

Social Networks Through Time

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Editors



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Contested Control in a Large Manufacturing Plant

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Abstract

Social scientists who study organizations—whether they study as theorists, researchers, or consultants—have long been aware of the importance of informal control mechanisms for an organization's functioning. The primary hurdle separating that awareness from more effective implementation, however, has been methodology. With a case study of a severely troubled firm, we illustrate how developments in network analysis can be useful in diagnosis and management. Using readily available corporate personnel records, we describe the social structure of interpersonal relations within and beyond the firm over a thirty year period. We show how control and leadership shifted over the thirty years, and how conflict within the firm is grounded in the changing structure of relations.

1 Introduction

This is a story of diseased capital, a story of neglect run to near ruin. The message of the story is both practical and methodological. More on that later.

For the moment, imagine yourself the man who commissioned this work. You are the CEO of a medium size American manufacturing firm in the mid 1980s. Most of the firm's activities are concentrated in one large manufacturing plant. You pretty much have a free hand to run the firm. The firm is profitable. In fact, a recent upsurge in market demand for your firm's product has the firm turning in record profits.

Perhaps the single most important other thing to note about your position is that your employees hate you. For a variety of reasons, most of them beyond your control, you have become for the employees a symbol of an unpleasant workplace. Shared disdain for you brings other people together. Projects originating in your office consistently fail for want of proper implementation. Sensitive opinions expressed in meetings with your senior management are common shop knowledge within a week. The problem has followed you home in a way rarely experienced by American executives. You and your family have received bomb threats.

What do you do? You can't wait for the problem to go away. It is getting worse with time. You can't walk away. Your credibility with important investors, not to

mention the bulk of your life savings, are invested in the firm. You are too old to start out fresh in a new career innocent of financial resources. The fact of the matter is that you're stuck. You have to deal with the problem. You have to understand what is driving it so that you can reorganize the firm to manage it—to get the firm, and yourself, back into stable, profitable production.

The first step is to recognize the problem. This is a problem of diseased capital. Not capital you can put your hands on, but capital nevertheless. To clarify, distinguish four kinds of capital held by a firm; its physical capital, its market capital, its human capital, and its social capital. Most obviously, there is the firm's *physical capital*; its liquid assets in cash and its tangible holdings such as equipment, real estate, and stocks that can be converted readily in cash. The inventory and management of these assets is the traditional domain of accountants and financial advisors more generally.

Second, *market capital* exists in less tangible corporate image and organizational assets such as the firm's market share, its product reputation, its organizational connections with suppliers and consumers, and so on. These are capital assets in the sense that they are held by the firm (if not exclusively), affect the stability of its earnings, and so affect the resale value of the firm. The inventory and management of these assets draws on social science expertise broadly defined, expertise typically found in business schools, often in economics departments, and increasingly in sociology departments.

Third, *human capital* exists in the skills and experience that make the firm's employees a critical component in the equation determining the firm's value. This capital exists in and between employees. Most obviously, it exists within individual employees as their personal skills and experience. It is in this form that human capital has been studied so extensively by economists and sociologists following Gary Becker's articulation of the concept focused on returns to investments in formal education, on-the-job training, health maintenance, and so on.

But even more important than the skills and experience of employees as individuals is the human capital represented by their coordination. Employees are in certain respects held together and in other respects forced apart in different ways, to varying degrees, by their personal relations with one another—relations of kinship, friendship, acquaintance, and respect. Coordinating the long and short-term use of a firm's physical and market assets, these relations define the social component in a firm's human capital. More simply, they define the firm's *social capital*. It is the social structure of these relations that determines resistance and cooperation with new management initiatives. It is the social structure of these relations that determines where conflicts will be most severe within the firm and how they can be managed. Moreover, the social structure of these relations can be studied to reveal the extent

to which the firm's social capital is invested in specific individuals—sometimes for the good of the firm and sometimes, as in the firm under study, as a threat to the very survival of the firm. The volume of an individual's leadership potential is indicated by the range of the individual's relations, the number and diversity of his or her contacts. The substance of the individual's potential leadership is indicated by the specific kinds of people in his or her network of contacts. In short, and of critical importance where labor contracts lock a firm into specific employees, a firm's social capital is the critical factor determining the firm's value and vitality.

The theory and methodology for reporting on these qualities of social capital is part of the rapidly expanding field of network analysis in sociology. Many of these developments are discussed by Lincoln (1982) as they bear on organization research. Unfortunately, the lack of data has inhibited the application of these developments. One data collection strategy—exemplified in Kapferer's (1969) description of the 23 employees in a zinc processing shop—is to have an observer make detailed notes over time on the manner in which conflict is grounded in changing relations among employees. This strategy is simply not practical for understanding the same phenomena as it plays out in a large plant, or for understanding the long-term etiology of current conditions in the plant. The difficulty is not size alone. Participant observation methods are no more useful here than the survey strategies used to study networks in large populations as described by Coleman (1958) or recent adaptations to probability samples as in the General Social Survey (Burt 1985, 1990; Marsden 1987). The usual sociometric methods for obtaining data on employee relations are intrusive, inviting distortion or reaction from employees troubled by outsiders investigating their personal relationships. Respondents are asked to name people with whom they socialize, people they respect, and so on. In familiar studies where such data are obtained, Lipset, Trow, and Coleman's *Union Democracy* (1956) or Lincoln and Miller's (1979) study of work and friendship relations within firms, employees vary from indifferent to supportive respondents. The firm under study is an extreme example of a site poorly suited to the usual survey network methods. Quite beyond biased data and a limited time horizon, we are here talking about physical danger to the interviewers.

There are alternatives. Our purpose in this paper is to show that considerable insight into a firm's social capital can be gleaned from archived personnel records. The data are completely nonreactive to employee interests. Employees need not be contacted at all in the data collection. In fact, studies such as this could be carried out in historical analyses to evaluate the assets of a firm or production facility that has been shut down or even gone out of business. From the data obtained, we were able to reveal the history and root of the problem bedeviling the firm under study and recommended organizational strategies for a hopeful future.

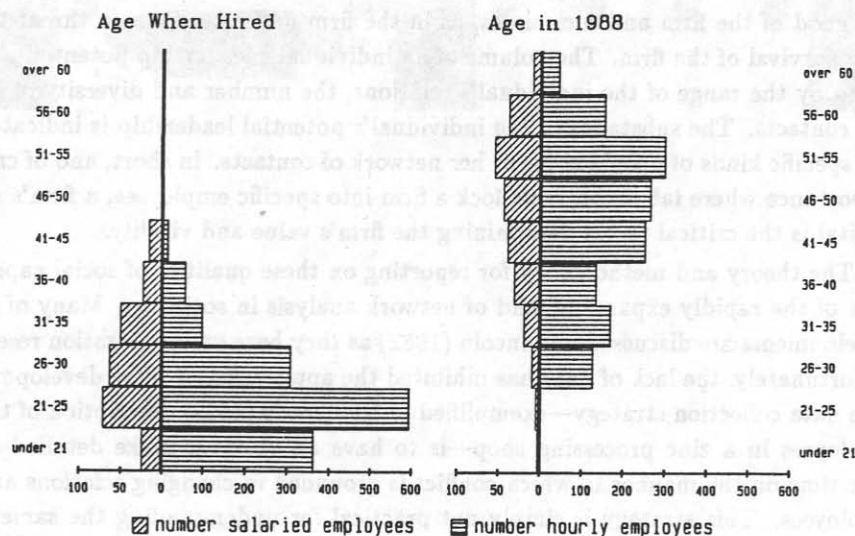


Figure 1: Employee age distribution

2 The firm

We initially presumed that to study the social structure of the firm without conducting personal interviews, we would be limited to a traditional case study of the communities surrounding the firm, relying on whatever records were readily available within the firm and community archives such as newspapers, the public registrar, and so on. Unhappily, the firm is located in an area where community archives are quite limited. They offered no assistance in understanding the history of the firm's current situation.

The firm's personnel records were richly informative. Among other things, we could see that the firm's current employees tended to have been hired when they were young and stayed with the firm through periods of being laid off (in accord with the union contract which determines lay offs and returns strictly by seniority). Most employees claimed on their applications to have graduated from high school or obtained an equivalent education during their military service or through a formal equivalency certificate. Most were applying to the firm just after high school or a year or two at a local college.

The point is illustrated in Figure 1 with age distributions for current employees. From the distribution to the left of the figure, you can see that most employees entered the firm when they were in their late teens or early 20s, just after high

school or a couple years of college. Few applicants were over 30 when they applied (17%). The distribution to the right in Figure 1 shows that these people aged with the firm, leaving few vacancies behind them. The employee age distributions in 1988 are skewed away from youth and building up toward retirement. Salaried employees were 29 years old on average when they applied. They were, on average, 47 years old in 1988. Hourly employees were 24 years old on average when they entered the firm and aged to an average of 45 in 1988.

In other words, their work with the firm was a way of life for the employees. They had grown from children to senior adults with a self-concept grounded in being an employee of the firm. Over this time, they had seen little technological change in the nature of their work. With occasional, minor, administrative variations, a routine day-to-day existence had evolved. Everyone was familiar with the 'way things were done' at the plant. The old explained it to the new, and no one saw a need for change. It had always been done this way.

Meanwhile, an economic engine for change was at work outside the firm in its supplier and consumer markets. The firm was no longer profitable. Living on borrowed income, the firm was to be shut down unless new owners could be found with the vision to make it profitable.

New owners were found. A more cost conscious management was put in place. The firm began to show a profit. As is usually the case, the transition to new management involved some changes in the salaried ranks. These changes seemed minor at the time judging from the productivity of the discharged personnel, but the changes proved to be significant for employee relations within the firm, bringing the firm once again to the brink of disaster. How that is so is the story here.

In the course of going over the firm's personnel records, we were struck by the wealth of sociometric data available from application forms. In addition to the usual background information on age, education, residence, and past employment, each employee was asked on the application form to name: (a) any acquaintances he or she knew among the people currently working for the firm, (b) any relatives employed by the firm, (c) the individual, if there was anyone, who informed the applicant of job opportunities at the firm, and (d) up to three references who could personally recommend the applicant.

These are the sociometric choice data for our study. Data are taken from the applications submitted by everyone employed by the firm in the spring of 1988 (including employees temporarily laid off or on disability). Their applications span the 33 years of the firm's operation, from its initial hires in 1956 through its few hires in 1988. Naturally, people were not named in a consistent fashion. People were named sometimes by their first name, sometimes by their middle name, sometimes by variations on a nickname, and sometimes just by their title and last name. Using

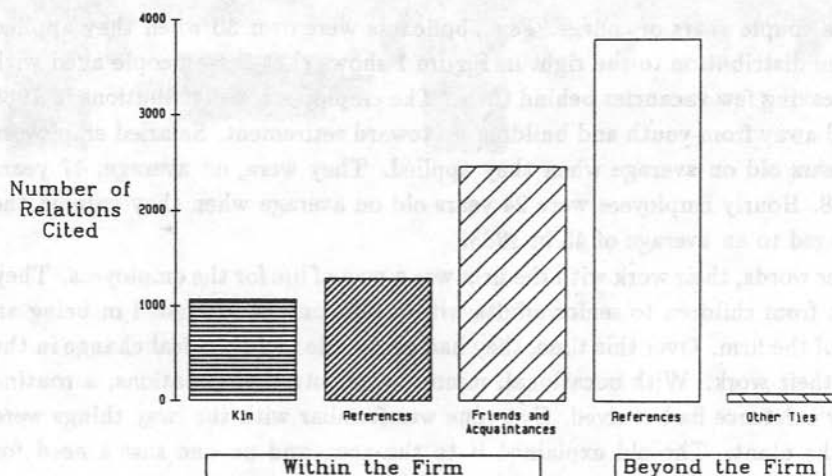


Figure 2: Kinds of relations

road maps of the area surrounding the firm combined with computer records on the age, hiring dates, and addresses of current and past employees, a team of five people worked for a month on the choice data so that citations to the same people could be identified.¹

3 Kinds of relations

The 1721 employees collectively made a total of 8743 citations to 4653 people in and beyond the firm. On average, in other words, each applicant cited five people and each person named was cited by two applicants. Each citation could include multiple kinds of relations. For example, an applicant could have cited a relative working for the firm, who had suggested that she apply for a job at the firm, and who the applicant cited as a personal reference. Figure 2 describes the aggregate frequency with which kinds of relations were cited.²

The two bars to the right of Figure 2 refer to relations with people beyond the firm. These relations will be used to describe the social structure of the communities surrounding the firm as the communities were connected with the firm's employees. Not surprisingly, these relations were cited principally as references, ties to community leaders that the applicant believed would enhance his or her attractiveness as an employee. Among the people cited were doctors, ministers, priests, teachers, local businessmen, and political leaders. The few other community ties in Figure 2 are relations with people beyond the firm (not named as references) who informed the applicant of job opportunities at the firm, suggesting that he or she apply.

The three bars to the left of Figure 2 distinguish three kinds of relations within the firm. (a) A quarter of the relations within the firm were with relatives. On average, each applicant had a relative already employed by the firm when he or she applied. (b) Another quarter of the relations were with people who were just friends or acquaintances working for the firm.

Recall that these relations span a 33 year period of time. Most were with people still employed by the firm in 1988, but many were with people who had taken up other jobs, retired, or otherwise left the firm. Of the 4846 relations with employees, 2292 (47%) were with people no longer working for the firm in 1988. These family, reference, and friendship relations with past employees will be another source of insights into the social structure of leadership outside the firm.

Cohorts of employees

Aggregate representations of the relations such as the graph in Figure 2 presume that the sociometric citations come from a single social structure of relations sampled over time. However, the social structure could have changed over time to invalidate such an assumption, requiring a multi-network analysis of relations within and across time periods. Figure 3 illustrates the point for the firm under study.

The graph at the top of Figure 3 plots the number of current employees hired in each year since 1956. The uneven hires over time correspond to production activities in the firm. A large number of people were hired when the firm moved into full operation through 1957 and 1958. Production facilities were expanded in the late 1960s, generating another wave of new hires. The weak economy of the early 1970s triggered a reduction in production facilities, but these were brought back in the late 1970s, generating a third wave of new hires.

Of course, these varying numbers of hires need not reflect changes in the social structure of the firm's labor market. The number of people hired each year merely indicates the volume of relations coming into the firm. It does not indicate the substance or structure of the relations.

However, the spatial map at the bottom of Figure 3 shows that the structure of relations was changing. The map is a multidimensional scaling of the extent to which applicants in each year cited identical patterns of relations. A graph like Figure 2 was constructed for each year from 1956 through 1988. Adjacent years were combined when there were very few hires in a year (e.g., 1983 and 1984 are reported as 83/84 at the bottom of Figure 3). The relative frequency with which each kind of relation was cited by applicants for the year defines the relation hiring profile for the year. Years close together at the bottom of Figure 3 had similar hiring profiles. For example, of the 484 relations cited by employees hired in 1966, 14%

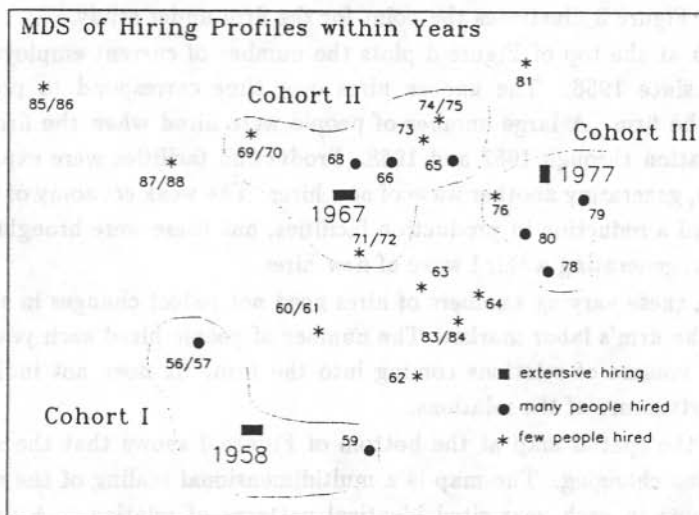
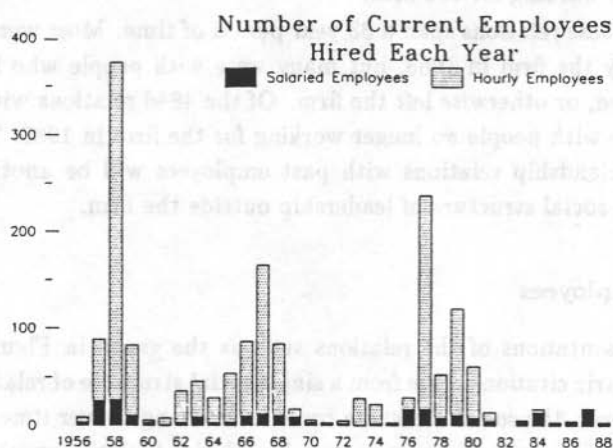


Figure 3: Identifying employee cohorts

were relatives working for the firm, 17% were employees cited as references, 24% were friends and acquaintances working for the firm, and 45% were people outside the firm. A similar pattern occurred across the 794 relations cited in 1967, with 14% employee kin, 15% employee references, 23% employee friends and acquaintances, and 48% people outside the firm. Without knowing the specific kinds of relations cited each year, you can see in Figure 3 that similar kinds of relations were cited in 1966 and 1967 because the two years are close together in the map at the bottom of Figure 3. A different profile of relations was cited by applicants hired in 1958, as you can see in Figure 3 from 1958 being far from 1966 and 1967.³

Circles have been drawn around adjacent years in Figure 3 to define cohorts of employees, sets of employees citing similar kinds of relations when they were hired. Note that each of the firm's three hiring waves occurred in the middle of a different cohort, indicating that different kinds of relations were cited in each wave. The first cohort entered when the firm began full time operation. These people were hired from 1956 through 1959, with most hired in 1959. The second cohort entered the firm in the late 1960s, a period extending from 1965 through the few hires during the early 1970s to 1975. The third cohort entered the firm with the expansion of production facilities in the late 1970s. These people were hired from 1976 through 1980, with most hired in 1977 and 1979.

The changing substance of relationships

Figure 4 describes the kinds of relations cited by each cohort of employees. Compare Figure 4 with Figure 2. Each cluster of bars in Figure 4 corresponds to Figure 2. If the same kinds of relations had been cited by each cohort of employees, then each cluster of bars in Figure 4 would look like the bars in Figure 2. Instead, there are dramatic differences across the cohorts in Figure 4. The differences show the firm's labor force disengaging from the social structure of the surrounding communities, becoming a society unto itself with politically able employees replacing the leadership formerly provided by the surrounding communities.

This conclusion is based on four classes of evidence. First, there is an increasing presence of kinship relations within the firm. The firm increasingly hired employees from the families of people already working for the firm, making the firm a place where multiple members of a family work, rather than one of the places where members of a family work. Kinship is pronounced by the late 1960s. Only 3% of the relations cited by employees in the first cohort were to relatives working for the firm. This increases to 15% in the second cohort and 18% in the third cohort. A log-linear model of these data indicates the magnitude of the changes. Overall, the kind of relations cited vary significantly between cohorts (745.3 chi-square, 8 df,

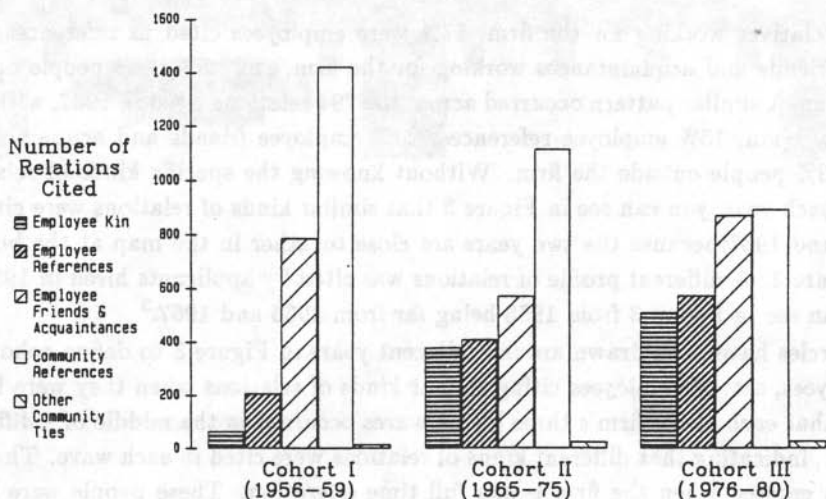


Figure 4: Kinds of relations within cohorts

$p < .0001$).⁴ The few employee kin cited in the first cohort are only 41% of the number expected by random chance.

Second, community leaders are increasingly replaced by employees as personal references. Over time, applicants seem to have believed increasingly that they were more likely to get a job with the firm if they could get a personal reference from someone already working for the firm rather than a reference from a community leader unaffiliated with the firm. Applicants in the first cohort tended to draw their references from leaders in the communities surrounding the firm. Only 13% of their personal references were people already working for the firm. This increases to 27% in the second cohort, and 39% in the third cohort. Here again, the log-linear model of the data is useful. There is linear increasing tendency for employees to be cited as references and a more steeply declining tendency to cite people beyond the firm. Beginning with a clear preference for community leaders in the first cohort, the two tendencies are indistinguishable in the second cohort, with community leaders clearly less preferable in the third cohort. In other words, the transition from community leadership to leadership within the firm was under way during the late 1960s, and in place by the late 1970s.⁵

Third, there is an increasing tendency for employees rather than community leaders to recruit new employees to the firm. Of the 46 recruited to the firm in the first cohort, 63% were recruited to the firm by employees. This increases to 92% and 90% in the second and third cohorts. To determine the tendency for new employees to have been recruited through each kind of relation, recruitment relations

can be compared to relations through which employees were not recruited. Log-linear parameters of these comparisons describe the relative tendencies for recruitment through each kind of relation in each cohort.⁶ The relative likelihood of community leaders recruiting new employees was greatest when the firm first opened, hiring the first cohort of employees in the late 1950s. Employees became the principal recruiters thereafter, recruiting friends and acquaintances in the second cohort, and their relatives in the third cohort. In each cohort, employees were especially likely to recruit their relatives to the firm when they learned of job opportunities, but this tendency increases with time. We also noted the changing role of employees named as references. These are the employees perceived by applicants to have prestige within the firm such that their personal endorsement of the applicant would improve the applicant's chances of getting a job. These employees were least likely to recruit applicants for the first cohort, but employee leaders change over time to the point where they had the greatest relative tendency to recruit employees by the late 1970s. Here again, the transition from community to employee leadership was apparent in the late 1960s and in place by the late 1970s.

Fourth, leadership becomes increasing evident among employees at the same time that it becomes less evident among community leaders. The frequencies in Table 1 show how relations were distributed across the people cited by employees in each cohort. For example, there were 1222 different community leaders cited by employees in the first cohort. Most of these people (1018, or 83%) were cited by only one employee. Only seven community leaders were sufficiently prominent to have been cited by ten or more employees in the cohort.

The clarity of community leadership—as indicated by the extent to which specific individuals were cited by multiple employees—clearly changes across the cohorts. Looking across the columns in Table 1 of citations to community leaders, you can see an increasing proportion of the people being cited by only one employee and a decreasing proportion cited by multiple employees. At the top of the social hierarchy, the seven community leaders cited by ten or more employee in the first cohort decreases to one such community leader for employees in the second cohort, and disappears altogether in the third cohort. We estimated a log-linear model of three levels of community leadership (number of community leaders cited once, number cited twice, and number cited three or more times) across the three cohorts. The declining presence of widely cited community leaders and growing presence of community leaders cited by only a single employee is quite strong (33.51 chi-square, 4 df, $p < .0001$).

These trends are reversed for leaders among the people already working for the firm, but only for those cited as references. The data in the bottom panel of Table 1 show no strong connection between employee cohort and the prominence

Table 1: Leadership in each cohort

	Number of People Receiving Each Level of Citations		
	Cohort I	Cohort II	Cohort III
Number of Citations Received by:			
community leaders			
one	1018	829	836
two	117	77	66
3-4	60	28	18
5-9	20	7	5
10+	7	1	0
Total	1222	942	925
employees cited as references			
one	157	208	212
two	100	121	132
3-4	57	76	102
5-9	25	23	61
10+	6	2	10
Total	354	430	518
employees never cited as references			
one	323	317	413
two	70	69	104
3-4	21	13	39
5-9	4	0	4
10+	1	0	0
Total	419	399	560

of employees cited only as kin, friends, or acquaintances. However, the data in the middle panel show an increasingly clarity of leadership among employees cited once or more as a personal reference. In a log-linear model of employee leadership, this change over time is less striking than it is for community leaders still but still strong (13.28 chi-square, 4 df, $p = .01$).

The first two cohort are not much different, but both are distinct from the third cohort. In other words, the clarity of employee leadership was improving during the

late 1960s and was in place by the late 1970s. The tendency for employee references to be cited by multiple applicants is high in the third cohort and their tendency to be cited by only one employee is low. Moreover, consider sheer number of employee leaders. Notice in Table 1 that 173 employee cited as references were each cited by three or more applicants in the third cohort—102 cited by three or four applicants, another 61 cited by five to nine applicants, and another 10 cited by ten or more applicants. These are the highest frequencies in the table for comparably prominent people.

4 Patterns of relations

We have studied relations as if they were independent units, kinship relations, for example, being compared on average to recruitment relations. This is useful analytical strategy for certain purposes, but it is inaccurate in at least one important respect. Relations do not exist in isolation. They are bundled together with other relations through specific individuals. Much of a relationship's meaning comes, not from the kind of relation it is, so much as its connection with other relations. For example, a personal reference from a prominent leader is very different from a personal references from a socially isolated person. Both are personal reference relations, but their difference lies in the way they are connected to other relations through specific individuals. Having described kinds of relations, we now shift to describing patterns of those relations defining the positions of individuals in the social structure in and beyond the firm.

Distinguishing patterns of relations

To do this, we have constructed the network surrounding each of 5429 different people; the 4653 people cited by the firm's current employees and 776 additional people who were currently employed by the firm but never cited by other employees. Each person's network contains their pattern of relations with others. Consider the illustration presents in Figure 5 for a hypothetical person named Samuel E. Bodacious. It is immediately apparent that the network data are much more complex than one might conclude from the preceding analysis of kinds of relations. Three kinds of direct contacts define Sam's network: (a) Most obviously, there is everyone he cited when applying for a job with the firm. These contacts occur in the same year and are only available for people employed by the firm in the spring of 1988. In Figure 5, Sam cites a relative working for the firm (Eugene Bodacious), a friend working for the firm (John Pitts), and three prominent references; Gene, his relative cited by five other people currently working for the firm, Bob Woods, also cited by

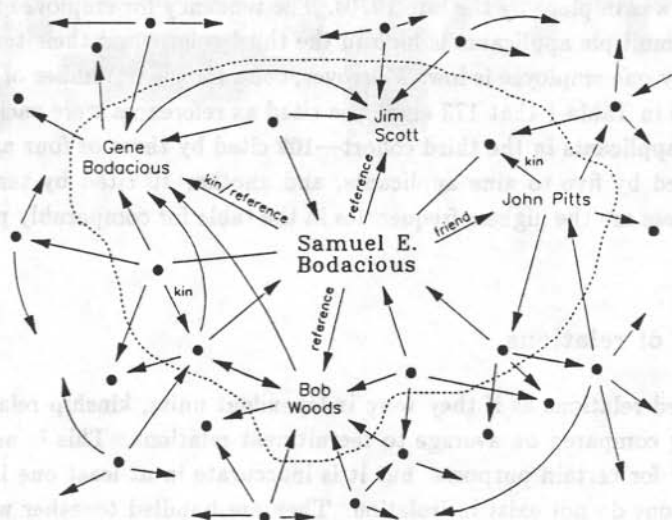


Figure 5: The network around Sam Bodacious

five other people, and a community leader, Jim Scott, cited by four other people working for the firm. (b) Second, there are the people who cited Sam when they applied for a job. These contacts occur over time and are available for all 4658 people in the analysis. Sam was cited by four people. (c) Finally, there are the relatives cited by, or citing, any of the people directly connected with Sam. These contacts too are available for all 4658 people in the analysis and occur over time. Sam has two such contacts in Figure 5; the son of someone citing him, and the brother of his friend, Jim Pitts. The above three kinds of relations collectively define Sam's direct contacts, enclosed by a dashed circle in Figure 5. On the basis of accumulated results in network analysis, we have also included a second zone of contacts in each network, indicated by dots outside the dashed circle in Figure 5. These are the people who cited, or were cited by, any of Sam's direct contacts. The total of Sam's direct and two-step indirect contacts define his network for this analysis. These are the names and dots in Figure 5, a total of 27 people, 28 including Sam. Arrows into empty space in Figure 5 are relations beyond Sam's immediate network.

Repeating this exercise for each of the 5429 people in the population yields the results summarized in Table 2. In the first column you can see that many people were never cited (776 employees) and the most common situation was to have been cited once. More than half of the people cited at any time were cited only once over the thirty years of the firm's operation. Direct contacts provide more information on the links integrating people into the population. These are the contacts inside

Table 2: Contact distributions

Number of Contacts:	Number of People		
	Citations	Direct Contacts	Indirect Contacts
0	776	8	8
1	3210	1392	251
2	645	922	490
3-4	480	1059	727
5-9	247	1060	1203
10-14	50	522	1056
15-24	14	367	832
25-49	5	92	510
50+	2	7	352
Total Number of People	5429	5429	5429
Mean Number of Contacts	1.6	5.6	19.8

the dashed line in Figure 5. Only 8 people remain isolated and a much smaller proportion of the population has a single contact. The average person had five or six direct contacts in the population. Integration is even more apparent from the distribution of indirect contacts, with the average person being able to reach an additional 30 people connected to his or her direct contacts.

The pattern of relations illustrated in Figure 5 would make Sam a prominent player among the firm's employees, but he would not be among the most prominent. In Table 2, there are 318 people who received more than the four citations that Sam receives in Figure 5. There are 2048 people with more than Sam's ten direct contacts. Although Figure 5 seems to be a complex network of contacts, in other words, many of the observed networks are much more complex. At the upper extreme, the most connected person in the population is a retired manager named Bill Glass who rose from being an hourly employee to foreman and then to a management position. His interpersonal skills are evident. He was cited by 106 of the current employees. He had a total of 199 direct contacts. Through those contacts, he was connected to another 950 people. In sum, he was connected either directly or through one intermediary with 1149 people, a fifth of the entire population in and beyond the firm! We will return to Mr. Glass shortly.

To distinguish the patterns of relations most characterizing the population, we focus on the richest pattern, the patterns that have made certain individuals prominent at one time or another in the firm's history. These are the past and present

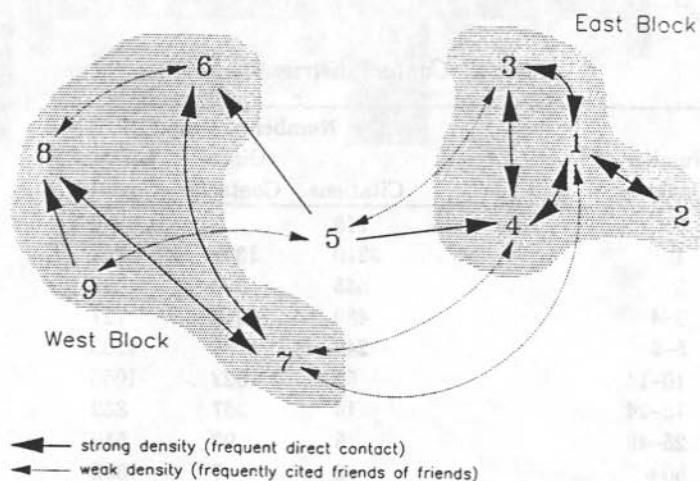


Figure 6: *The social structure of leadership*

leaders in the population. We began with the people cited five or more times within any of the three cohorts. There are 150 such people. These are the people most prominent within each time period even if each of them is not prominent across all time periods. These 150 leaders included all but two people receiving 10 or more citations over the history of the firm. Those two additional people were added to the pool of leaders. Also, there are two slightly less prominent people who had served in prominent union roles and continued to be active. These too were added, bringing the total to 154 leaders affiliated in one way or another with the firm.

We searched across the networks of the leaders for structurally equivalent individuals, leaders with similar patterns of direct and indirect contacts with each of the 5429 people in the population. The Appendix contains a detailed description of our search leading to the sociogram in Figure 6 describing relations among ten positions in the social structure of leaders. Each position is occupied by multiple structurally equivalent leaders. In other words, each position represents a unique pattern of direct and indirect contacts in the population of all 5429 people.

The sociogram in Figure 6 describes contacts between the leaders. A solid arrow from one position to another indicates that leaders in the source position had frequent direct contacts with leaders in the destination position. A dashed arrow indicates that leaders in the source position had infrequent direct contact with leaders in the destination position, but frequent indirect contact through one or more of the 5429 people in the population. In other words, a dashed arrow indicates numerous mutual acquaintances in the population despite infrequent direct contact with one

another. The lack of an arrow between two positions indicates that leaders in the two positions had infrequent direct contact, infrequent indirect contact, and in some cases, no mutual acquaintances at all among the 5429 people in the population.

The social structure is symmetric between two broadly defined groups. Positions 1 through 4 are components in a west block. Positions 6 through 9 are components in an east block. The blocks of positions are shaded and labeled Figure 6. The geographic labels will be explained in a moment. Each block has a core position holding together the block, position 1 in the east block and position 8 in the west block. Also, each block contains one position strongly connected with the broker position, position 5, that provides the principal bridge between the two blocks. In the east, position 4 is directly connected to the broker position. In the west, position 6 is directly connected to the broker position. Floating unattached to all other positions, position 10 is occupied by lesser leaders, leaders who received few citations and had few contacts within the population of leaders.

5 Patterns of relations in the aggregate

Leadership in the population is strongly dependent on where a person lives. People citing the same leader tended to live close to one another. This is illustrated in Figure 7 with a tabulation of citations to leaders by the area in which the person making the citation lived. If leadership were unrelated to where people lived, then the relative heights of the columns over each area would be the same for each area. The bar highest for one area would be highest in all areas. Instead, you can see that people in each area focused their citations on the east block leaders. Constituencies are strongly defined by geography. The chi-square statistic for the hypothesis that citations are independent of where people lived is 953.7 with 18 df, giving a low probability to the null hypothesis ($p < .0001$). You can also see in Figure 7 that the firm obtained most of its employees from the counties surrounding it. Only a very small proportion of the people citing the leaders lived in areas beyond the counties adjacent to the firm (the 'further away' columns in Figure 7).

Positions are arranged in the Figure 6 sociogram to show their social and geographic proximity to one another. The 54 leaders occupying positions 1, 2, 3, and 4 in the sociogram constitute an eastern block among leaders. The label seems appropriate because the employees citing these leaders come principally from the county to immediate east of the firm. For simplicity, we will discuss this county to the immediate east of the firm as Eastern County. (This and all other references to specific people or places are by pseudonym.) Eastern County is the richest, most densely populated, and most developed county in the area. It has been a principal source of employees for the firm. Of the 1678 citations to any of the 154 leaders,

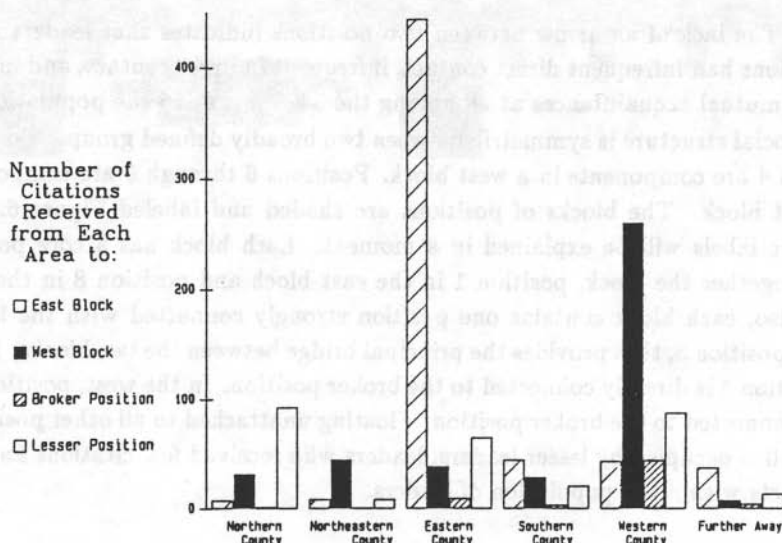


Figure 7: Geographic correlates of positions in the social structure

736, or almost half, come from people living in Eastern County. Of the 588 citations to east block leaders in Figure 7, 444, or three-fourths, come from people living in Eastern County. The firm's reliance for labor on Eastern County in the aggregate is strikingly evident on a more personal level. Two employees are exceptionally prominent leaders in the population, with 199 and 64 direct contacts relative to the third most prominent person's 32 direct contacts. Both of these exceptionally prominent leaders lived and built their constituencies in Eastern County.

The 42 leaders occupying positions 6, 7, 8, and 9 constitute a western block among leaders. The employees citing these leaders come principally from the counties to the west and south of the firm. Again for simplicity, we will discuss the county containing the firm as Western County and the adjacent southern area as Southern County. Western County is the polar opposite to Eastern County. With extensive unemployment, little business activity, and a lack of basic services, Western County is the poorest, least developed county in the area surrounding the firm. The geographic concentration of people citing west block leaders is evident in Figure 7 from the high solid column over Western County.

Support for the broker leaders (occupying the fifth leadership position in Figure 9) also comes from Western County. Notice how few people cite them from any areas other than Western County. Even the 43 lesser leaders have a geographic base, drawing their citations from Western County and communities in the county to the north of the firm.

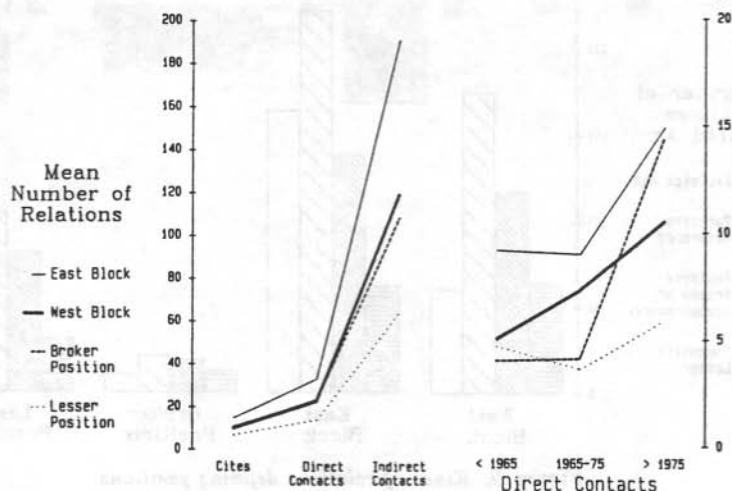


Figure 8: Growth and prominence of positions in the social structure

Figure 8 describes the form of the relations defining each position.⁷ The graph to the left shows the average number of citations, direct contacts, and indirect contacts for leaders in each position with all 5429 people in the population. All positions have exponentially more indirect contacts than citations, with east block leaders distinguishable by their extensive contacts and leaders in the lesser position distinguished by their minimal contacts. The graph to the right of Figure 8 shows changes in the prominence of leadership positions over time by direct contacts. As illustrated by relations inside the dashed circle in Figure 6, these contacts expand when a leader is cited by new employees and when relatives of his current contacts are hired. Summing contacts over the three time periods for a leadership position yields the total volume of direct contacts in the left-hand graph in Figure 8. For example, the lesser leaders on average acquired 4.7 direct contacts before 1965, another 3.6 from 1965 to 1975, and another 5.8 after 1975 for a total of 14.1 direct contacts, which is the number plotted for them over 'Direct Contacts' in the graph to the left of Figure 8.

Leaders in the east and west block experienced an increasingly expanding prominence over time. The average west block leader increased from acquiring 5 direct contacts in the first cohort to acquiring 11 after 1975. At a highest level of prominence, the average east block leader acquired 9 direct contacts in the first cohort, another 9 from 1965 to 1975, and another 15 after 1975. In contrast to the east and west blocks, leaders in the lesser position maintained a stable, low level of promi-

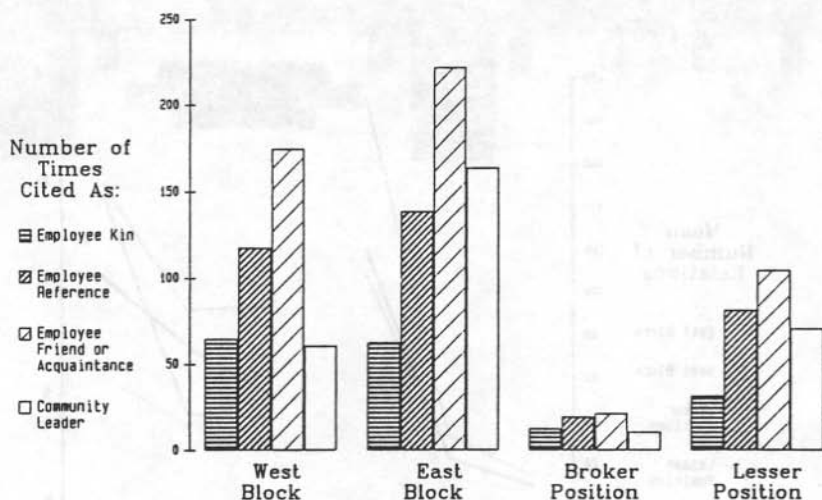


Figure 9: Kinds of relations defining positions

nence over time. On average, they acquired about 5 new direct contacts in each of the three time periods. It is the broker leaders who grew most dramatically in prominence. From a level of prominence during the late 1950s and 1960s on a par with leaders in the lesser position, the broker leaders tripled their rate of acquiring new contacts during the late 1970s as the most highly cited leaders in the population. This is all the more conspicuous because all but one of the employee leaders occupying the broker position were hired in the late 1950s when the firm first opened.

There is a little difference across the aggregate leadership positions in the kind of relations linking employee leaders with their constituents. Figure 9 describes the kinds of relations linking leaders in each position to their constituents. Figure 9 repeats the summary graph in Figure 2 for each of the four kinds of leaders. Allowing for the small number of leaders in the broker position, note the relative similarity of the bars for the three kinds of relations to employees. Each cluster of leaders in Figure 9 is cited as employee kin about half as often as they are cited as employee references which is in turn less than their tendencies to have been cited as friends of acquaintances.

Relations to community leaders define the clearest differences between the clusters in Figure 9. Community leaders are quite prominent in the east block and lesser position. They account for 28% of the citations to leaders in the west block and 25% of the citations to leaders in the lesser position. The west block leaders are more confined to the firm. Only 15% of the citations to them are to community leaders. Still, the differences between clusters in Figure 9 are negligible in the context of the

whole population. Figure 2 shows that community leaders were the people most often cited by applicants to the firm, accounting for 45% of all citations. The relative lack of citations to community leaders in Figure 9 merely shows again the extent to which the firm had become the focal point for social organization in the surrounding communities; more so for the people in the west block, but noticeably so throughout the population.

The aggregate picture, in sum, is one of two groups, a prominent east block and a less prominent west block, steadily expanding over the life of the firm. Each block contains four component leadership positions held together by relatively strong ties to leaders in a core position. A large number of leaders, relatively unconnected to either block, constitutes a lesser position that has existed at a stable, low level of prominence throughout the life of the firm. Most significantly, a set of broker leaders emerged in the late 1970s from among the west block leaders as the only strong bridge between the two blocks, a bridge only indirectly connected to the core position in each block.

You can begin to see where the social structure would be most likely to break in a serious conflict within the firm and you can see where leaders would be drawn for an enforceable negotiated settlement to the conflict. But significant aspects of leadership in the population remain to be revealed. We need to cut a little deeper into the structure of the leadership positions.

5.1 A closer look at the east block

The geographic basis for east block leadership is even clearer than the results in Figure 7 suggest. Leadership positions can be traced to specific communities. This is illustrated in Figure 10. Each pie chart in Figure 10 shows the distribution of citations to east block leaders from cities in Eastern County. Also presented for each east block leadership position are data on expansion of direct contacts (Figure 8) and kinds of relations linking the leaders with the people citing them (Figure 9).

Leaders occupying the first and third positions in Figure 6 drew their constituents from Eastfield, the seat of Eastern County government. As the county seat of the richest county, Eastfield is the most prominent city in the area surrounding the firm. Almost all of the Eastern County residents citing leaders in the third position come from Eastfield (95%) and a high proportion of the Easterners citing leaders in the first position come from Eastfield (80%). Recall from the sociogram in Figure 6 that the first position leaders form the core of the east block because of their strong direct contacts with leaders in each other position, but these leaders differ from the first position leaders in three ways: (a) They are not as strongly connected to position two leaders. (b) They draw more of their members from community leaders as

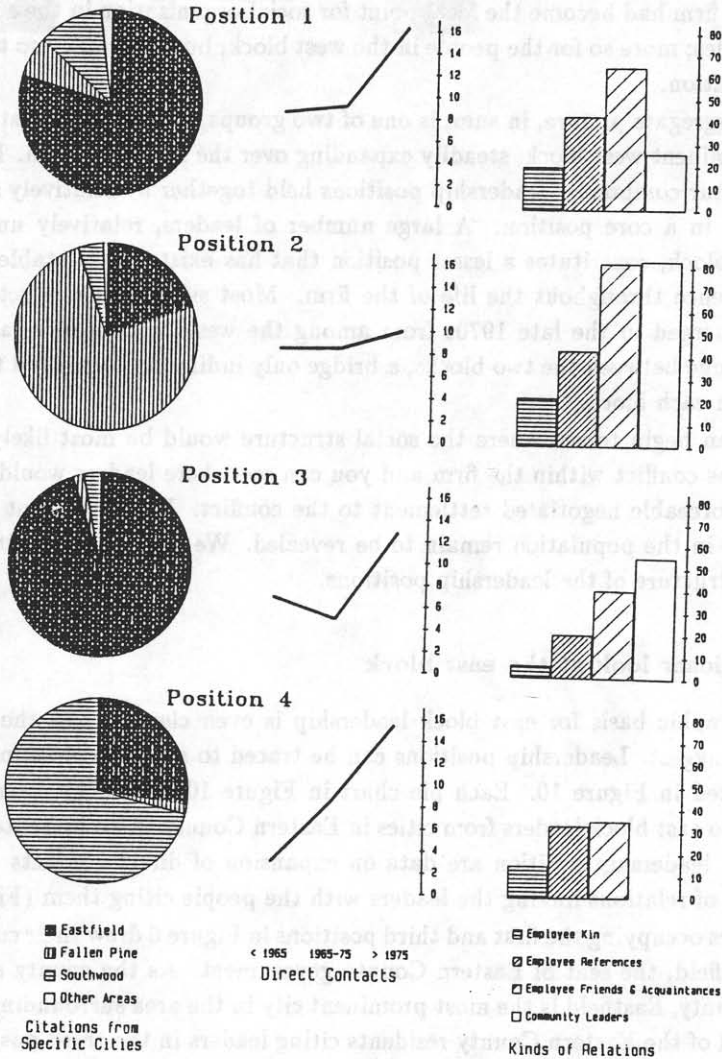


Figure 10: Geography, growth, and kinds of relations defining positions in the East Block

opposed to employees of the firm. (c) They are more strongly connected to leaders occupying the broker positions, position 5, that leads to rival west block leaders. On all three counts, they are less central in the east block than the position on the leaders.

Eastfield is a significant, but much less dominant base for the other two leadership positions in the east block. Leaders occupying the second position drew their constituents from a cluster of small towns within a couple of minutes drive of one another and centered around Fallen Pine. Of the 171 employees living in Eastern County who cited leaders in the second position, 128, or about three fourths, came from the Fallen Pine vicinity. Fallen Pine lies to the southwest of Eastern City where its residents make do on a substantially lower standard of living. Fallen Pine was the home of the second most prominent of the firm's employees (the most prominent person lives in Eastfield), but he died several years ago and no leaders from the area have risen to anything like a comparable level within the firm. You can see in Figure 10 that the Fallen Pine leaders have expanded their direct contacts at a constant rate over the life of the firm—the lowest rate of growth in the east block—and were often cited as community leaders rather than employees.

The fourth leadership position in the east block is the most rapidly expanding, acquiring an average of 3 new direct contacts per leader in the late 1950s and an average of 15 new direct contacts per leader during the late 1970s. These leaders drew their constituents from Southwood. Of the 62 Eastern County residents citing position four leaders, 44 lived in Southwood. Southwood is on the main highway passing south from Eastern County and has therefore never had a prominent role in Eastern County affairs relative to Eastfield. On the other hand, its peripheral position within the county has certain advantages. The position four leaders from Southwood have the strongest direct contact with the broker position that leads to the rival west block leaders. They are also unique in being entirely composed of past and current employees of the firm.

A closer look at the west block

The west block is much less strongly integrated. Like the east block, however, leadership positions can be traced to specific communities. This is illustrated in Figure 11, constructed with the same kinds of data use to construct Figure 10 to describe the east block. Each pie chart in Figure 11 shows the distribution of citations to west block leaders from cities in Western and Southern Counties.

To the extent that there is a central position in the west block, it is position 8. The position has the strongest average ties in Figure 6 with other positions in the west block and principally drew its constituents from Westfield, the seat of Western

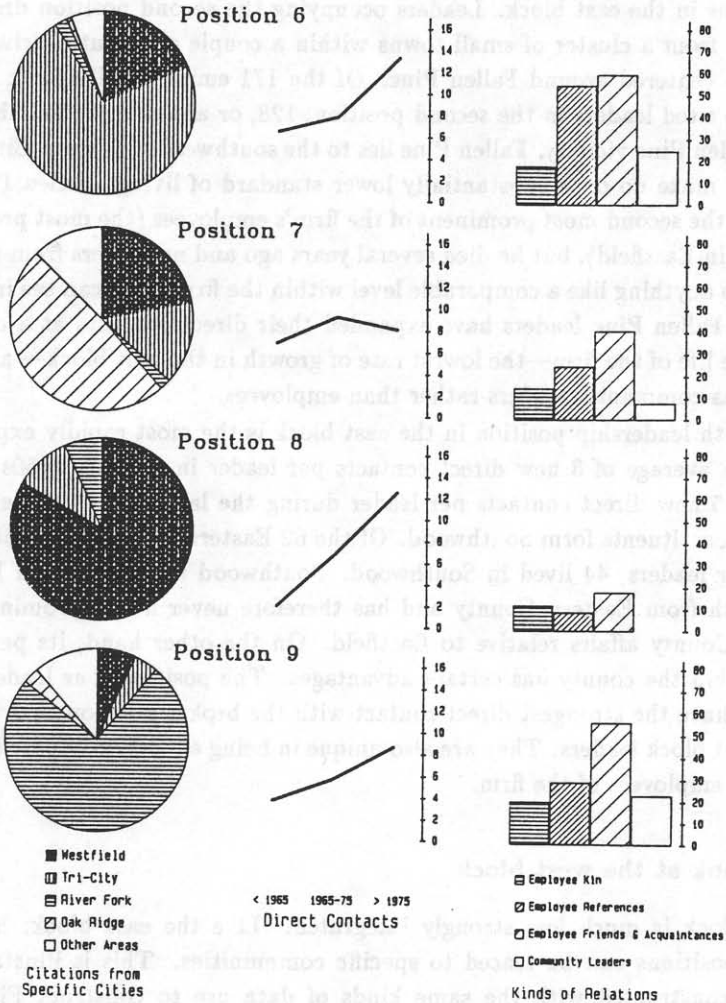


Figure 11: Geography, growth, and kinds of relations defining positions in the West Block

County government. Note that this is the most rapidly expanding leadership position in the west block and is composed entirely of people working for the firm. Further, these leaders have been actively recruiting new employees to the firm, relative to the recruitment efforts of leaders outside the west block, especially noteworthy in comparison to the weaker recruitment efforts of the better organized east block leaders. There is no ancillary position of Westfield community leaders in the west block comparable to position three in the east block. West block leadership is moored securely within the firm.

Leaders occupying the seventh and ninth positions drew their constituents from cities just south of Westfield. Like the core position, both of these southern positions contain few community leaders unaffiliated with the firm. Position nine leaders were most often cited by people living in River Fork, one of the poorest areas in the already poor Western County. Their extensive recruitment of new employees is focused on bringing relatives into the firm. This is somewhat evident in the relative frequency of kinship ties to position nine in Figure 11, but clear when the position nine recruitment frequencies are tabulated by kinship (not presented). Within the social structure of west block leaders, this position is distinct primarily because of its above average indirect contact with the broker position in Figure 6. Further south, position seven leaders were most often cited by people living in Oak Ridge, the seat of county government for Southern County. This is the slowest growing leadership position in the west block and the most distant from the outer positions. These are the only west block leaders with above average contact (via mutual acquaintances) with the east block, but the contact is more likely accidental than deliberate because of the position's close physical proximity to the east block. Oak Ridge is the next town after Southwood (the center for position four leadership) on the road leading south from Eastfield, so there must be frequent encounters between the Oak Ridge and east block leaders in the course of commuting to work or attending social events.

The sixth leadership position is perhaps the most critical in the west block. The leaders occupying this position drew their constituents from three communities (Tri-City) within a couple of minutes of one another on a main highway crossing the north of Western County. You can see in Figure 11 that these leaders were the most prominent of west block leaders, averaging 12 citations to the 9 received by other west block leaders and averaging 28 direct contacts to the 21 other west block leaders. More importantly, these are the only west block leaders directly connected to the broker position that leads to the east block leaders.

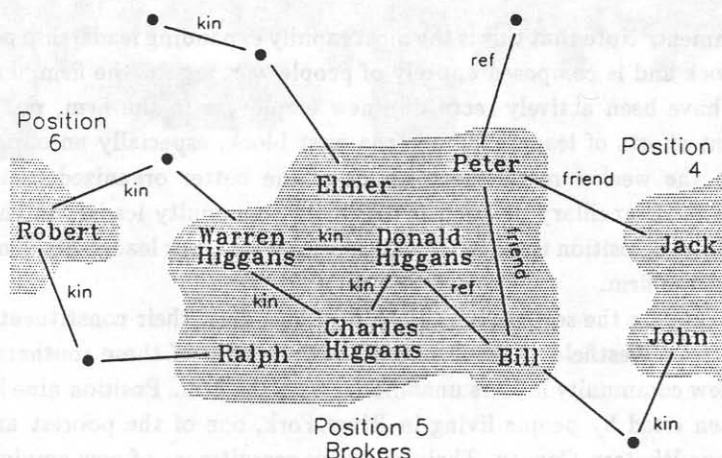


Figure 12: Broker direct contact with the most prominent leaders

A closer look at the brokers

The connection between east and west through the leaders occupying the fifth leadership position is much more fragile than it would seem from Figure 6. Balanced between east and west, these leaders drew their constituents from the southern boundary of Western County. Of the 66 employees citing the broker leaders, 45 lived in Western County, and of those, 31 lived in the communities clustered around River Fork. This explains the above average number of mutual acquaintances shared between the broker leaders and leaders in position nine who also drew their constituents from River Fork (see Figure 11 and the dashed line connecting positions 5 and 9 in Figure 6).

The fragility of the brokerage provided by the fifth leadership position is created by the lack of any one person, let alone multiple people, within the position providing direct contact between leaders in the east and west blocks. Figure 12 shows all of the direct contacts between the broker leaders and the 154 most prominent leaders.

Remember that leaders have been grouped together to the extent that they are structurally equivalent with respect to all 5249 people in the population. Two leaders can be equivalent yet have quite different relations with older leaders, who compromise only 154 of the 5249 people in the whole population. In Figure 12 you can see that the brokers are variably connected with one another and have quite different contacts with other leaders. What they have in common is a similar pattern of contacts with the 5275 people in the population below the most prominent leaders. In other words, they share a similar constituency.

The key to position five brokerage is the Higgans family. Contact with position six in the west block is through Warren Higgans, a salaried foreman employed by the firm, and a community leader named Ralph. Warren and Ralph were cited by people who were relatives of someone named Robert in the sixth leadership position. No one among the brokers was cited by, or cited, any leader in the sixth position.

Contact with position four in the east block is through two people; (a) through Peter, who cites a long-standing friend named Jack in the fourth position, and (b) through Peter's friend, Bill, who was cited by a relative of someone named John in the fourth position. The link between the east and west block is made by Donald Higgans, Warren's brother, citing Bill as a reference. Break Donald's relation with Bill, and contact with the east block is lost. Break Warren's relation with Robert's relative and the relatively direct link to the west block is broken. East en west meet in the Higgans family through indirect contacts of the brothers Warren and Donald.

Compare this situation with the diagram in Figure 13. The Figure shows all of Bill Glass's direct contacts with the 154 most prominent leaders. Bill is one of the residual leaders. In other words, his pattern of contacts in the population is unlike any of the ten kinds identified so he cannot be assigned to a single leadership position (see Appendix). He is unique in the scale of his contacts. He was cited by 106 employees, almost twice the number of the next most frequently cited leader, who was in turn cited twice as often as the third most frequently cited leader. Bill Glass's 106 citations generated 199 direct contacts and through those he is indirectly connected to another 950 people, putting him in close personal contact with a fifth of the entire population.

Quite apart from the number of people he can reach, Bill Glass is unique among the residual leaders for his strategic position to broker contact between the east and west block leaders. Like the leaders in the broker position, his contact with the west block is through the sixth leadership position. He is cited as a reference by a leader in position six and through that tie is connected to another leader in the position who is a relative of the first.

Glass's contact with the east block is principally with the core position, position one, anchored in Eastfield. He has direct contact with 10 leaders occupying the position, five by citation and another five who are relatives of his citations. Of the 13 leaders occupying the core position in the east block, in other words, Glass is strongly connected to 10. In comparison, Glass's contact with position four leaders is relatively weak. He is cited by a relative of one of the position four leaders, but that person is unconnected to any of position one leaders (except for an indirect contact through a mutual friend to one of Glass's contacts). Glass's message to the west block is clearly from the core position one in the east block.

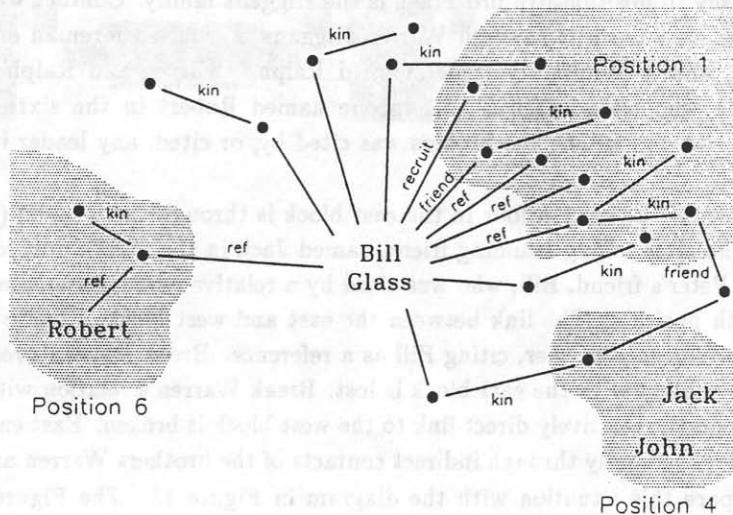


Figure 13: Bill Glass's direct contacts with the most prominent leaders

The alternative brokerage provided by Glass has important implications for contact between east and west. First, Glass provides a much stronger brokerage because he himself is the contact between east and west rather than the chain of contact in position five through the Higgans family.

More, he is likely to undermine whatever brokerage is provided through the Higgans family. In a routine cost-benefit analysis of personnel when the new management took over the firm, Glass was fired. He was judged—quite accurately, if judgement is restricted to the technical aspects of production—to be an insignificant component in the firm's production. Invisible to the new management were Glass's extensive connections throughout the population affiliated with the firm. The result of his forcible removal from the firm is a rejected, frustrated, but socially powerful Bill Glass who has actively, and quite successfully, promoted hostility in the population against the firm's management. Not surprisingly, this hostility is centered in Eastfield where Glass is most strongly connected and continues to live.

In this light, compare Figure 12 and 13. Bill Glass's contact in the west block is strongly tied to Robert, the broker position's contact in the west block is strongly tied to Robert, the broker position's contact in the west block in Figure 12. Robert is a relative to two people connected with the broker position and so might be expected to cooperate with the brokers rather than Bill Glass, but he is also a reference for someone citing Glass directly. At best, Robert must be the focus of conflicting orientations toward the firm. The broker position's contact with the east block is

directly affected by Glass. The fourth position leader connected to Glass has no contact with Jack or John, the leaders connected to the broker position in Figure 12. However, Glass is strongly connected to the core east block position four.

The bottom line is that positive brokerage between the east and west is very fragile. It is fragile in its own right because of the complex structure of ties linking east and west block leaders through the position five brokers. It is fragile also because of the stronger, contradictory brokerage that Bill Glass can be expected to exercise.

6 Conclusions

The firm's people are a population changing and divided. Three cohorts of employees can be distinguished by the patterns of relations they cited when applying for jobs with the firm; one in the late 1950s when the firm first opened, one in the late 1960s and early 1970s, and one in the late 1970s. Changes across these cohorts show the firm's labor force disengaging from the social structure of the surrounding communities, becoming a society unto itself with politically able employees replacing the leadership formerly provided by the surrounding communities.

Detachment from community leaders is evident in various forms. They are decreasingly cited as personal references, decreasingly referring new employees to the firm, and decreasingly likely to be among the prominent people cited by multiple employees. Increasingly over time, community leaders come only from the social worlds of individual applicants, e.g., a past employer for whom no other applicant has worked, or an older neighbor with whom no other applicant is familiar. Community leaders are decreasingly a point of contact between employees within the firm.

At the same time, the strengthening connections among employees through the firm is evident in various forms. There is an increasing presence of kinship relations strongly connecting employees within the firm. Not only do kinship ties increase in relative proportion within the firm, they are the most likely ties to be used to recruit new employees and the tendency to recruit through them increases over time. More, employee leadership was emerging in the late 1960s and in place by the late 1970s. Over time, employees are increasingly cited as personal references, increasingly responsible for recruiting new employees to the firm, and increasingly likely to be the prominent people cited by multiple employees. Increasingly over time, in other words, people already working for the firm are the prominent social connections between new employees entering the firm.

Linking relations into the patterns of direct and indirect contacts that defined leaders within the population, we found a population organized around a bipolar

social structure, symmetric in several aspects. Two groups were evident, a prominent east block and a less prominent west block, each steadily expanding over the life of the firm. Each block contains four component leadership positions held together by relatively strong ties to leaders in core position. A large number of leaders, relatively unconnected to either block, constitutes a lesser position that has existed at a stable, low level of prominence throughout the life of the firm.

Leadership is clearly tied to where people lived, the constituents for each leadership position coming disproportionately from adjacent areas typically anchored in one of the cities surrounding the firm. The kinds of relations linking employee leaders with their constituents were not much different across kinds of leaders, but the prominence of community leaders differed significantly between leadership positions with the fastest growing positions containing few or no community leaders. The population was clearly less differentiated by how people were connected than who they were connected to, and where that connection took place.

Most significantly, a set of broker leaders emerged in the late 1970s from among the west block leaders as the principal bridge between the two blocks, a bridge only indirectly connected to the core position in each block. However, details on the internal structure of the position revealed its fragility as a channel for communication between east and west. There is not one person, let alone multiple people, in the position who has direct contact with east and west block leaders. Instead, the brokers are organized in a chain of contacts through the Higgans family to connect east with west. Destroy any of several essential links in the chain and contact is broken between east and west. Further, the fragility of the position is exacerbated by the stronger, contradictory brokerage that a socially powerful east block leader, Bill Glass, can be expected to exercise.

With respect to the metaphor with which we began, it is clear that the firm's social capital is at risk. The population is ready to break apart at any time into hostile factions centered around the east and west block leaders with little hope of enforceable negotiation between the blocks. Elsewhere we describe a two-pronged strategy for reorganizing the firm in light of what we discovered: One prong focused inside the firm; staffing employee management teams with employees strategically drawn from the broker and adjacent positions in the social structure of the workforce. The second prong focused outside the firm, using the firm's resources to strategically reestablish the community leadership that has been destroyed over the preceding three decades.

Ending on a methodological note, we are excited by the potential of using network analysis to recover the social structural insights buried in corporate archival records. The analysis is completely nonreactive to the population studied. No one was asked about relations in the population until the sociometric data had been

coded from application forms and the basic features of the social structure revealed. All of the results we have presented could have been obtained without a single personal interview. This is an interesting new source of data for historical research and an important preliminary for ethnographic research. For example, we followed up our formal analysis with detailed, unstructured personal interviews with strategically selected informants. Armed with the formal analysis, we were able to focus informant attention on the most critical people and relationship defining positions in the social structure, enabling us to better elicit informant opinion about the ways in which critical relationships operated in real time. More, the kind of analysis illustrated here is enormously useful as an aid to advising management. With our results we were able to target public relations activities on the communities where they would have the greatest effect, indicate community and employee leaders to mobilize to strengthen the firm's community relations, and indicate probable sources of opposition to management initiatives. More generally, we were able to provide an unexpectedly accurate sense of where cleavages existed in the population affiliated with the firm, how deep the cleavages cut, how they have survived over time, and who is responsible; all in all, a healthy return on a week and a half of collecting data.

Appendix

Four activities are involved in constructing the sociogram in Figure 6 of ties among leaders: (a) scaling relations, (b) measuring structural equivalence, (c) detecting and assessing jointly occupied positions in the social structure of leaders, and (d) creating image matrices from density tables of the relations between leaders. These are generic tasks in network analysis and so described in most general references (e.g., Burt and Minor 1983). We carried out the equivalence analysis with the general purpose network analysis program STRUCTURE. Four levels of relationship are distinguished in Figure 6 and assigned quantitative values between zero and one as follows where z_{ji} is the relation between persons j and i :

$$z_{ji} = \begin{cases} 1.0 & \text{if } j \text{ or } i \text{ cited one another directly,} \\ 0.8 & \text{if } i \text{ is a cited relative of someone citing or cited by } j \text{ directly,} \\ 0.5 & \text{if } i \text{ is cited or is cited by anyone directly connected to } j, \text{ or} \\ 0.0 & \text{otherwise.} \end{cases}$$

Structural equivalence was measured in the usual way as the Euclidean distance between patterns of relations. The distance between leaders j and i , d_{ji} is defined as follows across their relations with all 5427 other people k in the population:

$$d_{ij} = \sqrt{\sum_k (z_{jk} - z_{ik})^2 + (z_{kj} - z_{ki})^2}$$

which varies from zero, when j and i have identical relations with the same people, up through positive values increasing with the extent to which j is strongly connected with people entirely different from those connected to i .

Distances among the 154 social leaders affiliated in one way or another with the firm were cluster analyzed to detect structurally equivalent leaders. The results of the cluster analysis were used to create a density table to describe relations within and between positions and to assess the structural equivalence of leaders assigned to the same position. Here are the ten jointly occupied positions with the number of leaders assigned to each and the principal component measure of their structural equivalence:

east block:				west block:			
position 1	62%	13 leaders	position 6	79%	13 leaders		
position 2	73%	20 leaders	position 7	85%	9 leaders		
position 3	79%	12 leaders	position 8	89%	5 leaders		
position 4	82%	9 leaders	position 9	86%	15 leaders		
broker position:			lesser position:				
position 5	86%	7 leaders	position 10	89%	43 leaders		

The lesser position is quite large, but you can see from the principal component that the 43 leaders assigned to it are highly equivalent within the system. Leaders assigned to the first position in the east block are least equivalent to one another, but each leader assigned to it has a high reliability as an indicator of the position (reliabilities range from .89 to .96). Each leader therefore can be assigned legitimately to the position, but the position is a complex one, in theory either because it is adjacent to other positions or because it covers a large area in the social space defined by the distances. As described in the text, this is the core position holding together the east block leaders. Position one is in the center of three adjacent positions and that accounts for the troubled principal component measure of structural equivalence within the position.

The leaders assigned to the above positions add up to 146 individuals. the remaining eight of the 154 most prominent leaders are residuals in the density table. They are structurally unique within the system. Their relation patterns do not resemble one another, nor do they resemble any of the patterns defining the above ten positions sufficiently to assign them to single position. The eight residual leaders exist between positions. These leaders are among the most prominent in the population, receiving an average of 39 citations, holding an average of 76 direct contacts,

and another 369 indirect contacts (cf. Figure 8 for comparable means on the other most prominent leaders). With the exception of Bill Glass, discussed in the text as a broker between many positions, each of the residual leaders can be assigned to one of the four aggregate leadership groups discussed in the text because of their strong ties to one or more of the specific positions within a block.

Density is the average strength of relations in a set. For example, .58 is the average value of z_{ji} between any two of the 154 leaders. This is the density of relations between all of the leaders. The table below gives the density of relations between each of the ten positions jointly occupied by structurally leaders:

POSITION	1	2	3	4	5	6	7	8	9	10
1	.363	.091	.225	.081	.044	.027	.067	.008	.021	.033
2	.090	.299	.027	.042	.032	.047	.014	.000	.050	.030
3	.237	.031	.300	.065	.060	.016	.014	.033	.008	.018
4	.091	.045	.073	.518	.068	.013	.062	.022	.007	.027
5	.044	.032	.060	.068	.355	.040	.016	.000	.062	.019
6	.027	.045	.016	.013	.033	.402	.067	.086	.015	.026
7	.064	.014	.014	.062	.016	.067	.401	.061	.030	.031
8	.000	.000	.033	.022	.000	.085	.056	.530	.040	.018
9	.022	.051	.008	.007	.065	.017	.030	.048	.131	.009
10	.033	.029	.017	.027	.018	.026	.032	.018	.009	.036

The .363 in the first cell, for example, is the average relationship between leaders occupying the first position. The .225 in the third column of the first row shows a strong average relation from first position leaders to leaders occupying the third position. Figure 6 is based on two components in the above aggregate density table. Separate tables were constructed for direct contacts (relations within the dashed circle in Figure 5) and indirect contacts (contacts just beyond the dashed circle in Figure 5). The following density table is for z_{ji} equal to 1 if i is one of j 's direct contacts (0 otherwise):

POSITION	1	2	3	4	5	6	7	8	9	10
1	.128	.027	.032	.000	.000	.000	.009	.000	.000	.004
2	.023	.079	.000	.000	.000	.012	.000	.000	.007	.005
3	.071	.013	.045	.000	.012	.000	.000	.000	.000	.006
4	.034	.011	.028	.264	.016	.000	.012	.000	.000	.003
5	.000	.000	.000	.032	.262	.022	.000	.000	.000	.003
6	.000	.008	.000	.000	.000	.212	.026	.000	.000	.007
7	.000	.000	.000	.012	.000	.026	.264	.022	.000	.003
8	.000	.000	.000	.000	.000	.000	.000	.300	.000	.005
9	.005	.010	.000	.000	.000	.005	.000	.027	.067	.000
10	.005	.002	.004	.003	.000	.005	.005	.005	.000	.010

Any density greater than the mean .015 strength direct relation between any pair of leaders among the .154 is represented in Figure 6 by a solid arrow. There are not many. Here is an image matrix of the density table with a 1 indicating an above average density and 0 indicating a below average density:

POSITION	1	2	3	4	5	6	7	8	9	10
1	1	1	1	0	0	0	0	0	0	0
2	1	1	0	0	0	0	0	0	0	0
3	1	0	1	0	0	0	0	0	0	0
4	1	0	1	1	1	0	0	0	0	0
5	0	0	0	1	1	1	0	0	0	0
6	0	0	0	0	0	1	1	0	0	0
7	0	0	0	0	0	1	1	1	0	0
8	0	0	0	0	0	0	0	1	0	0
9	0	0	0	0	0	0	0	1	1	0
10	0	0	0	0	0	0	0	0	0	0

The following density table is for z_{ji} equal to 1 if i is one of j 's indirect contacts (0 otherwise):

POSITION	1	2	3	4	5	6	7	8	9	10
1	.500	.135	.391	.162	.088	.053	.120	.015	.041	.059
2	.013	.463	.054	.083	.064	.073	.028	.000	.090	.051
3	.353	.042	.515	.130	.095	.032	.028	.067	.017	.025
4	.128	.072	.102	.569	.111	.026	.099	.044	.015	.049
5	.088	.064	.095	.111	.214	.044	.032	.000	.124	.033
6	.053	.077	.032	.026	.066	.429	.085	.169	.031	.039
7	.128	.028	.028	.099	.032	.085	.292	.089	.059	.057
8	.000	.000	.067	.044	.000	.169	.111	.500	.080	.028
9	.036	.087	.017	.015	.114	.026	.059	.053	.152	.017
10	.057	.053	.027	.049	.037	.041	.054	.028	.017	.055

Any density greater than the mean .091 strength indirect relation between any pair of leaders among the 154 is represented in Figure 6 by a dashed arrow – unless it was already represented by an above average direct relation. Also, where two positions are connected in one direction by an above average direct relation, an above average indirect relation in the other direction is indicated in Figure 6 with a reciprocal arrow between the positions. Here is an image matrix of the density table with a 1 indicating an above average density and 0 indicating a below average density:

POSITION	1	2	3	4	5	6	7	8	9	10
1	1	1	1	1	0	0	1	0	0	0
2	1	1	0	0	0	0	0	0	0	0
3	1	0	1	1	1	0	0	0	0	0
4	1	0	1	1	1	0	1	0	0	0
5	0	0	1	1	1	0	0	0	1	0
6	0	0	0	0	0	1	0	1	0	0
7	1	0	0	1	0	0	1	0	0	0
8	0	0	0	0	0	1	1	1	0	1
9	0	0	0	0	1	0	0	0	1	0
10	0	0	0	0	0	0	0	0	0	0

Authors' note

The work reported here was the initial step in a project to help the described firm's management reorganize the firm to get beyond the conflict crippling the firm; then profitable, but precariously so. Dr. Ronchi was the initial consultant on the project. Dr. Burt was brought in when it became clear that the firm's problems were deeply rooted in some as yet unknown way in the social structure of relations among the firm's employees. Dragging the metaphor into one more sentence, this paper describes that rooting. Portions of this work were presented at the 1988 Sunbelt Social Network Conference and at the 1989 annual meetings of the Academy of Management.

Notes

- 1 The need for this extensive data cleaning has implications for drawing inferences from the network analysis. Informants within the firm and data on full names were used to clean citations to past and current employees. With this information, we could determine that a citation to Sam Bodacious, and a citation to S.W. Bodacious were all citations to the Samuel Eugene Bodacious. Comparable information was not available on people beyond the firm. The implication is that relations within the firm will appear to be more structured than relations beyond the firm. In other words, structure within and beyond the firm cannot be compared on absolute grounds so much as it can be compared for variations with third variables (e.g., the relative concentration of citations over time within and beyond the firm).
- 2 For the purposes of this figure, relations have been coded into nonoverlapping categories. (a) Current employees who were not relatives and not named as references are coded as friends and acquaintances. (b) Any employee named as a reference is coded as a reference. (c) The kin category consists of all relatives working for the firm who were not named as references. Relatives were often named as references, but less often than

would be expected because applicants were instructed on the application form to name references beyond their immediate families.

- 3 More specifically, a four variable profile of percentages was constructed for each year as indicated in the text (e.g., 14%, 17%, 24%, and 45% for relations cited by people hired in 1966), and Euclidean distances were computed between years, zero distance between two years indicating that identical percentages of each kind of relation were cited in the two years. Distances between the 24 periods in Figure 3 were then scaled in two dimensions with the nonmetric multidimensional scaling algorithm in SYSTAT (minimizing Guttman's coefficient of alienation) to obtain the map at the bottom of Figure 3. The stress coefficient generated by squeezing the data into two dimensions is .0066, which is much lower than the stress of a single dimension (.216) and not much worse than the stress generated by adding a third dimensions (.007).
- 4 Likelihood ratio chi-square statistics are presented throughout. Effects for citations to people beyond the firm for reasons other than personal references are not mentioned here because they are negligibly different from 1.0 for all cohorts (multiplicative effects of 1.04 for the first cohort, 1.01 for the second, and .95 for the third).
- 5 Might these trends reflect the firm's limited population of potential employees? To the extent that the firm had a fixed number of people who could be hired, then by random chance, the probability of a new employee having a relative or suitable personal reference among the firm's employees should increase over time. Following this random chance line of reasoning, the lack of employee references and relatives in the first cohort is explained by the relative lack of employees for the first cohort of applicants to cite. However, friends and acquaintances typically outnumber relatives and people suitable to provide a personal reference, so the probability of merely knowing someone employed by the firm should increase faster than either the probability of having a relative employed by the firm or a personal reference employed by the firm. Just the opposite is true. In the log-linear results, the relative tendency for applicants to cite employees who were just friends or acquaintances decreases over time. Alternatively, the point can be seen in the relative heights of the bars in Figure 4. Of the relations with employees cited in the first cohort, 74% are just friends or acquaintances. Although relations with employees are cited increasingly in the next cohorts, friends and acquaintances are a smaller proportion of the employees cited, down to 42% of the employee relations cited in the second cohort and 44% of the employee relations cited in the third cohort. In sum, the decreasing relative tendency to cite employee friends and acquaintances indicates that the first two trends discussed in the text are not a spurious effect of a limited population of potential employees.
- 6 The effects are multiplicative coefficients in a model of ratios of recruitment to nonrecruitment relations across the three cohorts by four kind of relations. For example, cell (1,4) of the table is the tendency for new employees to have been recruited in the first cohort by community leaders (the ratio of 17 recruitment relations to 501 nonrecruitment relations). By modelling these ratios rather than the raw frequencies, third-order interaction effects are absorbed into the direct effects of cohort and kind of relation on tendency to recruit. There are significant third-order interactions in the data (39.4 likeli-

hood ratio chi-square statistics, 6 df, $p < .0001$), but our central concern here is with the way effects on recruitment shift with cohort (24.4 chi-square statistic, 2 df, $p < .0001$) and kind of relation (482.9 chi-square statistic, 3 df, $p < .0001$).

- 7 For the purposes of this figure, residual leaders spanning multiple positions within each block are added to the tabulations to provide a more accurate picture of the relative prominence of the four groups. See the Appendix for discussion of the residual leaders. Using routine statistical inference procedures for analyses of variance models, the differences in Figure 8 are significant beyond a .001 level of confidence for the detailed ten categories of leaders or for the aggregate four categories, with or without the residual leaders in included the analysis.

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