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Getting Social:
Multimodal Knowledge Transfer During Enterprise System Implementation

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ABSTRACT

Knowledge acquired by end users through their social networks facilitates optimal use of a newly implemented enterprise system. Existing research has conceptualized end users as being the only actors within such networks. Knowledge ties between actors have been treated as unidimensional. The actor-network theory emphasizes the role of all actors in influencing networking outcomes; hence, this study proposes an expanded multimodal social network that includes four institutionally mandated knowledge actors: the technology champions, the help desk, the service desk, and the shared inbox. Knowledge ties are treated as bidimensional through incorporating both technical and business process knowledge. Data collected from an enterprise resource planning system implementation validated this approach; end users sourced knowledge from other end users and the institutionally mandated network actors based on contextual requirements. End user performance outcomes were significantly associated with knowledge source and knowledge dimension.

KEYWORDS

Advice Networks, Help Desk, Knowledge Support, Knowledge Transfer, Service Desk, Shared Inbox, Social Networks, Technology Champions

INTRODUCTION

Enterprise systems enable efficiency across an organization through streamlining of business processes, faster access to real-time data, and the use of advanced management and reporting tools (Aremu et al., 2020; Galy & Sauceda, 2014; Huang & Handfield, 2015; Ranjan et al., 2016). However, its implementation transforms the operating paradigm within the organization and changes many aspects of day-to-day work roles, including operational workflows, technical procedures, and data requirements. As a result, implementation success depends on the ability of end-users to acquire, internalize, and utilize knowledge specific to the newly implemented enterprise system (Freeze et al., 2012; Sasidharan et al., 2012; Sasidharan et al., 2017; Sykes et al., 2009). However, end-user resistance to change arising from a lack of understanding of the technology and associated business processes can result in incompetent and, at times, improper use of the new system, leading to implementation failure and long-term financial losses (Aremu et al., 2020; Chadhar & Daneshgar, 2018; Ilie & Turel, 2020; Rai & Selnes, 2019; Ranjan et al., 2016).

Formal knowledge dissemination strategies adopted by organizations include the use of technology champions and support structures such as a helpdesk, a service desk, and a shared inbox (Andrews et

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al., 2016; Babinchak, 2017; Koch & Mitteregger, 2016; Konrad, 2020; Rahman, 2016). While end-users can source system-related knowledge from any of these entities, extant research has focused primarily on knowledge acquired from other end-users through social networking (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes, Venkatesh, & Johnson, 2014). Drawing upon the actor-network theory (Callon, 1996; Latour, 2005), this study argues that all actors contribute to the knowledge dynamics within the implementation environment, and the knowledge contributions of each can impact end-user system use and subsequent implementation outcomes (Kane & Alavi, 2008). It proposes an expanded and more inclusive multimodal social network, one extending beyond end-users, through the inclusion of knowledge actors such as technology champions, the helpdesk, the service desk, and the shared inbox. Current research treats knowledge ties as unidimensional, the proposed multimodal social network views them as bidimensional, through incorporating technical and business process knowledge.

This paper addresses two substantial research questions: (1) Do knowledge actors in the expanded multimodal social network influence end-user performance with the system? (2) Does their influence differ across the technical and business process knowledge networks? Data collected from an enterprise system implementation substantiated the proposed model: end-user performance levels were related to the knowledge actor from whom the knowledge was sourced, and the knowledge network involved. Top-level performers drew upon technology champions and, to a lesser extent, the helpdesk for technical knowledge, and other end-users for business process knowledge. In contrast, low-level performers preferred the shared inbox for both technical and business process knowledge.

LITERATURE REVIEW

Enterprise system implementations involve migration from discrete and often siloed systems and procedures to a cross-functional, cross-departmental, centralized, integrated system. Such implementations can involve a change from a narrowly defined department-focused operational model to a broader organization-wide approach, imposing a steep learning curve on end-users: they must unlearn what they already know and master the business processes, technology procedures, and data flows mandated by these complex systems (Aremu et al., 2020; Ranjan et al., 2016). Apart from understanding the system's technical features, they need to understand how their interaction with the system-driven business processes impact others within their department and across departmental units. Managers need to adapt to a more centralized decision-making philosophy instead of the more decentralized departmental-level approach previously used.

During actual use of the system, end-users have been found to network with coworkers to acquire knowledge regarding the system (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014). Turning to other users is done with the expectation that others in their immediate work environment have experienced similar problems and developed solutions or workarounds. Social network analysis has been used as tool to map and better understand end-user networking patterns and identify structures that influence the speed and range of knowledge dissemination. Knowledge sourced from such informal social advice networks have been found to enhance end-user competencies leading to improved implementation outcomes (Davison et al., 2021; Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014).

An end-user's centrality (the number of ties of that end-user with other end-users) can influence knowledge acquisition from an advice network. Centrality confers structural advantages that support enhanced learning and improved knowledge acquisition (Brass, 1984; Hanneman & Riddle, 2005). For example, end-users with extensive advice ties to other users have multiple channels for knowledge acquisition, exposing them to alternative solutions to problems. Some end-users may function as knowledge brokers by acting as a bridge between two otherwise unconnected end-users, removing the knowledge "hole", and acquiring knowledge while transmitting it from one end-user to the other.

THEORETICAL FRAMEWORK: THE MULTIMODAL SOCIAL NETWORK

End User Focus on Social Advice Networks

Sociologists developed the concept of social networking to assess interaction patterns between actors in naturally occurring social settings. Over time, it was used in other disciplines such as psychology, anthropology, and biology (Freeman, 2004; Zhang 2010). While the original conceptualization of an actor included both people and things, when applied to the context of advice networks in technology settings, the definition of an actor was limited to the end-user, despite the presence of organizationally mandated knowledge support entities such as technology champions, the helpdesk, the service desk, and the shared inbox (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014). End-users may reach out to these entities, and being explicitly tasked with providing knowledge support, they can add to or be a more reliable and authentic source of knowledge than other end-users. Hence, the current conceptualization of social advice networks is expanded to include all actors directly involved in knowledge dissemination.

Technology Champions

Technology champions perform the role of an intermediary between the business and the information system (Beath, 1991; Howell & Higgins, 1990). They are also referred to as subject matter experts, or SMEs (Baškarada & Koronios, 2014). This role has been found to predict information system success, specifically use, individual impact, and organizational impact (Bradley, 2008; Petter, DeLone, & McLean, 2013). They have been found to be capable of imparting skill, instilling confidence, and lifting the morale of employees who may be diffident in using the technology and uncertain about its use. This can promote end-user buy-in of the system, which can lead to positive attitudes toward the system and minimize end user resistance. For these reasons, many organizations make a conscious effort to recruit and transform individual employees into technology champion through extensive training and involvement in the system design and implementation business processes. They have proven valuable in enterprise implementations, data warehousing, and information security implementation and maintenance, contributing to both organizational (cultural) success as well as the technical project implementation success (Cram, D'Arcy, & Proudfoot, 2019; Wixom & Watson, 2001).

Help Desk

The help desk is a centralized unit that can handle a variety of technical issues. However, their primary focus is on solving tactical problems, and they are expected to provide expert, efficient, and effective resolutions allowing employees to return to work as soon as possible (Andrews et al., 2016; Magowan, 2019; Muller, 2020; Smith, 2019; Tayntor, 2017). Typically, employees receive a ticket number for each incident which is used for follow-up and reference. The primary help desk accountabilities include being the single point of contact for technology support and ticket escalation and resolution. Some of the issues submitted to the help desk, especially those with a strategic orientation, are resolved in coordination with the service desk (Knapp, 2013, 2014).

Service Desk

The service desk is a centralized unit that handles business process and strategy-related issues that focus more on the organization than on a specific task or incident. Its domain has recently been expanded to include cybersecurity (Knapp, 2013, 2014; Rahman, 2016; Rezaeian & Wynn, 2019; Magowan, 2019; Smith, 2019). While it can coordinate with the help desk to handle technical and tactical issues, it usually has a longer-term strategic orientation. The primary accountabilities of the service desk include the design, operation, and continuous improvement of technology-enabled business processes (Magowan, 2019; Rahman, 2016; Smith, 2019). For example, questions related to menu actions to perform a business process would be handled by the help desk; while the service desk would manage questions regarding the underlying process workflow and possible improvements through the installation of a new vendor module.

Shared Inbox

A shared inbox (or mailbox) is an email platform monitored by multiple users and can disseminate system-related recommendations and advice (Babinchak, 2017; Graham, 2009; Konrad, 2020). End-users can pose questions and support documentation and screenshots, and others can provide answers, insights, and supporting documentation. Over time, the questions asked, and the answers provided can develop into a support database that end-users can access directly without intermediaries. End-users can leverage this database when troubleshooting issues.

UNIDIMENSIONAL APPROACH TO KNOWLEDGE ACQUISITION

Social network research in enterprise technology settings has studied knowledge as a generic unidimensional entity (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014). However, system knowledge can include both technical knowledge and business process knowledge. The former involves system-specific procedures needed to accomplish tasks and is the primary focus of training and formal documentation. For example, an end-user with a question about how to change a customer's address in the system requires step-by-step instructions, including what icons to click and which information to fill in. However, business process knowledge involves understanding system-mandated workflows to address situational and contextual factors based on varying requirements and outcomes (Chatterjee, Ghosh, & Chaudhuri 2020). For example, understanding the difference in the sales order transaction for direct sales versus consignment sales might be needed to address a business process question. The technology-oriented helpdesk might not be an appropriate knowledge source in this context. The expanded multimodal social network views knowledge as bidimensional and differentiates between technology and business process knowledge. This would facilitate an understanding of the relative efficacy of knowledge actors in disseminating technical and business process knowledge.

BINARY APPROACH TO NETWORKING

Networking ties have often been viewed as binary; either the advice tie exists, or it does not. However, this approach reflects only the breadth of knowledge acquisition (i.e., the number of network connections to other end-users), and not its strength or intensity. The frequency of interactions can contribute to the strength or intensity of ties (Nelson, 1989; Park et al., 2017; Perry-Smith, 2006). Frequent interactions with individuals who have strong ties to many others may facilitate faster problem solving, provide context and task-relevant information, and transfer relevant knowledge at the right time (Kang & Kim, 2017; Park et al., 2017). In addition, strong ties have been shown to lead to less conflict, which encourages friendly overtones, reciprocal favors, and has a stress-buffering effect critical to facilitating end-user success when faced with steep learning curves (Li et al., 2021; Nelson, 1989). The proposed multimodal social network adopts a gradational approach by using the frequency of networking interactions. This would help account for the differential impact of networking frequency on knowledge transfer through advice ties.

THE ACTOR-NETWORK THEORY

The actor-network theory argues that all actors are essential to the network as they contribute to the social order in distinct ways. Such actors can include individuals and inanimate objects such as hardware and software (Callon, 1996; Latour, 2005). This comprehensive approach is rooted in the belief that interactions and outcomes within a network are the product of all actors. If they are not considered as a comprehensive system, there will only be a partial view of the social order existing within the network. Prior research on system-related knowledge dissemination through social networks has primarily focused on end-users as sole actors in the network (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014). There has not been consideration of knowledge sourced by end-users from knowledge actors such as technology champions, the help desk, the service desk, and the shared inbox. Excluding these from consideration may obfuscate end-user knowledge-seeking behavior during enterprise system implementation. This study extends this limited perspective of social networks to a multimodal social network that includes technology champions, the help desk, the service desk, and the shared inbox as knowledge actors. Knowledge is treated as bidimensional, encompassing both technical and business process knowledge. The frequency of interactions between knowledge actors is considered.

Figure 1. Current end-user only networking approach

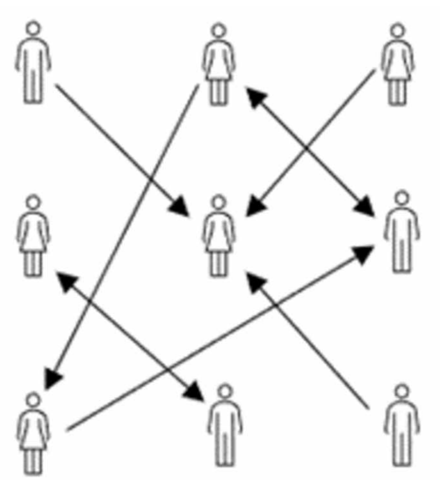
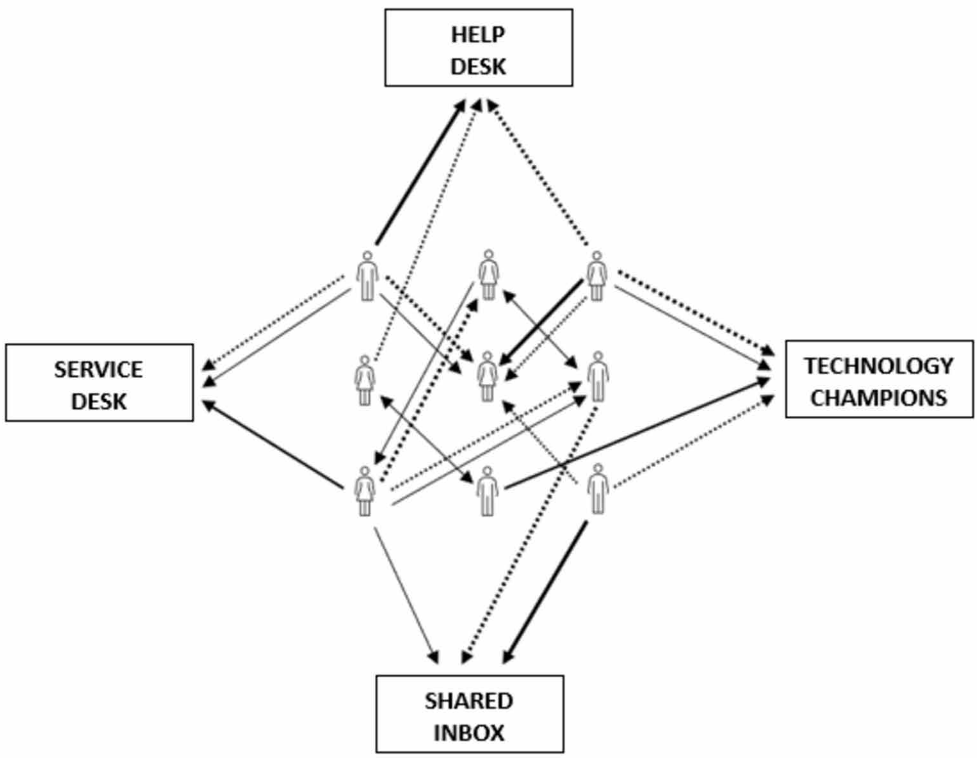


Figure 1 represents the current end-user only networking approach with the connecting lines representing binary and unidimensional knowledge ties. The expanded multimodal networking network is depicted in Figure 2; apart from end-users, it includes technology champions, the help desk, the service desk, and the shared inbox as knowledge actors; technical and business process knowledge interactions are treated separately (solid and dashed lines), and the frequency of interactions depicted by the thickness of the connecting lines.

Figure 2. Expanded multimodal networking approach



STUDY HYPOTHESES

The technical advice network encompasses end-users reaching out to the other knowledge actors for day-to-day operational knowledge regarding the system (for example, the sequence of menu operations to perform a standardized function). Technology champions are specifically trained to address operational issues associated with technical problems. Apart from that, they would be troubleshooting technical issues for end-users, gaining knowledge while doing so and exchanging it among themselves, and in the process enhancing and expanding their knowledge base. This can include practical solutions to newer, real-time problems that may not be available in the formal system documentation. The help desk too would be well-positioned to impart such factual knowledge, however, they may have support responsibilities for other systems within the organization and their advice often centers around the formal system documentation. They may not be able to anticipate or respond as well to newer and real-time operational issues. Knowledge sourced from other end-users or from the shared inbox could possibly be incorrect, and certainly less efficacious than knowledge obtained from the technology champions or the help desk. While the service desk might coordinate with the help desk in resolving technical issues, their primary focus is on the organization-wide strategic deployment and use of technologies and would likely be the least efficacious of the different knowledge sources in addressing real-time technical issues. Hence;

H1: For a technical advice network, knowledge sourced from technology champions would be associated with higher performance outcomes.

H2: For a technical advice network, knowledge sourced from the service desk would be associated with lower performance outcomes.

The business process advice network captures situational and contextual factors pertaining to process workflows. As opposed to technical knowledge which tends to be more factual and direct, business process knowledge can be more nuanced and tailored to a specific task or business requirement. The new enterprise system would have changed existing departmental work business processes and coworkers exposed to the new business processes might be better positioned to compare the old business processes to the newly introduced ones and suggest real-time solutions to problems as and when they arise. Hence, they may be better sources of business process knowledge than the more generic and technology-focused troubleshooters like the technology champions and the help desk or the strategically orientated service desk. The nuanced and contextual nature of process related knowledge could lead to the shared inbox being least adept at providing authentic and reliable knowledge to users. Shared inbox postings may not be able to capture in adequate detail the nuanced situational and contextual factors associated with process related issues and could inadvertently serve to mislead and misinform users. Hence:

H3: For a business process advice network, knowledge sourced from other end-users would be associated with higher performance outcomes.
H4: For a business process advice network, knowledge sourced from the shared inbox would be associated with lower performance outcomes.

Drawing on the proposed multimodal networking approach, these hypotheses were tested in the context of a newly implemented enterprise resource planning (ERP) system.

STUDY SETTING AND IMPLEMENTATION PROCESSES

The study setting was an ERP implementation at an agribusiness conglomerate located in a major city in the midwestern United States. They had four divisions specializing in trading commodities, formulating and selling plant nutrients, producing ethanol, and managing, leasing, and repairing railcars, together generating $80 billion in annual revenue. The organization used various systems at different divisions. These systems addressed divisional needs and requirements and were generally incompatible across the organization. This lack of interoperability among systems led to knowledge siloes, resulting in operational inefficiencies and delayed decision-making. A multitude of divisional level business processes were used to accomplish similar tasks with inconsistent and sometimes erroneous results. To address these operational inadequacies, senior leadership decided to implement an ERP system to standardize business processes and workflow patterns across the organization. This would upgrade their existing "home-brewed" business processes and workflows, making them comparable with industry best practices. Implementing a centralized database-driven system was expected to improve intra- and inter-divisional data and information sharing leading to improved and speedy decision-making.

There was considerable internal opposition to the implementation. Employees had heard "horror" stories about botched ERP implementations from colleagues in the industry. In addition, the steep learning curve imposed by complex technology features and system-mandated business processes and workflow patterns was intimidating to employees. Cognizant of these knowledge challenges, senior leadership embarked on an elaborate change management strategy, the centerpiece of which involved a comprehensive knowledge support strategy that included end-user training, development and use of technology champions, embedding the help desk and service desk with personnel having expertise in ERP systems, and the establishment of a dedicated shared inbox. End-user training was expected to provide the base technical knowledge required to interact with the system, and the other knowledge support entities would provide ongoing technical and procedural support during actual workplace use of the system.

KNOWLEDGE SUPPORT FOR SYSTEM USE

Senior leadership prioritized establishing an elaborate knowledge support framework to ensure a smooth transition to the newly implemented system. A group of eight mid-career end-users was selected and groomed to be technology champions. They were given advanced training on the system as they would act as ambassadors for the system, promoting advantages and benefits to end-users, and helping them with issues during its use. The help desk and service desk were expanded to include personnel knowledgeable about the technical and procedural aspects of the ERP system. In addition, a shared inbox dedicated to discussing issues with the ERP system was established. The inbox was expected to function as a platform for end-users to share their individual experiences and solicit help as and when needed.

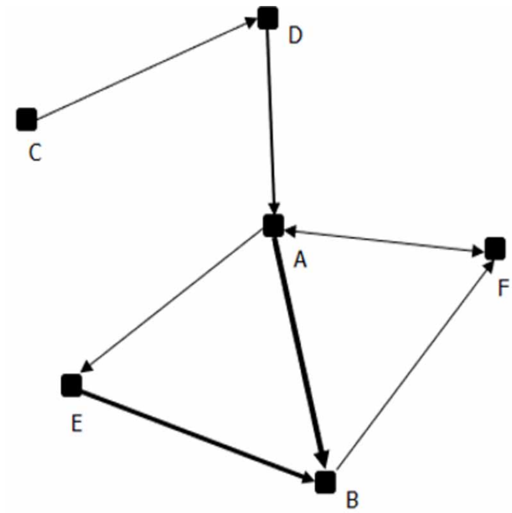
Despite identical exposure of all end-users to the same implementation processes and equal access to all four knowledge support entities, divisional managers reported considerable variation in their performance with the system. This could be attributed to some end-users being more central than others while sourcing knowledge from their social advice networks (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014). In addition, they might have depended on the four knowledge support entities in differing measures, and some of these entities might have been more adept in providing the specific type of knowledge required to meet the challenges posed by the system. The proposed multimodal social network was used to analyze knowledge patterns within the implementation environment and assess its impact on implementation outcomes.

RESEARCH METHODOLOGY

Social Network Analysis

At its core, a social network represents interactions between actors. Figure 3 depicts a six-actor network; actors are represented by square nodes, connecting lines between nodes representing interactions, and arrowheads on the connecting lines representing the direction of interactions. In figure 3, actor A has interactions with actors B, D, E, and F. The interactions with actors B and E are outgoing (i.e., initiated by A, see the direction of arrowhead), with actor D is an incoming interaction (i.e., initiated by D), and with actor F there is a reciprocal interaction (i.e., bi-directional). Social network theory argues that actors with extensive interaction ties wield informal power and prestige through access to valued resources not available to less-connected actors. In addition, actors may gain knowledge and power by acting as knowledge conduits between otherwise isolated actors (Borgatti & Li, 2009; Brass, 1984; Hanneman & Riddle, 2005).

Figure 3. A six-actor binary, valued network



Centrality in Social Networks

The degree centrality measure captures the extent of interactions using a numerical count of the interaction ties of an actor with other actors in the network. This centrality measure is divided into out-degree centrality (a count of outgoing interaction ties; in figure 3, actor A would have an out-degree centrality of 3) and in-degree centrality (a count of incoming interaction ties; actor A would have an in-degree centrality of 2). These interaction ties give actor A far more opportunities to acquire valued organizational resources than an isolated actor like C (out-degree centrality of 1; in-degree centrality of 0). In the context of this study, an outgoing interaction tie from an end-user to an actor would represent knowledge acquisition by that end-user from the actor. Hence, the out-degree centrality measure captures the breadth of knowledge acquisition (i.e., the number of actors from whom knowledge was acquired). These ties can have different strengths or intensities, reflected by the frequency of interaction.

Mapping Social Networks

Social networking data is usually acquired using a roster-based questionnaire. In the traditional binary approach, each actor is asked to indicate whether they interact or do not interact with other actors in the network. The extended version of this questionnaire captures the strength or intensity of ties by recording the interaction frequency between actors (see Appendix 1, Table 1). The corresponding gradational network diagram has the thickness of the connecting lines proportional to the frequency of interaction and is called a valued network (Hanneman & Riddle, 2005) (see Figure 3). In the context of this study, this traditional user-only advice network to encompass four new knowledge actors (viz., the technology champions, the help desk, the service desk, and the shared inbox) across two different advice networks (viz., the technical and business process advice networks)

DATA COLLECTION

Data was collected from 65 end-users in three of the four major functional divisions: transportation, fertilizer, and chemical. The operating environment and business processes within these divisions mandated extensive use of system features and functionalities. The "roster" approach (see Appendix 1, Table 1) was used to collect networking data. The actors included system end-users, technology champions, the help desk, the service desk, and the shared inbox. Each end-user was sent a questionnaire that listed all other actors they could have approached to acquire knowledge. Respondents had to select those actors they had approached to acquire knowledge and indicate the frequency of their interactions on a 5-point Likert scale. End-users were asked to indicate the type of knowledge they had acquired from other actors, specifically, whether it pertained to the technology or the business process. This information facilitated the development of the technical and the business process networks. There were 54 usable responses with a response rate of 83%.

Implementation Outcomes

The individual impact dimension of the DeLone and McLean Information Systems Success Model (DeLone & McLean, 1992, 2003; Petter et al., 2008) was used to measure implementation outcomes. Defined as "an indication that an IS has given the user a better understanding of the decision context, has improved his or her decision-making productivity, has produced a change in user activity, or has changed the decision makers' perception of the importance of usefulness of the IS" (DeLone & McLean, 1992, p. 69), the individual impact dimension encompasses desired business objectives such as enhanced decision quality, improved productivity, generation of new and innovative ideas, addressing client requirements, and time savings (see questionnaire in Appendix 1, Table 2). In addition, the questionnaire also collected data regarding alternate explanatory variables that could influence user performance with the system, such as age, gender, education, experience (in work, role, and with the ERP system), training, involvement in system design, task complexity (Sanders & Courtney, 1985), enterprise system self-efficacy, and subjective norms (Agarwal & Prasad, 1999; Venkatesh & Morris, 2000).

Developing the Technical and Business Process Advice Networks

This study attempts to link the knowledge acquisition patterns of end-users to implementation outcomes. Hence, end-users were categorized into three groups: high-performing, medium-performing, and low-performing. Those end-users with an individual impact performance score of greater than four were categorized as top-performing, a score between two and four was medium-performing, and a score less than two indicated they were low-performing. Of the 54 respondents, 17 were in the high-performing group, 19 in the medium performing group, and 18 in the low-performing group. The knowledge interactions of these end-user groups were mapped using the UCINET/NetDraw software (Borgatti, Everett, & Freeman, 2002) for both the technical (see figure 4) and the business process advice network (see figure 5). T1 to T17 represent the 17 top-performing users, M1 to M19 represent the 19 medium-performing users, and L1 to L18 represent the 18 low-performing users.

Figure 4. Overall technical advice network

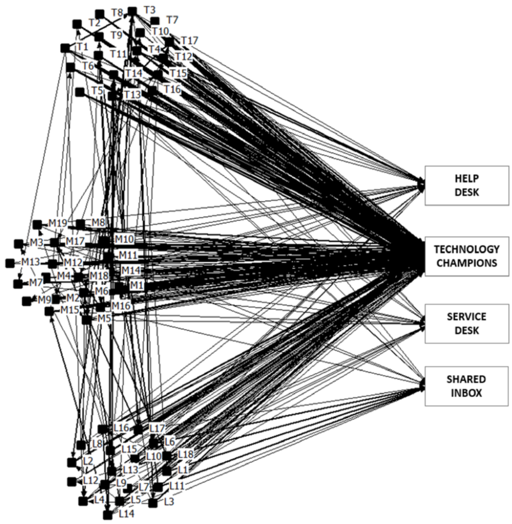
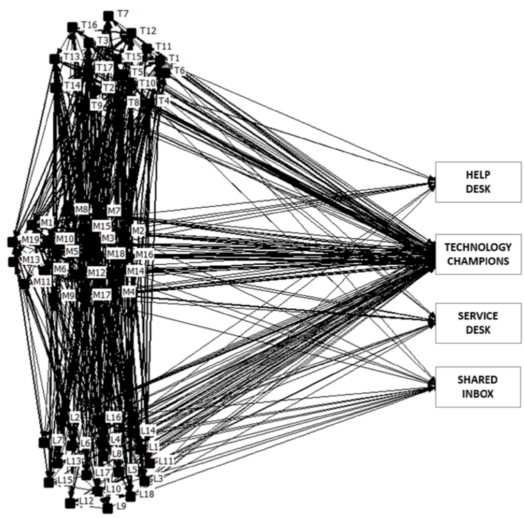


Figure 5. Overall business process advice network



DATA ANALYSIS AND FINDINGS

The out-degree centrality measure would capture an end-user's breadth and strength of knowledge acquisition (Hanneman & Riddle, 2005). To enable statistical comparisons, this study utilized the normalized version of outdegree centrality: the sum of outgoing tie strengths to its maximum possible value (computed by including all theoretically possible ties). The normalized out-degree centrality measure centrality for end-users was computed for their interactions with the technology champions, the help desk, the service desk, the shared inbox, and other co-workers. For example, a normalized out-degree centrality score of 0 for interaction with the help desk would indicate that the end-user never approached the help desk; a score of 1 (or 100%) would indicate knowledge acquisition from the help desk at the highest strength.

The means of the normalized out-degree centrality scores for the top-, medium- and bottom-performing groups are shown in Table 3. In the case of the technical network, the top-, medium-, and low- performing groups had out-degree centralities of 0.51, 0.33, and 0.22 with the technology champions, and out-degree centralities of 0.26, 0.16, and 0.12 with the help desk. For all three groups, the out-degree centralities with the other three actors (service desk, shared inbox, other users) were negligible (<0.10), except for the low-performing group that had an out-degree centrality of 0.30 with the shared inbox. These measures would indicate that the top- and medium-performing groups depended primarily on the technology champions and, to a lesser extent, on the help desk for acquiring technical knowledge. Hence, there is support for H1 (*For a technical advice network, knowledge sourced from technology champions would be associated with higher performance outcomes*). In contrast, the low-performing group preferred the shared inbox.

Table 3. Means of centralities for technical and business process networks

	Performance Group					
	Top		**Medium**		**Low**	
Actor	**Technical**	**Business process**	**Technical**	**Business process**	**Technical**	**Business process**
Champions (TC)	.51	.15	.33	.16	.22	.12
Help Desk (HD)	.26	.06	.16	.09	.12	.04
Service Desk (SD)	.08	.07	.07	.08	.09	.12
Shared Inbox (SI)	.08	.06	.06	.07	.30	.23
Other End Users (OU)	.05	.42	.02	.35	.04	.13

Table 4. Results of ANOVA for technical network (*p < = .05 **p < = .01 ***p < = .001)

Actor	**Source**	**Sum of Squares**	**df**	**Mean Square**	**F**	**p**
Champions	Between Groups	.745	2	.373	24.8	.000***
	Within Groups	.766	51	.015		
	Total	1.51	53			
Help Desk	Between Groups	.175	2	.087	1.72	.190
	Within Groups	2.59	51	.051		
	Total	2.77	53			
Service Desk	Between Groups	.002	2	.001	.060	.942
	Within Groups	.919	51	.018		
	Total	.921	53			
Shared Inbox	Between Groups	.626	2	.313	4.82	.012**
	Within Groups	3.31	51	.065		
	Total	3.94	53			
Other End Users	Between Groups	.009	2	.004	1.92	.157
	Within Groups	.114	51	.002		
	Total	.112	53			

Table 5. Results of ANOVA for business process network (*p < = .05 **p < = .01 ***p < = .001)

Actor	Source	Sum of Squares	df	Mean Square	F	p
Champions	Between Groups	.014	2	.007	.758	.474
	Within Groups	.478	51	.009		
	Total	.492	53			
Help Desk	Between Groups	.025	2	.012	.580	.564
	Within Groups	1.09	51	.021		
	Total	1.12	53			
Service Desk	Between Groups	.025	2	.013	.361	.699
	Within Groups	1.79	51	.035		
	Total	1.82	53			
Shared Inbox	Between Groups	.335	2	.168	4.60	.015*
	Within Groups	1.86	51	.036		
	Total	2.19	53			
Other End Users	Between Groups	.823	2	.411	16.8	.000***
	Within Groups	1.25	51	.025		
	Total	2.07	53			

Table 6. Tukey-Kramer comparison of means (*p < = .05 **p < = .01 ***p < = .001)

Advice Network	Actor	Performance Group	Mean Difference	p-value	95% CI	
					Lower Bound	Upper Bound
Technical	Champions	Top vs. Medium	.180	.001***	.081	.279
		Medium vs. Low	.110	.023*	.013	.207
		Top vs. Low	.290	.001***	.189	.389
	Shared Inbox	Top vs. Medium	.019	.972	-.186	.225
		Medium vs. Low	-.237	.018*	-.439	-.035
		Top vs. Low	-.218	.038*	-.426	-.009
Business process	Shared Inbox	Top vs. Medium	-.015	.970	-.169	.139
		Medium vs. Low	-.160	.037*	-.311	-.008
		Top vs. Low	-.175	.025*	-.330	-.019
	Other End Users	Top vs. Medium	.080	.285	-.046	.206
		Medium vs. Low	.215	.001***	.091	.339
		Top vs. Low	.295	.001***	.167	.423

In the case of the business process network, the top-, medium-, and low-performing groups had out-degree centralities of 0.42, 0.35, and 0.13 with other end-users, and out-degree centralities of 0.15, 0.16 and 0.12 with the technology champions. For the top- and medium-performing groups, the out-degree centralities with the other three actors (help desk, service desk, shared inbox) were negligible (<0.10). However, the low-performing group had an out-degree centrality of 0.23 with the shared inbox. The top- and medium-performing groups depended heavily on other end-users and, to a lesser extent, on technology champions for business process knowledge. Hence, there is support for H3 (*For a business process advice network, knowledge sourced from other end-users would be associated with higher performance outcomes*). In contrast, the low-performing group relied primarily on the shared inbox and, to a lesser extent, the service desk, and the technology champions. Hence, there is support for H4 (*For a business process advice network, knowledge sourced from the shared inbox would be associated with lower performance outcomes*).

A one-way between-groups factorial ANOVA was conducted for the five out-degree centralities between the three user groups (see Table 4 for the technical network and Table 5 for the business process network). The out-degree centralities with the technology champions and the shared inbox were significantly different across the three user groups for the technical network. In the business process network, the out-degree centralities with the shared inbox and other users differed significantly between the three user groups. A post hoc Tukey-Kramer simultaneous comparison of means test was conducted for these significant relationships (see Table 6).

In the technical network, the out-degree centralities with the technology champions were found to be statistically significant for all three pairwise combinations of the user groups. The breadth and strength of knowledge acquisition from technology champions dropped significantly when moving from the top-performing group to the medium-performing group ($p <= .001$), and from the medium-performing group to the low-performing groups ($p <= .05$). In addition, the out-degree centralities with the shared inbox were significantly higher for the low-performing group than the top- and medium-performing groups ($p <= .05$ in both cases). In short, the dependence of the top- and medium-performing groups on technology champions for technical advice was significantly higher than that of the low-performing group. In contrast, the dependence of the low-performing group on the shared inbox was significantly higher than that of the other two groups (see Figure 6).

Figure 6. Means of centralities for user groups in the technical network

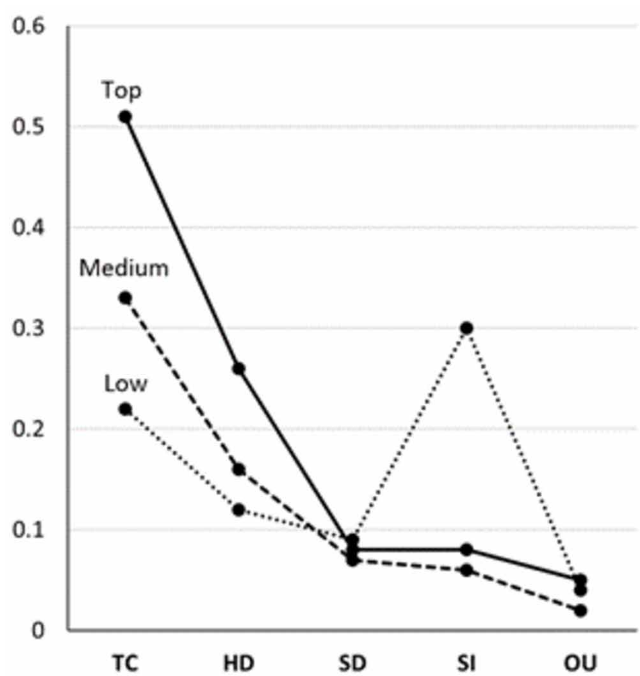


Figure 7. Means of centralities for user groups in the business process network

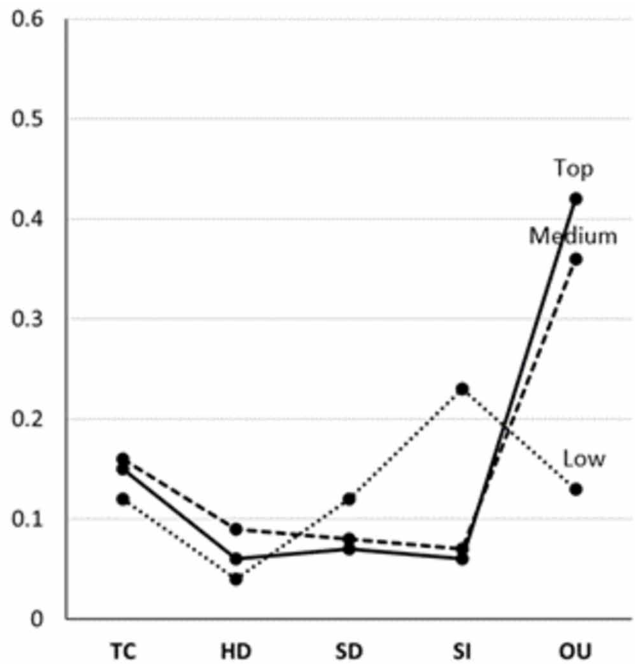


Table 7. Paired samples t-test between technical and business process networks

Performance Group	Centrality	Mean	SD	t-value	Df	p-value
Top	Champions	.36	.09	15.94	16	.000***
	Help Desk	.20	.34	2.43	16	.027*
	Service Desk	.01	.15	.32	16	.750
	Shared Inbox	.02	.09	1.00	16	.332
	Other End Users	-.37	.14	-11.04	16	.000***
Medium	Champions	.17	.12	6.13	18	.000***
	Help Desk	.07	.15	1.84	18	.083
	Service Desk	-.01	.21	-.224	18	.826
	Shared Inbox	-.01	.17	-.271	18	.790
	Other End Users	-.33	.19	-7.29	18	.000***
Low	Champions	.10	.09	4.83	17	.000***
	Help Desk	.08	.12	2.72	17	.015*
	Service Desk	-.03	.15	-.90	17	.381
	Shared Inbox	.07	.35	.81	17	.430
	Other End Users	-.09	.09	-4.33	17	.000***

For the business process network, the out-degree centralities with other users were statistically significant for two of the three pairwise combinations of user groups. The extent of knowledge acquisition from other end-users dropped significantly when moving from the top-performing group to the low-performing group and from the medium-performing group to the low-performing group ($p <= .001$ in both cases). Following the same pattern as in the technical network, the out-degree centralities with the shared inbox were significantly higher for the low-performing group than the top- and medium-performing groups ($p <= .05$ in both cases). The top- and medium-performing groups had a significantly higher dependence on other end-users than the low-performing group. As in the case of the technical network, the low-performing group had a significantly higher dependence on the shared inbox than the other two groups (see Figure 7). The means of out-degree centralities for each performance group across the technical and business process networks was then compared using a paired samples t-test. The results are shown in Table 7.

The difference in out-degree centralities for technology champions and other end users between the technology and business process networks were statistically significant for all three performance groups ($p <= .001$). Also, the difference in out-degree centralities for the help desk between the technology and business process networks were statistically significant for the top- and low- performing groups ($p <= .05$) and marginally significant for the medium-performing group ($p <= .1$). Thus, all three groups preferred the technology champions and, to a lesser extent, the help desk for acquiring technical knowledge; however, they chose other end-users for acquiring business process knowledge.

DISCUSSION

End-users encounter technical and business process-related knowledge challenges during the use of a new enterprise system (Palvia et al., 2021). They are generally exposed to a centralized, cross-departmental operating paradigm different from what they previously encountered in their work lives (Aremu et al., 2020; Chadhar & Daneshgar, 2018; Ranjan et al., 2016). They may acquire knowledge from formal knowledge support entities such as technology champions, the help desk, the service desk, and the shared inbox during actual use of the system. In addition to these institutionally mandated knowledge structures, end-users may network with other end-users in their immediate work environment to acquire contextually relevant knowledge during the execution of their work-related tasks (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014).

The quality of knowledge sourced from other end-users would be contingent on their expertise levels. Knowledge sourced from those with lower expertise levels may mislead and misinform, negatively impacting end-user performance with the system. In this context, knowledge actors such as technology champions and the help desk can be authentic, reliable, and accountable sources of high-quality knowledge that enhance, confirm, and at times correct knowledge acquired from other end-users of the system. However, research on system-related knowledge acquisition through social advice networks has focused primarily on other end-users and disregards the potential impact of other knowledge actors within the work environment. Furthermore, knowledge has been viewed as unidimensional, despite both technical and business process knowledge being required for effective use of the system. The strength or intensity of knowledge interactions has not been considered (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014). Hence, based on the actor-network theory (Callon, 1996; Latour, 2005), this study proposed a multimodal social network spanning both technical and business process advice networks, and including the institutionally mandated knowledge actors of technology champions, the help desk, the service desk, and the shared inbox (Kane & Alavi, 2008).

The multimodal social network approach revealed significant differences in knowledge acquisition patterns between the top-, medium-, and low-performing groups. For technical knowledge acquisition, the top- and medium-performing groups prioritized the technology champions and, to a lesser extent, the help desk over the other three knowledge actors. They made little use of the service desk and the shared inbox, and they hardly ever reached out to other end-users in their workplace. Technical knowledge would essentially be factual (such as the sequence of menu operations to perform a standardized function); the technology champions and the help desk would be well-positioned to impart such knowledge. However, the low-performing group depended on the shared inbox as their primary source of technical knowledge, ignoring other knowledge actors.

The shared inbox would involve minimal effort on the part of the knowledge seeker, as utilizing it involves sending an email outlining their technical issues. In general, email is an inadequate means of communication for resolving conflicts and complex issues and almost always involves a time lag and in some cases negatively affects trust (Bülow et al., 2019; Cambier & Vlerick, 2020). Had the end-user been seeking immediate redressal of a complex technical problem, the shared inbox might prove inadequate, and the user might go in for a temporary fix that may not be the preferred solution and could prove detrimental to eventual outcomes. In contrast, the top- and medium-performing user groups reached out to technology champions and the help desk, and this would more likely be accomplished using "richer" mediums such as telephone/video calls or actual face-to-face meetings, which could enable faster and more accurate resolution of technical problems. The other interesting question is why none of the groups reached out to other end-users in their workplace to acquire technical knowledge. In the case of the top- and medium-performing groups, they may have realized that the technology champions and the help desk could provide more objective technical knowledge than coworkers. For the low-performing group, it is conceivable that the minimal effort involved in using the shared inbox proved more attractive than the comparatively higher effort involved in reaching out and interacting with other end-users.

While the top- and medium-performing groups preferred to source technical knowledge from the technology champions, their focus shifted to other end-users while acquiring business process knowledge. Technical knowledge tends to be factual and direct, whereas business process knowledge may be more nuanced and, at times, department- or task-specific. Coworkers who have been interacting with the existing business processes and subsequently exposed to the new business processes would be able to assess their differences and formulate real-time fixes to process-related issues. As with technical knowledge, the low-performing group preferred the shared inbox as their primary knowledge source and rarely reached out to other users, the technology champions, or the help desk. The low-performing group had chosen the least burdensome avenue for sourcing technical knowledge (i.e., the shared inbox) and continued that pattern for sourcing business process knowledge.

Prior research has treated system-related knowledge as unidimensional (Freeze et al., 2012; Sasidharan et al., 2017; Sasidharan et al., 2012; Sykes et al., 2009; Sykes et al., 2014). However, this study's results indicate that end-users perceived technical and the business process as two distinct streams of system-related knowledge. Furthermore, the networking outreach for top- and medium-performing groups differed based on the type of knowledge being acquired. The networking outreach to other end-users for business process knowledge is consistent with existing literature; however, reaching out to the technology champions for technical knowledge introduces a crucial nuance that validates the need for treating knowledge as a bidimensional entity.

LIMITATIONS OF THE STUDY

This study was conducted at an agribusiness conglomerate in the midwestern United States; therefore, the results may not be generalizable to all business settings. However, its generalizability is increased as the tasks and knowledge required are similar to other enterprise-level systems widely used in industry. The sample selected for the study was one of convenience that met the criteria for the study: a newly implemented enterprise system, end-users who had just begun using the system, and the presence of all knowledge actors included in the proposed multimodal social network. The sample size is small; however, this is more a function of the implementation context and the response rate of 83% exceeds the recommended threshold of 80% for social network analysis (Brass & Borgatti, 2019). The grouping of high-, medium-, and low-performers was specific to this study and based on the individual impact dimension of the DeLone and McLean Information Systems Success Model (DeLone & McLean, 1992, 2003; Petter et al., 2008). A more comprehensive measure could have been developed based on end-user performance reviews, however this data was not available.

The study does not necessarily prove causality. Knowledge acquisition patterns and the strength of knowledge exchanges were analyzed between end-user groups having different performance outcomes. All study participants were subject to the same implementation environment, exposed to the same knowledge actors, with equal access to all knowledge activities including training. This would provide an inbuilt control to other factors that could impact performance outcomes. Moreover, a post hoc analysis indicated that there were no statistically significant differences between the three end-user performance groups on other possible explanatory variables that could influence user performance with the system: age, gender, education, experience, training, involvement in system design, task complexity, enterprise system self-efficacy, and subjective norms.

The networking questionnaire provided employees were given the opportunity to "write-in" the names of others they may have consulted, but that option was rarely used. However, it is possible that they reached out to colleagues and friends in other organizations that had implemented similar systems. They might also have referred to technical manuals and online help/FAQ pages provided by the vendor and other third parties. The study does not account for these knowledge sources. The networking data was self-reported, and given the prestige associated with the implementation, it is possible that some end-users could have exaggerated their networking ties with other actors viewed as possessing prestige and power withing the organization, including senior managers and technology champions.

CONCLUSION

Theoretical Implications of the Study

Social network research on knowledge dissemination during enterprise system implementation has focused on end-users of the system. However, most enterprise implementations have institutionally mandated knowledge support structures, including technology champions, the help desk, the service desk, and the shared inbox. End-users decide how to use these knowledge sources, so ignoring other possible knowledge sources captures only a partial picture of the knowledge dynamics within the implementation environment. The term knowledge has previously been used in a generic sense and conceptualized as a single cohesive entity. There has been little consideration of the strength or intensity of knowledge interactions. Such an approach results in the treatment of all knowledge interactions as equal and interchangeable. However, more than one type of knowledge can be sought at varying intensities from multiple knowledge sources. Each of these might differ depending on the problem being addressed and the knowledge source being tapped. Treating all knowledge interactions as equal and interchangeable overlooks the nuances associated with knowledge content, the complexities involved in knowledge acquisition, including the knowledge source being tapped, and their joint impact on implementation outcomes.

Practical Implications of the Study

End-users reach out to and obtain value from knowledge resources differently, depending on whether the knowledge relates to the technology or associated business processes. This can have serious implications for practice. For example, if an enterprise implementation results in technology-focused restructuring with minimal changes to the business processes, time and effort should be directed toward building a technology champions team and establishing a dedicated helpdesk. However, if the implementation changes both the technology and the business processes, there should be a significant end-user-focused change management and training effort. In addition, technology champions should be trained in departmental-level business processes, and they should be assigned to corresponding departments. The other approach could be to create a rotational program of end-users to serve as technology champions. The approach would increase the quality of knowledge of the general end-user population since end-users tend to consult each other when there are business process questions or issues.

Future Directions

An expanded multimodal networking approach as the one adopted in this study helped capture end-user knowledge interactions with multiple actors during enterprise system implementation. This would be in line with the actor-network theory and the results of this study that emphasizes the contribution of different knowledge actors in disseminating system-related knowledge through advice networks. However, the efficacy of the proposed approach needs to be determined through comparative studies that include alternate models and networking paradigms. Organizations could consider retiring the shared inbox and diverting resources to more value-added areas. The shared inbox proved ineffective in providing knowledge support commensurate with the demands of the new system in this study. The shared inbox involves a nominal initial investment with little or no continuing expenses, so an alternate approach would be associating it with the technology champions or with the help desk. The technology champions or help desk personnel could monitor the shared inbox periodically and reach out directly to those seeking issue resolution. The service desk was hardly ever used as a knowledge source and need not be configured as an end-user knowledge support entity.

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APPENDIX 1

Table 1. An extended social networking questionnaire

Name	Select (check) those with whom you interact with for the purpose of _________	Frequency of interaction 1 (Infrequent) to 5 (Very frequent)
Actor 1	☐	
Actor 2	☐ ☐	
Actor 3		
Actor 4	☐ ☐	
Actor 5		
…….		
If there are others you interact with, please include them below:		

Table 2. Individual Impact questionnaire

Measure	Items
Individual Impact (Doll and Torkzadeh, 1998)	The ERP system helps me create new ideas.
	The ERP system helps me meet client needs.
	The ERP system allows me to accomplish more work than would otherwise be possible.
	The ERP system saves me time.
	The ERP system increases my productivity.
	The ERP system helps me come up with new ideas.
	The ERP system helps me try out innovative ideas.
	The ERP system improves client satisfaction.

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