ERP as an organizational innovation: key users and cross-boundary knowledge management

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Abstract

Purpose – *The purpose of this study is to provide more insight in the ways key users act as knowledge managers and boundary spanners during the enterprise resource planning (ERP) system usage phase. Despite the recognized importance of key users during the implementation phase of an ERP system, little is known about their role in the ERP usage phase.*

Design/methodology/approach – *To provide rich insight in the boundary-spanning mechanisms utilized by key users to share knowledge, a qualitative approach was applied. In this study, "abductive" theme coding for 58 interviews with key users, end-users and managers has been used. This paper found six mechanisms and characterized them as "crossing" structural, social or cognitive boundaries.*

Findings – *Six boundary-spanning mechanisms have been distinguished which have been applied by key users to overcome several knowledge management issues. Subsequently, these mechanisms lead to a model which describes three different roles that key users may fulfill to efficiently share and transfer knowledge during the ERP usage phase.*

Research limitations/implications – *Knowledge barriers during an ERP implementation and their accompanying six boundary-crossing mechanisms have been distinguished.*

Practical implications – *The recognition of the essential role that key users can fulfill during the usage phase of an ERP system is an important implication. Management has to take into account that tasks and responsibilities of key users have to be clear from the start and they may cautiously select employees who are suited to become key users.*

Originality/value – *The main contribution is the importance of the impact of key users on the effectivity of knowledge management during the ERP usage phase.*

Keywords *Information systems, Knowledge management, Boundary spanning, ERP systems, ERP usage, Key users*

Paper type *Research paper*

Introduction

The objective of the article is to provide more insight in how key users can act as knowledge managers and boundary spanners in organizations that have implemented an enterprise resource planning (ERP) system. The role of key users offers organizations an opportunity to organize their information technology (IT)-induced innovations. In IT innovation projects, this role complements the roles of managers (initiating and enthusing project efforts), project teams (focused on technology and implementation), external consultants, and "common users" (Yin *et al.*, 2011). In an ERP system, all necessary business functions such as financial, manufacturing, human resources, distribution and order management are tightly integrated into a single system with a shared database (Karimi *et al.*, 2007). Unlike simpler systems that may only affect an individual or a small work group, an ERP system has organization-wide effects (Volkoff *et al.*, 2007). Therefore, such a system is a critical infrastructure in organizations. It potentially allows firms to manage their integrated business processes and associated knowledge and have more control of information and data in the organization. However, even if an ERP system is implemented successfully, this does not automatically mean that the organization will reap the full benefits. The use of such

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systems is knowledge-intense and requires high levels of knowledge absorption and knowledge sharing among organizational members (Vandaie, 2008). Therefore, the focus in this article is on the phase that follows after implementation: the ERP usage phase.

Prior research recognizes the importance of various stakeholder groups in successful ERP implementations, such as top management, consultants and end-users (Hwang, 2005; Lech, 2011; Liang *et al.*, 2007). However, key users are often overlooked as an important group of stakeholders (Pan and Mao, 2013). Key users are users of the system who in addition are formally assigned to support other users in the immediate work environment and who, to this end, liaise with organizational and/or external specialists. Key users typically are experts of business processes and act as educators, trainers, advisors and change agents (Wu and Wang, 2007). Their role before, during and after the implementation of an ERP system regarding effective knowledge transfer, influences the successful functioning of an ERP system (Nonino *et al.*, 2015). Yet, their specific role in post-implementation has been under-researched so far.

Due to their integrative nature, ERP systems involve multiple business units and ERP knowledge has to flow across their organizational boundaries. Boundaries refer to a demarcation line between an organization or a business unit and its environment. Knowledge can be created by combining knowledge across boundaries, but boundaries may also hinder knowledge flow (Sturdy *et al.*, 2009). Volkoff *et al.* (2007) suggest that key users function as boundary spanners who can cross boundaries and support other stakeholders to overcome organizational boundaries. However, how key users apply mechanisms to disseminate and integrate different types of knowledge when the system is in use is remotely unknown (Pan and Mao, 2013).

As mentioned, the objective of the article is to provide more insight in how key users can act as knowledge managers and boundary spanners. Moreover, key users apply boundary-crossing mechanisms to support stakeholders to receive the promised benefits of ERP. First, this article elaborates on the theoretical framework pertaining to system usage phases, intra-organizational knowledge transfer and boundary spanning by key users. Subsequently, the case study methods and the research site, a large-scale public sector organization in The Netherlands, are discussed. Based on the findings of this study, six boundary-crossing mechanisms and three essential key user roles are discerned. Finally, the implications for further theorizing, practice and future research directions are indicated.

Theoretical framework

Previous studies on the enterprise resource planning implementation and usage

In general, the ERP implementation and usage are well-researched domains. ERP represents a major organizational innovation launched for its integrating capabilities since the late 1990s (Markus *et al.*, 2000; Scott and Vessey, 1999). Previous studies have aimed at unpacking the determinants of beneficial use of the ERP systems, ranging from "one-shot" cross-sectional measurements to longitudinal case studies. These earlier studies have revealed, among others, the importance of the style and pacing of implementation (Motwani *et al.*, 2002), the impact of the organization's size (Buonnano *et al.*, 2005) and the implementation status of the various system modules (Madapusi and D'Souza, 2012), as well as the influence of technical resources, the organizational fit

between system and organizational practices, the extent of the implementation and the degree of managerial flexibility (Nwankpa, 2015).

More specifically, a number of studies have uncovered the importance of knowledge management practices for organizational IT innovations (Lech, 2014; Soto-Acosta *et al.*, 2014a, 2014b). This line of research also applies to implementing enterprise systems, i.e. achieving optimal use of the ERP systems. Chan and Rosemann (2001) identified five different types of knowledge that are essential for the successful use of the ERP systems: business knowledge, technical knowledge, product knowledge, company-specific knowledge and project knowledge (Chan and Rosemann, 2001; Soja, 2015). However, these kinds of knowledge become only gradually available, and they are dispersed throughout the organization (Becker, 2002). Knowledge integration throughout the organization is, therefore, unequivocally needed. In this connection, Nwankpa (2015) showed the moderating influence of knowledge integration mechanisms, such as communication, documenting and experimentation. Chou *et al.* (2014) pointed at the significance of knowledge sharing in facilitating the ERP system usage after the ERP implementation (Chou *et al.*, 2014). Knowledge sharing in their study turned out to be influenced by a number of psychological and sociological characteristics of users, such as intrinsic motivation, self-efficacy and the social capital users have, particularly in whom they trust.

Remus (2012) highlighted knowledge management challenges that come along with the implementation and use of the ERP systems, such as insufficient capture of process and legacy knowledge in the past, difficulties in knowledge integration and training processes and the impact of (disruptive) external factors at the strategic business level (e.g. acquisitions) (Remus, 2012). As to the implementation style again, Majchrzak *et al.* (2012) pointed at the importance of transcending knowledge differences in cross-functional teams instead of highlighting, deeply understanding and finally traversing each other's knowledge differences (Majchrzak *et al.*, 2012). The latter approach may cause a waste of time and hamper the quality of team relations.

Closer to this study of key users is the article authored by Pawlowski and Robey (2004), on knowledge brokering by IT professionals. This brokering is conditioned by technical and structural features related to the division of work and boundaries in an organization, created by decentralization and federalization in the organization (Pawlowski and Robey, 2004). Additionally, Ko *et al.* (2005) and Coelho *et al.* (2015) have pointed at the role of consultants in the implementation process (Coelho *et al.*, 2015; Ko *et al.*, 2005), whereas Liang *et al.*, (2007) underlined the importance of institutional pressure and the mediating role of top management in implementing enterprise systems (Liang *et al.*, 2007).

Taking all this together, there is a large supply of studies that have shed light on the antecedents of successfully using the ERP systems. However, the role of key users has not been researched explicitly before. This study aims to find out how key users apply mechanisms to disseminate and integrate different types of knowledge when the system is in use.

Enterprise resource planning usage phases

As known, the lifecycle of an ERP system passes through several phases, starting with the chartering of the project and the implementation – configuration and roll-out – of the ERP

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> **"The recognition of the essential role that key users can fulfill during the usage phase of ERP systems is the most important implication for practice."**

system (Markus and Tanis, 2000; Markus *et al.*, 2000; Nonino *et al.*, 2015). These phases are undeniably important for the ERP system and are initial milestones of ERP success (Ng *et al.*, 2009; Remus, 2012). However, the usage phase (also referred to as the post-implementation phase) is critical for organizations to obtain the benefits of ERP and realize returns on investment. The usage phase refers to the moment when the implementation project team passes the ERP system on to the regular IT unit. At the same time, the organization becomes familiar with the system, usually implying huge investments in training and supporting users. After this phase, the ERP system is fully in use and the organization is mainly occupied with supportive actions like maintaining and upgrading the system and user support.

Managing an ERP system is a knowledge-intensive task that necessarily draws upon the experience of a wide range of people with diverse knowledge capabilities. For organizations implementing such a knowledge-intensive information system, an important challenge is how they integrate the various types of knowledge (Chan and Rosemann, 2001). As said, it is assumed that key users play an important role in connecting experts and dispersing knowledge (Wu and Wang, 2007), but it is still unclear to what extent they act as boundary spanners and how they structure their role to facilitate knowledge transfer.

Intra-organizational knowledge transfer

Although key users are likely to have a number of different tasks, the focus in their work lies on the transfer of knowledge within and between business units in the organization. Knowledge transfer is a dyadic exchange, whereby a recipient is affected by the experience of a source (Costa *et al.*, 2015; Hung *et al.*, 2012; Majchrzak *et al.*, 2012). Knowledge is transferred when a knowledge reservoir – embedded in a person, tool, task, technique or network of these elements – is moved from one group to another, when an existing reservoir of the recipient is modified (Reagans *et al.*, 2015), or – even better – when knowledge differences between various groups of users are transcended (Majchrzak *et al.*, 2012). The literature has been motivated by the practical difficulty of transferring new practices (e.g. the ERP system procedures) between similar units in the same organization (Andersson *et al.*, 2015; Hsu and Chang, 2014). This includes the sharing of business and software knowledge with stakeholders, like end-users, middle management and other key users.

To understand the mechanisms that key users apply to fulfill their role effectively, more insight is needed in the knowledge barriers they have to overcome. Knowledge management literature, drawing on the theory of "internal stickiness", is important in this regard (Costa *et al.*, 2015). Szulanski (1996) proposed that intra-organizational knowledge transfer is inhibited by factors other than a lack of incentive; these factors are referred to as providing 'internal stickiness' (Szulanski, 1996). How well knowledge about best practices remains broadly accessible within an organization depends upon the nature of that knowledge, from where (or whom) it comes, who it gets and the organizational context within which any transfer occurs. The significance of this model (Szulanski, 1996) is the identification of these knowledge barriers in four categories: the knowledge transferred, the knowledge source, the knowledge recipient and the transfer context.

The successful transfer of knowledge begins by assessing origins of transfer difficulty and then selecting mechanisms to overcome the most significant barriers (Ko, 2014). Although

previous studies underline the complexity of knowledge transfer in an ERP context, they only recently have started to indicate mechanisms for examining these barriers and addressing it (Remus, 2012; Soja, 2015). Key users are assumed to play an essential role in the formation of mechanisms during the ERP usage phase and that they are able to support the organization to overcome knowledge barriers that may hinder the transfer of ERP-related knowledge within and between business units.

Boundary spanning

When considering what hinders effective knowledge transfer between actors across different domains and specializations, researchers have stressed the role of organizational boundaries (Farjoun *et al.*, 2015). Organizational boundaries may appear in tangible forms, as reflected in organizational charts and scope of governance and authorities. However, behind the tangible boundaries are invisible deeper boundaries including cognitive and interest differences between the parties on opposite sides of a boundary. In this sense, organizational boundaries have been considered to be a composite object consisting of three dimensions: structural, cognitive and social boundaries (Drori *et al.*, 2013).

Structural boundaries represent not only material partitioning such as the organization's infrastructural built-up and organizational structure, but also formal and informal regulations and rules that shape the interactions among organizational members and their interactions with the environment in the execution of tasks and discretion in the use of resources (Hernes, 2004). Structural boundaries are also made up by electronic means, regulating who has and does not have access to certain electronic domains, such as authorizations in an ERP system (Pawlowski and Robey, 2004). The presence of structural boundaries secures stability and predictability of organizational performance on one hand, whereas it creates geographical, functional and responsibility differences between and within organization units on the other hand, hindering the flow of knowledge (Sturdy *et al.*, 2009). These kinds of boundaries tend to be tangible and erected for instrumental purposes, although symbolic effects are also important (Pan and Mao, 2013).

Social boundaries arise from group members' identification with their own sub-group and rejection of other sub-groups. They refer to differences in organization members' identity and interests, largely given by the social bonding between people (Akkerman and Bakker, 2011). Social boundaries are likely to be reflected in social dynamics pertaining to loyalty, trust, identity and norms (Chou *et al.*, 2014). The presence of social boundaries leads to different attitudes of employees toward knowledge. Social boundaries also imply different interests on different sides, i.e., knowledge discovery on one side could have a negative effect on another, which is considered a pragmatic boundary (Carlile, 2004). Differences in interests may cause unwillingness to share knowledge.

Cognitive boundaries refer to differences in ideas, understandings and beliefs that guide organizational actions. These differences can render a meaningful explanation of a phenomenon in one organization or business unit completely meaningless in another one (Hara and Fichman, 2014). Drawing mental boundaries forms part of how individuals make sense of the world. The cognitive boundary concept is similar to terms like "cognitive distance" and "semantic boundary" (Abraham *et al.*, 2015; Kotlarsky *et al.*, 2015). Large cognitive distance between two parties may give rise to barriers to communication and

"This study indicates that the important contribution of key users does not end after the implementation phase, but that it continues after the system is in place as well."

shared understanding, and may hinder the extent to which different groups may transfer knowledge to one another (Sturdy *et al.*, 2009).

Key user role

As mentioned previously, many organizations appoint key users to support the implementation team. In most cases, key users (also super users or power users) are selected from the operating department and user groups (Mahdavian and Mostajeran, 2013). They tend to be familiar with business processes and have domain knowledge of their areas (e.g. logistics and finance), as most of the key users also fulfill their on-going business roles. After the implementation, key users return to their departments as resident ERP experts and can act as "internal consultants" in managing the ERP system. Key users specialize in parts of the ERP system and act as trainers, help-desk resources, educators, advisors and change agents (Lorenzo *et al.*, 2012; Wu and Wang, 2007). To function effectively, key users are expected to have in-depth knowledge of a number of knowledge dimensions; they have an important role in bridging the gap between end-users and higher management (Lech, 2014; Wu and Wang, 2007). Both users and managers depend on the knowledge of the key users about business processes and the ERP system itself.

Despite their assumed importance in organizations, the role of key users has been underexposed in the literature. According to Ko *et al.* (2005), key users are mediators of bringing external knowledge into the internal organization (Ko *et al.*, 2005). In most of the research focusing on knowledge transfer, key-users are seen as students learning from consultants. Still, some studies have acknowledged a more active role for key users. For instance, researchers pointed at the (content of the) interaction patterns that key users display to foster knowledge transfer when an organization implements an ERP system (Xu and Ma, 2008). Key users are said to know more about the technical operation of the system than IT developers and more about the value of the system in their own business context than consultants. Similarly, Jones *et al.* (2006) indicate that key users share knowledge with other key users and organizational members (Jones *et al.*, 2006). Key users not only help end-users to learn to use software, but also how to adapt their work processes. Yet, so far, studies on how key users fulfill this role during the usage phase have remained fragmented (Santhanam *et al.*, 2007). Therefore, this study intends to provide more insight in how key users – as a special category of information technology professionals in general (Pawlowski and Robey, 2004) – apply boundary-crossing mechanisms to overcome knowledge barriers and structure their roles.

Methodology

Case background

This study has been conducted in a large public sector organization at the national level in The Netherlands. The organization employs about 55,000 employees distributed over seven business units that work with the ERP system. The main objective of the ERP system was aimed at integration and standardization of financial and material-logistic processes. As such, this sizable organization confirms to what large organizations in general aim to do with such systems (Buonnano *et al.*, 2005). The implementation of the system was initiated to replace 35 standalone information systems by one integrated software package, but also to standardize business processes involving multiple business units. The organization is ideally suited for this study, as it is a revelatory case for several reasons (Eisenhardt and Graebner, 2007). Due to the public and varied nature of the organization, a wide range of organizational boundaries were involved. Moreover, the organization is sizable and geographically dispersed, having a multi-divisional structure. This made barriers for cross-boundary knowledge transfer prominent. Additionally, there was a sense of urgency in implementing and using the system properly since the organization's managerial processes have met with outside criticism concerning the organization's efficiency for a

number of years. Finally, previous research in this type of organizations has not been abundant.

Interviews with employees of all the business units of the organization were conducted, to grasp a broad view of how the key users worked throughout the organization. The business units studied in this paper were responsible for material management and logistics and the employees (users and key users) had been using the ERP system for over a year at the start of the study. Typical business processes completed by the users include the maintenance of high-tech equipment, practicing with the equipment and performing tasks related to logistical processes (warehousing and configuration management). At the time of this study's fieldwork, around 6,000 employees worked with the ERP system, with a total of 300 key users. The job description of the key users included supporting, training, educating and helping the end-users. However, the organization also expected key users to act as advisors for their managerial supervisors.

Sample and data collection

Due to the complex nature of an ERP system in the usage phase, there was a need for rich and contextual data. Therefore, the case study method was found to be appropriate in this research setting since the "understanding of the phenomenon needs to be holistic, comprehensive and contextualized" (Ritchie and Lewis, 2003, p. 52). Data for this study have been collected through semi-structured interviews and observations. In the first step of data collection, two semi-structured interviews with a strategic advisor of the ERP system and the former project manager of the ERP implementation were conducted to gain information concerning the content, aims and structure of the ERP system.

Second, 58 semi-structured, in-depth interviews with key users, managers and end-users were conducted. Table I shows an overview of the respondents. The average length of an interview was about 80 min. The interviews have been conducted in three phases during 2012 and 2013. The interviews have been conducted working together with two graduate students as a team effort. During the first phase (January 2012), the ERP system had been "live" for over a year. Along the subsequent phases (September 2012 and May 2013), the way key users developed mechanisms to overcome most of the knowledge barriers encountered during the first phases could be charted.

Each interview started with the respondents' background and overview of their role in the ERP system. Four main topics were specified for each interview, based on the knowledge barriers as originally proposed by Szulanski (Harvey *et al.*, 2015; Quereshi and Evans, 2015). This included reflections on the respondents' role as a key user, looking at how the organizational characteristics enabled them in their role and what kind of tasks and responsibilities they had as a key user. Next to that, key users were asked about their reflections on what kind of knowledge they transferred and how they absorbed it. Examples of this topic included questions about ERP training and their interactions with superiors, key users and end-users. The last main topic reflected upon the key users and the ERP system in detail. Questions pertained to how key users work with the system and what kind of knowledge-related issues with the ERP system they perceived to occur during their daily work tasks.

To get a broader overview of the key users' context, managers and end-users of the ERP system were included in the sample. Their perspective on the role of key users was probed

Table I Interviews: overview of the sample

Unit	*Key users*	*Managers*	*End users*	*Total per phase*
Phase 1 (January 2012)	12	3	3	18
Phase 2 (September 2012)	15	3	3	21
Phase 3 (May 2013)	13	3	3	19
Total	40	9	9	$n = 58$

for, including how they interacted with them. This also included assessment of their roles in terms of their activities and behaviors. Due to the size of the organization, the selection of interviewees resulted from snowball sampling. The fieldwork started at the different units with a number of initial interviews, and after figuring out the structure of the unit, other key users were selected (managers or end-users) for the interview. To triangulate and enrich the interview data, organizational memos and documents about the ERP system were studied (Yin, 2013). All interviews have been recorded and transcribed and were coded subsequently.

Data analysis

Data analysis of the interviews can be described as "abductive" (Richardson and Kramer, 2006), which is a procedure in-between inductive and deductive research analysis. Existing theoretical ideas can contribute "to a meaningful story of the phenomena under study by the mechanism of abductive inferences" (Richardson and Kramer, 2006, p. 497). A framework consisting of theoretical notions on intra-organizational boundary spanning in combination with the theory on "internal stickiness" occupied a central role during the analysis of the data (Costa *et al.*, 2015).

Interaction with the data followed the theme coding approach by Gioia and Thomas (1996). During the phase of open coding, the data were categorized by grouping them in lists of concepts (Gioia and Thomas, 1996). Coding involved extensive tagging for each segment (one or several related sentences) of interview data, using the informants' wording. Qualitative software (MaxQDA) was used to tag the sentences and group them under a specific concept.

Second, these initial first-order concepts were identified, based on concepts from the first phase by comparing similar sentences and segments of data. Comparisons were made constantly among different and similar wordings by different informants to identify patterns of first-order concepts (Gioia and Thomas, 1996). The resulting first-order concepts were key words frequently mentioned by the informants (Bryman and Bell, 2015). The first-order concepts were ordered by placing them in a framework, which included the different types of knowledge boundaries following Szulanski (1996).

After all the first-order concepts were classified in the framework, the relationships among the different knowledge barriers have been interpreted (first-order concepts) and categorized into groups. Each group became a second-order theme (Bryman and Bell, 2015), which was a mechanism resulting out of the first-order concepts, and was given a label in relation to its theoretical underpinning. For example, the first-order concepts, "Training is too theoretical and abstract", "Hard to apply knowledge in work context" and "Education is too general", share a common theme, which is the role of local context in training users. As a reaction, key users started to develop a mechanism to overcome these knowledge barriers. Therefore, these first-order concepts were aggregated to a second-order concept named "Practical Learning Environment". In Table II, some examples of first- and second-order concepts and their corresponding quotes are illustrated.

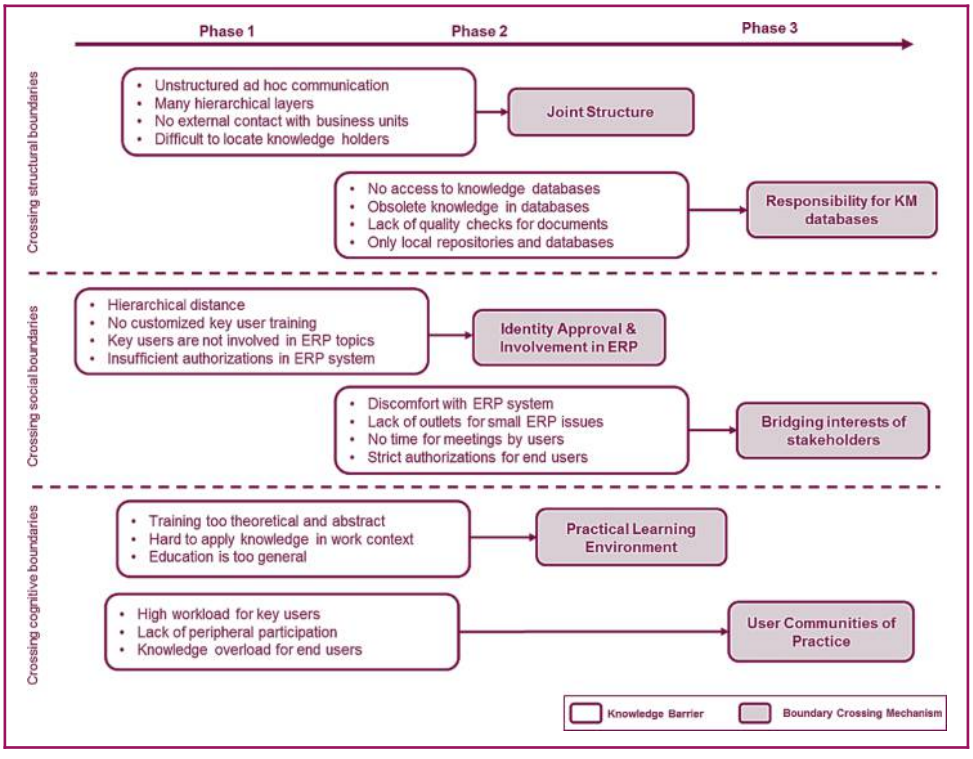
Results

A wide range of mechanisms was used by the key users to overcome knowledge barriers that users, managers and the key users themselves encountered. The mechanisms have been classified in three types of boundaries, crossed by the key users. In Figure 1, an overview of the different knowledge barriers (first-order concepts) that led to the boundary-crossing mechanisms (second-order concepts) has been provided. The barriers and the accompanying mechanisms have been classified within the time frames in which they occurred.

Table II Example of coding strategy

Example of quote	*First-order concept*	*Second-order concept*
Well, we see that different hierarchies exist within [the organization]. Certain hierarchies have grown for years and years and it is almost impossible to get rid of them, still they impede ways to improve the process. Dependent on the position you have within these hierarchies other people are more or less reluctant to listen to you. (P1-Mf)	Many hierarchical layers	Joint Structure
The training is way too general, it is very hard for users to convert what they have learnt to their 'own' context and apply it to everyday situations. They urge for more practical solutions that show them exactly what they have to do during their work day. (P1-KUh)	Education is too general	Practical learning environment

Figure 1 Knowledge barriers and boundary-crossing mechanisms



Prerequisites for key users

Before any of the mechanisms to overcome the knowledge barriers emerged, several prerequisites for the key users had to be fulfilled. Most of the issues emerging at the start of the usage phase (Phase 1) were related to the fact that the ERP system had no priority for both users and managers. Only after the organization enabled key users during the subsequent phases, they were able to develop boundary-crossing mechanisms.

First, the managers had to assign some of their subordinates with the key user function. However, the organization did not provide clear guidelines about the skills and knowledge a key user had to possess. There was no description of the key users' tasks and responsibilities, and this led to a random way of assigning key users. A majority of the key users received their role because they had "time for extra tasks", regardless of their affinity or skills with ERP or IT.

As one of the key-users stated in an interview:

> Most of the key-users have been assigned without thinking about their specific skills and knowledge. I have seen many cases, in which colleagues were assigned in a formal mail from their supervisor that stated 'From now on you are the key user in the ERP system.' Subsequently the key user-to-be responded with 'OK, what do I have to do, and by the way, what is an ERP system?' Well, I think that says enough about the way we initially assigned key users to support the end-users, don't you think?

Moreover, many of the assigned key users had to fulfill their task on a part-time basis. This was a logical choice because some of the locations were small and just did not have enough personnel to allow for a full-time key user. However, managers and users permanently prioritized other core-tasks over spending time with the ERP system. Key users had to fulfill maintenance and logistic tasks before they could spend some of their limited time on learning the ERP system and transferring knowledge about it. This made it hard for them to effectively carry out their role as key users and act as an internal consultant for colleagues in the ERP domain.

Just after the system had been "live" over a year, top management had picked up signals from the business units about the inadequate fulfillment of the key user role. To grasp the exact problems, a task force was initiated to get more insight in the key user issues. Issues about the lack of priority, time and uncertainty about the key user role in general were reported. The task force listed a series of action points to enable key users to better do their job. The main points of action included the development of general guidelines and procedures for the appointment of key users and a clear description of the function. Middle managers were still responsible for the appointment of their key users – as they know their personnel best – but were now supported with more information about what kind of skills, capabilities and available time key users needed. More and more, managers started to realize they had to prioritize ERP-related tasks and offered key users more time to fulfill their key user role. This made key users able to do their jobs properly; however, this caused the emergence of new and challenging knowledge barriers to overcome.

Crossing structural boundaries

Joint structure. A prominent mechanism to overcome knowledge barriers was the creation of a joint structure between key users, users, managers and other employees involved with the ERP system. During the first year and a half, key users struggled with communication about the ERP system. They experienced difficulties to connect users with the right people to solve the ERP issues. This was also the case when key users tried to find complementary expertise about a specific topic, like process descriptions. Next to finding the right person to receive or share knowledge with, key users also reported they were uncertain about the path they had to take to solve specific topics.

Consequences of the unstructured way of communicating between stakeholders of the ERP system led to undesirable outcomes. One example included a workaround developed by one of the business units causing problems in other business units. After a system update, labels for outgoing packages did not only have to include a barcode but also an article code. The business unit responsible for packaging added the article code on the label. However, they did not use the designated feature for this, but used a workaround to adjust the label in another program and imported it back in the ERP system. Although the packages were labeled correctly, units receiving the packages were unable to scan them. In the words of one interviewee:

> The barcode on some of the articles was not readable anymore. Why? In one of the new releases the article code had to be included in the same frame (of the barcode) and someone had shrunk the barcode in order for the article code to fit. However, because the bar code and the article code had become too close to each other, the scanner was no longer able to recognize the difference between the two codes. As a result we were unable to scan incoming packages and had to put them in the system by hand.

Many days were spent to locate the cause of this problem. Several business units assumed the scanners were malfunctioning and tried to repair them. Only after some key users of different units informally met, they discovered more business units faced the same problem with the scanners. Not much later, the problem was found and resolved.

This and other comparable problems stimulated key users to start developing some sort of – informal – structure to communicate about ERP-related topics. One of the initiatives pertained to creating a list of key users, indicating their areas of expertise and knowledge competences. This list was placed on the intranet and was updated regularly when new key users were appointed. Other initiatives included monthly meetings and visits between key users to exchange knowledge.

Responsibility for knowledge databases. Where the mechanism of creating a "joint structure" was predominantly aimed at overcoming knowledge barriers of a tacit nature, knowledge databases aimed at codifying ERP knowledge. During the implementation and in the first months after the "go live" moment of the ERP system, the implementation team provided online-help files and made general instructions about the system, hence filling the knowledge databases. However, after the system went "live", the databases were no longer updated.

Key users were not authorized to access or update these central databases; like end-users, key users were only able to document their knowledge within their own local business units. This meant that general problems or frequently asked questions had to be solved by each business unit separately, leading to key users reinventing the wheel over and over again. New barriers, as a consequence of obsolete and outdated knowledge, emerged. After the system went "live", system updates occurred regularly, and changing procedures about workarounds caused many documents to become rapidly outdated. This only stimulated key users to draft their own ERP documentation. However, the proliferation of all the local initiatives eroded the quality of the documents, as no one checked their quality. Therefore, errors, wrong procedures or faulty workarounds turned up in some of the locally made documents. In the words of one of the interviewees:

> Since the implementation has been finalized, large parts of the system have changed or have been updated but the documents are not updated for new kernels. We fall back on local knowledge and local documentation. This worries me because many workarounds have emerged the last months and many of them have led to undesirable outcomes, for instance we encounter a lot of corrupted data in the system.

During one of the key user meetings – organized as a result of the joint structure – a group of key users developed ideas for a new central knowledge repository. They made a list of characteristics that this database should have. For instance, the database had to be managed by a central entity, but should also give key users access to upload and maintain documents applicable to their local context. To assure a certain level of quality, the idea was that all uploaded documents needed to receive a positive check by other key users before they could be accessed by the ERP users. Also key users should have the possibility to rate the documents and mark them as superfluous when documents would have become outdated. These ideas were submitted to the chief information officer of the organization and were eventually approved. During the final wave, the central knowledge repository was accessible to all the key users, providing them with an extensive knowledge database to upload information about the ERP topics, share instructions and learn about the ERP system from documentation provided by key users from all over the organization.

Crossing social boundaries

Identity approval and involvement in the ERP issues. Although key users were to become important players in the organization, their role and identity as key users were not directly confirmed by users and managers. The main cause for the "identity crisis" of key users was the hierarchical distance between key users and other stakeholders. Many key users did not feel comfortable in their new role and felt underpowered. Hierarchy plays an important

role in the organization under study, and it influences the way employees perceive each other. Initially, many key users were ranked close to the middle management level. However, most end-users experienced these key users as uninformed about what happened and mattered at the level of the users. This also worked the other way around when key users were assigned low in the hierarchy. In this case, managers felt too much distance with the key users and did not see them capable enough to address managerial ERP issues. This harmed the way key users, managers and end-users communicated and interacted with each other.

After the task force (Phase 1) composed a new policy for the key users, managers diversified the different levels of the key users. Key users got more confidence to portray their identity as an ERP expert, advisor and trainer through the customized education and training program they could follow during Phase 2. During the training, key users learned about the ERP system, but they also received instructions including how to train and teach the ERP users. The program made it possible for key users to really provide "added value" for users and managers and enable them to share knowledge more effectively, significantly raising the social status of key users.

Bridging interests of stakeholders. The next mechanism by which key users were able to cross social boundaries within the organization is based on thinking from the perspective of other ERP system stakeholders, including fellow key users, end-users, middle managers and consultants.

Due to the hierarchic nature of the organization, it was hard for users to communicate easily with middle managers and provide them feedback about system changes and their ways of working with the ERP. Because of their – renewed – status as ERP experts, key users were able to act as a bridge between users and management. For example, users indicated that a system to solve or report small ERP issues was not in place. Key users picked up this feedback and discussed it with the middle management. Eventually, a system to report minor bugs and problems was installed. This also worked the other way around. Managers wanted to conduct meetings to become informed about the users and their experiences with the ERP, but many users did not want to attend these meetings, as they "had no time for such things". Again, key users acted as a bridge and persuaded users to attend these meetings, as it also functioned as an outlet to get in touch with the middle management.

Moreover, many end-users felt uncomfortable when they had to use the system, and, as a consequence, some of them reverted back to legacy systems. This happened because users faced strict authorizations, making them unable to use specific ERP system features. To overcome this, key users brokered deals with middle and even top management to provide users with less stringent authorizations. This motivated end-users to start using the ERP system extensively, as it would offer them more advantages than the legacy systems.

Crossing cognitive boundaries

Practical learning environment. Key users made knowledge about the ERP systems' logic easier to understand for end-users and managers. They did this by providing a practical learning environment. Although many of the end-users received ERP training, they had difficulties to apply the subject material to their daily work. Users experienced the training as being too general because many examples did not relate to their local context. For instance, exercises were related to machines and procedures completely different from the devices in their own work situations. Moreover, many users found the material very abstract, as trainers would teach in-depth knowledge about the principles of the ERP systems. Due to the lack of common ground, many users did not show up at the training sessions at the ERP training center.

As a result, many ERP users did not receive any training at all or became frustrated by the fact that all the material they were taught during their training was hard for them to apply in

their own job setting. At several departments, key users started to develop more practical ways to train users by appealing to the local context of end-users. A simulation room was arranged to practice the exact actions users had to perform during their normal work tasks. A complete room was turned into a warehouse, including shelves with products and parts. During the training, users practiced different practical situations, enabling them to learn what to do when parts would come in or how to order spare parts from outside suppliers. The practical learning environment provided a useful link with the theoretical training they had received at the main training facility. Moreover, instead of learning about abstract ERP transactions, users now learned about actual job processes. In the words of one of the interviewees: "We notice that many users profit from this method and become enthusiast to learn about the possibilities of the new system". So, by translating the ERP language toward practical and contextual knowledge, the cognitive distance between users and the trainers and educators was decreased.

User community of practice. The practical learning environment stimulated users to share their knowledge about the system. Still, many users reported that they struggled due to an overload of new system, business and process knowledge. Although key users were increasingly relieved of their regular job functions, they still experienced high workloads and acknowledged that they lacked time to give all users the necessary attention. Several users already met on a regular basis to discuss the "ins" and "outs" they experienced during their system use. Key users started to pick up on this, and started to organize "communities of practice". Users who performed similar tasks or who were engaged in the same task domain were encouraged to interact with each other and share their best practices. As a shared purpose, they would support each other regarding the ERP system on a regular basis.

By forming different "communities of practice" among end-users, key users were able to connect users while they could ease their workload. Within the communities of practice, users applied peripheral participation to teach one another about their experiences with the system. Over time, more and more different sub-communities emerged, covering different ERP knowledge domains. The main role of the key users was the coordination of the multiple communities of practice and facilitating users to participate in the communities.

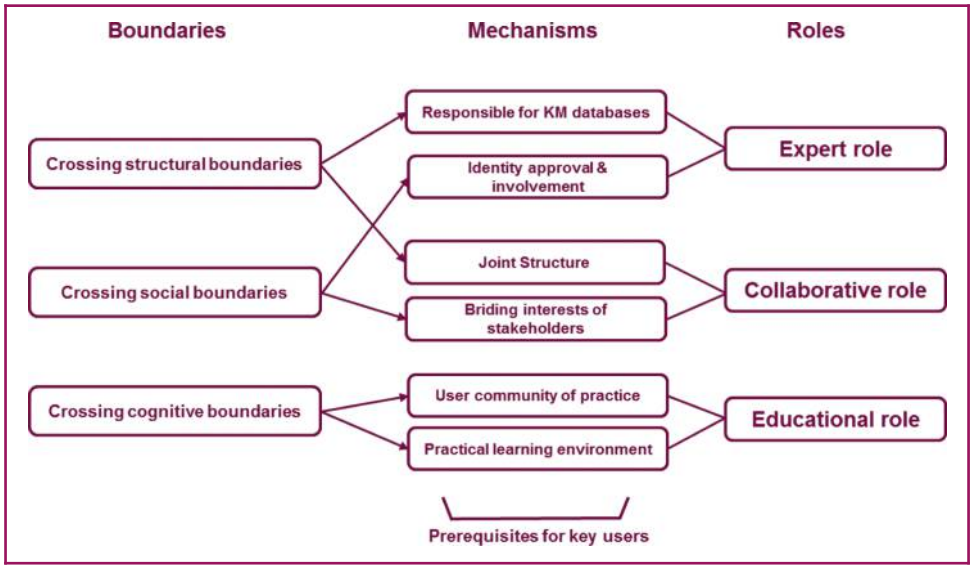
Key user roles

Looking back at the six different mechanisms applied by key users to cross structural, social and cognitive barriers, three types key user roles appear to originate from these mechanisms. These include the expert role, the collaborative role and the educational role as depicted in Figure 2.

The *expert role* can be seen as the most reactive key user role and is predominately demand-driven. After all, due to their status as ERP experts, managers started to get key users involved in specific ERP-related "projects", such as the development of training programs, the configuration of user authorizations and the editing of instructions. As most key users have expertise in a specific domain of the ERP system, they are needed by multiple stakeholders to share their knowledge and skills with them. Important aspects for key users to successfully fulfill this role are the continuous development of their knowledge and the recognition of the key user as an expert by users, managers and consultants alike.

The *collaborative role* is mainly aimed at bridging gaps between ERP stakeholders, end-users and middle management. This role is crucial, as key users connect a knowledge holder (e.g. other key users with different knowledge domains) with someone who demands a certain body of knowledge. Frequent issues can be solved efficiently, and the experience of key users from other departments can be used to effectively overcome barriers that are already taken by others. Key users can act as a linking pin between users and managers and bridge their differences. The collaborative role has an informal and formal nature. However, to function properly, it is important for an organization to create a formal structure that enables key users to perform their bridging function. In this way, the

Figure 2 Overview of boundary-crossing mechanisms and the key user roles



formal regulation of organizational processes, functions and individuals can decrease the effects of environmental uncertainty or scarcity.

The *educational role* is predominantly supply driven. To use the system and its transactions effectively, end-users need a certain amount of theoretical education to grasp the basic principles of the ERP system. However, this is not enough for most end-users because this knowledge is abstract and hard to apply in everyday work situations. Therefore, key users have to provide practical exercises for users to really understand how to use the ERP system. This is not only important for their general knowledge level; the development of a shared understanding and a shared language with other ERP stakeholders is also valuable. Next to that, key users may also have a proactive role in one or more "communities of practice" with end-users. This includes leading the start-up of "communities of practice" or supervising them on a regular basis.

The three roles are all equally important for key users to fulfill, as they are interdependent, but key users are also dependent on the degree to which other key users fulfill their roles. For instance, when key users start referring users to other key users (collaborative role), they enable the expert role for their colleagues. This is also the case for the educational role of key users. When users approve the key users as experts, they are more likely to be confident and willing to teach end-users about the ERP system.

Discussion

The objective of the study was to provide more insight in the ways key users act as knowledge managers and boundary spanners during the ERP usage phase. More specifically, we were interested in the role key users play in making organizational IT innovations a reality. Despite the recognized importance of key users during the implementation phase, little is known about their role in the ERP usage phase, let alone how they overcome knowledge barriers during this phase (Santhanam *et al.*, 2007). Our study makes a number of contributions and has implications for research and practice.

Contributions and implications for research

This study contributes by applying the theoretical perspective of cross-boundary knowledge transfer. Using this theory, six mechanisms used by key users during the ERP usage phase were distinguished. The study shows that key users apply these boundary-crossing

mechanisms to bridge the gaps between knowledge about software, organizational processes and different functional areas. The six mechanisms are aimed at increasing knowledge transfer and overcoming knowledge barriers, thus indicating the brokerage position of key users during the ERP usage phase. This paper echoes outcomes of previous work on key users, however it is the first to acknowledge this for the ERP usage, i.e. the post-implementation, phase. This indicates that key users are not only of importance during the implementation of an ERP system (Lorenzo *et al.*, 2012; Wu and Wang, 2007), but their position remains essential, even when the system is in place and in use by the organization.

Moreover, prior work related to key users of the ERP systems has predominantly studied which skill sets they need to effectively function in an implementation team (Mahdavian and Mostajeran, 2013; Xu and Ma, 2008) and in which manner the management needs to involve, enable and engage key users as stakeholders during the ERP implementation phase (Santhanam *et al.*, 2007, Wu and Wang, 2007). In this article, however, insight is provided as to how the various components of the key user role evolve after the implementation. The findings indicate three roles that incorporate the main tasks and responsibilities of key users. A key user role consists of a collaborative, educational and expert component, which is equally important to cross-organizational boundaries and transfer knowledge. The results of this study acknowledge that an organization has to enable key users first before they can fulfill their roles effectively (Pan and Mao, 2013), but as the ERP project advances, the content of the role of a key user also shifts. Instead of becoming mainly involved with consultants, leading to a lot of knowledge absorption during the implementation process, the key user role evolves into a knowledge broker role with three clear role components. In this way, the study contributes by providing an elaborate insight in how key users function and carry out their tasks in a complex environment, applying knowledge-crossing mechanisms to overcome different types of organizational boundaries.

Another contribution relates to the role key users played in previous research (Ko *et al.*, 2005; Ifinedo, 2011). The majority of the research focused on key users as passive recipients of knowledge from consultants. However, results indicate that key users have a dual role of:

- absorbing software, business and process knowledge; and
- creating and transferring contextualized knowledge to a whole range of stakeholders.

Next to that, it is important to emphasize the influence of the social climate during knowledge transfer (Palacios-Marqués *et al.*, 2015a, 2015b), such as dealing with conflicts and reaching comprise (bridging interests of stakeholders) but also bridging and brokering with other key users to facilitate knowledge transfer (joint structure). This is in line with previous work about knowledge brokers (Pawlowski and Robey, 2004), who argue that the role of a knowledge broker is relevant when differences in practice (e.g. users and managers) are significant.

Moreover, this study enriches and elaborates cross-boundary knowledge management theory. Although it is a robust theory with high explanatory power, it is still lacking sufficient application in empirical research (Rau *et al.*, 2012). This study contributes to the literature by applying this theory in an ERP system context and by identifying several mechanisms based on this study's results using the three key dimensions of cross-boundary knowledge management.

Reverting to the organizational IT innovation literature, our study contributes to an initial understanding of how key users can be effectively embedded in organizations and how they may impact the organization (Table III). This represents a multilevel research domain: organizations and key users as a subgroup of organizations with a specific and often task. While our study concentrated on the impact of key users as boundary spanners on positive organizational outcomes (middle of Table III aimed at positive organizational outcomes), boundary spanning is a process that interacts with the broader literature on ICT and organizations (top of Table III).

While structural, social and cognitive boundaries can be interpreted as boundaries which key users have to cross, they can also be considered dimensions which an organization has to deal with when innovating IT practices. These dimensions shape the interrelation of

Table III Linking IT, boundary spanning and organizational innovation

Topic	*Structural dimension*	*Social dimension*	*Cognitive dimension*
IT and organizational innovation	Structural dimension of IT and organizational innovation: IT infrastructures, interorganizational IT, combinations of IT Nylén and Holmström (2015), Popa *et al.* (2016), Soto-Acosta *et al.* (2015), Yoo *et al.* (2010)	Social dimension of IT and organizational innovation: IT supporting relationships, e.g. electronic communications, social networking, collaborative IT, and e-communities Faraj *et al.* (2015), Palacios-Marqués *et al.* (2015a), Van Osch *et al.* (2015)	Cognitive dimension of IT and organizational innovation: IT supporting understandings, e.g. content management systems, Web 2.0/semantic web, data mining, knowledge communities Faraj *et al.* (2011), Hara and Fichman (2014), Palacios-Marqués *et al.* (2015b), Soto-Acosta *et al.* (2014a, 2014b)
Reciprocal relationship between organization and key users	a) Structural, social and cognitive enabling and embedding of key users b) Key users having a structural, social and cognitive impact on the organization		
Boundary spanning	Structural boundaries *This study's results on the role of key users:* Joint structure between key users, users, managers and other employees Responsibility for knowledge databases	Social boundaries *This study's results on the role of key users:* Identity approval and involvement in ERP issues Bridging interests of stakeholders	Cognitive boundaries: *This study's results on the role of key users:* Practical learning environment User community of practice
Positive organizational outcomes	Boundary spanning is required for: Effective knowledge transfer, organizational performance/business value and innovation		

key users as an organizational subgroup with the organization at large. First, from an organizational perspective, key users need enabling (f.i. is sufficient time allotted for their work?) and embedding facilities (do they connect well with the main organization; is isolation avoided?). Second, conversely, one can study the impact of key users as a subgroup on the entire organization, i.e. their effectiveness as organizational citizens with a special task. Future research can examine drivers of a vicious versus virtuous innovation pattern between key users and the organization they work for (Akkermans and Helden, 2002). Virtuous would imply effective interrelating and positive organizational outcomes, while a vicious cycle could refer to isolated key users with limited or even negative impact on the organization and organizational innovation projects.

Finally, with ERP crossing organizational boundaries (Andersson, 2015), new challenges emerge for actors positioned between organizations. Key users may take on an additional role as inter-organizational boundary spanners or they may assist individuals responsible for inter-organizational cooperation.

Implications for practice

The recognition of the essential role that key users can fulfill during the usage phase of the ERP systems is the most important implication for practice. As mentioned, several prerequisites have to be met before key users are able to cross boundaries and overcome knowledge barriers. That is, organizations need to accommodate key users by providing the right infrastructure and facilities for them at the beginning of the ERP implementation. Next to that, supervisors have to be prepared about the consequences that one of their subordinates is becoming a key user. Key users have to invest a lot of time and effort in their new role and have to be facilitated by their managers. Especially in organizations where the ERP systems are not directly impacting the primary process, it is not immediately apparent for managers to allocate

a lot of time to the ERP system and their key users. This study indicates that the important contribution of key users does not end after the implementation phase, but that it continues after the system is in place as well. This implies that for managers of an organization, the effort to educate, facilitate and invest in key users is more justified than ever, as they remain essential long after the ERP system has been implemented.

Management has to take into account that the key users' tasks and responsibilities have to be clear from the start; furthermore, they need to cautiously select the right employees to become key users. However, as, in the current literature, it has been unclear what the exact roles and responsibilities of key users are, this paper contributes to practice by providing clear insights about the educational, collaborative and expert roles key users have to fulfill during the ERP usage phase.

Another implication for practice is that the six boundary-crossing mechanisms may act as best practices for organizations using the ERP systems. Organizations have been struggling with boundary crossing in software, product development and services (Kotlarsky *et al.*, 2015; Vlaar *et al.*, 2008). Referring to our mechanisms, jointly designing a formal structure to exchange knowledge could be used as a mechanism that has been described and applied in multiple contexts (Barley, 2015; Rau *et al.*, 2012). By supporting and facilitating these mechanisms from the start of the ERP implementation, organizations may benefit more effectively from the ERP system. Also, the timely involvement of key users during the ERP implementation phase may function as a best practice. Moreover, the cross-boundary knowledge mechanisms indicate that an ERP implementation is not finished when the system has been implemented (Santhanam *et al.*, 2007). The phases afterwards are crucial to translate the possibilities of the system to benefits for the organization. Organizations may take into account that successfully using an ERP system requires ongoing effort, even when the implementation is considered to be successful.

Limitations and implications for further research

This comprehensive study in a large-scale organization contributes to both theory and practice, although it may have some limitations. Potentially, the most striking limitation of this study pertains to the snowball sample strategy used in this study. Given the apparently strong role of organizational boundaries in this sizable organization, it may have occurred that some voices may have been underrepresented as a consequence of the referral system in the study's sample. Possibly, purposive sampling could have served this study better. Still, a set of 40 key users – distributed over the various business units and out of a grand total of 300 – is large enough to have confidence in the quality of the data.

Other limitations open opportunities for new research initiatives. First, this study has been conducted within a public organization. Some characteristics of these organizations – related to their not-for-profit-character – differ from private organizations. Therefore, further research may explore different types of organizations (e.g. low/high tech or hierarchical/flat organization) to compare how key users structure their role and cross-knowledge boundaries. This is acknowledged by Soto-Acosta *et al.* (2014a, 2014b), who argue that organizational factors may restrict or facilitate the implementation of technologies (Soto-Acosta *et al.*, 2014b). Still, although some differences exist, results from this study can be generalized to different contexts because the ERP system is a commercial-off-the-shelf package. Many of the features are best-practice based on private organizations, meaning that many of the requirements for key users are comparable for public and private organizations.

Finally, although the organization has been studied for over a year and a half during the ERP usage phase in this study, it is hard to make statements about the effectiveness of the key users. Despite the positive outcomes of the applied boundary-crossing mechanisms, it is hard to state to what extent the system has been more successful than before. Clearly, our study did not have the set-up of an experiment. After all, the efforts of the key users are aimed at supporting the ERP stakeholders and increasing their level of system usage. This limitation is in line with the ongoing discussion about the ERP system success measurements (Tate *et al.*,

2014). Future research may provide more insight as to how the effectiveness of key users can be measured and how their efforts contribute an increased system performance. All in all, this study provides an initial approach to explore the role of the key user in the ERP usage phase and contribute by distinguishing knowledge barriers and their accompanying boundary-crossing mechanisms.

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