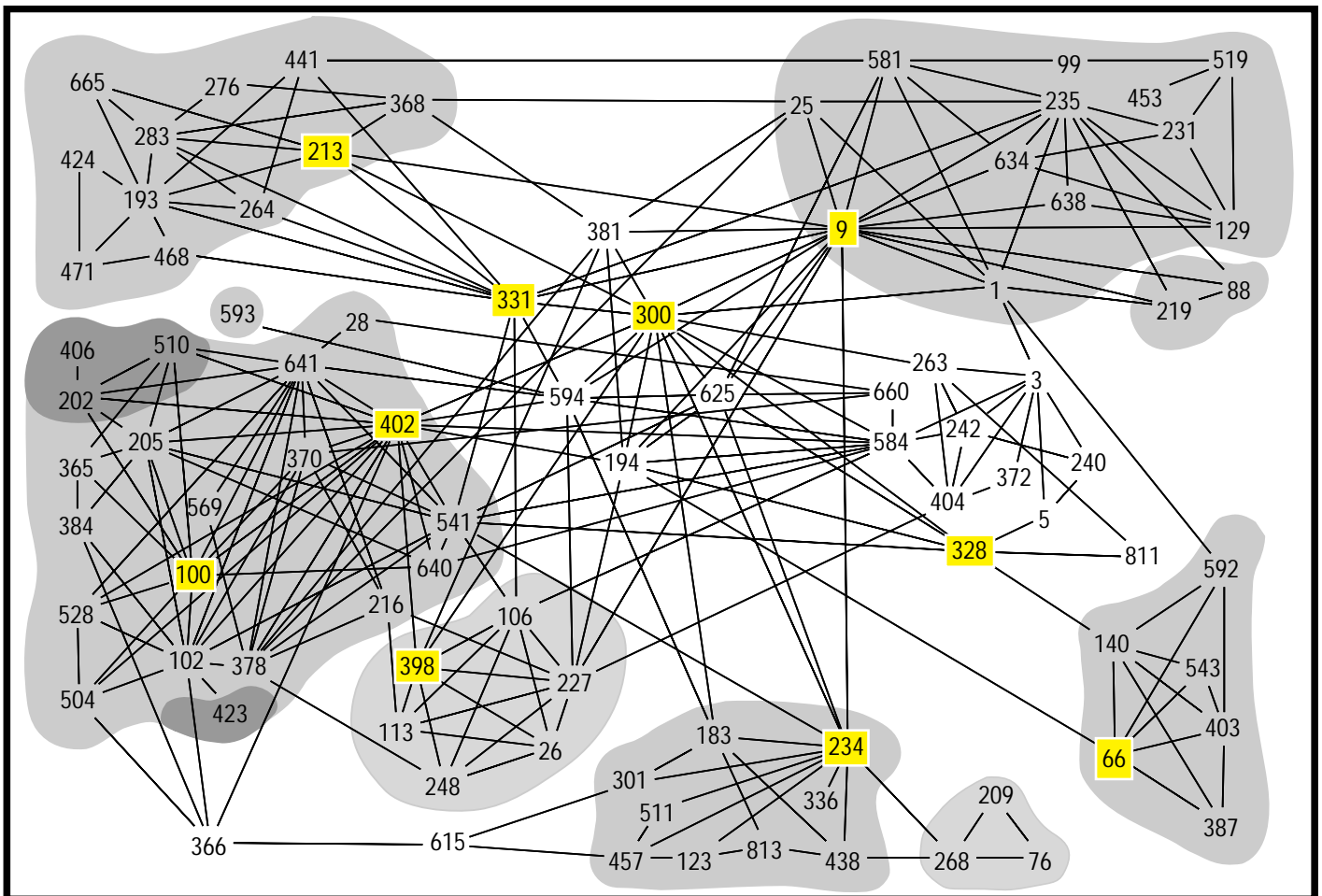# Figure 3. Core Network in the Supply Chain

Figure 4. Brokerage and Employee Performance

Y = 1.023 - .026 C
(-5.6 test statistic, black dots indicate Director or VP)

Probability Promotion-Raise
(-6.5 logit test statistic)

Probability "Outstanding" Evaluation
(-5.0 logit test statistic)

Probability "Poor" Evaluation
(4.7 logit test statistic)

Salary Relative to Peers (studentized residual)

Discussion Network Constraint (C) Around Employee

Figure 5. Brokerage and Employee Best Idea

$$Y = a + b \ln(C)$$

	$\hat{a}$	$\hat{b}$	t
Judge 1	6.42	-1.04	-5.8
Judge 2	4.08	-.63	-3.9
Combined	5.51	-.91	-7.4

$\hat{P}$(no idea)
11.2 logit test statistic

$\hat{P}$(dismiss)
5.5 logit
test statistic

". . . for those ideas that were
either too local in nature,
incomprehensible, vague,
or too whiny, I didn't rate them"

Management Evaluation of Idea's Value

Probability

Discussion Network Constraint (C) Around Person Offering Idea
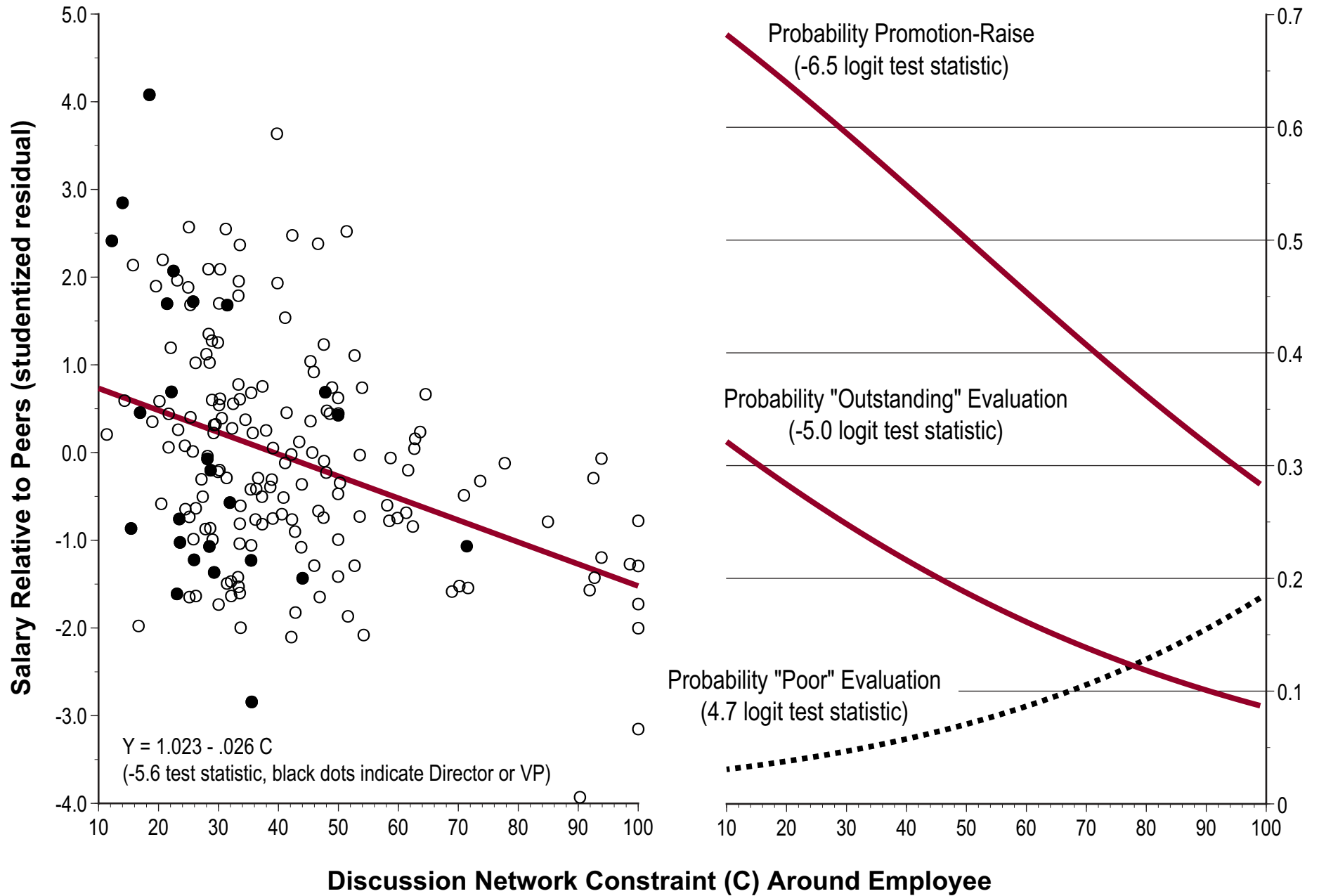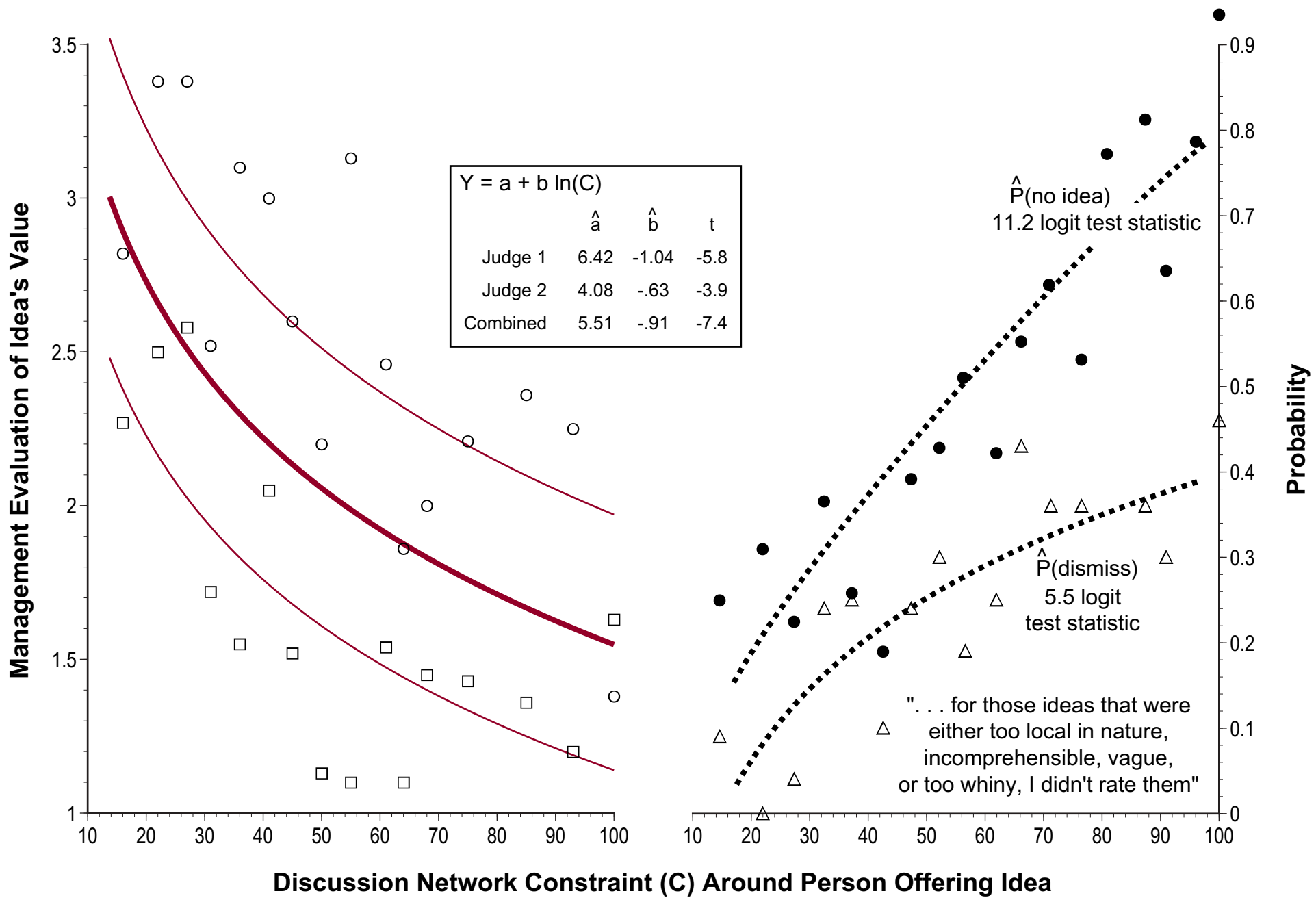
Figure 6. Idea Discussion and Individual Contacts