

Network Characteristics and an Integrated Model of Network Performance*

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Network structure is one explanatory variable to explain network performance, but its effect may be small or misleading. Much research, however, has not attempted to combine network structures with other characteristics of networks that may operate to explain network performance. Addressing four network characteristics (structure, content, process, and management), this study proposes an integrated model of network performance. This study first proposes simple relationships between each characteristic and network performance, and then extends intermediated effects of each characteristic on others. This study emphasizes interdependence among network characteristics and provides theoretical implications that go beyond organizational effectiveness arguments.

Key words: network performance, network structure, network social capital, network learning, network management

The concept of network has become central to discussion in interorganizational relationships and public management. O'Toole (1997) declares that “complex

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networks are not only relatively common, they are also likely to increase in number and importance” (p. 46). He argues that the importance of networks is inescapable, not only because intergovernmental programs make up a sizable proportion of total government activities, but also because collective interactions have considerably increased by the expansion of quasi-governmental arrangements.

Over the past decades network has been studied from various perspectives. Most network studies demonstrated a linear relationship between network characteristics and performance, and focused on influence of network structures on performance (i.e., Provan and Milward 1995; Ahuja and Carley 1999). The studies did not attempt to combine network structures with other characteristics of networks that may explain network performance. Network structure is one of the explanatory variables to explain network performance, but its effect may be small or uncertain (Provan and Milward 1995; Ahuja and Carley 1999; Schneider et al. 2003). Carley (2002) argues that static descriptions of network structures on network performance may be misleading or erroneous. The consideration of other network characteristics in explaining network performance cannot be ignored. This study addresses the following questions: i) what characteristics of network influence its performance? and ii) What relationships exist between network characteristics and network performance?

Network Performance: Beyond the Framework of Organization Effectiveness

Why do some organizations perform better than others? For the past forty years, organization effectiveness has been mainly used to assess organization performances or outcomes. However, theories about organizational effectiveness

have been criticized for their inability to explain the dynamics or interactions of interorganizational relationships (Wolf 1993; Bushmen 1994; Kaplan and Norton 1992; Judge 1993). A fuller understanding of service outcomes can be achieved by considering the effectiveness of the entire network of service providers, not whether some agencies that are part of the network do a better job than others. For instance, if the overall well-being of clients is a goal, effectiveness must be assessed at the network level since client well-being depends on the integrated and coordinated actions of many different agencies separately providing relevant services.

Studies on network performance add considerable knowledge beyond the lessons learned from organizational performance. First, current public service systems emphasize collaboration and cooperation. This implies that researchers should observe interorganizational relationships among participating organizations rather than a single organization. Moreover, if researchers examine just an organization's performances, they are not able to consider other aspects of collaborate activities or cooperation to assist other organizations. Provan and Milward (2001) argue that network effectiveness may have three different dimensions: community, network, and organization level. They emphasize that researchers need to consider relationships among relevant stakeholders, such as clients, service providers, and communities.

Meanwhile, a series of studies (Milward and Provan 1998; O'Tool and Meier 1999, 2001; Ahuja and Carley 1999; Provan and Sebastian 1999; Provan and Milward 1995) used network performance in examining the effectiveness of existing policy networks and interorganizational relationships. As such, network performance is still being advanced for assessing performance or outcomes of organization and policy networks. In this sense, the proposed research questions provide a significant contribution for re-examining the organizational effectiveness arguments.

Defining Network and Network Performance

Network in this study is defined as “a multiorganizational form which is subsumed under contents of varying degree of shared ideas or norms and can learn and evolve itself strategically through collaboration and cooperation among participants”. This definition is based on four characteristics of networks for which there is no existing integration in the literature. A great deal of research on networks has considered one or two characteristics of networks. For example, Provan and Milward (1995) and O’Toole and Meier (1999) stress network structure among the characteristics while Carley (2002) examined network structure and network learning. It is true that the studies provided theoretical contributions to network studies. Nevertheless, this study submits that research findings from the studies might be more substantially argued if other network characteristics, which will be introduced in this study, would be considered. In other words, to what extent other network characteristics affect performance is not well understood in the network literature.

Network performance, a dependent variable, has not been elaborated and instead, most of the research has studied networks as an independent variable to explain policy outcomes and service effectiveness (Berry et al. 2004: 537). That is, current literature on network performance and its measurement does not appear to achieve a consensus (cf. Provan and Milward 1995, 2001). Provan and Milward (1995) used outcome data - overall clients’ quality of life and satisfaction including various economic, social, and daily living services, and their psychopathology and physiological status - in community mental health networks as a measure of network performance. However, the measures do not evaluate network’s contribution to building trust (social capital) among network participants. Ahuja (1995: 30) used “collective effectiveness” of network participants as network performance. She used both perceptual (satisfaction of network participants) and

objective (publications of network participants) data to measure network performance to overcome limitations of using performance data alone. Meier and O'Toole (2001) used program output as a measure of education network performance to assess the effectiveness of school and school districts. They measured program performance as the percentage of students in each school district who pass state-required, standardized reading, writing, and mathematics tests each year (Meier and O'Toole 2001: 281). This measure of network performance does not consider stakeholders' satisfaction or trust building among network participants. Burt (1992, 1997) appears to use aggregated rewards or profits (e.g., managers' promotion) of network participants as network performance, although he did not focus on performance at the network level. Carley et al. (2001) used diffusion of information as network performance. Lee et al. (2003) used decision-making accuracy as a primary outcome measure (e.g., frequency of medication errors).

In sum, each scholar uses different definitions of network and various measures. This tendency is caused from the confusion of network definitions and insufficient consideration of measurement issues. First, limited definitions of network may lead to misrepresenting network performance. For example, Ahjua (1996) used the number of publications as network performance in a virtual organization. It can be argued that number of publications is an inappropriate network performance measure, and this leads to misspecification of the overall model. Second, thus far, network studies do not pay attention to measuring network performance, and instead network performance is given or measured by researchers' judgments. This study proposes that network studies need collectively to ask "what is the network" and "how is network performance measured" for readers to make sense of this confusing body of literature. Researchers also need to use operational definitions and measures of network performance in order to avoid confusing misuse and misinterpretation. For example, a workforce

development network can be defined operationally as a network composed of different groups (i.e., job-seekers, service providers, and employers) to get or provide workforce development services defined by the Workforce Investment Act. Further, network performance can be measured using a set of metrics developed by the American Customer Satisfaction Index and a workgroup which consists of local workforce program directors and the board members. Such clear operational definitions and measures overcome the problem, described above, that network performance has not been defined well.

Network Characteristics

Research on network performance appears to use conceptually mingled characteristics of network, and particularly emphasizes the effects of network structure on performance. There is a paucity of literature which combines network structure factors with other network characteristics explaining network performance. Others found that other network attributes (e.g., social capital, learning, and management) may also influence network performance (e.g., Burt 1997; Uzzi and Gillespie 2002; Carley 2002; O'Toole and Meier 1999). Four network characteristics are discussed.

Structural/positional characteristics. Structure is about “who talks to whom,” “who interacts with whom, or “how the configuration of the patterns influences actions.” Network is a mixed structure involving multiple organizations or parts thereof, where one unit is not merely the formal subordinate of others but is of some larger hierarchical arrangement (O'Toole 1997: 45). Scholars distinguishes form and content respectively as morphological (structural) and interactional characteristics of a network (Mitchell 1974; Simmel 1917). This distinction is important for this study because some authors merge these concepts in their models. In practical action, there is no necessary separation between content and

structure. While acknowledging that they are conceptually distinct aspects of networks, network models of structure can be quite useful in describing qualities of relational content. It is important to understand interdependence between form and content. Regarding network structure, current literature on the definition seems to include both structural/positional form (e.g., Provan and Milward's focus on structural features) and interactional content (e.g., Podolny and Baron's emphasis of network content) characteristics. Podolny and Baron (1997) raised questions about how network participants sort relations into kinds, and how kinds of relations differ in their contribution to social capital. They emphasize network content more than network structure.

Interactional content characteristics. Content has to do with the "purpose" for network interaction within a network or with the meanings that they attach to their interactions. This characteristic is about what contents or relationships are connected through a network. Content is thought to capture the meanings people attach to certain relationships (Mitchell 1969) and the quality of these relationships (Ostgaard and Birley 1994). These meanings incorporate the individual's motivations, expectations and outcomes of network participation (Curran 1993; O'Donnell et al. 2001). Examples of network content in existing research include 'advice or friendship network' (Krackhardt 1990), 'interlocal agreements network' (Thurmaier and Wood 2002), and 'emergency management network' (Choi and Brower 2006). Recently, Berry et al. (2004) emphasize contents - 'embedded context and institutionalized expectations' of network which have been neglected by scholars in the explanation of 'role.' They argue that "a particular role relationship (content of network) may have to do with authority, influence, information, marriage, kinship, friendship, economic exchange, or a host of other contextual meanings, and no role exists without a contextual definition of this sort' (Berry et al. 2004:530).

Network participants get shared values or professional norms within a network.

As one of the ingredients commonly discussed in the interorganizational relationships that are necessary for developing a network, social capital (i.e., network contents, trust, institutional rules or norms, and shared values in this study) creates values and facilitates the actions of network participants (Burt 1997; North 1990; Ostrom 1990, 1992; Putnam 1993). Trust lubricates cooperation, and cooperation itself breeds trust. It may lead to further development of relationships, which increase still further the willingness to engage in additional social exchange (Putnam 1993). It may also indicate greater openness to the potential for value creation through exchange. In this respect, trust among network participants may become a potent form of expectation asset (Camerer and Knez 1994) that participants can rely on more generally to help solve problems of cooperation and coordination (Kramer et al. 1996). In this sense, unlike the structural/positional characteristics, interactional content characteristics underscore more the contents of network rather than forms of network.

Cognitive process characteristics. This characteristic is about how network participants share their ideas and learn network norms and rules. It stresses the flow of information and knowledge within a network (Carley 1998). Although organizations begin very similarly they tend to learn different things that affect whether and when the various learning mechanisms collide and evolve. Learning involves the detection and correction of error, discrepancy between organizational roles and actual practice (see Argyris and Schön 1978). Argyris and Schön (1978) argue that, through “single-loop” and “double-loop learning”, network participants may change current plans or rules, and underlying beliefs or strategies framed for given target goals and performance. Single-loop learning tends to look for another strategy within given roles and rules when error or discrepancy occurs, and double-loop learning offers the underlying policies or rules themselves (Argyris and Schön 1978: 2-3). Although learning is in the network process, adaptation processes are important in a network because they strengthen

the bonds and mutual orientation between organizations (see Johanson and Mattsson 1987; Parkhe 1991; Lorange and Roos 1987). In this vein, Etheredge and Short (1983) assert governmental learning as a reflection of increased intelligence and behavioral effectiveness. In this characteristic, error and detection processes may be an important component.

Strategic-Managerial characteristics. Network management becomes more important in a network situation than in a hierarchy (O'Toole 1999). Networks can stimulate collaboration and cooperation that encourage network participants to develop common perspectives for better performance. Scholars view network as a strategy for solving conflicts or problems that are not settled easily by a single organization (e.g., Agranoff and McGuire 2001; Schneider et al. 2003). Network participants attempt to increase their capacity by changing their communication structures or learning systems (e.g., Brewer and Selden 2000; Senge 1990; Agranoff and McGuire 1998; McGuire 2002; Gargan et al. 1984). Network management requires a comprehensive leadership that is different from that of single organization management because public service networks have been created by specific statute or by intentional managerial designs for obtaining particular purposes. Thus, strategic network management is required in order to change the network rules or administrative processes. At the same time, we need to caution about "dark side implications" of network management. That is, some network structures and activities imprison their participants in ways that may not be good for their own long-term interests and ongoing mental health (Berry et al. 2004: 537).

Network participants need a sense of identify useful in mobilizing resources, organizations, and actions that are necessary for better performance (Marshal 1997). Without common purposes, network participants cannot discern either the efficacy or desirability of association or know whether actions are directed toward cooperative gains. Bartunek and Moch (1987) provide an insight for successful

network management. They discussed “third-order change” which helps network participants develop the capacity to identify and change their minds to improve network performance. Network participants can improve their chances of success by developing their capacity to identify and change network rules through network management (e.g., training of network participants or planned change efforts).

Integrated Model of Network Performance

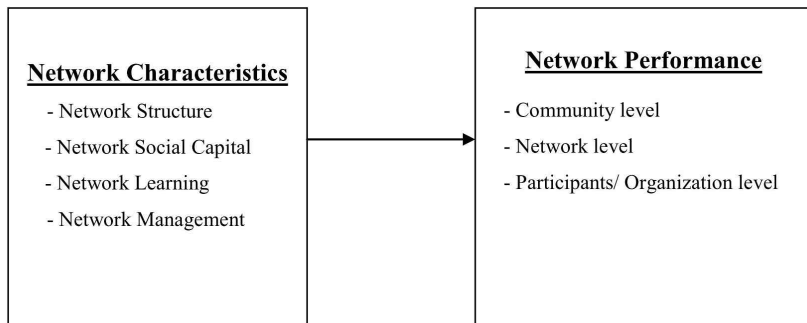
This study discusses an integrated model of network performance that draws on the theories set out to identify the key components of network characteristics. This model argues that network performance is determined by four network characteristics: network structure, network social capital, network learning, and network management. The theoretical focus of this study stands in contrast to other network studies which have tended to study a single network characteristic. Rather, this study focuses on the interdependence of network characteristics and network performance. For example, a highly dense structure, which has positive effects at the participant level, may not have positive effects for the network itself or for communities. Likewise, network learning has both positive and negative impacts on network performance. In this context, we need to investigate how individual network characteristics affect network performance, as well as what interaction effects exist among network characteristics.

A Simple Model of Network Characteristics and Network Performance

Figure 1 shows a simple model of network characteristics and network

performance that has been utilized for recent decades. This simple model examines individual network characteristics that influence network performance, but the interaction of network characteristics has been partially ignored. Actual effects of each network characteristic sometimes were overestimated or underestimated in part due to this limitation. Recent research argues that network performance should be evaluated based on the consideration of multiple levels of network performance (e.g., Provan and Milward 2001). It is necessary to undertake a comprehensive research model and theory building.

Figure 1. A simple model of network characteristics and network performance



Network Structure (Structural/Positional Characteristic). The configuration of ties that are either present or absent among network participants demonstrates a specific network structure. Structures of relations among actors and the location of network participants have important behavioral, perceptual, and attitudinal consequences for the network as a whole (Mitchell 1969; Knoke and Kuklinski 1982). In the workforce development network, for example, employers get various information and guidance on job posting/recruiting and job-training services or benefits from service providers. Employers try to look for good job candidates with well-trained skills or appropriate techniques from service

providers. Thus, employers would be satisfied to get more services from the service providers within their community. Multiple and diverse relationships among network participants are likely to create stronger relationships and be more conducive to transferring experience. Opportunities to interact across different types of relationships increase opportunities for communication and also increase understanding between organizations. When organizations have multiple organizational affiliations with a network partner, they are more likely to get more information and resources from that partner. We assume that *more multiple and diverse (higher multiplexity) networks lead to more effective or desirable performances in the networks.*

Network Social Capital (Interactional Content Characteristics). Social capital encourages cooperative behavior, thereby facilitating the development of new forms of association and innovative organization (Fukuyama 1995; Jacobs 1965; Putnam 1993). Scholars, for example, illustrate that strong social capital leads to high-performance work (Ichniowski et al. 1996), efficiency of action (Nahapiet and Ghoshal 1998) and allocative efficiency (North 1990), decrease of transaction costs (Putnam 1993), and collaborative work and learning (Leana and Van Buren III 1999). The economic function of social capital is to reduce the transaction costs associated with formal coordination mechanisms like contracts, hierarchies, and bureaucratic rules. Organizations with less social capital are more vulnerable to opportunistic behavior and less able to build an enduring cooperative behavior with their partners over time. In contrast, the more social capital available to a network, the fewer resources it needs to manage existing relationships and the more resources it can use to establish new ones. Important elements of social capital are trust and legitimacy.

Trust is an explicit and primary feature of individuals' and organizations' embedded ties and it increases an organization's access to resources and strengthens its ability to adapt to unforeseen problems (Uzzi 1996). Legitimacy is

a process whereby an organization justifies to a peer or superordinate systems its right to exist (Suchman 1995). It connotes “congruence between the social values associated with or implied by organizational activities and the norms of acceptable behavior in the larger social system” (Suchman 1995: 573). Different groups in the workforce development network share guidelines or administrative processes of workforce development programs. Network participants expect to provide useful information and resources for each other. That is, they are willing to trust others for their own benefits; otherwise they will leave the network. In this respect, level of trust and legitimacy among network participants may play a significant role in the network. It can be hypothesized that *networks with higher levels of trust and legitimacy may lead to better performance.*

Network Learning (Cognitive Process Characteristics). Network learning refers to the capacity of a network to learn how to do what is done, and what it learns is possessed not by network participants but by the aggregate itself. When network participants acquire the know-how associated with their abilities to carry out collective activities, this constitutes network learning. Networks have a target level of performance or aspiration level that adjusts over time in response to performance. The network determines whether it has performed above or below its aspiration level. Duncan and Weiss (1979) argue that organizational learning takes place through the detection of a “performance gap” and its closing by the acquisition of organizational knowledge. Networks evolve and change over time in adaptive ways. Such changes may be precipitated by actual or anticipated changes in network members, or network environments. Network learning generates the ability to learn meta-change strategies which can be either adaptive or maladaptive (e.g., Carley 1998, 2002). In this sense, network performance may be increased by adaptive learning processes.

High and low performance organizations have different learning mechanisms even though organizations begin very similarly (Carley 1998; Carley and Hill 2001).

Studies find that organizational changes can be modeled as the result of a learning process (i.e., Argyris and Schon 1978; March and Olsen 1976; March and Simon 1958). As a result, this learning process itself has to be legitimized so network members would be willing to work together to build and maintain the levels of involvement and norms of cooperation that would be critical for sustaining the network. In the workforce development networks, for example, service providers and employers must consider change of learning to be legitimated; they must be willing to adapt their own goals and activities for the network to perform effectively. It is assumed that *more adaptive networks lead to better performance*.

Network Management (Strategic/Managerial Characteristics). O'Toole and Meier (2001) illustrate that network management is dependent upon choices of structures (e.g., networks versus hierarchies) and stability (structural stability versus instability) (see also O'Toole and Meier 1999). Stability promotes cooperation (Milward and Provan 1998). Stability does not automatically guarantee better performance, but it may offer opportunities for network participants to avoid uncertainty of program services. O'Toole and Meier (2003) illustrated four types of stability (administrative, structural, mission, and production or technology stability). Regarding changes of any stability, for example, when network participants are asked to change administrative processes, their structures, and their roles or goals, they may experience disruptions or uncertainty that may not lead to better performance. For example, job-seekers in the workforce development network do not try to contact service providers to find information on job recruiting if service providers frequently change their services or administrative processes. Network participants may attempt to increase capacity of networks that enable them to have more benefits than provided by single organizations (e.g., Agranoff and McGuire 2001; McGuire 2002; Brewer and Selden 2000). In this context, we expect that *networks with more stable programs and strong capacity building lead to more effective or desirable*

performances.

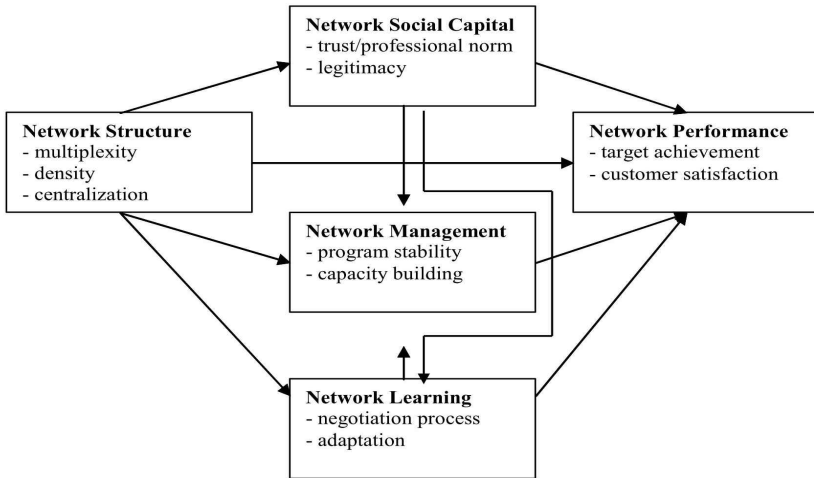
Interdependences among network characteristics

Although individual network characteristics can be conceptually separate, they overlap each other. In practice, the point is how much a particular characteristic is interdependent with others, how well it can fit into the others? It is significant to consider how much each characteristic shares with other without giving up what is unique in each one.

Nevertheless, this study does not deny that each network characteristic may affect network performance directly. Of much concern in this study are intermediate effects of network characteristics on network performance. Network structure, for example, can influence network performance directly, as well as affect other network characteristics: network social capital, network learning, and network management. Likewise, network social capital, network learning and network management are affected by network structure and each of them affects network performance.

Network structure and network social capital. A lack of contacts reduces information exchange since information is shared with others through frequent contacts (e.g., Tsai and Ghoshal 1998; Zack 1999). Zack (1999) argued that some level of contacts among network participants is necessary to share information or resources. A dense network can provide the opportunity for interaction, increasing the likelihood of information sharing or transfer (Droege and Hoobler 2003). However, Droege and Hoobler (2003) argued that the interaction can remain on a superficial level with little sharing of ideas and information. Thus, a structural characteristic of the network, like density alone, is not sufficient to

Figure 2. An Integrated Model of Network Performance



share resources or information; collaboration through some level of interaction is important. Powell (1998) argued that collaborative ties, not simple contact, among network participants, are important to transfer information and resources. Collaboration brings network participants together, for example, to understand each other's views, and share network rules or processes. Thus, collaboration intensifies interaction, increasing the odds that resources or information residing in a network participant's view are transferred to others. According to Walker et al. (1997) insisted network structure plays an important role in the development of social constraints which direct information flows in building and maintaining social capital. Network social capital may play a significant intermediate function between network structures and network performance. The effect of social capital is dependent upon its position in the network structure. In this sense, the network structure and network capital dimensions are interdependent for better network performance.

Meanwhile, in terms of weak tie and strong tie theories (cf. Granovetter 1973;

Krackhardt 1992), relationships of network structures and network social capital may be inconclusive. A strong ties model may predict that embeddedness in dense networks leads to effective network cooperation. In contrast, in terms of weak ties, in a dense network structure information would be readily disseminated and thus hard to share new values and trust. Structural holes, introduced by Burt (1992), present opportunities for brokering information flows among network participants. These opportunities have greater benefits because the broker's information advantage creates the potential for better workforce development services. Burt (1992, 1997) describes social capital in terms of "brokerage opportunities" within a social system, whereby individuals who are able to bridge gaps between otherwise disconnected others (i.e., fill "structural holes") enhance their stores of social capital. It is assumed that *network social capital may be determined by network structure and has an intermediate effect on network performance.*

Network social capital and network learning. Network social capital facilitates network learning through value creation and information diffusion (e.g., Tsai and Ghoshal 1998). Carley (1998) argued that high and low performance organizations have different learning mechanisms even though organizations begin very similarly. In the workforce development network, each service provider attempts to collaborate with others to provide relevant services for jobseekers. In this collaboration process, service providers share or understand their implementation rules or processes with other service providers within a network, and thus service providers sharing higher levels of trust or legitimacy (network social capital) are more likely to adopt the rules or processes. In other words, this learning process itself has to be legitimized so that network participants would be willing to share and maintain rules or understanding of collaboration this is critical for better network performance. It can be argued that *network social capital will have a positive relationship with network learning.*

Network social capital and network management. Social capital is a valuable asset for maintaining a network since it constraints network participants to be more cooperative. Networks with less social capital are more vulnerable to opportunistic behavior and less able to build an enduring history of effective cooperative behavior over time (Walker et al. 1997). Thus, the networks will be unstable because of less social capital. Further, the network participants are required to expend greater time and effort monitoring the relationship. In contrast, the more social capital available to a network, the fewer resources it needs to manage existing relationships and the more resources it can use to establish new and better services. For example, early in the history of a network, social capital among network participants may be low, and thus network participants will need to have more time and resources to have the identification and acquisition of new relationships. In this early period, they create relationships according to their differences in need and capability, and these relationships determine the network characteristics. In this sense, network social capital has a significant association with network management. It is hypothesized that *network social capital has a positive association with network management.*

Network learning and network management. Network The learning is the process to be legitimized so that network participants would commit to work together to build and maintain norms of cooperation that would be critical for sustaining the network (Powell 1998; Lant and Mezias 1992). Although the learning model deemphasizes the role of agency leadership (e.g., Child 1972), Tushman and Romanelli (1985) highlight agency leadership to emphasize strategic management on capacity building throughout adaptation to visionary leadership. For example, in a stable environment, network participants develop learning procedures which cause them to lock into particular network forms or rules. In a changing environment such learning can be unexpectedly devastating. In other words, maladaptive network organizations lock into strategies of change that are

counter-productive. In contrast, adaptive network organizations lock into strategies that enable continued flexibility. Bartunek and Moch (1987) argue that “third-order change” helps organizational members develop the capacity to identify and change their own views in order to explore new situations through a different perspective. Through the network learning process, for example, workforce development network participants attempt to make incremental changes in particular performance evaluation criteria or administrative rules (first-order change) and ‘modify the criteria or rules themselves (second-order change)’. Then, through network management (e.g., training of network participants or planned change efforts), network participants can improve their chances of success by ‘developing their capacity to identify and change network rules (third-order change)’. That is, throughout such learning the norms and procedures developed within the organization become institutionalized. In this sense, network learning is closely related to network management for successful network maintenance or operation. As a result, truly stable and adaptive networks, which facilitate three different orders (first-order, second-order, and third-order changes) of network norms or rules, enable learning readily and adapt their network forms or norms. It is assumed that *network learning has a positive association with network management.*

Network structure and network learning, and network management. Regarding relationships of network structure and network learning, multiple and diverse relationship among network participants is more likely to be easier to detect errors and performance gaps for their networks. Second is the relationship of network structure and network management. Multiple and diverse relationships among network participants are more likely to make networks stable and lead to increase network capacity. We anticipate that *more multiple and diverse (higher multiplexity) networks lead to more effective network learning as well as network management.*

Discussions and Implications

This study suggests that the explanations of network performance must take into account the integrated analysis of a network setting. It considers the four network characteristics to make a comprehensive conceptual framework, since they have not been examined in network performance studies. This model emphasizes interaction effects on network performance, even though it is true that individual network characteristics can influence network performance. Thus, this study has attempted to demonstrate the fertility of network characteristics by formulating several propositions about interdependent relationships among network dimensions. The following are theoretical and practical implications of proposed propositions.

Conceptual separation between network structure and content

In identifying network performance determinants, a clear definition of network structure which excludes content may be more useful than a complex definition holding two network characteristics. Other network characteristics, such as network learning and management, can be elaborated better in theoretical terms by employing a simple network structure definition since existing network structure studies tend to oversimplify the impacts of network structure on network performance. Furthermore, by delimiting what is meant conceptually by structure our investigation becomes more sensitive to differences in contents. For example, by making this distinction, we can illustrate how similar structure can have very different effects when they carry different contents (e.g., Krackhardt 1990, 1992). For example, it is assumed that “1” frequency of contacts among workforce development networks, for example, is equal to “1” among

environmental protection networks, whereas their interaction may be relatively incomparable. This study argues that although the above assumptions of network structure are generally accepted, researchers need to think about ‘degree of contacts’ or ‘variance of contents’. Current literature on network structure appears to have different expectations of effects on network performance. Some studies, for instance, argue that a centralized network structure is more likely to lead to better performance (Provan and Milward 1995; Sparrowe et al. 2001), whereas other authors find that decentralized network structure is associated with high productivity (Roch et al. 2000; Carley and Hill 2001). What is needed is an approach that clearly separates structure and content so that their theoretical and empirical potential can be more fully identified.

The contingencies and value of social capital

Regarding the relationship of network structure and network social capital, existing weak and strong ties studies might have misleading results in that the studies did not reflect other network characteristics (e.g., network social capital or network learning) that this study examines. In terms of this study, both weak and strong ties approaches are limited because neither approach reflects intermediate effects of network social capital. In other words, network structure influences network social capital, and at the same time network social capital intermediates the relationship between network structure and network performance. In this sense, this study supports Burt’s (1997) “contingent value of social capital,” which is able to make up theoretical gaps of weak and strong ties arguments in the current literature.

Overall structure of a network position in the social structures influences the likelihood of accessing resources (Krackhardt 1992; McGuire 2002; Wellman 1982). According to Granovetter’s strength of weak ties thesis, a weak tie may

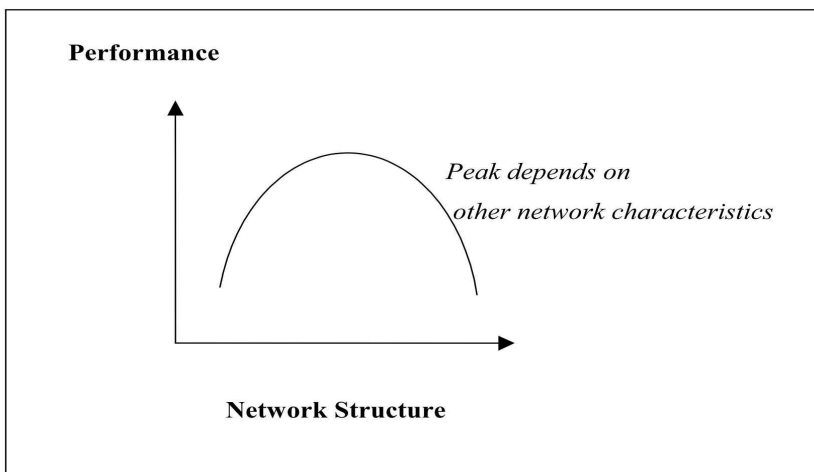
provide access to resources throughout the new group's densely connected network. Burt (1992) also stressed the importance of unique and nonoverlapping relationships for acquiring unique information in organizations, giving individuals a better chance to find information or resources and thus providing them better opportunities. From the individual's point of view, weak ties are an important resource in making possible mobility opportunities, and from a more macroscopic vantage, they play a role in effecting social cohesion (Granovetter 1973, 1974). For example, when a man changes jobs, he is not only moving from one network of ties to another, but also establishing a link between them. On the other hand, Coleman (1990) stresses strong ties for control in his study of school communities. He argued that large and dense networks create shared resources and influence participants. Particularly central positions in the network represent a source of power (Ibarra 1993). However, effects of weak and strong ties on performance seem to be inconclusive. Hansen (1999) found that weak ties are not effective in transferring complex information. There is little incentive for individuals connected by weak ties to assist in the transmission of information that is difficult to share with others. Strong ties are necessary to provide others with the incentives required to assist in transferring information or knowledge.

Where is the optimal level of network ties in a network? Weak ties are needed for non-redundant information (Granovetter 1973), but strong ties are necessary when complex information is involved (Hansen 1999). By extension, this study suggests that researchers need to consider *the contingencies* on the effect of network structure factors in terms of other network features. Further research on the contingencies should be followed in the future.

Curvilinear relationships between network characteristics and network performance

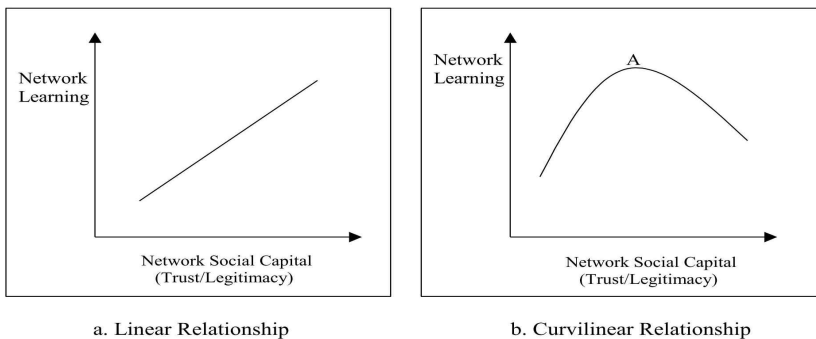
This study proposes a curvilinear relationship between network structure and network performance *if* other network characteristics can be considered (see Figure 3 modified from Carley [2001]). That is, network performance can degrade with too many or too few ties/linkages. Where the peak is may depend on other network characteristics or environments (e.g., social capital, task characteristics, technology, or cognitive limitations). Without knowing where this peak is for a network in question, we need to be cautious to tell which levels of network structure makes networks better. This argument provides significant implication to current network studies because so far most studies have assumed a linear relationship between network structure and network performance. We should note that we need to investigate direct and intermediate effects of each network characteristic.

Figure 3. Relationship of Network Structure and Performance



This study also proposes a curvilinear relationship between network social capital and network learning. There is a positive relationship until a peak point (point A); after passing the peak point the relationship will be negative. Figure 4 represents a new curvilinear relationship between network social capital and network learning. In explaining the relationship between network social capital and network learning, a key issue is to understand what benefits or incentives each individual network participant has from the relationship. In the workforce development network, for example, service providers attempt to reduce their performance gaps through error detection and correction processes (learning process) and adaptation processes. If service providers have trusted other service providers or employers, service providers would try to understand others' situation, share network goals or visions, and finally adapt network rules or procedures for better performance. That is, at the lower levels of network social capital and network learning, service providers have incentives to increase higher levels of network social capital as well as benefits to have more adaptive network learning. In this case, current literature and my suggestions about the relationship are identical in predicting a positive linear relationship between network social capital and network learning.

Figure 4. Relationships between Network Social Capital and Network Learning



However, once service providers have already had higher levels of trust and legitimacy among network participants, service providers may not have more attractive incentives to maintain higher levels of network learning. Service providers have already shared network rules or administrative procedures since they have understood others' situations or goals. Instead, service providers try to look for problem solving strategies or skills to meet their performance targets or goals. This implies that if service providers perceive higher levels of trust and legitimacy in a network, service providers may not have many incentives to make their time and efforts on network learning. In these settings, service providers will find it easier to identify their critical problems or potential solutions. Within this context, service providers will not have to spend more time on making network learning effective because they have already done so from increasing activities of network social capital.

Conclusion

The principle guideline of this study was that network structure is one important explanatory variable to explain network performance, but consideration of other network characteristics is also valid and useful. This study discussed four characteristics of network and presented an integrated model of network performance. The model included unique aspects (structure, content, process, and management) of networks. This study first proposes simple relationships between each characteristic and network performance, and then extends intermediated effects of each characteristic on others.

This study specifies expected relationships between network characteristics and network performance. The integrated model may contribute to theory construction by creating rationale that either strengthens or alters our initial

simple model. Some network characteristics may have contradictory implications across different levels of analyses. This study specifies two different levels of network performances. As practitioners learn more about how an interorganizational relationship shapes organization and network performance, they may acquire a proactive interest in developing and sustaining this valuable collective asset. Management is crucial, but it is also contingent on other network characteristics. Here is an example; within a network, the authority or reporting network (who reports to whom) is interlinked with many other networks including the task structure (which tasks are connected to which), and the task access structure (who is assigned to what task). Change in any part of this ecology of networks ultimately affects all other parts and the behavior of the entire system is a function of the specific way in which these networks are interlinked.

Implications for organizational research. Organizational research would benefit if we overcame the tendency to use conceptually mingled characteristics of network, and particularly to focus on the effects of network structure on performance. In theory building on network performance, a clear definition of network structure which excludes content may be more useful than mixed definitions. We can elaborate effects of other network characteristics (such as, network learning and management) by employing a simple network structure definition. We need to separate characteristics of structure and content so that their theoretical and empirical potential can be more fully examined.

Network performance research would benefit beyond the framework of organizational effectiveness. We need to understand better the downsides of current organizational effectiveness framework because of the inability to explain the dynamics or interactions of interorganizational relationships. A fuller consideration of the effectiveness of the entire network should be made in evaluating the public service delivery systems (see Provan and Milward 2001). Researchers should consider interorganizational relationships among relevant

stakeholders rather than a single organization. Thus, network performance is still being advanced for assessing performance or outcomes of organization and policy networks.

Implications for action. This study suggests a number of managerial implications. First, to meet a target level of network performance, network managers (or network participants) need to understand network characteristics and the direct and moderating effects on each network perspective on network performance. Second, the discussion of the contingent value of social capital suggests that management should pay heed to keep an optimal level of network ties in terms of potential contingencies. Namely, network managers need to investigate what are *the contingency factors* to determine network performance, and then maintain the optimal level of network ties. Third, following from the two previous points, it would seem useful for management to match the network structure with key components of other network characteristics. Hopefully, future theoretical and empirical research tests proposed arguments and propositions. Management matters, but how the energies of management are directed to the complex network characteristics is a significant empirical question.

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