Chapter XVIII
Applying Social Network Theory to the Effects of Information Technology Implementation

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ABSTRACT

While some studies have found a significant link between information technology (IT) and firm performance, others have observed negative or zero returns on IT investments. One explanation for the mixed findings is that the causal link from IT to firm performance may be mediated. However, previous information system (IS) research has paid relatively little attention to such mediators. In this chapter, we develop a conceptual framework in which social network plays a mediating role in the relationship between IT usage and firm performance. Specifically, IT usage helps organizations strengthen inter- and intra-organizational networks, which, in turn, enhance firm performance.
INTRODUCTION

Today, many organizations are leveraging information technology (IT) to develop innovative products and/or create new business models for generating revenues and engaging consumers. Consequently, strategic use of IT has been viewed as a key driver of organizational success in an increasingly dynamic business environment. Given the great importance of IT, a large body of research has been dedicated to the relationship between IT usage and firm performance. For example, Bharadwaj (2000) argues that IT can be conceptualized as an organizational capability and empirically examines the association between that capability and firm performance. Hitt and Brynjolfsson (1996) suggest that empirical results on IT value may depend heavily on what research questions are being addressed and what data are being used. Drawing on economic theory, they investigate the link between IT spending and business value in terms of productivity, profitability, and consumer value.

While some studies have found a significant link between IT and firm performance, others have observed negative or zero returns on IT investments (Dehning & Richardson, 2002). One explanation for the mixed findings is that the causal link from IT to firm performance is too long and that many studies have ignored key organizational competences that mediate the relationship between IT and firm performance (Tanriverdi, 2005). This chapter proposes a theoretical approach to the exploration of the underlying mechanism through which IT contributes to business success. Specifically, this study is based on social network perspective and delineates the mediating role of such networks in the relationship between IT usage and firm performance.

BACKGROUND

The origin of social network theory can be traced back to the late 1800s. Tönnies (2001) argues that individuals who share values and beliefs are linked by social ties. Durkheim (1997, 1982) models the modern society as “organic solidarity”, which emphasizes the role of cooperation between differentiated individuals with independent roles.

In 1900s, the further development of social network analysis has rested on three cornerstones. The first one is sociometric analysis developed by researchers working on small groups with techniques of graph theory. One of the distinguished achievements in the sociometric analysis is made by Moreno (1934), who pioneers the systematic recording and analysis of social interaction in small groups, especially in classrooms and work groups. The second one is the investigation of interpersonal relations conducted by the Harvard researchers in 1930s. One such investigation is known as Hawthorne Studies led by Warner and Mayo. The third one is the examination of community relations in tribal and village societies by the Manchester anthropologist. Gluckman, a central figure at Manchester, makes great contribution to the development of structural approach during his investigation of community networks in southern Africa. In 1960s and 1970s, the three strands of research have been brought together and the contemporary social network analysis has emerged (see Scott, 2000 and Freeman, 2004 for the history of social network analysis).

Social networks have become one of the hot research areas in recent years. The network research has boomed in management as well as in other disciplines (Borgatti & Foster, 2003). A social network is comprised of nodes and ties. Nodes are actors (i.e., individuals, groups, and organizations) in the network, while ties are the relationships between the actors. Social network theory suggests that social networks actors are embedded within ties, which facilitate or hinder their actions and performance.

The literature in management provides consistent evidence of the influence of social networks on performance at different levels. Focusing on the link between micro-level networks and performance, researchers observe that employ-
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Employees’ social networks can lead to their career development and performance improvement. For example, Mehra and colleagues (2001) investigate how people shape the networks that constrain or benefit their work performance. Their results indicate that high-self monitors are more likely to occupy central positions than low-self monitors and that self-monitoring and centrality in social networks independently predict individuals’ workplace performance. Seibert and colleagues (2001) have employed structural holes theory, weak ties theory, and social resource theory to explicate the effects of social networks on career success. They observe that structural holes and weak ties affect social resources, which in turn influence individuals’ salary, promotion, and career satisfaction through access to information, resources, and career sponsorship.

More recently, social network research has been extended to the macro level. McDonald and Westphal (2003) examine how CEOs’ networks affect firm performance and strategic change. Based on a sample of 600 CEOs, they find that CEOs of firms with poor performance seek more advice from other firm executives who are their friends, work in the same industry, and have similar functional backgrounds. Their results indicate that such advice seeking is not very helpful to CEOs striving to leverage best practices to enhance business strategies. Ingram and Roberts (2000) posit that managers’ friendships with competitors and the cohesiveness of the friendship networks can improve firm performance. The data collected from 51 general managers in the Sydney hotel industry confirm the proposition and also suggest that cohesiveness of friendships with competitors plays the most important role in firm performance.

**SOCIAL NETWORK AS A MEDIATOR**

As discussed above, many studies have explored the effects of IT usage on firm performance, but few of them have investigated the mediating role of social network in the relationship between IT usage and firm performance. In this chapter, we propose that IT usage will affect both intra- and inter-organizational networks – the key determinants of firm performance and competitive advantages. Our theoretical model is shown in Figure 1.

Specifically, for intra-organizational network, we mainly focus on internal network closure, and for inter-organizational network, we are primarily interested in external network centrality. Thus, the theoretical framework can be adjusted as shown in Figure 2. Below we describe and discuss the two network constructs and the four conceptual links in the research model.

**Internal Network Closure**

IT usage can affect organizational performance via internal network closure of that organization.
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Closure is a network structure where actors are highly interconnected (Burt, 2000). Coleman’s (1988) seminal work in social capital is based on the closure argument. He asserts that network closure is the source of social capital. Individuals in a dense, strongly interconnected network build trust, establish effective norms, and share understandings and meanings. When network closure is high, these common norms, meanings, and trust reinforce one another and generate a synergistic influence on the flow of information (Gnyawali & Madhavan, 2001). In this case, information exchange channels are more unblocked; individuals prefer to share good ideas and knowledge, help accelerate information flow, and provide useful feedback. Prior research suggests that information is likely to be distorted as information moves from one to another in a large chain of people. Networks with a high density and more direct connections can alleviate the decrease of information quality in exchange.

In our context, high internal network closure implies that an organization consists of strongly interconnected employees who are embedded within an internal organization network with shared understandings, routines, and norms. IT usage makes connections among employees more robust and their communications more efficient. For example, by connecting users from different locations, instant messaging allows users to communicate in real-time and be aware of online status of coworkers. At Honda, the development of Pentaccord, a full-service communication system, makes information and knowledge sharing much easier on a global scale and thus improves efficiency, productivity, and competitiveness.

Specifically, IT can strengthen social networks in the following ways. First, IT leads to more ties, which improve an organization’s internal network density or closure (Granovetter, 1982; Coleman, 1988). As Coleman (1990) suggests, network closure is essential for an organization to become more efficient. It will accelerate information flow from one employee to another. Dense network linkages act as conduits for employees to communicate about and share perceptions, interpretations, and norms via IT-based channels (Ibarra & Andrews, 1993).

Second, IT makes an organization more cohesive. Granovetter (1992) puts forward with “structural embeddedness;” that is, employees are embedded within an intra-organizational network and have mutual coworkers so that they have more confidence in cooperation. Furthermore, these employees will build an organizational identity and view themselves as part of the organization. This identity stems from a collective mind, a common language, and a shared organizational culture (Nahapiet & Ghoshal, 1998; Podolny & Baron, 1997; Weick & Roberts, 1993). IT usage improves internal network density, which, in turn, enables employees to have the organizational identity. Employees will consider themselves as important components of the organization and try to make contributions. The collective interests will take precedence over their self interests (Coleman,
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1988). For example, employees will be more willing to share information, knowledge, and working experiences. They will cooperate with each other and pay more attention to the cooperative image they present (Burt, 2000).

Third, IT usage enhances tie strength and multiplicity, and thus increases the number of strong ties, which help deal with complex organizational information and knowledge (Hansen, 1999). As mentioned earlier, ties act as conduits through which information, knowledge, and resources flow. The strength of a tie is “a combination of the amount of time, emotional intensity, intimacy, and the reciprocal services that characterize the tie” (Granovetter, 1973, p. 1361). The stronger the ties, the more likely will the focal actors and their contacts share and exchange resources (Lin, 2001). People who possess strong ties with each other often have a history together, so they are highly motivated to cooperate with one another and even provide help (Krackhardt, 1992). Strong ties also provide a base for trust, which is critical to an organization’s ability to meet business challenges and handle crisis situations. Krackhardt (1992) points out that the strength of strong ties lies in trust, especially in cases of crisis. Close and frequent interactions provide employees with comfort in the face of uncertainty. Employees with a high cohesion usually trust each other and can respond quickly to a crisis.

Fourth, strong ties based on IT facilitate individuals to develop and share norms of behavior and thus accelerate resource flow. Common norms provide a guideline for employee behavior. Employees share and obey these norms, which increase the ease of interaction and cooperation. More to the point, strong ties enhance the rate of resource flow. Therefore, focal actors can draw on more resources from their contacts. In the context of an organization, the focal actor can be an employee, a project team, or a division. For example, strong ties between an organization’s divisions (e.g., production, R&D, sales) enable timely knowledge integration and make the organization more efficient and effective (Hansen, 1999; Szulanski, 1996). The two-way interaction between the source and the recipient through strong ties allows the two parties to articulate some complex knowledge in detail. Hansen (1999) examines the influence of strong ties on knowledge transfer across organization divisions and finds that weak ties facilitate searching for useful knowledge outside of the divisions, whereas strong ties greatly foster the transfer of complex knowledge within the divisions.

The positive effect of network closure on firm performance has been verified in recent empirical research. For example, Tsai and Ghoshal (1998) argue that shared values and collective visions within an organization encourage its members to trust each another. This perceived trust encourages different organizational units to have resource exchange and combination, which, in turn, results in high firm innovation. Results from 15 units of a multinational electronics company show that common visions and trust are positively related to resource exchange and combination, which significantly influences value creation. Maurer and Ebers (2006) examine the configuration and dynamics of organizational network closure of start-ups and explicate how it affects firm performance. They observe that firms’ social capital in terms of network closure, cohesion, and organizational identity is vital to the founding and continued growth of biotechnology start-ups. Ng (2004) finds that strong network closure promotes the sharing of resources, knowledge, and experiences, and that the formation of network closure is positively associated with the social capital, which greatly improves efficiency.

In short, IT usage can improve internal network closure by increasing the number of ties and tie strength, hence affecting firm performance. Our propositions for the relationship between IT usage, internal network, and firm performance are as follows:
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P1: There is a positive relationship between IT usage and internal network closure.

P2: There is a positive relationship between internal network closure and firm performance.

External Network Centrality

In today’s global business environment, firms are increasingly embedded into a competitive and cooperative external (or inter-organizational) network. Gnyawali and Madhavan (2001) define an external network as a cooperative relationship among companies that involves flows of assets, information, and status. The role of external network in firm’s behavior and performance has been examined from different angles. Fracassi (2008) suggests that a firm’s financing policy decisions depend on its position in the network. Walske and colleagues (2007) find that strong-tie venture syndicates increase the likelihood of entrepreneurial firm success. Hochberg and colleagues (2007) observe that better-networked venture capital firms experience significantly better performance. Gompers and colleagues (2005) indicate that entrepreneurial networks play an important role in the foundation of a start-up company. Leitner (2005) develops and empirically tests a network model for financial institutions and finds that social networks or linkages may allow the institutions to obtain some mutual insurance.

Recently, more and more researchers have investigated the influence of centrality on performance at the inter-organizational level. For example, Palmer and Barber (2001) find that well-networked top managers who are central in elite social networks but relatively marginal with respect to social status are more likely to pursue diversifying acquisitions. Bell (2005) examines the relationship between innovation of 77 mutual fund companies and their centrality in managerial or institutional tie networks. The results show that centrality in the network of managerial ties positively impacts firm innovation.

IT usage helps organizations have high centrality in a network. An organization using a powerful database system may be able to increase network centrality because the system permits the organization’s easier and speedier access to important information. A virtual private network (VPN) system may result in a higher centrality of a company through its ability to quickly provide secure information to others. An organization may also reach higher centrality in a social network by implementing online analytical processing (OLAP) technology, which enhances its information-processing capability and allows it to obtain valuable business information. In addition, communication systems can help an organization become more active and attentive in a social network by eliminating the obstacles to participation, such as lack of time and budget for travelling. IT may also help an organization go toward higher centrality by improving organizational learning, which is viewed as a key to knowledge-based organization development.

IT-based systems can connect organizations
to each other, open up opportunities for collaboration, and increase the possibility of resource sharing. Thus, the organizations are likely to develop more and strong ties with other nodes and increase their centrality. In the absence of such systems, some organizations may remain isolated, making it difficult for others to reach them and exchange information with them. Moreover, IT-based systems facilitate organizations to share goals, values, and beliefs, which help engage in inter-organizational relationships and thus lead to higher centrality.

As for the effect of centrality on firms’ behavior and performance, we argue that higher centrality can lead to a firm’s more aggressive, timely, and complex competitive actions, which result in superior firm performance. This is in line with Ferrier and colleagues’ (1999) finding that unaggressive, simple, and slow action explains poor firm performance in terms of market share erosion. Below, we offer more reasons.

First, a central firm can take advantage of great resources to conduct (or initiate) more and aggressive competitive actions (Gnyawali & Madhavan, 2001). The reasons are as follows. With a higher centrality in an inter-organizational network, a firm often has better access to resources including assets, information, and the associated status and power. This superior resource base enables the firm to initiate competitive actions (Chen, 1996). In addition, the central firm usually has earlier and more convenient access to relevant new information and technological developments in the network. Thus, it is in a good position to take actions. Furthermore, after the central firm’s initial action, a non-central competitor’s response is expected to be delayed or weakened because of their lack of assets, information, and power. Such expectation will further encourage the central firm to initiate competitive actions (Chen, 1996).

Second, a central firm can conduct (or initiate) more timely competitive actions (or responses) due to its information advantage. Within an inter-organizational network, a central firm can enjoy information advantage in terms of its access to and judgment about competitors’ behaviors and motives, and the competitive dynamics in the network. Thus, the central firm can conduct competitive attacks (or responses) more timely and quickly. Action timing, defined as the time elapsed between the actions carried out by a firm and those carried out by a rival, has been widely recognized as a critical factor for firm performance (e.g., Smith et al., 1992; Ferrier et al., 1999).

Third, a central firm can conduct more complex competitive actions. Competitive action complexity is regarded as important in affecting firms’ performance because firms with more complex competitive action repertoire are less predictable for rivals (e.g., D’Aveni, 1994) and more likely to capture and sustain a lead (Schumpeter, 1934, 1950). As mentioned earlier, a high centrality offers a firm better access to resources such as assets, information, and the associated status and power. With that resource advantage, a central firm is capable of increasing its action repertoire complexity, hence capturing the competitive advantage and improving performance.

Taken together, we contend that higher centrality leads to superior firm performance due to a central firms’ capability to conduct more aggressive, timely, and complex competitive actions achieved through a resource advantage. In short, IT usage can impact firm performance by improving external network centrality. Formally, we propose:

**P3: There is a positive relationship between IT usage and external network centrality.**

**P4: There is a positive relationship between external network centrality and firm performance.**

**IMPLICATION**

Social network analysis has been increasingly used to explain important phenomena in many fields.
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For example, Allen and Babus (2008) suggest that modern financial system can and should be examined from the network perspective because of the high degree of interdependence of financial system. However, very few studies in IS field have paid attention to the social network theory. This chapter tries to fill this gap by proposing a linkage between IT usage and social network.

Applying social network theory to IS field has several important implications for researchers. First, while traditional IS studies have investigated the effect of IT adoption on individual’s behavior, they typically ignore its effect on the social network. Such ignorance certainly undermines our understanding of the role of IT in firm performance. This is because increasingly, IT is being used by organizations to build social connections and collaboration, which provide employees with access to knowledge benefiting both individual work and group projects. Second, by examining IT usage from a network perspective, we can construct a bridge between micro- and macro-level effects of IT. Specifically, the perspective may help address the following research questions: (1) Does IT-based network impact individual, team, and firm performance? (2) If so, does it impact them differently? It may also help investigate how IT usage at individual level impacts the development and evolution of an organization-level social network. Third, Granovetter (1982) argues that further development of network ideas should move away from static analysis and toward more systematic accounts of how such systems develop and change. Actually, IT usage is an important driving force for network dynamics. Therefore, IT researchers may make considerable contributions to the development of social network analysis by combining network theory with IT studies. Forth, applying network theory to IT usage may provide IS researchers with a good opportunity to improve and extend current research methodology.

This study also sheds light on some areas that may benefit practitioners. First, this study sends an important message to business managers that they should pay careful attention to IT-based network in the interest of bottom-line performance for their firms. Managers must look broadly and deeply at strengths and weaknesses in their own social network, especially internal network closure and external network centrality. A second key implication for managers relates to the application of IT to the development and improvement of social network. Our research model suggests that IT can play a key role in the network maturity. Thus, managers may purposefully use IT to enhance network closure, increase network density, and boost the number of strong ties.

CONCLUSION

Drawing on a social network perspective, this study explores the underlining mechanism through which IT usage contributes to firm performance. Specifically, we contend that IT usage has a positive effect on firm performance via inter- and intra-organizational networks. That is, IT usage increases an organization’s internal network closure and external network centrality, which, in turn, enhance firm performance. The current study makes several contributions. First, this study examines the impact of IT usage on firm performance through inter- and intra-organizational networks. Such impact has so far received insufficient research attention. Second, this study is one of the first to employ social network theory to investigate the effects of IT usage on firm performance. Third, this study contributes to the social network research by identifying IT usage as one of the key drivers of network development and evolution.

REFERENCES


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**KEY TERMS AND DEFINITIONS**

**IT Usage:** Refers to an organization’s ability to use IT to meet business needs and improve business process.

**Network Centrality:** Describes the extent to which the focal actor occupies a strategic position in the network by virtue of being involved in many significant ties.

**Network Closure:** Describes the extent to which actors are strongly interconnected (Burt, 2001).

**Network Density:** Measures “the extent to which all possible relations are actually present” (Scott, 2000, p. 32).

A **Social Network:** Is comprised of nodes and ties. Nodes are actors (i.e., individuals, groups, and organizations) in the network while ties are the relationships between the actors.

**Social Network Theory:** Suggests that actors are embedded within the network and an actor’s behavior and performance are dependent on its position and relationship in the network.

**Strong Tie and Weak Tie:** The strength of a tie is “a combination of the amount of time, emotional intensity, intimacy, and the reciprocal services that characterize the tie” (Granovetter, 1973, p. 1361). For example, ties to friends are strong ties whereas ties to acquaintances are weak ties. Strong ties enable individuals to gain more resources from their contacts than weak ties.