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Exploring the Role of Knowledge Networks in Perceived e-Government: A Comparative Case Study of two Local Governments in Korea

Jooho Lee[1]

Abstract

What are the knowledge network configurations associated with effective e-government? To answer this question, a social network perspective is applied to explore the connection between e-government actors' social networks and their perception of e-government effectiveness. Specifically, this study closely looks at both intraorganizational networks between program and IT units and interorganizational relationships with IT vendors in the context of local e-government. Two Korean local governments who provide online parking services through the same IT vendor were selected as comparative cases. Through the network analysis of two local governments, the study suggests preliminary findings for the knowledge network conditions for effective e-government: e-government effectiveness is likely to be enhanced (1) members of IT and program units are linked through a greater number of strong cross-unit ties; (2) they maintain strong ties with IT vendors; (3) CUBS take central positions in knowledge networks in a program unit; and (4) they are embedded in high density of intra-unit networks within their units.

Keywords

electronic government, social networks, organizational effectiveness, South Korea

Introduction

Electronic government (e-government)—defined as provision of government information and services 24/7/365 via the internet beyond space and time (Moon & Norris, 2005)—has been touted as a useful means of achieving organizational outcomes including quality service and enhancing organizational processes such as knowledge acquisition. Although some studies (Brown 2007; Norris & Moon, 2005; West, 2004) have identified driving forces behind effective e-government, they provide limited understanding about the role of intraorganizational

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networks—relationships among internal e-government actors (e.g., program and IT units) within a government organization. Prior research in the IT/IS discipline emphasized the relationship between IT and business units within an organization as the key factor that affects effectiveness of IT-enabled service (Ray, Muhanna, & Barney, 2005; Sambamurthy & Zmud, 2000). However, given that government organizations often contract out IT vendors for the development and maintenance of e-government applications, extant IT/IS studies provide limited information about how the interorganizational relationship between a government organization and external IT vendors is associated with e-government effectiveness.

This study attempts to fill this research gap by addressing the research question: "What are the knowledge-network configurations associated with e-government effectiveness?" Specifically, this study focuses on both intraorganizational networks between parking and IT units and interorganizational relationships with IT vendors in the context of local e-government. As a key facilitator of e-government effectiveness, knowledge networks refer to the web of direct and indirect ties through which key e-government actors mutually exchange knowledge for organizational activities. Using a social network perspective, this research claims that knowledge networks influence e-government effectiveness, because they shape knowledge sharing among e-government actors by affecting the uncertainty triggered by the engagement of innovative e-government technology and external IT vendors and in turn, contribute to timely and informed decision making.

A comparative case study is designed to explore knowledge networks among parking, IT units and IT vendors who are directly or indirectly involved in delivering the online parking services of a local government in Korea. Two local governments with similar characteristics were selected; both governments have provided identical online parking services through the same IT vendor for a similar length of time. There are, however, differences in terms of e-government actors' perception of e-government effectiveness. Social network and employee perception data were used to measure key characteristics of knowledge networks (i.e., number and strength of cross-unit ties, degree centrality and network density) and perceived e-government effectiveness.

This study begins by the discussion of the relationship between knowledge networks and e-government effectiveness and research hypotheses draws from a social network perspective. The following section describes the research method including research setting and design, data collection, and measurement. Then, the findings are reported and discussed. Finally conclusions, limitations, and contributions are presented.

Knowledge-Network Theory of e-Government Effectiveness

Government organizations often provide e-government services through private IT vendors who do not work within a hierarchical setting. The engagement of those IT vendors in the provision of e-government services increases uncertainty, especially with regard to their commitments, understanding, and information because of the lack of clear accountability, control, and coordination mechanisms (Frederickson, 1999; Milward & Provan, 2000; O'Toole & Meier, 1999). They also face technological uncertainty due to the ongoing use of new e-government technologies. Government organizations might face uncertainty in terms of the outcomes of new e-government technologies because they cannot anticipate exactly how such technologies will work, what problems will take place, and how those problems will be solved (Lee, 2008). If government organizations cannot effectively cope with those uncertainties, they are less likely to make informed and timely decisions on resource allocation, and in turn, are more likely to hamper organizational effectiveness (O'Toole & Meier, 1999). Thus, it is crucial to reduce uncertainty to strengthen e-government effectiveness. Uncertainty can be defined as the gap between the knowledge requirements to perform tasks and the existing knowledge possessed by organizations

(Galbraith, 1973). Accordingly, such uncertainty can be reduced when government organizations access e-government knowledge possessed by other organizations such as IT contractors. Uncertainty can also be diminished when a government organization effectively integrates existing knowledge dispersed in IT and program units within a government organization to meet that requirement.

In the context of local e-government, the provision of e-government services requires the formation of mixed work teams comprised of such key e-government actors as the program unit, IT unit, and external IT vendors, and their commitment to ongoing management and operation of e-government applications. Program units (e.g., a parking department) are more knowledgeable in specific public service areas (e.g., parking service), but they lack IT knowledge. Likewise, an IT unit is an expert about the management of organization-wide information systems for internal operations, but it lacks local knowledge of complicated public service procedures and of the various external needs of e-government services. Given that local governments outsource e-government services to IT vendors, they act as a key player for local e-government services. IT vendors are experts on specific e-government application systems, but they lack knowledge about specific public services and internal information systems.

To promote the quantity and quality of knowledge, government organizations must be equipped with the capacity to integrate existing internal knowledge which disperses across organizational units and outside organizational boundaries. Internal boundary spanning is often used to integrate heterogeneous knowledge that organizational units have produced and accumulated within their boundary (Kogut, 2000; Kogut & Zander, 1996). Also, a local government is required to use external boundary spanning to explore the knowledge of the IT vendors. External boundary spanning provides local government with an opportunity to minimize uncertainty by gaining access to the knowledge of IT vendors, which helps buffer technological changes in the market and improve the operation of e-government applications. Although IT vendors maintain e-government services, they are often required to access organization-wide information systems (e.g., central database systems) for which the IT department is responsible. This situation requires close interactions among employees of program and IT units and IT vendors to share heterogeneous knowledge.

Therefore, it is likely that e-government effectiveness does not depend simply on knowledge sharing between a local government and the external contractors (e.g., IT vendors). It also depends on the knowledge sharing across, and within subunits in a government organization. However, knowledge sharing is difficult when a knowledge seeker lacks opportunities to access a knowledge source, the source lacks the motivation to share knowledge with the seeker, or the seeker lacks the ability to absorb knowledge from the source (Szulanski, 1996). Given that knowledge is often socially constructed (Nonaka, 1994), the lack of opportunities to access the source stems from a lack of connections between the source and seeker. Intraorganizational secrecy and competition often inhibits the motivation to share knowledge between organizational units (Hansen, 1999). Moreover, as knowledge is often locally constructed within the organization (Szulanski, 1996), it is required for both the source and seeker to build an ability to understand the local context.

Research Hypotheses

This study develops research hypotheses making a connection between social networks and e-government effectiveness by focusing on the role of social networks in knowledge sharing among key e-government actors. A social network perspective assumes that actors are interdependent and their purposeful actions (e.g., knowledge sharing) are embedded in large social networks of interrelationships; social networks act as constraints and offer opportunities for that action

(Brass, Galaskiewicz, Greve, & Tsai, 2004; Granovetter, 1985); and interpersonal ties serve as conduits for the exchange of resources such as knowledge and emotional support (Lee & Kim, 2011; Kilduff & Tsai, 2003).

Strength of Tie and e-Government Effectiveness

A dyad can be classified as having a strong or weak tie depending on the frequency and duration of interaction as well as emotional intensity (Granovetter, 1973). In this study, *tie strength* refers to the extent to which two actors frequently interact (Granovetter, 1973). Weak cross-unit ties between IT and program units provide members of those units with opportunities to access heterogeneous knowledge (e.g., IT and program knowledge) with each other, which often serves as a source of new information and creative ideas for a given problem (Granovetter, 1973). Some empirical studies (Hansen, 1999; Perry-Smith, 2006) found the positive effect of weak cross-unit ties on knowledge search and individual creativity.

Meanwhile, given a local government is often forced to deal with rapidly changing IT environment and citizen expectation on IT-enabled services, strong cross-unit ties (e.g., frequent interaction) provide a better opportunity to access new knowledge in a timely manner. Also, although weak cross-unit ties are valuable for accessing diverse knowledge, they do not automatically translate this into the generation of new solutions for a given problem because accessing new ideas is fundamentally different from implementing the ideas (Obstfeld, 2005; Tortoriello & Krackhardt, 2010). As program and IT knowledge have been constructed in a different context, it is crucial for members of program and IT units to be able to understand its context to transfer it into feasible solutions (Tortoriello & Krackhardt, 2010), which in turn contributes to organizational effectiveness (Kraatz, 1998; Krackhardt & Stern, 1988). Strong cross-unit ties promote mutual understanding between program and IT units in that they allow the members of both units to easily share the context and meaning of knowledge to each other by repeatedly sharing language, vocabulary, and collective narratives (Reagans & McEvily, 2003). Moreover, these units are less motivated to share their knowledge because adoption of new technology often provides both program and IT units with opportunities to reinforce their power (Bugler & Bretschneider, 1993; Kraemer & Dedrick, 1997; Lee, 2008). Facing this situation, strong cross-unit ties facilitate the motivation of parties to engage in knowledge sharing. Their motivation is often driven by obligations (e.g., unspecified future return) created in the process of dyadic social exchange (Blau, 1964), social considerations such as the desire to reciprocate and maintain balanced relationships (Larson, 1992) and trust (Uzzi, 1996).

Thus, this study predicts that the number of strong cross-unit ties between the members of program and IT units is positively associated with their perception of e-government effectiveness because the greater number of strong cross-unit ties provide both program and IT employees with better opportunity, ability, and motivation to share knowledge each other, which serves as a means of making timely and informed decision. In turn, this reduces uncertainty and enhances e-government effectiveness.

> *Hypothesis 1*: Other things being equal, the number of strong cross-unit ties between members of program and IT is positively associated with their perception of e-government effectiveness.

With respect to the strength of ties with IT contractors, a local government's weak tie strategy can be more valuable at the early stage of e-government development. At the early stage, a local government as a contracting organization might face uncertainty of new information technologies in the market so that it is limited in evaluating and selecting an appropriate IT contractor

equipped with IT capabilities that meet the local government's e-government needs (Kim, Lee, & Kim, 2008). Then, weak ties serve as a useful means of external boundary spanning in that they help local governments tap into and search for novel information about IT solutions in market than do strong ties with the IT vendor (Granovetter, 1973; Hansen, 1999).

As e-government development matures, however, strong ties with IT vendors can be more beneficial. As discussed earlier, strong ties provide local government with better opportunities to access IT contractors immediately, to be able to transfer their knowledge easily and promote the willingness to share knowledge, which helps local government buffer environmental uncertainty, and in turn, enhance organizational effectiveness (Meier & O'Toole, 2001, 2003). In addition, a local government's strong ties with IT contractors contribute to e-government effectiveness because they serve as control mechanism (Milward & Provan, 2000) by allowing local government to monitor the performance of the contractors effectively.

Hypothesis 2: Other things being equal, the number of strong ties between a local government and IT contractors is positively associated with perceived e-government effectiveness.

Network centrality of CUBS and e-Government Effectiveness

An actor's position affects his or her action in that a different network position provides different opportunities to access the resources of others such as knowledge (Burt, 1992). At the actor level, this study focuses on degree centrality, which is defined as the number of direct ties an actor possesses (Freeman, 1979). Thus, an actor's central position provides better and more opportunities to access a larger pool of potential knowledge sources in the network and to lower their level of uncertainty about the knowledge they seek (Burt, 1992). Empirical studies (Burt, 1992; Sparrowe, Linden, Wayne, & Kraimer, 2001; Tsai, 2001) found that centrality positively affects the effectiveness of individuals, groups and organizations.

This study focuses on the network centrality of cross-unit boundary spanners (CUBS) in program unit. CUBS refer to individuals who facilitate the sharing of knowledge by linking two or more groups of people separated by function (Cross & Parker, 2004). Then, CUBS in the parking unit serve as broker between the parking and IT units in a local government. Once CUBS in a program unit are centrally positioned in knowledge networks, they are linked to greater numbers of IT employees (sources of IT knowledge) as well as program employees (seekers of IT knowledge) directly. Also, CUBS can reach a greater number of employees in both units through indirect ties. The central position of CUBS is valuable in that CUBS are able to access more IT knowledge per contact through a larger number of direct ties with members of IT units and to quickly access IT knowledge through shorter indirect paths (Burt, 1992; Hansen, 2002). As knowledge is sometimes available from sources beyond those who are directly tied with an actor, CUBS' indirect ties serve as conduits for knowledge flow. The shorter the length of indirect paths, the more accurate and up-to-date the knowledge will be (Hansen, 2002). Thus, the central position of CUBS provides non-CUBS in the program unit with better and more opportunities to access accurate and up-to-date IT knowledge and to make informed and timely decisions on e-government issues. Thus, this study expects that e-government effectiveness will be enhanced when CUBS are centrally embedded in their intraunit knowledge networks.

Hypothesis 3: Other things being equal, e-government effectiveness is likely to be enhanced when cross-unit boundary spanners take central positions in their intraunit networks.

Network Density and e-Government Effectiveness

At the whole network level, *network density* refers to the interconnectedness among actors (Provan & Milward, 1995). With respect to organizational effectiveness, dense networks are valuable in that in dense networks, organizational resources such as knowledge flow quickly and smoothly across actors due to the fact that dense networks provide knowledge seekers with better opportunities to access the knowledge sources that are beyond direct ties. Within the dense network, knowledge is more widely available for the seekers because the ties are well connected to each other, which allows knowledge to flow easily. Also, the sources in the dense networks are more motivated to exchange their knowledge with the seekers. The source's motivation stems from the network effect on cooperative behaviors because news, norms and reputation about uncooperative behaviors (e.g., reluctance to share knowledge) quickly spread to other members in dense networks (Coleman, 1988; Reagans & McEvily, 2003). Moreover, in dense networks, the seekers are better able to absorb knowledge from the sources because they tend to possess a common language, which is necessary for sharing heterogeneous knowledge (Tortoriello & Krackhardt, 2010). Some studies (Reagans & McEvily, 2003; Reagans & Zuckerman, 2001) found a positive effect of network density on the effectiveness of individuals, teams, and organizations.

In the context of local e-government, the primary responsibility of managing e-government applications often belongs to program units such as a parking department. Therefore, it is vital for members of a program unit (the knowledge seekers) to blend their program knowledge with IT knowledge gained through external and internal boundary spanning to promote e-government effectiveness (Choudury & Xia, 1999). Once IT knowledge flows to a program unit, it should be internalized through effective diffusion channels within a program unit. As knowledge seekers, non-boundary spanners may not be directly linked to the sources serving as internal or external boundary spanners in the unit. Then, dense intraunit networks provide the seekers with better chance to access the sources, foster the sources' incentives to share knowledge by creating cooperative norms and facilitate the seekers' capability of understanding the context and meaning of IT knowledge that the sources have. Thus, this study asserts that dense intraunit networks facilitate knowledge sharing between the seekers and sources, which helps the seekers make informed and quality decisions, and in turn decreases uncertainty and increases the effectiveness of e-government service delivery.

Hypothesis 4: Other things being equal, network members in dense intraunit network structure are more likely to perceive greater e-government effectiveness.

Research Method

Research Context and Design

To identify network configurations associated with effective e-government services, online parking services provided by two local governments in Seoul, South Korea were selected as comparative cases. South Korea has adopted a two-tier local government system: 16 upper-level governments (i.e., Seoul special city, six metropolitan cities and nine provinces, which are equivalent to state-level governments in United States) and 234 lower-level governments (which are equivalent to local-level governments in United States). Local governments at both levels are politically autonomous in that the chief executives (e.g., governor) and the legislators have been elected by local residents since 1995. Like local governments in United States, local governments in Korea operate within the political context of numerous constraints placed on them

by external players (e.g., the legislative body, the courts and outside interest groups). Specifically, public service functions at the lower-level of local governments are divided into two broad areas: functions delegated by the central agencies and upper-level local government (e.g., collecting individual property tax) and original functions that are inherently local in nature (e.g., issuing and collecting parking tickets and fines).

While performing delegated service functions, lower-level local governments are fairly dependent on a variety of external political authorities for their legislation, annual budgets, personnel authorizations, and policy oversight. Meanwhile, when they perform original service functions, the degree of dependence on external political institutions (especially, corresponding central and upper-level local agencies) is relatively weak in that lower-level of governments are responsible for managing organizational resources (e.g., IT, financial and human resources) for the original service functions. Because of the weak dependence on external authorities, the methods of delivering original services (e.g., in-house or outsourcing) often rest on a lower-level government's decision. Also, the relatively weaker influence from external authorities requires more effective coordination among organizational units within a lower-level local government to perform original service functions.

Of the few original service functions, online parking services were chosen because parking functions play an important role in ensuring local financial autonomy, which serves as a strong incentive for the effective management of online parking systems. Also, online parking services involve both information and monetary transactions (e.g., online parking ticket payment service), which implies that online parking systems deal with citizens' personal information. This serves as another incentive for local governments to effectively manage parking application systems to provide reliable and secure services.

Due to the limited resources for collecting social network data from large *N* local governments for statistical analysis, a comparative case study (Przeworski & Teune, 1970) or multiple-case study (Yin, 1994) was designed to test the study hypotheses. With regard to the selection of multiple or comparative cases, Yin suggests that selected cases generate contrasting results (e-government effectiveness in this study). In a similar vein, a most-similar systems approach (Peters, 1998; Przeworski & Teune, 1970) has been widely used as a comparative case study design strategy (e.g., Provan & Milward, 1995). This approach compares multiple cases that are as similar as possible on the assumption that the more similar the cases, the more likely it should be to isolate the factors responsible for differences between them. Following the suggestions of Yin (1994) and Prezworski and Teune (1970), this study applied three criteria—the adoption of online parking services, IT vendor who provides online parking services, online parking service experiences—to select comparative cases.[1] As a result, two of the 25 lower level of local governments within the Seoul city jurisdiction—Alpha and Beta local governments (pseudonyms, hereinafter Alpha and Beta)—were selected as comparative cases. Alpha and Beta were chosen because they have provided online parking services through the same IT vendor for similar lengths of time (51 and 52 months respectively) when the data were collected. To provide online parking services, both Alpha and Beta have built a relationship as a form of contract-out with the same IT vendor since April 2000 and April 2001 respectively, mainly because of the lack of IT staff and knowledge.

The selection procedures help to rule out many alternative explanations related to the e-government effectiveness. Although this study applied a most similar comparative case study design to control for factors which potentially influence the dependent variable (i.e., perceived e-government effectiveness), some variables may not be controlled for. Therefore, this is an exploratory study, but not explanatory one. That is, as discussed later, some factors can be alternative explanations for the variation of perceived e-government effectiveness.

At the time of data collection in June 2004, Alpha served more than 530,000 citizens and employed 1,387 full-time civil servants and had 24 departments. Beta served nearly 400,700 residents and hired 1,274 full-time employees in 24 departments at the time of data collection in June 2005. Mayors in both local governments had each been in their position for 11 years at the time that this research was conducted. Social network and perception surveys were conducted at both parking and IT departments of Alpha and Beta because they are responsible for providing online parking services directly and indirectly. Alpha and Beta were keenly concerned with optimizing coordination between parking and IT departments in a bid to effectively deliver online parking services. In addition, the need for close coordination between these local governments and the IT vendor increased because online parking services are operated and maintained by the IT vendor.

Data collection

Using social network and perception surveys, this study collected data from employees at parking and IT departments at Alpha and Beta in 2004 and 2005, respectively. To conduct a social network survey, a social network survey instrument was designed by adopting a mixture of roster, free choice, and ratings formats.[2] The study population of surveys consisted of the full-time employees of the parking (a total of 85 at Alpha and 69 at Beta) and IT departments (a total of 20 at Alpha and 10 at Beta) in both Alpha and Beta. In 2004, both social network and employee survey data were collected from 98 employees (84 from parking and 18 from IT employees) at Alpha. The response rate was 94.2%. The same procedure that was conducted at Alpha was applied to collect survey data from 76 employees (67 from parking and nine from IT department) at Beta in 2005. The response rate was 98.7%.

Survey participants were asked to respond to five social network questions about work-related communication relationships by using a Likert-type scale (daily, weekly, and monthly or less) only if they "communicate with them" (see a sample network question in Appendix A). Each question probed one type of knowledge sharing relationship: a communication relationship regarding typical work, online parking systems, information technology, the performance of outsourcing partners, and citizens' issues. Attached to the network survey questionnaire, the employee surveys were distributed to the participants. They were asked to respond to employee survey questions including perceived e-government effectiveness.

While implementing social network and employee surveys, respondents' names were marked on the survey instrument to identify who communicates with whom. The research team and the author promised that all individual responses would be kept completely confidential, and confirmed that analyses would not identify any individuals. In addition, after both network and employee survey items and scales were translated into Korean, a pilot test (20 employees at the Social Welfare Department of Alpha) was conducted to establish the content validity of the items and scales (e.g., "Was the item understandable?").

Measurement

Perceived e-government effectiveness. Because the employee surveys were not originally designed for this particular study, limited survey items were used to measure perceived e-government effectiveness. Seven survey items were used to capture different dimensions of e-government effectiveness (see survey items in Appendix B). A factor analysis was used to uncover latent dimensions of e-government effectiveness. As a result, two factors were identified by using the varimax rotation method. One factor includes two items (i.e., competent e-government knowledge and collaborative relationships with IT contractors) that capture the dimension of process-based e-government effectiveness. Another factor consists of five items, which reflect the dimension of

Table 1. Number of Interunit Ties and Number of Strong/Weak Interunit Ties

Network characteristics/types of knowledge	Alpha (N = 98)	Beta (N = 76)
Number of cross-unit ties		
Typical work	7	1
Online parking systems operation	3	0
Number of strong cross-unit ties		
Typical work	5	0
Online parking systems operation	0	0
Number of weak cross-unit ties		
Typical work	2	1
Online parking systems operation	3	0

outcome-based e-government effectiveness. Five items are (a) enhanced quality of service to citizens, (b) promoted citizens' trust, (c) improved responsiveness to citizens, (d) enhanced transparency in government, and (e) changed citizen-centered behavior.

Tie strength. As a measure of tie strength, this study focused on communication frequency between two actors (Tortoriello & Krackhardt, 2010). Using the binary symmetric matrix[3], each employee's number of strong ties was measured by counting the total number of employees a focal employee checked as either "daily" or "weekly." Weak ties were measured by "monthly or less" communication ties.

Degree centrality. Freeman's degree centrality was adopted to measure network centrality of CUBS because it is the most straightforward (Freeman, 1979). It measures the level of activity of an actor based on the number of direct interactions with other actors. The normalized degree centrality index ranges from 0 (*when an actor has no direct connections to other actors*) to 1 (*when actors are connected to all other actors*).

Network density. The network density was computed by dividing the number of actual knowledge sharing ties among all network actors by the number of total possible ties (Wasserman & Faust, 1994). Density scores range between 0 (*when they are all isolated*) and 1 = (*when all network actors are linked to one another*) and are generally reported as percentages.

Results

An F test was conducted to examine the mean differences of perceived e-government effectiveness between two local governments. The results show that the two local governments exhibit significant differences in their means of process-based measure of e-government effectiveness ($p < .01$) and outcome-based measure ($p < .05$). The results indicate that respondents in Alpha perceive greater e-government effectiveness than those in Beta.

Two types of knowledge sharing relationships—typical work and online parking systems operation—were used because both parking and IT employees are directly involved in both relationships. Table 1 shows the Alpha has seven (.07 % of 9,506 possible ties) and three (.03 % of 9,506 possible ties) cross-unit ties in knowledge networks for typical work and online parking systems operations, whereas Beta features one tie (.02 % of 5,700 possible ties) in the networks for typical work. The most distinctive difference between the two local governments is that Alpha has a greater number of strong cross-unit ties in both types of knowledge networks than Beta. Specifically, in Alpha, parking and IT employees are linked through five (of seven) strong cross-unit ties (71.4% of total number of cross-unit ties) in the knowledge networks for typical work and

Table 2. Number of Strong/Weak Interorganizational Ties

Network characteristics/types of knowledge	Alpha (*N* = 98)	Beta (*N* = 76)
Number of interorganizational ties		
Typical work	0	0
Online parking systems operation	5	7
Number of strong interorganizational ties		
Typical work	0	0
Online parking systems operation	4	0
Number of weak interorganizational ties		
Typical work	0	3
Online parking systems operation	1	4

Table 3. Positional Characteristics of CUBS

Network characteristics/types of knowledge	Alpha (*N* = 98)	Beta (*N* = 76)
Degree centrality (*M*, %)		
Typical work	28.8	20.7
Online parking systems operation	3.30	0

two cross-unit ties (28.6%) in the networks for online parking systems operation, respectively. However, in Beta, parking and IT employees are connected through only one single strong cross-unit tie in the knowledge networks for typical work and they are disconnected in the networks for online parking operation. With respect to the number of weak ties, Alpha features a greater number of weak cross-unit ties (two in the networks for typical work and three in the networks for online parking operation) than Beta.

Table 2 indicates that Beta has (with seven) a slightly greater number of interorganizational ties with an IT contractor than Alpha (with five) in the knowledge networks for online parking systems operation. However, the number of strong and weak ties between two local governments and the IT vendor shows distinctive patterns. That is, Alpha and the IT vendor are linked through a greater number of strong ties (four of five in the networks for typical work), whereas Beta and the same IT vendor are connected through a greater number of weak ties (three and four in the networks for typical work and online parking systems, respectively). This pattern implies that Alpha and the IT vendor communicate with each other more often regarding online parking systems.

Because of the importance of cross-unit and interorganizational knowledge sharing, the degree centrality of boundary spanners was further analyzed to examine the extent to which they are centrally positioned in the knowledge networks. Table 3 reveals that within both types of knowledge networks, the average degree centrality scores of CUBS in Alpha (28.8% and 3.3%) are higher than those in Beta (20.7% and 0%). This result indicates that CUBS in Alpha are more effectively positioned in the networks, which provide them with greater opportunities to directly access non-CUBS within their units.

With respect to the role of the most central actor in knowledge networks, as seen in Figure 1, in Alpha, the central actor (No. 231) is most actively involved in sharing parking-related work knowledge with parking employees, and even with an IT employee (No. 271) who is embedded in highly dense networks within the IT department. Meanwhile, in Beta, the most central actor (No. 437) is actively involved in sharing his or her knowledge only with parking employees. That

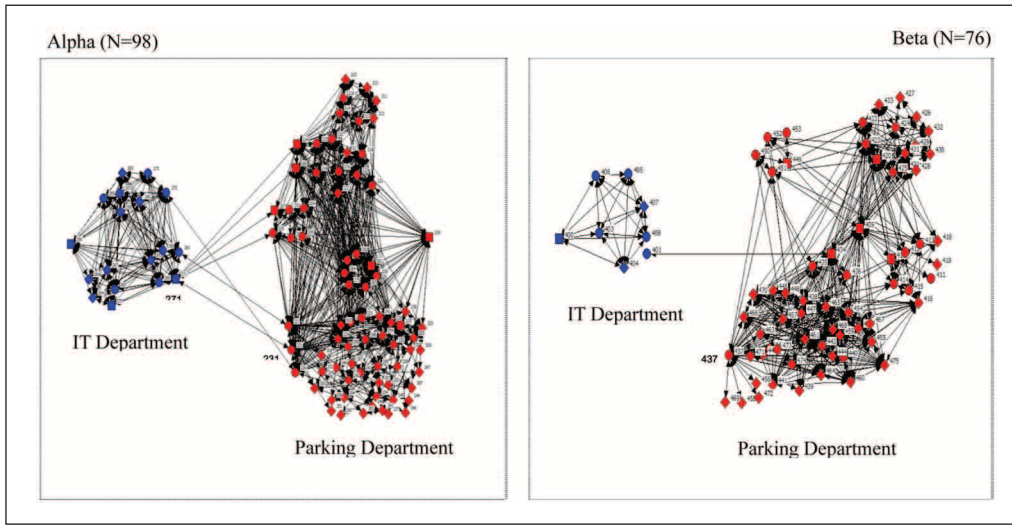

Figure 1. Knowledge networks for typical work

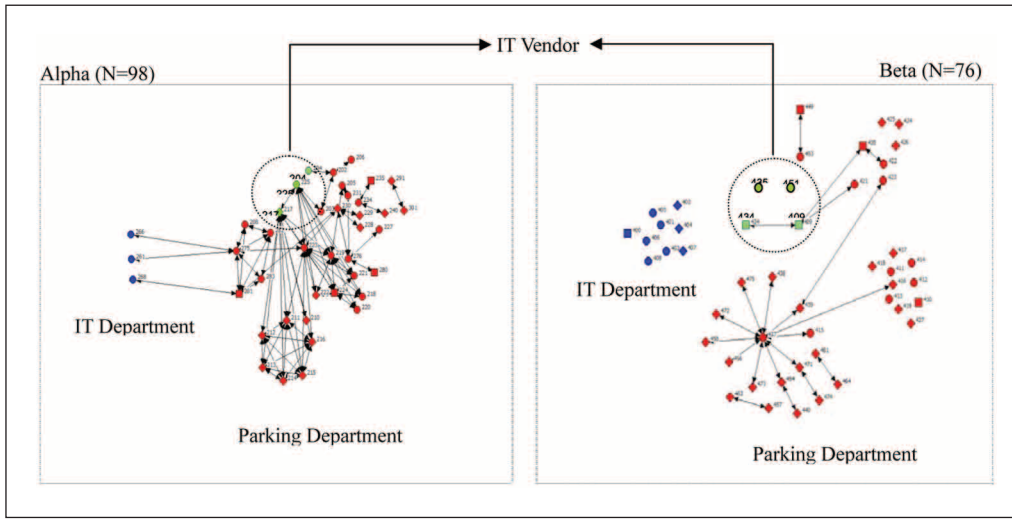

Figure 2. CSBS in knowledge networks for online parking systems operation

is, the central actor in Alpha serves as CUBS in a knowledge network for typical work, but in Beta, the central actor doesn't play such a role.

The adoption of a free format questionnaire design allowed for the identification of cross-sector boundary spanners (CSBS) who share knowledge with the IT vendor of online parking systems. In Figure 2, even though both local governments have a similar number of CSBS (Actors No. 204, 225 and 217 for Alpha and Actors No. 435, 451, 434 and 409 for Beta, in the dotted circle), the high centrality scores of Actors No. 217 and 225 (11.3% and 8.2%, respectively) in Alpha indicate that they are effectively positioned in the network.

With respect to the network density measure, as seen in Table 4, density scores for typical work within parking departments are similar for each local government (approximately 19%). However, Alpha has a greater density score for online parking systems operation (2.4%) than Beta (0.9%).

Table 4. Network Density of Two Local Governments

	Parking		IT	
Network characteristics/types of knowledge	Alpha	Beta	Alpha	Beta
Network density (%)				
Typical work	18.4	18.2	84.3	58.3
Online parking systems operation	2.4	0.9	0	0

Also, the IT department of Alpha features more dense knowledge networks for typical work than Beta (84% vs. 58%).

Moreover, Figure 2 reveals that the linkages with internal peer actors show distinctive differences. While CSBS in Alpha are embedded in more dense local knowledge networks, those of Beta are positioned in sparse local networks (that is, they are not well connected to the rest of their colleagues in the network).

Alternative Explanations

In addition to knowledge-network characteristics of two local governments, this study used employee survey data to compare other factors that potentially affect perceived e-government effectiveness. These factors include employee perception of leadership support for e-government (four survey items), e-government resources (two items), internal and external stakeholders' e-government support (three items) and e-government training (two items; see specific survey items and the results of F test in the Appendix C. F-test results show that the two local governments exhibit significant differences in their means of leadership support and e-government resources. The respondents in Alpha perceive greater leadership support and e-government resources than those in Beta. However, there are no significant differences between two local governments in terms of perceived internal and external stakeholders' e-government support and e-government training. The results imply that employee perception of greater e-government effectiveness in Alpha can be also explained by strong executive and managerial leadership support and munificent e-government resources, which is consistent with the findings of previous studies (Danziger, Dunkle, & King, 1993; Moon & Norris, 2005).

Discussion

The findings imply that members of IT and program units perceive greater effectiveness of e-government when greater number of strong cross-unit ties are maintained. This is consistent with the findings of prior studies (e.g., Hansen, 1999). Strength of cross-unit ties contribute to organizational effectiveness by playing different roles. Weak cross-unit ties facilitate internal boundary spanning for searching for, and gaining access to innovative knowledge in other groups. Strong cross-unit ties promote combining different knowledge in a timely fashion and facilitate coordination necessary to implement new knowledge. Some (Granovetter, 1973; McFadyen & Cannella, 2004) argue that if the members of social group are strongly connected to one another, they tend to posses similar knowledge. However, it does not necessarily serve as constraint on e-government effectiveness. Rather, similar knowledge can serve as a necessary common base to integrated different knowledge sources (Cohen & Levinthal, 1990) and to promote program–IT alignment by translating it into actual innovations such as e-government service delivery (Levina & Vaast, 2005; Pawlowski & Robey, 2004).

The number of strong ties matters for program and IT units to build mutual understanding about the alignment of strategic e-government plans, objectives of IT management and

day-to-day operations to integrate program and IT knowledge (Ray et al., 2005; Van der Heijden, 2001). For example, the IT unit is equipped with different types of IT knowledge (e.g., operational IT skills, managerial IT, or strategic IT knowledge) to manage organization-wide information systems. Multiple channels between IT and parking units provide members of program units with easier access to diverse sources of IT knowledge, which generates innovative perspectives and creative solutions. Also, diverse sources clarify, confirm, and verify IT knowledge so that program employees avoid potential misunderstanding while aligning e-government strategic plans, managerial IT objectives and day-to-day operations, and make informed decisions and creative ideas.

The findings of this study suggest that IT and program employees perceive greater e-government effectiveness when they are linked to external IT contractor through strong ties. Prior studies (e.g., Provan & Milward, 1995) found that health services are effectively delivered when a state agency maintains a long term relationship with a central contractor. However, the findings of this study imply that the length of the relationship between a local agency and contractor might be necessary, but may not be sufficient. Rather, the intensity of relationships might be directly associated with the effectiveness of e-government service delivered through external IT vendors.

In this study, both parking units of the two local governments maintained relationships with the same IT vendor for a similar length of time. Long-term relationships might provide both a local government and an IT vendor with shared experiences, trust, common language, silent communication systems, and bonds of friendship. This promotes effective knowledge sharing. However, because of the frequent turnover of employees at IT vendors and repeated job rotation at local governments, local employees who take new responsibility for managing e-government applications are forced to build new relationships with new members of IT vendor, even though they might have a chance to gain e-government knowledge from those who were charged with e-government applications. Different employees have different ways of building relationships and sharing knowledge with IT vendors (and vice versa). It is likely that those new employees maintain strong ties with the IT vendor because they want to take control in their work by gaining knowledge about e-government systems in a timely and accurate fashion.

The findings also show that in effective local e-government, CUBS take central positions in their intraunit networks. CUBS enjoy a better chance to access the knowledge of another unit (Tsai, 2001). Once the CUBS take central positions, the networks are likely to produce a greater amount of e-government knowledge, and to create a better quality of e-government knowledge because the intraunit networks provide both the CUBS and non-CUBS with opportunities to access more accurate and up-to-date knowledge. The more and better knowledge gained from the CUBS enables the non-CUBS in a program unit to make better informed decisions while running e-government applications, and enables the non-CUBS in an IT unit to provide better IT services, which contributes to diminishing technological uncertainty. For instance, if IT staff members who serve as the CUBS take central positions in the network, then the network provides more non-CUBS in an IT unit with opportunities to receive up-to-date programmatic knowledge in a timely manner. Then, IT staff members who take non-cross unit boundary positions are likely to better understand the program context, and to offer program-specific advice to program professionals who are engaged in running e-government applications.

Lastly, the findings imply that members of program and IT units perceived greater e-government effectiveness when they are embedded in high-density knowledge networks for online parking systems operations. That is, knowledge sharing relationships for specific task (rather than general task) is more important for a local government to improve e-government effectiveness. Also, the findings imply that a local government is likely to deliver e-government service effectively when cross boundary spanners (CBS) are embedded in dense local networks. In dense

networks, there are greater possibilities that the CBS and non-CBS are connected. Meanwhile, if CBS are located in sparse networks, there are fewer chances that non-CBS access the CBS who possess IT knowledge gained from either IT unit or IT vendors. Thus, sparse networks serve as a constraint for the diffusion of external IT knowledge into the unit. As well, the speed of IT knowledge flow is likely to decrease in sparse networks. The lack of knowledge sharing opportunity and slow knowledge flow are likely to hamper non-CBS from making informed and timely decisions to respond to citizens' e-government needs appropriately and to solve technical problems quickly.

Conclusion

This research attempted to uncover the knowledge-network configurations associated with effective e-government in the context of local e-government in South Korea. The preliminary findings support that local governments provide effective e-government services when (a) members of IT and program units are linked through a greater number of strong cross-unit ties, (b) they maintain strong ties with IT vendors, (c) CUBS take central positions in knowledge networks in a program unit, and (d) they are embedded in a high density of intraunit networks within their units.

This study has some shortcomings. The first limitation is the measure of e-government effectiveness because it is assessed by employee perception. Employee perception might not accurately capture the outcome-based effectiveness of e-government applications. Second, a limited generalization might stem from the nature of government services. As an e-government service, online parking services may not be representative of most e-government services. Due to the independent nature of parking services in local government in Korea, the knowledge sharing relationships for other e-government services might have different patterns. The third limitation involves time-related external validity. As this study focused on online parking services which have matured in terms of e-government development stages, the findings might not be applicable to e-government services at different e-government development stages because knowledge-sharing demands might vary depending on e-government development stages (Kim et al., 2008).

Although these limitations imply that some caution is warranted in interpreting the findings, the study contributes to both network management studies with regard to organizational effectiveness in the public sector and to e-government research. Existing network studies (Agranoff, 2008; Goerdel, 2006; Herranz, 2010; O'Toole & Meier, 2003; Provan & Milward, 1995) have presented limited information about how both intra- and interorganizational structural configurations are associated with organizational effectiveness. In adopting multilevel social network analysis, this study suggests that both micro- and macrostructures of networks within organizational units, between the units and between government organizations and contractors, are necessary to better understand organizational effectiveness. With regard to e-government studies, as most e-government studies have mainly used content analysis or employee surveys to understand e-government effectiveness (West, 2004; Moon & Norris, 2005), we have limited understanding of what happens behind e-government systems. This research also proposes a preliminary theory of e-government effectiveness from a network perspective. Specifically, it uncovers how internal and external e-government actors work together behind e-government websites and how their knowledge networks influence the management of e-government applications, and in turn, e-government effectiveness. The findings imply that public managers must realize the importance of interpersonal relationships among key internal and external e-government actors to build effective network strategies for improving e-government services.

Appendix A

Summary of Social Network Survey Questions

This is a summary of the sample questions that are included in the social network survey. Each respondent is asked to read each question and place a checkmark by the name of each employee's name that meet the question's criteria. Below is a brief example of one page from the survey.

Q1. With whom do you typically communicate? Please check as many names as may be appropriate.

	Daily	Weekly	Monthly or less	**IT department**	Daily	Weekly	Monthly or less
Employee name	[ ]	[ ]	[ ]	Employee name	[ ]	[ ]	[ ]
Employee name	[ ]	[ ]	[ ]	Employee name	[ ]	[ ]	[ ]
Employee name	[ ]	[ ]	[ ]	Employee name	[ ]	[ ]	[ ]
Parking department				Employee name	[ ]	[ ]	[ ]
Employee name	[ ]	[ ]	[ ]	Employee name	[ ]	[ ]	[ ]
Employee name	[ ]	[ ]	[ ]	**Others (e.g., IT vendor, Seoul City)**			
Employee name	[ ]	[ ]	[ ]		[ ]	[ ]	[ ]
Employee name	[ ]	[ ]	[ ]		[ ]	[ ]	[ ]
Employee name	[ ]	[ ]	[ ]		[ ]	[ ]	[ ]
Employee name	[ ]	[ ]	[ ]		[ ]	[ ]	[ ]

Appendix B

Survey Items

Perceived e-government effectiveness[a]

1. I believe my work unit has adequate know-how to provide e-government services
2. I believe my work unit has adequate relationship with the outsourcing vendors to provide e-government services
3. e-government services in my work unit have improved the quality of service to citizens
4. e-government services in my work unit have increased citizens' trust in my local government
5. e-government services in my work unit have increased responsiveness to citizens' needs
6. e-government services in my work unit have increased openness and transparency in my local government
7. e-government services in my work unit have changed my coworkers' behavior from an authoritative style to citizen centered service approach

[a]All seven survey items were designed with 5-point Likert-type scales ranging from *strongly agree* to *strong disagree*.

Appendix C

Alternative Variables/Survey Items and F-test Results

Variables/survey items (5-point Likert-type scale)	Alpha	Beta	*F* value
Leadership support			
(1) Mayor's leadership has been a significant facilitator to e-government development	3.82	3.14	14.33***

(continued)

Appendix C (continued)

Variables/survey items (5-point Likert-type scale)	Alpha	Beta	*F* value
(2) Mayor clearly identifies e-government visions	3.93	3.11	26.96***
(3) Mayor does encourage employees' innovative ideas for e-government services	3.99	3.26	19.34***
(4) My bureau director understands the close alignment of organizational goals with the necessary e-government application systems	3.60	3.21	6.06**
e-government resources			
(1) I believe my work unit has adequate IT resources to provide e-government services	3.51	2.95	8.98**
(2) I believe my work unit has adequate financial resources to provide e-government services	3.55	2.98	10.15**
Internal and external stakeholders' e-government support (reverse coded)			
(1) Lack of collaboration among departments within my government has been a barrier to e-government initiatives	2.81	2.82	0.01
(2) Lack of support from district council has been a barrier to e-government initiatives	3.05	2.95	0.58
(3) Lack of collaboration among different levels of government has been a barrier to e-government initiatives	2.82	2.92	0.52
e-government training			
(1) I have received IT training necessary to stay up-to-date	2.56	2.51	0.11
(2) I have received e-government training related to management and legal issues	2.25	2.32	0.22

**$p < .05$. ***$p < .001$.

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Notes

1. The first selection criterion is the adoption of online parking services. This criterion helped control for the potential effect of service characteristics on e-government effectiveness. The second selection criterion is the IT vendors who developed and maintained online parking systems. This criterion helped control for the effects of the technological capacity of IT vendors on e-government effectiveness (Kim,

2005). The third criterion is the local governments' experiences of online parking services. The assumption is that different levels of technological experience lead to different levels of learning and knowledge obtained from the management of online parking systems. The comparative sites were selected by considering the experiences of online parking services to minimize the potential effect of technological experiences on e-government effectiveness (Moon & Norris, 2005).

2. By using both a roster and free recall format in the questionnaire design, the network survey instrument contains a wider circle of colleagues around each respondent than the instrument based on either roster or free recall questionnaire design. A list of employees at the parking and IT departments was provided by the Policy and Planning Department of Alpha and the Human Resource Department of Beta. Both lists of employees allowed this research to design a roster-format questionnaire before implementing the social network surveys. To understand the respondents' relationships beyond a network boundary within the units, this study also applied a free-recall format which allowed respondents to list people who work outside their units in the local governments (e.g., IT vendors). A free-choice format questionnaire was designed to allow respondents to choose others who are not listed in the instrument without any constraints on the number of nominations (Wasserman & Faust, 1994). A ratings-format questionnaire was designed to ask respondents to rate the frequency of communication with all the other employees in the set for each measured relation.
3. The raw data (the 98 × 98 matrix in Alpha and 76 × 76 matrix in Beta) consist of valued (i.e., frequency of communication) and asymmetric ties (i.e., an actor's in-ties are not always same as his or her out-ties). Prior to calculating each employee's number of strong or weak cross-unit ties, a binary symmetric matrix was constructed by dichotomizing and symmetrizing the raw data. As the frequency of communication was measured by three ordered categorical values (daily, weekly, or monthly or less), the raw data were converted into two binary matrices by recoding "daily," or "weekly," communication ties as 1 and "monthly or less" communication ties as 0. Then, the asymmetric binary matrix was converted into symmetric matrix by adopting a so-called "agreement" method (Borgatti, Everett, & Freeman, 2002). Thus, a communication tie between Actor A and Actor B was counted as a valid one if both actors confirm or agree that the tie exists. This method is often adopted to produce more reliable social network data (Wasserman & Faust, 1994).

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