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Abstract

Prior research on ERP assimilation has primarily focused on influential factors at the organizational level. In this study, we attempt to extend our understanding of individual level ERP assimilation from the perspective of social network theory. We designed a multi-case study to explore the relations between ERP users' social networks and their levels of ERP assimilation based on the three dimensions of the social networks. We gathered data through interviews with 26 ERP users at different levels in five companies. Qualitative analysis was used to understand the effects of social networks and individual interactive learning. We found that user social networks play a significant role in individual level ERP assimilation through interactive learning behaviours among users. We also found five key factors that facilitate users' assimilation of ERP knowledge: homogeneity (age, position and rank), tie content (instrumental and expressive ties), tie strength, external ties, and centrality. Our research has significant implications for managing assimilation of ERP systems and improving users' ERP assimilation level in organizations.

Keywords: Enterprise resource planning (ERP), Individual level ERP assimilation, Social network, Interactive learning.

1 Introduction

In order to survive and thrive in the increasingly uncertain, dynamic and fierce marketplace, many firms embrace enterprise resource planning (ERP) systems to improve operational efficiency, support business development and enhance competitive advantage. According to a recent report authored by Gartner, during 2012 the worldwide ERP market was $24.5 billion, experienced slow growth of 2.2% over 2011. ERP systems are commercial packages for enabling the integration of transactions-oriented data and business processes throughout an organization (Markus and Tanis, 2000). As integration software that includes various functional areas (Davenport, 1998), ERP systems excessively complex. Consequently companies often encounter significant difficulties in assimilating the embedded knowledge and stimulating employees to use the systems in desired ways (Fichman and Kemerer, 1999; Jasperson et al., 2005; Purvis et al., 2001), which often result in ERP project failures, lead companies to financial difficulties (Markus and Tanis, 2000; Robey et al., 2002; Xue et al., 2005).

A typical lifecycle of ERP systems is generally divided into three phases: ERP adoption, ERP implementation and ERP assimilation (Swanson and Ramiller, 2004; Wu and Chuang, 2010). With the

expectation to improve the chances of ERP success, recent researches have focused on the assimilation phase at the organizational level (Liang et al., 2007; Ke and Wei, 2008; Min et al., 2011). However, the prevailing literatures on ERP assimilation have not paid enough attention to the role of individual users (Liu et al., 2011). As the end-user of ERP systems, "the degree of cognitive understanding of ERP technology and the extent to which the technology is used beyond routine tasks by an individual user" (a.k.a. individual level ERP assimilation) play an important role in realizing the anticipate benefits from ERP systems (Liu et al., 2011).

During the long assimilation phase of ERP lifecycle, compared with formal ways like training and IT help desk, end-users mostly assimilate ERP technology through informal ways to learn ERP technology by consulting to peers, interacting with each other in practical work within the organizational boundary (Robey et al., 2002; Boudreau and Robey, 2005). End-users frequently relied on each other for assistance; if a user within a department discovered how to perform a particularly useful task, peers were quickly updated about the tip (Boudreau and Robey, 2005). Therefore, in this study, focusing on end-users' interactive learning behaviours when using ERP systems, we argue that end-users' ERP assimilation is through an interactive and improvised learning process.

There is a growing interest in examining how the social networks formed by users impact their behaviours towards IT (Bruque et al., 2008; Montazemi et al., 2008; Sykes et al., 2009; Sasidharan et al., 2012; Zhang and Venkatesh, 2013; Sykes et al., 2014). Thus we argue that user's learning behaviour about ERP systems within organizational boundary happens in the social networks, and propose that user's learning behaviour will be depend on the characteristics of the social networks. The social networks of employees within the organization will influence user's ERP assimilation. Users are embedded in networks of different relationships that impact their ability to diffuse complex technology necessary for higher individual level ERP assimilation.

In the extant literature, no studies have focused on understanding the relationship among the social networks interactive learning and individual level ERP assimilation. With this backdrop, in this study, we take a social network perspective to examine individual level ERP assimilation, focusing on users' interactive learning within the organization. We have the following objectives: (1) Address the question whether the individual social networks indeed affect individual level ERP assimilation, and (2) Explore the influential factors from social network constructs to individual level ERP assimilation. Given the sparse literature on the relationship between social networks and individual level ERP assimilation, we conducted an exploratory multi-case study, visited five companies, and interviewed 26 individuals ranging from frontline ERP users to CIOs by following the case study protocols and guidelines as specified in Yin (2003) and Pare ´(2004). The case evidence suggested that individual social networks have a positive impact on individual level assimilation, proposed that the individual interactive learning is important to assimilate ERP technology. This study identified five key factors: homogeneity (age, position and rank), tie content (instrumental and expressive), tie strength, external ties, and centrality.

2 Theoretical Foundations

2.1 ERP Assimilation

Realizing that individual users in fact play significant roles in ERP assimilation, Liu et al. (2011) argued that ERP assimilation is a multi-level phenomenon: the assimilation occurs at organization and individual levels simultaneously. At the organization level, assimilation is indicated by the extent of ERP coverage of business processes and degree of ERP usage for decision making; and at the individual level, assimilation is indicated by the degree of understanding of ERP systems and the ability to use ERP for non-routine tasks.

At the organizational level, the overwhelming majority of extant literature focus attention on finding the internal and external drivers or mediators to ERP assimilation (Liang et al., 2007; Ke and Wei, 2008; Wang, 2008; Chang et al., 2009; Seddon et al., 2010). By contrast, few scholars considered the role of individual users in ERP assimilation. Actually, individuals should be focused on because of the meaningful role played in IS success (Petter et al., 2008) and individual performance when using ERP systems (Kositanurit et al., 2006). Thus Liu et al. firstly defined individual level ERP assimilation as "the degree of cognitive understanding of ERP technology and the extent to which the technology is used beyond routine tasks by an individual user". He stated that individual level ERP assimilation is crucial for organizational level ERP assimilation and the success of ERP systems (Liu et al., 2011).

Through a multi-case study, Liu et al. (2011) suggested that according to the level of assimilation, ERP users can be categorized into transactional users, power users, and VIP users in a pyramid structure of the hierarchical model. Users who use the functionality of an ERP system only for routine tasks and have little knowledge about how the ERP system works system-wide belongs to shallow assimilation at the bottom of the pyramid hierarchical model (Liu et al., 2011). In contrast, deep assimilation is characterized by users who can use an ERP system in new and innovative ways and have intimate knowledge about the ERP system and its inner workings within an organization (Liu et al., 2011).

Additionally, Liu et al. (2011) proposed an individual level ERP assimilation model that identifies four key organizational and cognitive factors that drive users towards higher levels of the assimilate hierarchy, as well as two significant moderators to the impacts of the organizational and cognitive factors: drivers are influence of supervisors, performance evaluation schemes, intrinsic motivation, and perceived usefulness; two significant moderators are job specifications and individual absorptive capacity.

2.2   Individual interactive learning Context

In the context of the large-scale and complexity of ERP systems, individual users frequently encounter problems when assimilating ERP technology and using ERP systems (Robbin-Gioia, 2002). ERP systems are rich in features that impose considerable interpretive flexibility and challenge individual users(Jasperson et al. 2005; Orlikowski 1996).Thus companies adopt various formal processes and measures, such as providing training, operation manuals, IT help desk, to resolve users' questions, reduce knowledge barriers, and enhance assimilation abilities (Nah et al., 2001).

However, these formal processes and measure often fail to achieve desired outcomes for some critical reasons. For example training is one of the most pervasive approaches to enhance individual abilities within organizations (Gupta and Bostrom, 2013), but most knowledge explained in trainings is superficial and functional. Individuals can't master complex skills necessary for higher level ERP assimilation through trainings. In fact, our observations show that individuals frequently learn ERP technology through informal collaborative learning within organizations, learn to use ERP systems in a trial-and-error, improvised learning process (DeSanctis and Poole, 1994; Griffith, 1998). An employee may recommend a useful feature or a shortcut in an application discovered in her work to colleagues; or walks them through a complex process that the colleagues may not have known (Sykes et al., 2009).

Based on this observation, we propose that individual assimilation of ERP systems technology entails an interactive, improvised and informal learning process with different levels of users. Users within a company interact with each other, share information and knowledge, and collaboratively explore ERP systems for their tasks. Furthermore, we argue that individual interactive learning happens in social networks within organizational boundary.

2.3   Social Network Theory

The social network theory views social relationships between individuals in terms of nodes and ties (Wasserman and Faust, 1994). Nodes are the individual actors within the networks, and ties are the relationships between the actors. Different ties between individuals contribute to different networks. Such networks have been characterized into three dimensions: relational, structural and cognitive dimension (Lechner et al., 2010). The relational dimension refers to the content and quality of relationships/ties, including their frequency, degree of closeness etc. (Uzzi, 1996); the structural dimension reflects the position of individual actors relative to others in a network and the combination of direct and indirect ties surrounding actors (Zukin and DiMaggio, 1990); and the cognitive dimension describes the similarity between the interpretations, mental models, and worldviews of individuals (Tsai and Ghoshal, 1998). From this perspective, extant research has revealed that a network of social relationships/ties produces numerous outcomes like information benefits (Ibarra 1993a, 1993b; Walter et al., 2007), heightened control and power (Brass, 1984), more efficient knowledge transfer (Hansen, 1999; Tortoriello et al., 2012; Wei et al., 2011), better job performance (Mehra et al., 2006; Zou and Ingram, 2013) etc.

In the ERP assimilation phase, users mostly rely on each other to learn about the system and to resolve any problems that arise. This is in contrast to the ERP implementation phase in which users mainly seek help from ERP consultants. Thus in the ERP assimilation phase, the interactive learning behaviour based on the ties of the social networks formed by ERP users is much more significant in driving users towards higher assimilation levels. Extant social network literature suggests that social network ties like instrumental ties and expressive ties can transmit information and knowledge (Hansen, 1999; Tortoriello et al., 2012). If users encounter problems while using ERP systems, they can share information, learn new ERP knowledge, and solve the ERP problems through the ties with help from peers. The nature of the ties in these networks involving discretionary patterns of interaction may be work-related, social, or a combination of both (Galaskiewicz, 1979). In this study we focus on the social networks formed only by ERP users within the boundaries of an organization.

2.4   Our Concept Model

Liu et al. (2011) study individuals are assumed to be on their own when attempting to understand and use ERP systems, the widespread social interactions among the individual users are not considered in their assimilation model. And in IS literature, little research has focused on understanding the relationship between social networks and individual level ERP assimilation, which provides the motivation for this study to address the question that how social networks impact individual level ERP assimilation through interactive learning in organization.
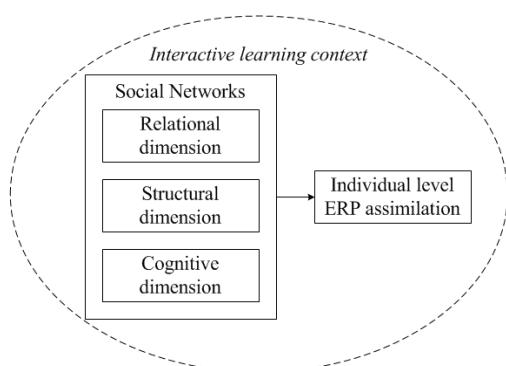

Figure 1.   *The research framework of social networks and individual level assimilation*

In this study, we attempt to address this issue by extending the work of Liu et al. (2011) to the context of organizations where extensive social networks exist among individual users and examine how the characteristics of such social networks influence user learning and eventually ERP assimilation at the individual level.

Basing on the three dimensions of social networks identified above, we propose a research framework describing social networks and individual level assimilation in the context of interactive learning, as depicted in Figure 1. The research framework directs our attention to the characteristics of social networks covering the three dimensions. This framework also guided us in designing our interview questions and the case study protocol. Additionally, the research framework provides potentially useful vocabulary to anchor our interpretation without straying to different directions (Sarker et al., 2012).

3 Case Study Design and Methodology

3.1 Multi-Case Study Design

"Case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigators have little control over events, and when the focus is on a contemporary phenomenon within some real-life context." (Yin, 1989) Hence, the exploratory case study methodology fit well with our purpose to understand the social network and individual level ERP assimilation. We followed the general guidelines for conducting positivist exploratory case studies (Paré, 2004; Yin, 1989). Based on an extensive literature research and brainstorming, a case study protocol was first developed that outlined the scope and objectives of the research, the nature of the research design, the characteristics of the target interviewees, firms, and industries, and the initial set of interview questions.

Company	Type of enterprise	Industry	Annual revenue (billion RMB)	Number of employees	ERP modules in use	ERP vendor	Used years
A	joint venture	medicine	3	1000	Finance, Assets	Oracle	2.5
B	overseas investment	refractory material	1.8	1200	Finance, Purchase, Sales, Inventory, Plant Assets, Manufacturing,	UFIDA	3
C	joint venture	passenger car	16	30000	FI/CO, SD, MM, PP, PS, PM, CS, QM, IS,PP	SAP	11
D	Privately owned	food	3.5	10000	SD, FI/CO, HR, PP	SAP	3
E	state-owned	petroleum	66.7	5000	FI/CO, MM, PS, PM	SAP	4

Table 1.   Profiles of the case companies

Because ERP systems in organizations vary significantly, in order to increase the reliability and generalizability for the findings, our multi-case design called for visiting companies that had successfully implemented ERP systems with various sizes and in different industries, representing a spectrum of ERP users both in organizational and individual terms. We wanted to be able to interview about 3-5 ERP users in each firm, from top executives, mid-level managers, to professional staff. Based on these criteria, the research team utilized the alumni network of a major Chinese university to identify candidate targets. After initial contacts with managers in these candidate firms, four companies in Zhengzhou and one company in Daqing were selected as the targets of this study based on ERP history, ERP vendor, company size and implemented ERP modules. The five companies all

had implemented several ERP modules like finance, inventory, and HR, and were assimilating ERP systems technology. Table 1 and 2 show the detail profiles of the selected five companies named by letters and interviewees.

Company	Number of Informants	Description of Informants
A	3	• Top managers: CEO • Middle-level managers: ERP project manager • ERP end users: a user from finance department
B	5	• Middle-level managers: IT supervisor, finance manager • ERP end users: a user from production management, a user from finance department, an intern from IT department
C	5	• Middle-level managers: information technology architect, manager of production plan module, manager of HR module, manager of CRM module • ERP end users: a user from finance department, an employee from IT department
D	4	• Top managers: CIO • Middle-level managers: finance manager, IT manager, ERP project manager
E	9	• ERP end users: three users from FI/CO module, two users from MM module, one user from PM, two users from PS module, one employee from IT department

Table 2.   Profiles of interviewees

3.2 Data Collection

Because our target companies located in different cities, and the visiting time permitted by companies are different, the data were collected in two different time periods. The first data collection took one week in July 2012. Our research team, consisting of four authors and three doctoral students, visited four companies in Zhengzhou, spent from half to one day at each site. With the agreement of every interviewee, all interviews were recorded using digital recorder for later transcription. In each location, the interviews were conducted with individuals separately that averagely lasted 43 minutes. In all, 17 employees participated in the interviews resulting in about 728 minutes of recording, and these recordings were transcribed by our research team into a document about 130 pages in Chinese. The second data collection took two days in December 2013. The research team including one author and one doctoral student, visited one company in Daqing, and interview 9 employees separately that yielded about 312 minutes of recording and a transcript about 70 pages in Chinese.

4 Case Analyses and Main Findings

4.1 Analyses Methodology

Construct	A	B	C	D	E	Construct	A	B	C	D	E	Construct	A	B	C	D	E
Age		√	√	√	√	Interactive learning	√	√	√	√	√	Tie strength	√	√	√	√	√
Position	√	√	√		√	Instrumental ties	√	√	√	√	√	External ties	√	√		√	√
Rank	√		√	√	√	Expressive ties			√	√	√	Centrality	√	√	√	√	√

Table 3.   Influence factors for individual level ERP assimilation

Based on social network theory, we created a list of characteristics of social networks, including shared goals, shared context, instrumental ties, expressive ties etc. Then we read the transcript word

for word, took careful analysis on each respondent's response, summarized the constructs appearing in the transcript, and ticked with a hook behind the list. The constructs we chose were mentioned by individual informants in most companied we visited. Table 3 showed the constructs with frequent appearances.

4.2 Main Findings

4.2.1 Individual Interactive Learning and Individual Level ERP Assimilation

Studies have shown that in the implementation phase of enterprise systems, users rely on other more skilled, knowledgeable and resourceful ERP consultants and employees to resolve puzzles through informal communications (Jasperson et al., 2005; Orlikowski, 1996). In the ERP assimilation phase, the consultants have left, and ERP users have to rely on each other to learn new ERP skills and solve ERP problems. Such interactive learning among ERP users is emergent and improvising but significant for users to assimilate ERP technology through learning by doing. ERP users seek help from peers, and during the process resolving puzzles and problems, resulting improved level of ERP assimilation. Thus we suspected that in the ERP assimilation phase, individual interactive learning would play a significant role. When we asked the question 'How do you obtain ERP knowledge in daily work?', most respondents answered that in contrast to training and self-study, they very much relied on learning through solving problems on the job. A user from Company A's finance department expressed this view:

I think direct communication and learning between individuals are more [important] than training. [Learning trough]QQ is about a quarter, training is about another quarter, and the remaining half is trough face to face communication.

A user from Company E's FI/CO module also confirmed the importance of individual interactive learning:

[In my company] there is no company-wide training, so we need to see the operational manuals or ask others directly. But for a novice user it's difficult to read and understand specialized words in the operational manuals. For example, if they see [the word] "key user", they may not know who the key user is.

The IT supervisor of Company B expressed similar views:

When I started to use this software, my first feeling was that if you don't directly manipulate the software, your understanding of the software isn't deep. The teacher just told you how to operate step by step during the training, you followed mechanically without your own understanding. So you had to learn from others to do your job or study by yourself.

Many interviewees voiced the similar thought that informal learning, especially individual interactive learning, is more meaningful than formal ways like trainings. Hence, we propose:

Proposition 1: *The individual interactive learning is significantly related to individual level ERP assimilation.*

4.2.2 Structural Dimension: Centrality

Centrality is a construct depicting the individual position within social networks (Wasserman and Faust, 1994). The person occupying the central position has the advantage of accessing to more useful information and resources (Krackhardt and Hanson, 1993), better system use (Sykes, 2009), higher

task impact and information quality (Sasidharan et al., 2012). And for the ERP users, a large social network can provide employees with increased access to other employees' knowledge of ERP systems, appreciation of their tasks, and ability to exchange much-indeed ERP skills (Ibarra and Andrews, 1993, Sasidharan et al., 2012). ERP users with large networks are more likely to keep abreast of different types of information that ERP systems provide. Centrality needs to be calculated by drawing social network diagrams (Wasserman and Faust, 1994). Although the multi-case study is not a quantitative research, we qualitatively observed the structure of social networks by asking the question 'Whom do you often seek for help when confronting ERP problems?'. From the case evidence, we discovered a trend reflecting the role of centrality. For the most frequently asked ERP users, they have large networks to learn a variety of knowledge about ERP systems, although they may already at high levels of ERP assimilation. A user from Company E's FI/CO module said:

In the practical work, I would like to ask [the peer's name], and most others also ask him. On one hand, he is a nice and helpful person; on the other hand, he is also one of the two most knowledgeable people about FI/CO module.

The user's statement was corroborated by the colleague she mentioned in above sentences:

For these new employees, I think they ask me more than others. They say that I'm comfortable to get along.

Such situations also existed in the other companies that users tend to intensively consult with only a few people. For example, a user from Company B's finance department said:

In our department, if there are problem, we all would like to ask [the person's name]. He is familiar with both the business process and ERP technology. If he can't solve them, we will submit our questions to the IT department staff.

Thus, we propose:

Proposition 2: *The individual that occupies the center of a social network has significant impact on the individual interactive learning network about ERP systems.*

4.2.3 Cognitive dimension: Homogeneity

In our analysis of the transcript about the answers to the question 'Why do you ask these persons for help?', some words frequently appear, like "*the same ages*", "*similar things*", and "*peers*" etc., that we characterize it as homogeneity. Brass (1995) noted that "similarity is thought to ease communication, increase predictability of behaviour, and foster trust and reciprocity". Homogeneity is on the basis of similarity in age, gender, education, tenure, occupation etc. (Ibarra, 1995; Leenders, 1996). Users who are similar to each other are more likely to communicate directly, as well as communicate frequently with each other (Zhang and Venkatesh, 2013), which creates more chances to resolve ERP problems, transfer ERP knowledge, and enhance interactive learning . Additionally, ERP information and knowledge are easier to transmit between users who have similar cognitive paradigms (Reagans and McEvily, 2003). And in our case interviews, there was plenty of evidence shown that homogeneity positively impacts individual learning in assimilating ERP technology. Table 4 summarizes some of the evidence.

Thus, we propose:

Proposition 3: *Homogeneity in age, position and rank among individual users facilitates interactive learning in assimilating ERP technology.*

Homogeneity	Typical Case Evidence
Age	• I mostly share ERP problems with my peers whose age is similar to me ….We are a group of young people, can easily play together, and get along well with each other (User, Company B, production management). • I have a junior partner, we always talk about ERP, we telephone each other every day. We have the same age. Both of us are born in 1980. When communicating with each other, we all know what the opposite side wants to say even before talking (User, Company E, ERP FI/CO model). • For these new employees, I think they ask me more than others. They say that I'm comfortable to get along; their ages are similar to mine, and they think older peers as elders, so they feel embarrassed to directly ask them (User, Company E, ERP FI/CO model).
Position	• Except asking IT support staff, I often asking other finance peers. We do the similar things, so if I have questions, my first thought is whether they have encountered the same questions or not (User, Company C, finance department). • I have a junior partner. We always talk about ERP, we telephone each other every day.…. He is also a cost accountant in another production team, his professional proficiency and expressive language skills are good (user, Company E, ERP FI/CO model).
Rank	• After I came here, I first learned ERP technology by looking at the operational manuals. If I have unknowns, I ask other peers… I never ask my leaders once. I think first he is a leader with many things to do; and second, he may not use ERP systems personally (Intern, Company C, IT department). • Of course I choose to ask my peers at the same level, the leaders are always busy and I feel distant from the leaders, so you can't freely ask questions (User, Company E, MM module).

Table 4.   Case evidence for homogeneity

4.2.4   Relational Dimension: Tie Content, Tie Strength, External Ties

We use the questions 'What do you think of the relation between you and the peer you consult? And how does the relation influence your learning from him/her?' to identify factors of the relational dimension. In our analyse of the case evidence, we found the words such as "*personal relation*", "*work relations*", "*close*", "*always*", that are spread all over the transcripts. Based on social network theory, they are descriptors of tie content (e.g. "*personal relation*", "*work relations*") and tie strength (e.g. "*close*", "*always*"). The ties between ERP users provide the foundation for individuals' interactive learning. Tie content and tie strength are often used to depict the relationship between individual actors simultaneously. Tie content means the relations linking individuals, and are classified into instrumental/work ties and expressive/friendship ties (Lincoln and Miller, 1979; Wu, 2013). Tie strength reflects the quality of ties, often distributed into strong and weak (Granovetter 1973; Krackhardt, 1992).

Extant literature states that instrumental ties are often work- related, and used to seek expertise, information (Lincoln and Miller, 1979); expressive ties are often friendship and affective based, and used to exchange trust, emotional support (Krackhardt, 1995). In our interviews, we found that some respondents considered instrumental ties as the ties connecting users' learning behaviours, while others regarded expressive ties as the linkage connecting users' learning behaviours. Thus we propose that both of instrumental and expressive ties are significant for individual ERP systems assimilation. A user from Company E's FI/CO module expressed this view:

I think personal relation is very important for my learning. Because if the two individuals are close, they can unreservedly talk and explain ERP technology in detail; but if they aren't close, the explanation could be awkward and without patience.

In his statement, "*personal relation*" can confirm the construct of expressive ties, and "*close*" depicts that the strength of expressive ties is strong. From the statement, we can conclude that the stronger the strength of expressive ties, the greater the impact on individual level ERP assimilation. His view was also confirmed by his colleague by saying like this:

Personal relation is more important to me. For example, I always ask and communicate with [his peer's name], we are good buddies. As long as I have questions, he will help me even if it may take a whole night. Sometimes his wife complained that he didn't care for his child because of taking time to help me.

A user from Company E's MM module also expressed similar opinion. She said:

I think personal relation is more important. Taking training for example, in my department there are five people participated in the training provided by the company. But during the training some colleagues didn't conscientiously listen to the teacher, they joked that they could ask me, so I should listen carefully to help them later. But the colleagues are not close to me, they had to study really hard. Maybe they felt uncomfortable to ask and trouble me.

But there are different voices on this opinion. They thought instrumental tie is important as well. A user from Company A's finance department expressed this different view:

The work relations are more important. We all want to complete the job quickly. So if I have doubts about ERP, I most often ask the colleagues closely related to my job. I put the job first. Whoever can help me resolve problems quickly, I will consult with them.

Here *"work relations"* means instrumental ties, and *"closely"* describes the strength of instrumental ties. We also can conclude that the stronger the strength of instrumental ties, the greater the impact on individual level ERP assimilation. A user from Company E's MM module held the similar opinions. She said:

The personal relation is not that important. It's not that I will ask the person who is close to me. Personally I first ask the person who is the nearest to me, If he/she doesn't know, I will then ask others. You see, we sit together, and do the similar things, asking them is the most convenient way to get the job done. Only if you complete your jobs, you can go home.

Tie strength is used to describe the quality of ties, which does not exist independently without tie content. If there are no relationships between users, tie strength doesn't exist either. The case evidence prove that tie content can facilitate interactive learning, and the stronger the strength of expressive and instrumental ties, the greater the impacts. We can conclude that tie strength is the moderator to individual interactive learning. Although in our interviews we did not differentiate which is more significantly related to individual level ERP assimilation between instrumental and expressive ties, we can, nevertheless, based on the case evidence, propose:

Proposition 4: *Both instrumental and expressive ties between individual users significantly facilitate individual interactive learning in assimilating ERP technology. Tie strength moderates the impact of tie content on interactive learning to assimilate ERP technology. The stronger the tie, the stronger the impact.*

External ties are another construct describing individual boundary spanning relations (Geletkanycz and Hambrick, 1997), and are linked to different information, resource advantage (Burt, 1992), and performance (Geletkanycz and Hambrick, 1997). In this study, we define the boundary as the ERP module used by individual users and the departments within an organization. If a user has relations with other users using different ERP modules or in different departments, we regard she has external ties. On the basis of the transcripts, we found external ties have a positive impact on individual level

ERP assimilation. The more external ties users have, the more variety of ERP knowledge they can learn. The ERP project manager from Company D said:

If you want to learn and know more about ERP, it's not enough to understand the technology about your own module. You should also know the ERP technology about the upstream and downstream business workflow. So in our company, we use the job rotation to make employees to know more.

Interviewees in Company E expressed similar views. For example, a user of FI/CO module said:

There indeed are differences between users. For example, the user today you will interview is proficient at ERP...He is the best user among the people who entered the company together. If he has ideas to extend his job to other modules, he contacts other modules' users. Now he even knows the PM module better than the PM module users, and some PM module users need his help.

Hence, we propose:

Proposition 5: *The more external ties related to ERP systems an individual user has, the higher the level the individual user reaches in assimilating ERP technology.*
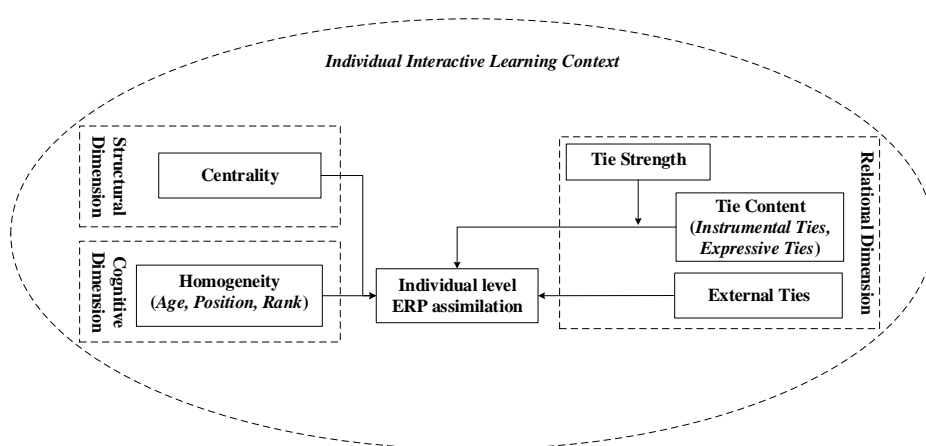

Figure 2.   The individual level ERP assimilation model from a social network perspective in the individual interactive learning context

The relationships between these factors and individual level ERP assimilation are depicted using the model shown in Figure 2. Homogeneity belongs to the cognitive dimension; centrality is part of the structural dimension; tie content, tie strength and external ties belong to the relational dimension. The model shows two important findings: ERP users learn from peers to reach higher ERP assimilation level; and the five influential factors in users' social networks play a significant role in individual interactive learning that facilitates individual level ERP assimilation.

5   Discussion

5.1   Theoretical Implications

From the theoretical perspective, this paper contributes to research in several ways. First, this study proposed that interactive learning is different from learning from consultants of vendors in the assimilation phase of ERP systems, and interactive learning is more meaningful than formal processes such as training in ERP assimilation. Specifically, we used social network theory to enrich our understanding of the impact of individual interactive learning on users' ERP assimilation. Second, the

study sheds light on how social networks are related to individual level ERP assimilation in the interactive learning context. By integrating social network theory into ERP assimilation literature, we open up the black box of interdependent social factors and individual interactive learning in affecting individual level ERP assimilation. The study describes a model for understanding the social network constructs' specific influence to individual level ERP assimilation. And we identified five key favourable factors from different dimensions of the social networks: homogeneity in cognitive dimension, tie content, tie strength, external ties in relational dimension and centrality in structural dimension. Third, this study extends the individual level ERP assimilation literature with a social network perspective. Liu et al. (2011) conducted one of the first studies about individual level ERP assimilation, but their study did not consider the social interactions occurring in daily work. In contrast, our study is based on the fact that users frequently rely on peers to help assimilate ERP technology through social networks. Lastly, this study identified social factors influencing individual level ERP assimilation. Although these factors already existed in social network literature, they are seldom mentioned in ERP assimilation literature, especially in individual level ERP assimilation research.

5.2 Managerial Implications

From the managerial perspective, this study offers some prescriptive guidance for managing and deepening individual level ERP assimilation. To users, our research informs those users who strive to enhance their ERP assimilation. Our study suggests that it's important that users are well connected in social networks because these networks provide channels for them to access valuable resources related ERP systems. Our study also indicates that the outcomes of learning between similar users are better than those between dissimilar users because communication and shared understanding more easily occur between the similar users. As managers, they must be aware that ERP knowledge acquisition not only occurs during training, but perhaps more significantly via interactive learning in social networks. They should pay more attention to the social context and structures in their organization. Managers should focus on the individual learning networks, foster stronger instrumental and expressive ties between users. And managers should provide more opportunities and give considerable time for employees to discuss, share knowledge and interact with other departments' peers, or users in different modules. Finally managers can utilize the individual learning network to identify who is in the central position by drawing the learning network diagram and then focus on the employees with high network centrality.

5.3 Limitations

While we believe our study makes contributions to the current theory of individual level ERP assimilation, we must qualify our finding with known limitations. First, the generalizability of our findings may be restricted by the limited number of firms and industries sampled in this study. Empirical studies with much broader participation and larger sample size are certainly needed to test and validate the findings and propositions of this study. Second, the analysis method we used is manual, labour intensive, and prone to inter-coder error, thus limits the reliability of our findings. Third, although we believe the individual interactive learning proposed in this study through our observation is more meaningful than training, we should notice that the interactive learning is also one type of learning. But theoretical basis about learning is insufficient in our study. Future study should take learning theory into consideration. Fourth, although we proposed that instrumental and expressive ties both are key social factors, this study didn't differentiate which is more significantly related to individual level ERP assimilation between instrumental and expressive ties. It would be interesting to conduct a multi-level empirical analysis to address this question. Fifth, as an exploratory study, we didn't collect quantitative social network data and couldn't draw the network diagrams to verify the validity of some of our findings. Finaly, our study was based on the *a priori* theory of social network to guide our research, which may have excluded other factors that influence individual interactive

learning and ERP assimilation, such as the concept "guanxi" that is a unique type of personal connections in Chinese culture (Gold et al., 2002).

6 Conclusions

Using social network theory as a theoretical lens, we adopted a multiple case study design to conduct interviews with top managers, middle-level managers, and frontline ERP users at five companies to explore the relationships between social networks and individual level ERP assimilation. We found five key factors that have positive impacts on individual level assimilation, namely, homogeneity (age, position and rank), tie content (instrumental and expressive ties), tie strength, external ties, and centrality. The model proposed in this study describes influencing mechanisms of social networks on individual level ERP assimilation. The study proposes that the individual interactive learning is different from learning from consultants, and that the former is more impactful to ERP assimilation than that the later. The study calls for more attention to the impact of social networks formed by users on individual level ERP assimilation within organizational boundaries.

Acknowledgement

References

Markus, M. L. and Tanis, C. (2000). The enterprise systems experience–from adoption to success. Framing the Domains of IT Research: Glimpsing the Future through the Past, 173-207.

Davenport, T. H. (1998). Putting the Enterprise into the Enterprise System. Harvard Business Review, July-August, 121-131.

Fichman, R. G. and Kemerer, C. F. (1999). The illusory diffusion of innovation: An examination of assimilation gaps. Information Systems Research, 10(3), 255-275.

Jasperson, J. S., Carter, P. E. and Zmud, R. W. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. MIS Quarterly, 29(3), 525-557.

Purvis, R. L., Sambamurthy, V. and Zmud, R. W. (2001). The assimilation of knowledge platforms in organizations: An empirical investigation. Organization Science, 12(2), 117-135.

Robey, D., Ross, J. W. and Boudreau, M. C. (2002). Learning to implement enterprise systems: an exploratory study of the dialectics of change. Journal of Management Information Systems, 19(1), 17-46.

Xue, Y., Liang, H., Boulton, W. R. and Snyder, C. A. (2005). ERP implementation failures in China: case studies with implications for ERP vendors. International Journal of Production Economics, 97(3), 279-295.

Swanson, E. B. and Ramiller, N. C. (2004). Innovating mindfully with information technology. MIS Quarterly, 28(4), 553-583.

Wu, I.-L. and Chuang, C.-H. (2010). Examining the diffusion of electronic supply chain management with external antecedents and firm performance: A multi-stage analysis. Decision Support Systems, 50, 103-115.

Liang, H. G., Saraf, N., Hu, Q. and Xue, Y. J. (2007). Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. MIS Quarterly. 31(1), 59-87.

Ke, W. L. and Wei, K. K. (2008). Organizational culture and leadership in ERP implementation. Decision Support Systems. 45(2), 208–218.

Min, H. T., Chou, S. W. and Chang, Y. C. (2011). Examining The Factors That Affect ERP Assimilation. PACIS 2011 Proceedings, Paper 133.

Liu, L., Feng, Y., Hu, Q. and Huang, X. (2011). From transactional user to VIP: how organizational and cognitive factors affect ERP assimilation at individual level. European Journal of Information Systems, 20(2), 186-200.

Boudreau, M. C. and Robey, D. (2005). Enacting integrated information technology: A human agency perspective. Organization Science, 16(1), 3-18.

Bruque, S., Moyano, J. and Eisenberg, J. (2008). Individual adaptation to IT-induced change: The role of social networks. Journal of Management Information Systems, 25(3), 177-206.

Montazemi, A. R., Siam, J. J. and Esfahanipour, A. (2008). Effect of network relations on the adoption of electronic trading systems. Journal of Management Information Systems, 25(1), 233-266.

Sykes, T. A., Venkatesh, V. and Gosain, S. (2009). Model of acceptance with peer support: A social network perspective to understand employees' system use. MIS Quarterly, 33(2), 371-393.

Sasidharan, S., Santhanam, R., Brass, D. J. and Sambamurthy, V. (2012). The Effects of Social Network Structure on Enterprise Systems Success: A Longitudinal Multilevel Analysis. Information Systems Research, 23(3), 658-678.

Zhang, X. J. and V. Venkatesh (2013). Explaining Employee Job Performance：The Role of Online and Offline Workplace Communication Networks. MIS Quarterly. 37(3), 695-722.

Sykes, T. A., V. Venkatesh and J. L. Johnson (2014). Enterprise System Implementation and Employee Job Performance: Understanding the Role of Advice Networks. MIS Quarterly. 38(1), 51-72.

Yin, R. K. (2003). Case study research: Design and methods. Sage, Thousand Oaks, CA.

Paré, G. (2004). Investigating information systems with positivist case research. Communications of the Association for Information Systems, 13(1), 233–264.

Wang, P. (2008). Assimilating IT Innovation: The Longitudinal Effects of Institutionalization and Resource Dependence. ICIS 2008 Proceedings, Paper 21.

Chang, K.C., Kettinger, W.J. and Zhang, C. (2009). Assimilation of Enterprise Systems: The Mediating Role of Information Integration of Information Impact. ICIS 2009 Proceedings, Paper 90.

Seddon, P. B., Calvert, C. and Yang, S. (2010). A multi-project model of key factors affecting organizational benefits from enterprise systems. MIS Quarterly, 34(2), 305-328.

Petter, S., Delone, W. and Mclean, E. (2008) Measuring information systems success: models, dimensions, measures, and interrelationships. European Journal of Information Systems, 17(3), 236–263.

Kositanurit, B., Ngwenyama, O. and Osei-Bryson, K. M. (2006). An exploration of factors that impact individual performance in an ERP environment: an analysis using multiple analytical techniques. European Journal of Information Systems, 15(6), 556-568.

Robbins-Gioia. (2002). Accessed May 2010, Press-releases. http://www.robbinsgioia.com/news_events/012802_erp.aspx.

Orlikowski, W. J. (1996). Improvising organizational transformation over time: A situated change perspective. Information Systems Research, 7(1), 63-92.

Nah, F. F. H., Lau, J. L. S. and Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. Business Process Management Journal, 7(3), 285-296.

Gupta, S. and Bostrom, R. (2013). An Investigation of the Appropriation of Technology-Mediated Training Methods Incorporating Enactive and Collaborative Learning. Information Systems Research, 24(2), 454-469.

DeSanctis, G. and Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. Organization Science, 5(2), 121-147.

Griffith, T. L. (1999). Technology features as triggers for sensemaking. Academy of Management Review, 24(3), 472-488.

Wasserman, S. and Faust, F. (1994). Social network analysis: Methods and applications. Cambridge University Press, New York.

Lechner, C., Frankenberger, K. and Floyd, S. W. (2010). Task contingencies in the curvilinear relationships between intergroup networks and initiative performance. Academy of Management Journal, 53(4), 865-889.

Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. American Sociological Review, 674-698.

Zukin, S. and DiMaggio, P. (Eds.). (1990). Structures of capital: The social organization of the economy. Cambridge University Press, New York.

Tsai, W. and Ghoshal, S. (1998). Social capital and value creation: The role of intrafirm networks. Academy of Management Journal, 41(4), 464-476.

Ibarra, H. (1993a). Network centrality, power, and innovation involvement: Determinants of technical and administrative roles. Academy of Management Journal, 36(3), 471-501.

Ibarra, H. (1993b). Personal networks of women and minorities in management: A conceptual framework. Academy of Management Review, 18(1), 56-87.

Walter, J., Lechner, C. and Kellermanns, F.W. (2007). Knowledge transfer between and within alliance partners: private versus collective benefits of social capital. Journal of Business Research, 60(7), 698–710.

Brass, D. J. (1984). Being in the right place: A structural analysis of individual influence in an organization. Administrative Science Quarterly, 518-539.

Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. Administrative Science Quarterly, 44(1), 82-111.

Tortoriello, M., Reagans, R. and McEvily, B. (2012). Bridging the knowledge gap: The influence of strong ties, network cohesion, and network range on the transfer of knowledge between organizational units. Organization Science, 23(4), 1024-1039.

Wei, J., Zheng, W. and Zhang, M. (2011). Social capital and knowledge transfer: A multi-level analysis. human relations, 64(11), 1401-1423.

Mehra, A., Dixon, A. L., Brass, D. J. and Robertson, B. (2006). The social network ties of group leaders: Implications for group performance and leader reputation. Organization Science, 17(1), 64-79.

Zou, X. and Ingram, P. (2013). Bonds and boundaries: Network structure, organizational boundaries, and job performance. Organizational Behavior and Human Decision Processes, 120(1), 98-109.

Galaskiewicz, J. (1979). Exchange Networks and Community Politics. Beverly Hills, CA: Sage Publications.

Sarker, S., Sarker, S., Sahaym, A. and Bjørn-Andersen, N. (2012). Exploring Value Co-Creation in Relationships between an ERP Vendor and Its Partners: A Revelatory Case Study. MIS Quarterly, 36(1), 317-338.

Yin, R. K. (1989). Case Study Research: Design and Methods. Newbury Park, CA: SAGE Publications.

Krackhardt, D. and Hanson, J. R. (1993). Informal networks. Harvard Business Review, 71, 104-11.

Ibarra, H. and S. Andrews. (1993). Power, social-influence, and sense making—Effects of network centrality and proximity on employee perceptions. Administrative Science Quarterly, 38(2), 277–303.

Brass, D. J. (1995). A social network perspective on human resources management. Research in Personnel and Human Resources Management, 13(1), 39-79.

Ibarra, H. (1995). Race, opportunity, and diversity of social circles in managerial networks. Academy of Management Journal, 38(3), 673-703.

Leenders, R. T. A. (1996). Evolution of friendship and best friendship choices. Journal of Mathematical Sociology, 21(1-2), 133-148.

Reagans, R. and McEvily, B. (2003). Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. Administrative Science Quarterly, 48(2), 240-267.

Lincoln, J. R. and Miller, J. (1979). Work and friendship ties in organizations: A comparative analysis of relation networks. Administrative Science Quarterly, 24, 181-199.

Wu, L. (2013). Social network effects on productivity and job security: Evidence from the adoption of a social networking tool. Information Systems Research, 24(1), 30-51.

Granovetter, M. S. (1973). The strength of weak ties. American Journal of Sociology, 78(6), 1360-1380.

Krackhardt, D. (1992). The strength of strong ties: The importance of philos in organizations. Networks and Organizations: Structure, Form, and Action, 216-239.

Krackhardt, D. (1995). Entrepreneurial opportunities in an entrepreneurial firm: A structural approach. Entrepreneurship Theory and Practice, 19, 53-70.

Geletkanycz, M. A. and Hambrick, D. C. (1997). The external ties of top executives: Implications for strategic choice and performance. Administrative Science Quarterly, 42, 654–681.

Burt, R. S. (1992). Structural holes: The social structure of competition. MA: Harvard University Press, Cambridge.

Gold, T., Guthrie, D., & Wank, D. L. (2002). An Introduction to the Study of Guanxi. In T. Gold, D. Guthrie & D. L. Wank (Eds.), Social Connections in China: Institutions, Culture, and the Changing Nature of Guanxi (pp. 3-20). Cambridge, UK: Cambridge University Press.