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J. DAVID JOHNSON\*

## INFLUENCE RELATIONSHIPS WITHIN A COMMUNITY OF PRACTICE

Communities of Practice (CoP) represent often informal arrangements for bringing together diverse participants interested in organizational learning and innovation. Here the focus is on the Cancer Information Services Research Consortium (CISRC), an interesting consortium of cancer control researchers and practitioners who formed a coalition to implement trials related to three major cancer control projects in the US. Contrary to the normative expectations of the CoP literature I found that formal players dominated this CoP, although regional Project Directors played an interesting brokerage role. I discuss the importance of methodological problems, the balance between formal and informal structures, and the unique role of Project Directors.

*Keywords:* innovation, communities of practice, cancer information service.

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Within a CoP, people collaborate directly; teach each other; and share experiences and knowledge in ways that foster innovation (Smith & McKeen 2003: 395).

The operation of Communities of Practice (CoP) has been increasingly central to theoretical work on organizations and, not so coincidentally, it is of increasing pragmatic concern to organizations, particularly related to the development of knowledge management (KM) practices and the implementation of innovations (Johnson 2005). While most of the literature has focused on the diffusion of innovations and their adoption, organizational structures and approaches may be considerably different for their implementation (Klein and Sorra 1996; Real and Poole in press).

CoPs represent the people side of KM and how it is negotiated communicatively (Iverson & McPhee 2002). CoP are formed by groups of people who share tacit knowledge and/or learn through experimentation focusing on central organizational processes or problems (Tidd 2000; Lesser & Prusak 2004). CoP form around areas of common interest and exchange information that result in improvements in the whole (Huysman & van Baalen 2002; Kuhn 2002). These communities are particularly important for geographically dispersed, virtual organizations (Scarborough & Swan 2002). Here we will use the Cancer Information Services Research Consortium (CISRC), an interesting consortium of cancer control researchers and practitioners who formed a CoP to implement trials related to three major cancer control projects.

### The Cancer Information Service Research Consortium

The Cancer Information Service (CIS) is an award-winning national information and education network, which has been the voice of the US National Cancer Institute (NCI) for over 30 years (Marcus, Woodworth, and Strickland 1993; Marcus, Morra et al. 1998). While the CIS has extensive outreach programs dedicated to reaching the medically underserved (Thomsen & Maat 1998), it is probably best known for its telephone service that has a widely available toll free number (1-800-4-CANCER) in the US. Fundamentally, the CIS is charged with providing high quality information to its clients. It represents an integrated KM system designed for effective use of information. It obtains the consensus

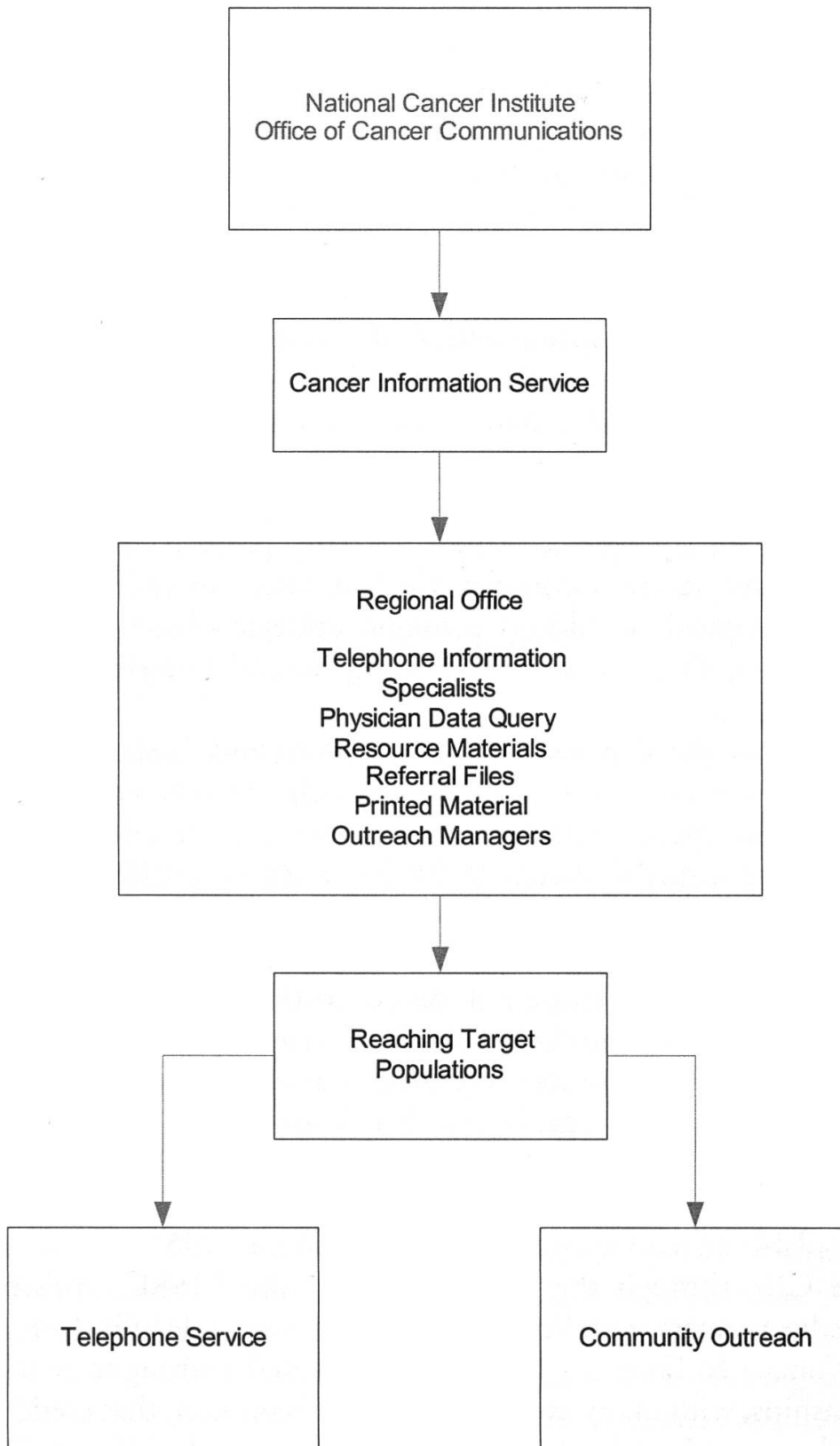
based scientific information it transfers from its parent organization, the NCI. This research focuses on a unique, four year longitudinal study of the CIS. During this time period the CIS was facing the sort of downsizing, reorganization, and survival threats that have so characterized the health services administration area in the US in recent years (Johnson et al. 1998).

The most unique characteristic of the CIS at this time was its geographic dispersion in 19 Regional Offices serving the entire U. S. (Morra, Van Nevel et al. 1993). What brought all of the Regional Offices together is a classic fee for services contract, which in effect hired existing organizations, for a specified time, to provide services toward the accomplishment of a common goal. Although the Regional Offices were technically temporary, many of the offices had been in service to the CIS for over twenty years, having successfully competed for contract renewal (Morra, Van Nevel et al. 1993). These offices, however, still retained their membership in their local sponsor or parent organizations (e.g., cancer centers) and identified with and addressed their regional concerns. Yet there was also a strong normative thread that runs throughout the activity of this network, a commitment to providing high quality information, free to the public, concerning cancer (Marcus, Bettinghaus et al. 1993). The public has expressed very high levels of satisfaction with this service (Darrow et al. 1998; Maibach et al. 1998; Ward et al. 1998).

The unique characteristics of the CIS become apparent when contrasted with more conventional organizational forms, because, even though the Regional Offices are formally members of other organizations, the CIS network itself has many of the characteristics of traditional, unitary organizations: centrally determined goals, a formal bureaucratic structure of authority, a division of labor, formal plans for coordination (e.g., sharing of calls), and a high normative commitment to providing service to callers. (See Table I for the CIS Mission and Vision Statements and Figure I for an Overview of the Cancer Information Service). The CIS was one section of the larger division of the Office of Cancer Communications during this time period. The Office of Cancer Communications was organized around several classic KM functions, providing comprehensive KM services for NCI.

*Table I: Mission and Vision Statements for the Cancer Information Service*

<i>Mission Statement</i>
<p>The Cancer Information Service (CIS), a national information and education network, is the voice of the National Cancer Institute, the Federal Government's primary agency for cancer research. Created in 1976, the CIS is the source for the latest, most accurate cancer information for patients, their families, the general public, and health professionals. The CIS provides the most recent scientific information in understandable language and assists other organizations in developing education efforts to meet the needs of underserved populations.</p>
<i>Vision Statement</i>
<p>The National Cancer Institute's Cancer Information Service (CIS), the foremost public resource for cancer information, was founded based on the conviction that constant advances in scientific research combined with the public's knowledge, understanding, and use of these medical findings saves lives. Believing in the importance of person-to-person interaction as well as the application of advanced technologies, the CIS is committed to using a range of communications approaches to ensure that as many people as possible have access to our service. By providing the latest, science-based information about cancer in understandable language, the CIS helps people become active participants in their health care.</p>
<p>Note. From <i>Cancer Facts</i>, National Cancer Institute, December, 1996.</p>



*Figure 1: Overview of the Cancer Information Service*

## The CISRC as a CoP

The strength of user innovation communities lies in the free revealing of detailed information about the innovation among members of the community (Huysman & van Baalen 2002: 4).

Since its origins within the work of Lave and Wenger (1991), CoPs have been applied to a variety of learning situations (see also Wenger 1998). Organizations experimenting with CoP's understand the learning needed in the flexible structures of new organization forms (Smith & McKeen 2003). The CIS had a rich tradition of work with CoP's primarily in the form of Task Forces (see Johnson 2005). These Task Forces, then, represented the major sites of organizational learning and the generative mechanisms for change within the CIS. They prepared the CIS for what would become its most complex CoP to date, the CISRC consortium that was designed to address a major strategic objective of the CIS, demonstrating that it could perform higher-end knowledge generation functions.

Over time, the CIS had become a community-based laboratory for state-of-the-science communication research (Marcus et al. 1993) and had conducted more research on cancer-related information seeking than any other site (e.g., Arkin et al. 1993; Freimuth et al. 1989), while simultaneously meeting its service goals (Marcus 1998a). The CISRC followed in this tradition, it was a series of Program Project grants funded by NCI (Marcus 1998b). The creation of this consortium was, in part, a response to the lack of slack resources within the CIS and also the reality that creating a new semiautonomous structure is often necessary when embarking on an innovative organizational activity (March & Simon 1958). Companies seek to acquire knowledge from the outside when there is a capability gap – that is, when strategically important technical expertise is unavailable or inadequate internally (Leonard 1995).

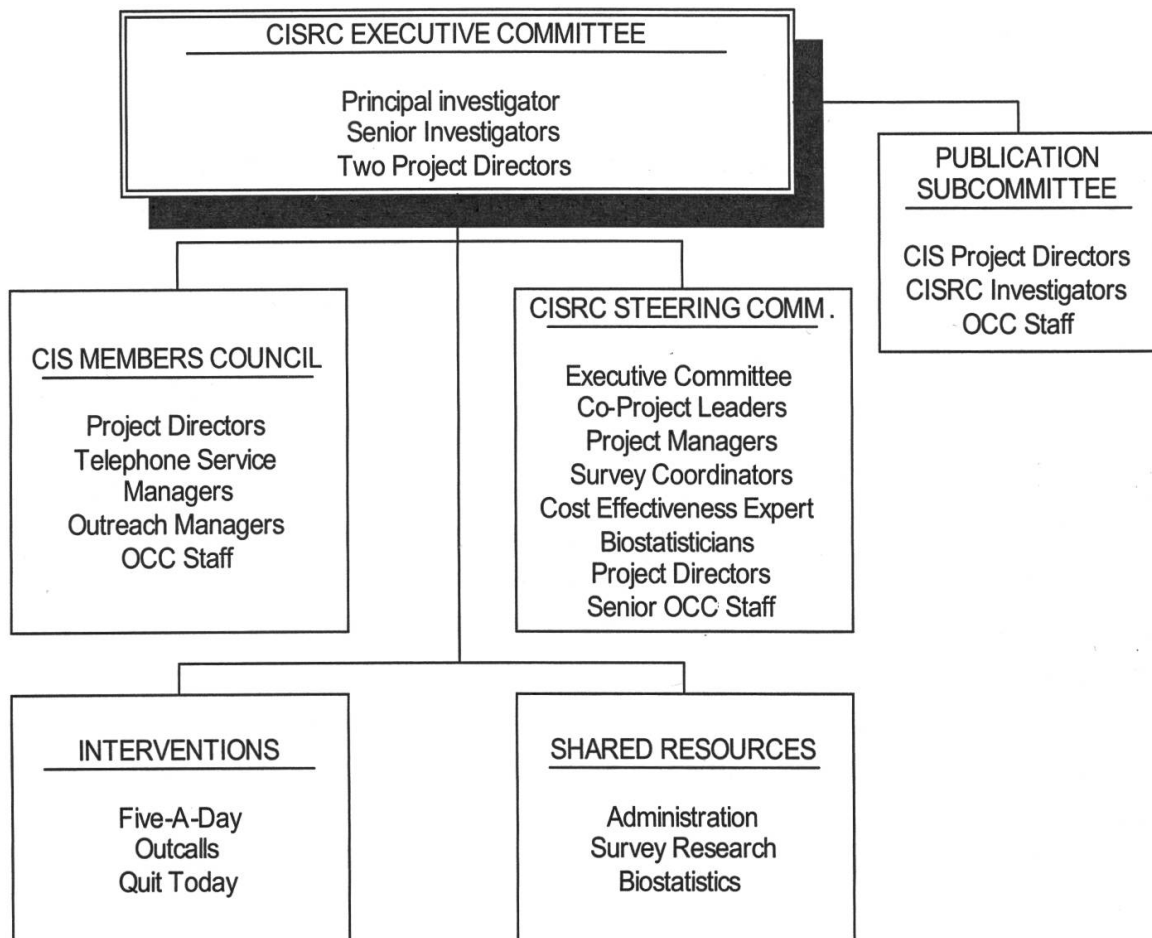
The CIS, through the development of the CISRC, constructed a knowledge network with key research partners outside of its formal structure (Nonaka & Takeuchi 1995). This provided a strong formal base for relationships, with many associated informal contacts, that could be used to build an even broader coalition, combining with key Project Directors at Regional Offices to form a CoP.

The CISRC thus represented a strategic alliance between researchers from a variety of institutions and practitioners within the CIS to implement three new intervention strategies that might result in new practices. It was strongly believed that this was central to long-term survival of the CIS and it was hoped the alliance would lead to new practices- this is the classic conception of a CoP (Borgatti & Foster 2003; Davies 2005). The CISRC was charged with implementing and evaluating preventive health innovations to reach traditionally underserved sectors of the American public (Marcus et al. 1993). In this endeavor, the CIS needed to be creative in its attempts to manage innovation in order to generate organizational members' acceptance of change that at times could be challenged by geographic, institutional, and other less tangible barriers.

In 1993 members of the CIS formed a CoP with several senior researchers outside of it to determine if it could serve as a dynamic laboratory for cancer control research at the same time it was providing regular service (Marcus 1998b). Membership was diverse, following established CoP practice, including representatives from various functional roles in Regional Offices, NCI/Office of Cancer Communications liaisons, and outside expert advisory members and/or other interested parties (e.g., outreach partners).

To insure appropriate collaboration several committees served as means for the various groups to interact with each other in this CoP including the Executive Committee, the Steering Committee, the Publications Subcommittee, Members Council, and advisory committees for each of the projects (Marcus, Morra et al. 1998). This collaboration was further reinforced by periodic national face-to-face meetings that helped to develop tacit understandings (Sarmiento et al. 2003) and where open and frank discussions helped to develop mutual engagement critical to CoPs (Davies 2005; Huysman & Van Baalan 2004). One unique feature of Program Projects of this sort is that they have shared resources that all of the projects can draw on including in this case Administration, Survey Research, and Biostatistics. As Figure II reveals in more detail, there was considerable complexity involved in the CISRC CoP that was further enhanced by four out of the six major components being spread across the US at different host institutions. This consortia was designed to become a basic structure within which a number of innovations could be developed: thus, turning the CIS into an 'innovation factory' (Hargadon & Sutton 2000).





*Figure 2: CISRC Organizational Chart*

During this time period, the CISRC was piloting three new intervention strategies to facilitate the dissemination of cancer information to the public. The first and third innovations were connected to the CIS 1-800-4-CANCER telephone service, utilizing the toll-free number as a nexus from which to disseminate cancer information to targeted populations. The second and third projects were tailored to the health information needs of traditionally underserved sectors of the American public. Project 1 (5-A-Day for Better Health) involved the use of proactive counseling to offer information about fruit and vegetable consumption to callers who would not ordinarily receive this information as part of usual service at the end of a regular call (Marcus, Heimendinger et al. 1998). Project 2 was concerned with encouraging women to receive regular mammograms by making 'cold calls' from the CIS to low income and minority women in targeted communities in Colorado. This interven-

tion strategy was unique in that it focused on making outcalls from the CIS, an activity that was substantially different from the traditional role of a telephone service that responds to calls placed by people in the community to a toll-free number (Crane et al. 1998; Crane et al. 2000, for follow-on study). Project 3 ("Quit Today!" Smoking Program for African Americans) was a tailored, multichannel media campaign designed to increase the CIS call volume of low-income African American smokers and recent quitters by providing accurate, up-to-date information in response to caller requests (Boyd et al. 1998).

The CISRC operated within the larger political context of an evaluation of a federal government health information program: One implicit understanding related to the research was that the results would be utilized to demonstrate that the CIS could be used as a research arm of NCI. Thus, the CISRC was designed to develop the research potential of the CIS, to foster collaboration among investigators and the CIS network, and to move the service toward high-quality, peer-reviewed research (Fleisher et al. 1998).

### Normative Expectations

In this research I will use this case study of the CISRC to determine if communication and influence relationships developed in the normative pattern suggested by the literature with high volumes of communication associated with participation (Johnson 1990), influence attempts (Fidler & Johnson 1984), and reinvention (Johnson 2005; Rogers & Kincaid 1981; Valente 1995). Indicators of these impacts would include: higher volumes of participants and group members, higher density of communication, increases of centrality for key members of the organization, greater redundancy in communication ties, as the strategies were implemented. It also would suggest strong ties of influence relationships among members of the community given the centrality of this CoP. Particularly important would be the role of brokers who tie together members of a consortia (Johnson 2004).

One key feature of CoPs is bringing together members of diverse groups. However, the issue of how individuals represent these groups to the community and in turn influence their constituencies has not been detailed. Organizational innovation requires the fulfillment of specific key roles that guide a new idea through the innovation process. These roles are carried out by members of the organization, and are commonly

referred to as idea generators, sponsors, and orchestrators (Galbraith 1984), who are likely to be prominent individuals in innovation networks.

Idea generators are the creators of the innovative ideas that could be of potential use to the organization. Idea generators initiate innovation by reformulating a particular problem through a creative perspective that they are willing to promote within the organization (Brimm 1988). The sponsor, or idea champion, usually a mid-management level person, is responsible for recognizing the usefulness of the idea to the organization, and lending authority and resources to the innovation throughout the development and implementation period (Galbraith 1984). The sponsor of an innovation plays a significant role in gaining organizational acceptance. Sponsors are committed to a particular innovation, which is demonstrated through a personal identification with the innovation and its outcomes (Brimm 1988).

The third role needed in the innovation process is that of an orchestrator. Innovations are rarely neutral. Instead they are often disruptive, and may be perceived as impinging upon territorial rights and personal investments of others within the organization. Therefore, orchestrators are needed to maneuver the innovation through the organization's political process. The orchestrator must protect the innovation process by supporting idea generators, finding sponsors for innovations, and promoting the trial period and testing of innovative ideas. As the organization's political process is biased toward those who have authority and control resources, orchestrators are typically the organization's top managers. Orchestrators use their authority and resources to promote the innovation process.

This research takes place in the CISRC CoP, an organization that provided a innovation-centered strategic alliance between researchers and practitioners within a geographically-dispersed network. In this case, Program Project staff are simultaneously cast in dual roles: First, they are idea generators who conduct research and evaluation related to new intervention strategies; second, they should play a key role as orchestrators in building support for innovation by developing and maintaining an innovation-related communication structure across the network. Further, since Program Project Staff are orchestrators of innovation, it would seem reasonable to expect that they would report higher levels of weak ties associated with innovation and be more prominent in innovation networks than organizational members in other functional roles.

Office of Cancer Communications staff are officials at the policy level who are most involved in centralized decision-making processes related to innovation adoption and implementation. Project Directors are officials at the regional level who had day-to-day responsibility for managing the CIS. To this end, Office of Cancer Communications staff and Project Directors would be idea sponsors or idea champions for the innovation. People in other functional roles (e.g., Outreach Managers and Principal Investigators) were less directly involved. Telephone Service Managers were left to operationally implement the innovations.

In sum, if the CISRC was working in the normative pattern described in the CoP literature one could have certain expectations on the nature of these relationships. First, there would be key players who linked the consortium's disparate entities, bridging gaps across functional roles representing both researchers and practitioners. Natural candidates for these positions would be individuals in key formal roles such as the leader of the CIS, the Principal Investigator of the CISRC, members of COP's, and the Principal Investigators of the individual research projects. These key players could be expected to link more informal groups that would emerge around the individual projects each of which had advisory groups, formal training, periodic face-to-face meetings, and continued operational support during implementation, all of which one would expect would lead to the development of influence relationships. Second, the literature implies, and the strategic importance of this consortium suggests, that this would be an area of broad concern with considerable discussion and influence attempts made during its course.

## Methods

### Site

The CIS's basic structure has changed considerably since this study was conducted (Johnson 2005). All descriptions and acronyms used here reflect the formal structure of the CIS at the time this data was collected. The network examined here was composed of the key leadership of the CIS in Regional Offices (Principal Investigators, Project Directors, Telephone Service Managers and Outreach Managers), national Office of Cancer Communications staff, and key Program Project personnel (see Johnson et al. 1994b for detail).

## Procedures

The study was part of a much larger project designed to evaluate the impact of three planned innovations over a four year period (Johnson 2005; Johnson et al. 1994a for a much more complete discussion of methods and design issues). As part of the last of 14 recurring quarterly data collections associated with this larger project, a package was sent to respondents with a communication log and a battery of substantive questions relating to perceptions of innovation characteristics (see Johnson, LaFrance et al. 1997 for more details) as well as the questions focused on here.

The self-report questionnaires were mailed to the respondents approximately ten days prior to the sample time period. To ensure completion a personalized letter explained the issues that would be examined and urged participation in the project. At the same time, an e-mail was sent to all participants to notify them that they would be receiving the questionnaires in the mail shortly. A second e-mail was sent the day before the sample time period, reminding participants that they should begin recording their communication contacts for the next three days. A third e-mail was sent the day after the sample time period concluded, to remind participants to return their questionnaires in the stamped, self-addressed envelope provided. Many follow-up steps (e.g., letters, faxes, e-mails) recommended in the literature (e.g., Dillman 1978, 1991) were taken in these recurring data collections (see Johnson et al. 1994a for more details). Through these extensive follow-up efforts, we achieved a very satisfactory response rate (93%).

The participants in this study were highly educated: 92 percent of respondents had earned college degrees, 61 percent of which were graduate degrees. The majority of respondents were low in tenure: approximately one-third of respondents had worked for the CIS for five years or more.

Over a three and one-half year project we had been asking respondents to record their communication activities related to intervention strategies and other work related communication in a diary-log format quarterly, for a three day period (For a report on these results see Johnson 2005). During the last of these data collections respondents were asked to respond more globally using a classic self-report, sociometric measurement approach which is the focus of our analysis here.

The analytical power and breadth of any network analysis is determined by how the relationships between nodes, referred to as links, are

defined. Links are the basic datum of network analysis (Rogers & Kincaid 1981). Essentially the measurement of linkages focuses on the classic question of who speaks to whom about what using which communication modality. Two types of content were recorded in the log: intervention strategies and other work-related issues. Other work-related issues were contacts involving coordinating work with other Regional Offices, using uniform procedures to respond to calls, implementing national procedures, methods of handling calls; while intervention strategies focused on innovations such as counseling protocols for special target populations, targeted outreach activities using the telephone, responses to calls associated with communication campaigns and so on.

Since the primary focus of this project was evaluation of new intervention strategies designed to reach target audiences within the CIS, it was decided it would be more appropriate to focus on this more limited type of innovation, which also may clear up some of the confusion found in prior studies when the broader category of innovation was used (Bach 1989; Cheney, Block & Gordon 1986). While the CIS traditionally has engaged in a number of specific types of campaigns designed to reach target audiences, this type of activity has often been sporadic and ad hoc, focusing on national initiatives. The CISRC was designed to gradually and to systematically increase the adoption of specific intervention strategies within the CIS network. Accordingly, the intervention strategies category, while initially unfamiliar to some members of the network, would become increasingly familiar to them as the CISRC program project developed. Responses to open-ended questions concerning what operational and innovation messages meant to respondents were used to craft definitions and examples used in the next rounds of pretesting. It was also decided not to include other categories of communication (e.g., social) because of concerns over the sensitivity of respondents and respondent burden, since each additional content category vastly increases it (Marsden 1990).

## Questionnaire

The following general overview was given to respondents to explain the portion of the questionnaire that we will focus on here:

For the past four years we have been asking you to record your communication contacts within the CISRC network in a diary format that we have called the Communication Log.

In the interest of reducing participant burden in future projects we are trying to develop a simpler format for obtaining information about communication contacts. We are hopeful that this experiment will lead us to more user-friendly formats that can be used in the future.

This survey asks you to identify the *core* relationships you have within the CISRC Network in a more general way. You may use the enclosed directory as an aid to remember names. Instead of asking you to record your communication contacts for a specific three-day time period, this survey asks you to identify the people who you consider to have been your *key* contacts, *since the inception of the project*.

*Note: We are asking you to identify your key national communication contacts with respect to intervention strategies only* (initiatives that relate to the development or implementation of programs which focus on reaching various target populations such as counseling protocols, targeted outreach activities using the telephone, responses to calls associated with communication campaigns, etc.).

Respondents were asked to fill in their name, title, and region if they were from a Regional Office. They were provided with an example to illustrate how the questionnaire should be filled out. Based on prior log questionnaire responses, we then provided them with 10 spaces for names. We asked respondents to report their key communication relationships using the following instructions:

Please think about your key national communication contacts since the beginning of the CISRC Program Project (November, 1993). Specify with whom you have had frequent communication contacts regarding *intervention strategies* in the space below. If you need additional space, feel free to write on the back or attach additional sheets.

Following a classic sociometric approach similar to that used in many prior studies that have examined advice seeking (e.g., Burt 1992; Lazega & Duijn 1997; Wasserman & Faust 1994), we asked people who they might have turned to for advice, who most influenced their thinking over the life of the project.

Please think about your key national communication contacts since the beginning of the CISRC Program Project (November, 1993). Please indicate the individuals that you consider to have most influenced your ideas about *intervention strategies*. These may or may not be the same people you listed in the previous question. If you need additional space, feel free to write on the back or attach additional sheets.

## Analysis

UCINET 6 for Windows was used to conduct the analyses reported here (Borgatti, Everett & Freeman 2002).

## Results

The networks consisted of 185 people who were members of the CISRC during at least one period during the course of the project. This census composed the leadership of the Regional Offices, Office of Cancer Communications, and Program Project. Due to turnover, this network had approximately 60 more people than the typical quarterly data collection.

### Communication Network Results

For the communication network there was a total of 476 links which represented only a tiny fraction of those possible, although they were substantially higher than the results for the individual quarterly log-based data collections (See Johnson 2005). The Freeman-Granovetter Groups procedure found no strong ties of this network and 33,794 absent ones. Only 246, or .7% of the ties, were weak. Similarly, an analysis of weak components, found a .8 fragmentation level of nodes that could not reach each other. As Table II reveals there were clear differences ( $\chi^2=331.31$ , 15df,  $p < .01$ ) in links for groups ranging from a low of 2 for Principal Investigators to a high of 133 total links for Project Directors. There were also critical differences in reciprocity with Program Project people having many more links coming in (75 links in and 17 out) and Outreach Managers having more links going out (19 and 62).



*Table II: Frequencies For Communication Relationships By Functional Role\**

Role	n	In	Out	Total
National Cancer Institute	25	14	9	23
Office of Cancer Communications	11	32	17	49
Project Directors	23	54	79	133
Principle Investigators	19	2	0	2
Program Project	24	75	17	92
Outreach Manager	40	19	62	81
Telephone Service Manager	34	31	45	76
Other	9	11	9	20
	185	238	238	476

Table III contains the results for the top nine key players in the communication network over this four year period as determined by a cut-off of eleven total links both in and out. In a more sophisticated way I also tried to assess the centrality of these individuals and their relative freedom of action by reporting some commonly used metrics. Freeman's degree centrality measured overall network activity. Effective size indicated structural holes by the average degree of alters within ego's network, not counting the ego. Constraint reflected the extent to which ego is invested in people who are invested in other ego's alters.

Several things are noteworthy about these results which included classic indicators of centrality and structural holes. First, two people were clear over-reporters, reporting numerous links with others when no one

\*  $\chi^2 = 331.31$ , 15 d.f.,  $p < .01$

reported links with them. This reflects classic problems with the accuracy of self-reports in network analysis. Second, two others reflected classic non-response problems since they did not complete the questionnaire, but had numerous individuals reporting linkages with them. Third, discounting these individuals a clearer pattern emerges, with an interesting couplet of a formal manager of Office of Cancer Communications and a high level Program Project staff member (who had the lowest level of constraint in the network) having minions who handled operational details, with one of these individuals having the highest degree centrality and effective size scores. Fourth, a couple of 'old-time' Project Directors clearly had wide-ranging communication links.

*Table III: Results for Communication Relationships*

Role	Links In	Links Out	Freeman Degree	Effective Size	Constraint
Office of Cancer Communications Minion	14	7	19	16.93	.11
Program Project Minion	12	8	17	14.90	.13
Project Director	6	13	15	11.32	.17
Program Project Formal Leader	18	0	18	16.17	.09
Office of Cancer Communications Formal Leader	8	9	14	10.53	.16
Project Director	7	9	14	11.19	.14
Office of Cancer Communications Minion	15	0	15	13.47	.11
Outreach Manager	0	13	13	12.04	.11
Project Director	0	12	12	9.38	.16

### Sociometric Network Results

As one might expect, there were fewer sociometric influence links, with 276 reported overall (see Table IV). The Freeman-Granovetter Groups procedure found no strong ties for this network and 33,900 absent ones. Only 140, or .4% of the ties, were weak. Similarly, an analysis of weak components, found a .9 fragmentation level of nodes that could not reach each other. As Table 4 reveals there were clear differences ( $\chi^2 = 249.65$ , 15 d.f.,  $p < .01$ ) in links between groups, ranging from a low of 1 for Principal Investigators to a high of 80 for Project Directors. There were also critical differences in reciprocity with Program Project, Office of Cancer Communications, and NCI people having many more links coming in and Outreach Managers and Telephone Service Managers having more links going out.

*Table IV: Frequencies for Sociometric Relationships by Functional Role\**

Role	N	In	Out	Total
National Cancer Institute	25	10	0	10
Office of Cancer Communications	11	35	21	56
Project Director	23	32	48	80
Principle Investigators	19	1	0	1
Program Project	24	46	10	56
Outreach Managers	40	9	30	39
Telephone Service Manager	34	5	27	32
Other	1	1	0	1
	185	138	138	276

\*  $\chi^2 = 249.65$ , 15 d.f.,  $p < .01$

Table V contains a ‘top-10’ list of key players in the sociometric influence network over this four year period as determined by a cut-off of nine total links both in and out. Several things are noteworthy about these results. First, only one person on this list is a clear over-reporter, while two were non-responders. Second, again there is an interesting couplet of formal managers of both Office of Cancer Communications and the CISRC and minions, although the formal, hierarchical leaders, as one would expect, are more paramount in this network than those who handled operational details. These hierarchical leaders of Office of Cancer Communications and the CISRC were clearly higher in Freeman’s degree centrality and effective size metrics and had the lowest levels of constraint (see Table V). Third, a couple of ‘old-time’ Project Directors clearly had informal influence far beyond the reach of their narrow Regional Office.

*Table V: Results for Sociometric Relationships*

Role	Links In	Links Out	Freeman Degree	Effective Size	Constraint
Office of Cancer Communications Formal Leader	12	7	18	15.81	.11
Program Project Formal Leader	18	0	18	16.17	.11
Project Director	9	4	11	8.08	.19
Project Director	5	6	8	6.39	.25
Office of Cancer Communications Minion	6	4	10	8.65	.16
Project Director	0	10	10	7.95	.18
Office of Cancer Communications Minion	10	0	10	9.00	.16
Program Project Minion	5	4	8	6.78	.19
Outreach Manager	2	7	9	7.94	.16

The 'old-timer' most closely tied to fellow Project Directors had the highest constraint. An Outreach Manager also appeared on this list, but interestingly no Principal Investigators from Regional Offices or project leader from the CISRC, and no Telephone Service Managers (who were central to implementing these projects) were on this list.

### Implications

In this section I will focus on three implications of these results. First, I will examine classic limitations of this study. Second, I will discuss the importance of formal relationships and the neglected role of psychological consequences in the operation of more fluid types of organizational arrangements. Finally, I will discuss the unique role of Project Directors in the operation of this CoP.

### Limitations

Classically network analysis has suffered from a number of problems in practice which clearly impacted these results. First, self-reports of network communication relationships are notoriously inaccurate (e.g., Bernard & Killworth 1977; Richards 1985; Scott 2000). This is perhaps most dramatically revealed here in the key players who reported numerous relationships with others, but for whom no one in the network reported a link. Second, relatedly, is the severe impact non-response can have on networks that rely on a census of network members (Johnson 1993; Scott 2000; Stork & Richards 1992). Unfortunately, one key player, did not complete the sociometric questionnaire, although his influence was clear from the reports of others in the network. This did diminish his scores on the network indices. Finally, most of the literature on CoPs focuses on private sector organizations, the unique government contractual network focused on here represents a considerably different context.

### Importance of Formal Roles

Although the CoP literature often discounts this, and at times tries to define it away, formal authority may be particularly important in this governmental context (Lesser & Storch 2004; Smith & McKeen 2003). Office of Cancer Communications, in particular, had oversight responsi-

bilities for implementation of the Regional Offices contracts that may have led to their central role in the influence networks. In the case of the sociometric network it was clear from their centrality scores that there were two orchestrators, who occupied formal leadership roles in the CIS and Program Project respectively. Both had secondary leaders within their respective units: two middle managers within the CIS and an operational leader within the CISRC. The Program Project leader also had critical linkages to internal sponsors who provided him with legitimacy and access within the CIS (Burt 2000). In effect, the Office of Cancer Communications formal leader and her two minions increasingly represented the interests of the CIS when apparently a vacuum arose in the operation of the Program Project when the leaders of the separate innovation projects were less active in the networks. The minions appeared to operate in tandem with the formal head who acted as an ambassador representing the interests of the formal organization, while the minions handled more operational details with mid-level status personnel.

These findings, when coupled with the fact that Program Project research project leaders did not report many ties, indicated that the orchestrators of innovation had dropped the baton (Meyer & Johnson 1998). The lack of communication initiated by the idea generators of innovation, the individual project leaders to other CISRC members suggests that they are out of the loop, relatively unaware of how practitioners were appropriating their innovations. Clearly Program Project leaders were primarily idea generators and not orchestrators, perhaps not a surprising finding for researchers. It should come as no surprise then, given these findings that, in spite of their scientific success, these interventions were not subsequently incorporated more broadly in the operations of the CIS (Johnson 2005). The CISRC innovations were clearly seen by leaders of the CIS as a way of satisfying key decision makers within the NCI by demonstrating that the CIS could also contribute to the NCI's research mission, but there was considerable debate within the CIS as to the centrality of research in relation to its traditional vision and mission statements (Fleisher et al. 1998; Marcus, Morra et al. 1998; Johnson 2000). Ultimately none of the preventive health innovations were adopted on a system-wide basis (Marcus 1998a), even though trials indicated a generally high level of pros on specific attributes (Boyd et al. 1998; Crane et al. 1998; Marcus, Heimendinger, et al. 1998). All this is perhaps most poignantly summarized in the following quote from a report of a replication of Project 1:

Although such research could make important contributions to the science of cancer prevention and control, sustaining interventions like the one tested here is of major concern. At the present time, there would seem to be few organizations prepared to adopt this type of intervention beyond the research setting (Marcus et al. 2001: 213).

Also somewhat unexpected, given their key role in implementation of the interventions, was the lack of involvement of Telephone Service Managers, since all of the innovations focused on the telephone service. It would be expected that Outreach Managers would not be terribly involved and also as expected Principal Investigators of the Regional Offices were the least involved group, since they largely occupied a figure head role. Interestingly, the low level of reciprocity reported for these groups also indicated they were reaching out to others, but their calls for attention were being ignored.

This entire system was apparently built on weak ties and very fragmented cliques, in fact, not unlike the empirical findings for innovation networks found elsewhere (Farace & Johnson 1974; Albrecht & Ropp 1984; Bach 1989; Monge, Cozzens & Contractor 1992; Johnson, Donohue et al. 1995). Thus, all available evidence pointed to much lower levels of communication than one would expect. This lack of communication may have related to weak tie roles of members of CoPs who do not focus on operational matters which is reflected in the lower number of links for influence as opposed to communication ties. The critical role of CoPs appears to come in episodic influence relationships related to focused organizational learning in conferences and other face-to-face meetings which complements the formal structure of the organization. The many changes the CIS was experiencing during this time period occurred in an organization that had a core of members that had a strong normative commitment to its basic, traditional mission, but which also had some new Regional Offices, as well as many new occupants of the Outreach Manager role.

A key finding of another of the empirical studies in our research stream was that formalization was positively related to communication quality (Johnson, Meyer et al. 1997). This may be explained by the logic of Organ and Greene's (1981) rationale for the effects of formalization on professional involvement. They argued that formalization may be negatively related to professional involvement because high levels of formalization increase the probability of role conflict. However, they caution

that this effect of formalization on involvement may be mediated or even reversed by the extent to which formalization decreases role ambiguity. In fact, in their study the authors found that the net effect of formalization is a tendency to reduce the alienation of professionals, thus increasing their level of involvement.

### Filling Structural Holes: The Role of Project Directors

From the outset, the plan was to mobilize and recruit CIS Project Directors to serve as 'idea champions'. Fortunately for the CISRC, the CIS Project Directors embraced this challenge and became highly effective idea champions within their organizations (Marcus et al. 1998: 13).

CoP's involve key players who represent different groups in the organization. Of all the groups, including surprisingly the Program Project staff, Project Directors had the most cohesive influence linkages among themselves and with other key roles, primarily Office of Cancer Communications and Program Project staff, related to this project. Their overall volume of links was the highest for both communication and influence relations, although they had more links directed outward than were reciprocated to them. This may reflect some of the frustrations they had with the Program Project voiced in their lessons learned article (Fleisher et al. 1998).

In many ways, as a group they filled a crucial structural hole (Burt 1992, 2000). Networks rich in structural holes offer the flexibility needed by organizations to adapt to fluid circumstances (Gargiulo & Benassi 2000). As revealed in the role of the two Project Directors who were the third and fourth key players in the influence networks, Project Directors were the 'heart and soul' of the culture of the CIS and its policy development (Morra et al. 1993). They were instrumental in promoting the CISRC as a way of surviving institutionally within NCI and they were implementing the individual projects in the various Regional Offices. Thus, they operated in the classic middle ground, uniquely positioned to influence the development of the project. They adopted a middle-up-down management process for managing innovations (Nonaka & Takeuchi 1995).



## Conclusion

As in many other cases, empirical examination of innovation processes often uncovers findings relating to communication and influence relationships that do not conform to normative expectations. Particularly important here is how formal and informal influence intermesh in the implementation of innovations involving CoPs. These results also suggest that middle managers, Project Directors, and operational minions, who act to represent upper managers, may play a critical roles in actually implementing innovations. Recent years have seen a resurgence of interest in network analysis as a way of portraying informal communication and sociometric influence relationships. It offers many compelling advantages in the investigation of new organizational forms like CoPs. Network analysis offers the most complete picture of the overall configuration of communication relationships, both formal and informal, yet developed, and certainly a much more complete view than that offered by formal approaches alone (Monge & Eisenberg 1987). As we have seen in this research it can develop very rich descriptions of the role of CoP's in innovation processes.

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