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ANTECEDENTS OF EMPLOYEES’ EXTENDED USE OF ENTERPRISE SYSTEMS: A PROACTIVE BEHAVIOR PERSPECTIVE

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Abstract

After enterprise systems (ES) are infused to daily businesses, employees’ extended use has already become an important concern to firms striving for reaping benefits from IT investment. Considering the innovative and extra-role nature of extended use, the paper further re-conceptualizes extended use as proactive behavior. And based on the theory of proactive motivation, a research model is developed to explain how three specific antecedents, i.e., system self-efficacy, leader-member exchange, and system modularity jointly impact employees’ extended use. The model is tested with a survey of enterprise system users in six firms which have already implemented ERP systems, and several meaningful findings are yielded. First, except for leader-member exchange, both system self-efficacy and modularity can positively and directly affect extended use. Second, leader-member exchange, rather than exerting a direct effect, can positively moderate the effects of system self-efficacy and modularity on extended use. Third, system modularity can strengthen the relationship between system self-efficacy and employees’ extended use. The limitations and implications for research and practical fields are discussed.

Keywords: Extended Use, Proactive Behaviour, Interaction, Enterprise Systems.
In most contemporary firms, enterprise systems (such as ERP and CRM) have been greatly infused to employees’ daily business tasks. In other words, employees have already engaged in routine use, which is defined by the management as the standardized system use (Li et al., 2013). However, due to the dynamic work environment in current workplace (Schyns, 2004), employees’ tasks are often characterized as changing and full of uncertainty (Raub & Liao, 2012). And this dynamic work context is likely to require employees to, go beyond routine use and proactively explore the features of the introduced system, which is conceptualized as extended use in IS literature (Cooper & Zmud, 1990). Routine use and extended use coexist in the post-acceptance stage, and both of them are critical for firms to benefit from the introduced system (Li, et al., 2013). While routine can ensure firms to gain the basic return from the technology investment, extended use can further help firms to explore the potential of, and thus fully reap benefit from the investment in enterprise systems (e.g., Cooper & Zmud, 1990; Hsieh & Wang, 2007).

Despite the increasing body of relevant literature in recent few years (e.g., Ahuja & Thatcher, 2005; Hsieh & Wang, 2007; Ke et al., 2013; Magni et al., 2011; Saga & Zmud, 1994), several research gaps remain to be fulfilled. First, while prior research exclusively underlines the innovative nature of extended use (Ahuja & Thatcher, 2005; Gupta & Karahanna, 2004; Ke, et al., 2013; Magni, et al., 2011; Magni et al., 2010; Nambisan et al., 1999), however, it cannot comprehensively cover the characteristics of extended use. At least, employees often engage in the extended use actively without rewards, suggesting the extra-role or citizenship behaviour nature of extended use which are not well studied (Karahanna & Agarwal, 2006). It is thus necessary to re-conceptualize extended use in a more comprehensive manner, and theoretically justify some critical antecedents to extend our understanding of this phenomenon. Second, although prior literature has greatly underlined the technological antecedents, such as perceived ease of use and perceived usefulness, we have little knowledge on how technology acceptance and use can be influenced by IT features at infrastructure level (Duncan, 1995). Particularly considering the fact that system functions are interlinked with employees’ tasks (Davenport, 1998), it is urgent to explore how employees balance the technical features for accomplishing the tasks. Third, although ES implementation practically involves social relationship between employees and supervisors (Joshi, 1991; Orlikowski, 1992), the theoretical understanding on the impact of the social relationship is far from clear with regard to technology acceptance and use in general, and extended use in particular.

Drawing upon relevant literature, we re-conceptualize extended use as proactive behaviour. And based on the features of enterprise system and the theory of proactive motivation (Parker et al., 2010), system self-efficacy, leader-member exchange, and system modularity are theoretically identified as three critical antecedents respectively, and integrated into a research model for predicting employees’ extended use of enterprise systems. Specifically, system self-efficacy and modularity are identified as “can do” motivation, and leader-exchange is conceptualized as “reason to” motivation (Parker, et al., 2010), and both of which can directly affect extended use. Further, by conceptualizing system modularity and leader-member exchange as work context, it is particularly proposed that: (1) leader-member exchange can positively moderate the effects of system efficacy and modularity on extended use; and (2) system modularity can strengthen the relationship between system self-efficacy and extended use. To test the research model, a survey of enterprise system users was conducted in six firms which have already implemented ERP systems, and most of the hypotheses are supported except for the direct effect of leader-member exchange on extended use.

This study can make several significant research contributions. First, it extends our knowledge on extended use by theoretically re-conceptualizing extended use as proactive behaviour, and developing a research model to predict the dependent variable. It is believed that the new conceptualization is novel and more appropriate for theoretically explaining employees’ extended use. Second, involving leader-member exchange in this study can contribute to both technology adoption and leadership literature. While information systems imply relationships between employees and the organization.
(e.g., Joshi, 1991; Orlikowski, 1992), we particularly justify that relational feature of enterprise systems can impact employees’ extended use, and explain how person-supervisor fit operates to affect employees’ behaviour in the system implementation context. Third, this paper also contributes to literature by investigating the impact of technological feature at the infrastructure level. Particularly, the feature of system modularity can both directly, and interact with system self-efficacy and leader-member exchange, to impact on extended use.

The remainder of this paper is organized as follows. The next section describes theory and research model. Then, research method and results are presented. After discussing the findings, theoretical and practical implications, and limitations for future research, the paper ends with a short conclusion.

2 THEORY AND RESEARCH HYPOTHESES

2.1 Extended Use

According to prior research (Hsieh & Wang, 2007; Saga & Zmud, 1994), extended use in this study is defined as the extent to which employees use more of the introduced enterprise system’s features to support their task performance. While there is tremendous IS literature which examines IS use at the pre-acceptance and acceptance stages, we have relevant little knowledge on IS usage behaviors in the post-acceptance stage in general (Jasperson et al., 2005), and extended use in particular (Hsieh & Wang, 2007). Considering the fact that extended use is critical for firms to fully benefit from IT investment (Cooper & Zmud, 1990), it is thus urgent to further explore this special phenomenon in the post-acceptance stage.

There are two ways to conceptualize the employees’ extended use of enterprise systems. First, extended use can be considered as a kind of innovative behaviour. Specifically, extended use means either exploring and using more functionalities to support a more comprehensive set of tasks, or exploring new functionalities to accomplish existing tasks (Hsieh & Wang, 2007; Saga & Zmud, 1994). Obviously, both types of feature exploration imply new method or ideas for work tasks, such that they involve critical cues of innovative behaviour. To this end, prior relevant research has mainly focused on the innovative nature of system exploration (Ahuja & Thatcher, 2005; Gupta & Karahanna, 2004; Ke, et al., 2013; Magni, et al., 2011; Magni, et al., 2010; Nambisan, et al., 1999). Second, extended use can also be conceptualized as a kind of extra-role behaviour. Extra-role refers to the role of performing activities which are not pre-defined or required by their jobs (Katz & Kahn, 1978). Considering the complexity of enterprise systems, the organization can prescribe some (i.e., routine use) but not all aspects of the integration of system functionalities and work tasks, and employees’ extended use primarily derives from their continuous interaction with the introduced system (Hsieh & Wang, 2007). In other words, employees can accomplish their tasks with routine use (even though the routine use is not effective enough for task accomplishment), such that extended use is not prescribed as part of employees’ duties, and they have the autonomy and freedom to choose whether or not to explore the functionalities of the introduced system (Karahanna & Agarwal, 2006). Unfortunately, this theoretical point is greatly neglected in IS literature (Karahanna & Agarwal, 2006).

Drawing upon prior relevant literature, we find that research on proactive behaviour, which involves cues of both innovative behaviour and extra-role behaviour, can provide us with an insightful theoretical lens for obtaining a more comprehensive conceptualization and theoretical understanding of employees’ extended use of enterprise system. In general, proactive behaviour is a way of behaving at work (Grant & Ashford, 2008), it focuses on self-initiated and future-oriented action that attempts to improve current circumstances (e.g., Parker et al., 2006; Unsworth & Parker, 2003), and “involves challenging the status quo rather than passively adapting present conditions (Crant, 2000, p.436).” It is argued that proactive behaviour can more comprehensively describe the notion of extended use. On one hand, “self-initiated” depicts the situation that employees do something (that can potentially contribute to individual or organizational performance) without being told (Parker, et al., 2006). This
can be linked to extra-role feature of extended use. On the other hand, “future-oriented” and “challenging the status quo” describe the phenomenon that employees adopt a long-term perspective to prevent problems, which in turn stimulate them to change and improve the current circumstance (Parker, et al., 2006). Obviously, this point can be linked with the innovative nature of extended use.

2.2 Theory of Proactive Motivation and Research Model

According to the model of proactive motivation (Parker, et al., 2010), proactive behaviour is driven by two fundamental motivations, i.e., “can do” motivation which depicts individuals’ perceived ability of behaving proactively, and “reason to” motivation that reflects individuals’ desire to behave proactively (Raub & Liao, 2012). Particularly considering the context of ES implementation, employees depends on the introduced system to accomplish their tasks (Davenport, 1998), thus “can do” motivation is determined by both person and technology.

System self-efficacy can represent capability derives from employees per se. While it has been widely identified as an important antecedent for technology use (e.g., Compeau & Higgins, 1995b; Compeau et al., 1999; Venkatesh & Bala, 2008), system self-efficacy is likely to be particularly predictive for employees’ extended use of enterprise system. On one hand, as a kind of proactive behavior, extended use implies a relatively high psychological risk to employees, which requires high system self-efficacy to attenuate (Parker, et al., 2010). On the other hand, as a large-scale software package, enterprise system is interlinked with employees’ tasks (Davenport, 1998), and often create knowledge barriers that require employees to develop new skills to overcome (Attewell, 1992; Fichman & Kemerer, 1997). And high system self-efficacy can greatly decrease the negative effect of knowledge barriers on system usage.

With regard to technology, it is believed that system modularity is particularly significant for employees’ extended use of enterprise systems. Prior research suggests that individuals will not engage in proactive behavior when they perceive that their effort (including time, money, energy, or other resources) involved is too costly relative to the gain they receive (Aspinwall, 2005). Considering the fact that modules in enterprise systems are tightly linked to business tasks, high system modularity can provide users with reusable modules which can be flexible applied to changing task domains. This can greatly reduce employees’ perceived cost (also known as another type of “can do” motivation (Parker, et al., 2010)), which in turn may provoke employees to explore the modules and actually apply them to accomplishing their daily business tasks.

Further considering the social nature of ES, perception and behaviour toward technology can be considered as the outcome of social exchange between employees and organization (Joshi, 1991). While local management often acts as the human agency that can translate an external influence into managerial actions (Liang et al., 2007), it is believed that the exchange between local management and employees, i.e., leader-member exchange can act as “reason to” motivation, and thus potentially influence employees’ system usage behaviour. Specifically, leader-member exchange can affect employees’ extended use of enterprise systems based on its social exchange nature (Ilies et al., 2007). According to the social exchange mechanism, employees have the obligation to reciprocate the high quality relationship with their leaders (Blau, 1964) by conducting extended use which is desired by the leader. This mechanism can be linked to “reason to” motivation, which indicates the impact of leader-member exchange on extended use, which is a kind of proactive behavior (Parker, et al., 2010).
Also based on theory of proactive motivation, work context can moderate the relationship between motivations and behaviour. In the context of ES implementation, it is argued that system modularity and leader-member relationship can be particularly conceptualized as work context. Thus, we propose research model (see Figure 1) of this study. Following prior research on user acceptance and use, we propose that system self-efficacy, system modularity, and leader-member exchange can directly impact on extended use (i.e., H1, H2, and H3). More importantly, based on relevant arguments, we propose that these three factors can interact with each other so as to further predict employees’ extended use of enterprise systems (i.e., H4, H5, and H6).

![Research Model](image)

**Figure 1. Research Model**

### 2.3 Direct Effects of Antecedents

#### 2.3.1 System Self-Efficacy

Following prior relevant research (e.g., Compeau & Higgins, 1995b; Venkatesh & Bala, 2008), we define system self-efficacy in this study as *the extent to which an employee believes she or he has the capability to perform a specific task/job using the introduced enterprise system*. While it has been widely identified as an important antecedent for technology use (e.g., Compeau & Higgins, 1995b; Compeau, et al., 1999; Venkatesh & Bala, 2008), system self-efficacy is likely to be particularly predictive for employees’ extended use of enterprise system. On one hand, as a kind of proactive behaviour, extended use implies a relatively high psychological risk to employees, which requires high system self-efficacy to attenuate (Parker, et al., 2010). On the other hand, as a large-scale software package, enterprise system is interlinked with employees’ tasks (Davenport, 1998), and often create knowledge barriers that require employees to develop new skills to overcome (Attewell, 1992; Fichman & Kemerer, 1997). And high system self-efficacy can greatly decrease the negative effect of knowledge barriers on system usage. Thus, we hypothesize:

**H1**: System self-efficacy is positively related to extended use.

#### 2.3.2 System Modularity

Despite the various system characteristics, we focus on modularity because it has been recognized as the most salient characteristic for enterprise systems (e.g., Chung et al., 2011; Uwizeyemungu & Raymond, 2005). Following prior relevant research (e.g., Chung, et al., 2011; Schilling, 2000), system
modularity in this study is defined as the extent to which modules of the implemented enterprise system can be separated and recombined. In general, modularity represents system flexibility at the infrastructure level (Duncan, 1995), and it relates to the ease of using the introduced system (Byrd & Turner, 2000).

It is believed that system modularity is particularly significant for employees’ extended use of enterprise systems. Prior research suggests that individuals will not engage in proactive behaviour when they perceive that their effort (including time, money, energy, or other resources) involved is too costly relative to the gain they receive (Aspinwall, 2005). Considering the fact that modules in enterprise systems are tightly linked to business tasks, high system modularity can provide users with reusable modules which can be flexible applied to changing task domains. This can greatly reduce employees’ perceived cost (also known as another type of “can do” motivation (Parker, et al., 2010)), which in turn may provoke employees to explore the modules and actually apply them to accomplishing their daily business tasks. Further, prior research has found that the freedom and flexibility, with which employees can play with ideas and expand the range of possibilities and materials from which a solution may emerge, are significant for employees to behave creatively in workplace (Amabile, 1983; 1988). Echoing this point, system modularity offers employees increased autonomy and room for extended use. Therefore, we propose:

H2: System modularity is positively related to extended use.

2.3.3 Leader-Member Exchange

Generally, leader-member exchange refers to the quality of the relationship between a leader and a subordinate (Gerstner & Day, 1997; Liden & Maslyn, 1998). In the context of ES implementation, local management often acts as the human agency (Lewis et al., 2003), and practically takes responsibility for benefiting from the introduced enterprise system. In this study, we focus on employees’ perceptions, and leader-member exchange is specifically defined as the extent to which the support an employee perceive that she/he can get from local management, in the form of the supervisor’s help on and understanding of her/his work problems, contribution to her/his needs, recognizing her/his potential, and her/his effective work relationship with the supervisor (Drach-Zahavy, 2004; Liden & Maslyn, 1998; Settoon et al., 1996).

While prior research has found that leader-member exchange can directly impact on employees’ innovation on work tasks (e.g., Atwater & Carmeli, 2009; Liden et al., 1993) and extra-role behaviour (e.g., Ilies, et al., 2007; Settoon, et al., 1996), it is argued that leader-member exchange can positively predict employees’ extended use of the introduced enterprise system. Specifically, with high leader-member exchange, supervisors tend to provide employees with autonomy and discretion for innovating with, and thus employees’ extended use of the introduced enterprise system (Graen & Scandura, 1987; Lee, 2008). Further, employees who perceive high-quality leader-member exchange would engage in the exchange of material and nonmaterial resources that extend beyond what is specified in formal job description (Liden et al., 1997), and believe that they have the obligation to behave as desired and expected by the supervisors (Blau, 1964; Emerson, 1976; Settoon, et al., 1996). Thus, to reciprocate high leader-member exchange relationship, it is likely that employees will go beyond defined technology use (which is an in-role behaviour) and engage in extended use (which is extra-role), such that the social exchange can be balanced (Wayne et al., 2002). Based on the arguments above, we thus hypothesize:

H3: Leader-member exchange is positively related to extended use.

2.4 Interaction Effects among Antecedents

Prior research suggests that leader-member exchange can influence extended use by moderating the effects of motivations on employees’ extra-role behaviour (Ilies, et al., 2007) and innovative behaviour
First, while self-efficacy can directly affect extended use, we further propose that this relationship can be strengthened by leader-member exchange. With high leader-member exchange, supervisors would expect employees to better appropriate the introduced system (including extended use) so as to actually benefit form the investment. Such expectation will serve as social persuasion and instill a “can do” attitude in employees (Liao et al., 2010), which in turn can further stimulate employees to apply their personal IT ability to conquer the knowledge barriers in extended use. Further, employees who perceive high-level leader-member exchange tend to believe that their supervisor trust and respect them (Graen & Uhl-Bien, 1995), which in turn may accord employees a safe and supportive network with regard to extended use (Boies & Howell, 2006). That is, in the presence of high-quality relationship with supervisors, employees’ perceived uncertainty and potential risks of conducting extended use is likely to be low, which in turn would be also likely to stimulate employees to put effort on extended use of the introduced system. Based on the arguments above, it is hypothesized that,

**H4**: Leader-member exchange can positively moderate the relationship between system self-efficacy and extended use, such that when leader-member exchange is perceived as high, the positive effect of system self-efficacy on extended use would be strengthened.

Second, prior research has suggested that how a technology is appropriated depends on the surrounded social and organizational context (e.g., Orlikowski, 1992; Zuboff, 1988). From this point of view, the degree to which an employee explores different modules to accomplishing tasks is contingent upon leader-member exchange (which is a kind of organizational context). First, while system modularity offers employees with increased autonomy and room for extended use, leader-member exchange can further increase employees’ perceived autonomy in the work context (Graen & Uhl-Bien, 1995). Second, despite that system modularity is critical for extended use, whether employees would actually applying these provided modules to their tasks is questionable, because the extended use involves uncertainty and cost. Prior research has found that employees who perceive high-level leader-member exchange tend to believe that their work context is safe and supportive for risk taking (e.g., Boies & Howell, 2006; Erdogan & Liden, 2002; Graen & Uhl-Bien, 1995). To this end, high leader-member exchange can further lower down employees’ perceived cost of experimenting with different modules, and thus stimulate them to practically applying the modules to their daily tasks. Therefore,

**H5**: Leader-member exchange can positively moderate the relationship between system modularity and extended use, such that when leader-member exchange is perceived as high, the positive effect of system modularity on extended use would be strengthened.

Further, the impact of system modularity on extended use is likely to go beyond just the main effect, and it can moderate the effect of system self-efficacy on extended use. Specifically, employees often calculate the possibility of success with extended use (Parker, et al., 2010). While high system modularity provides employees with more potential ways of attain business goals (Jasperson, et al., 2005), it is argued that this potential would not be realized unless users can well handle the modularity. That is, system modularity describes the organizational facilitation with regard to extended use, and it can be considered as “work context”, which in turn can moderate the effect of “can do” motivation (Parker, et al., 2010). This view is consistent with research on self-efficacy which suggests that the complexity of the task (i.e., one aspect of work context) involved can impact on the strength of the relationship between self-efficacy and performance (Gist, 1992; Stajkovic & Luthans, 1998). Specifically, high system modularity can reduce the complexity of the introduced enterprise system, and enables employees to flexibly adapt to multiple tasks without additional cognitive load (Byrd & Turner, 2000). Further, system modularity offers employees increased autonomy and room for their technology appropriation. Based on the arguments above, it can be concluded that: with the same level
of system self-efficacy, high modularity can enable employees to conduct more extended use. Thus, we propose:

\[ H6: \text{System modularity can positively moderate the relationship between system self-efficacy and extended use, such that when system modularity is perceived as high, the positive effect of system self-efficacy on extended use would be strengthened.} \]

3 METHOD

3.1 Data Collection

To test the research model, a field survey was conducted in six Chinese firms which have already implemented ERP systems. In general, these firms are operating in six industries respectively, belong to three ownership types, employ four ERP providers, and have implemented ERP for an average of 3.67 years. It is believed that these diversities can promise sufficient variance in the constructs involved. A total of 240 employees from six different functional areas (accounting, human resource, manufacturing, purchasing, R&D, and marketing) in these companies were selected as survey respondents based on following two criteria: (1) the respondents have used ERP system for at least one year, and (2) they depend on ERP system to accomplish their daily work tasks. With the facilitation of the top managers in these firms, 240 paper-based questionnaires were distributed to target respondents by either department head or firm human resource office. Particularly, respondents were informed that the survey was anonymous, and they needed to submit the completed questionnaire to the researchers in person a few days later, implying that their peers can not see their response in the questionnaire. One week later, three researchers (including one of the authors and two PhD students) collected the questionnaire in person site by site.

In all, 221 respondents returned the survey questionnaire, with a response rate of 92.1%. Due to excessive missing data, 8 questionnaires were dropped, leaving 213 valid samples for data analysis. Among the 213 subjects, 94 (44.1%) were male, and 119 (55.9%) were female. A majority of the respondents age from 20 to 39 (93%), and have an associate, bachelor’s degree, or above educational levels (95.3%).

3.2 Measurement Development

In general, all the measures were adapted or adopted from existing validated scales, and takes seven-point Likert style, ranging from 1 “strongly disagree” to 7 “strongly agree”. We adopted Heish and Wang’s (2007) instruments for extended use, while leader-member exchange was adapted from Graen and Uhl-Bien (1995). In this study, system self-efficacy described the system-specific ability, and was adapted from Venkatesh and Bala’s research (2008). Measures for system modularity were adapted from prior relevant research (Byrd & Turner, 2000; Rivard et al., 1997). Moreover, three control variables, i.e., task autonomy, perceived ease of use and perceived usefulness, which were considered as antecedents of extended use in prior research were included in this study. Specifically, items for job autonomy were adapted from Ahuja and Thatcher (2005), and measures for perceived ease of use and perceived usefulness were adopted from Venkatesh and Bala (2008).

4 DATA ANALYSIS

A component-based path modelling software which is based on the PLS method, i.e., SmartPLS 2.0 (Ringle et al., 2005) was employed to test the research model.
4.1 Measurement Model and Common Method Bias

The validity of constructs was established by examining their reliability, convergent validity, and discriminant validity. First, construct reliability was assessed by checking composite reliability, Cronbach’s alpha, and individual item loadings. As shown in Table 1, all of the values for composite reliability and Cronbach’s alpha were greater than the threshold of 0.70, indicating good construct reliability (Hair et al., 1998). Second, a confirmatory factor analysis (CFA) was conducted to assess convergent and discriminant validity. As shown in Appendix A, most of the individual item loadings (except for the loading of LMX2) were greater than the threshold of 0.60 (Barclay et al., 1995; Chin, 1998b), indicating an acceptable convergent validity (Comrey, 1973). Further, discriminant validity was assessed based on two methods: (1) checking whether the item loadings on their own construct were greater than the loadings on other constructs, and (2) checking if a construct’s square root of AVE is greater than its correlation with other constructs (Fornell & Larcker, 1981). The results in Table 1 and Appendix A indicate good discriminant validity.

Table 1 also depicts the descriptive statistics including the mean value, standardized deviation, and correlations of all the variables. Due to the relatively high correlations among some constructs, a colinearity diagnostics was conducted. The results indicated that the VIFs for all the constructs were much smaller than the threshold of 3.3 (Diamantopoulos & Siguaw, 2006), indicating that multicollinearity was not a concern. Besides, Harman’s one-factor test (Podsakoff & Organ, 1986) and Liang et al.’s (2007) rigorous analysis based on PLS were employed to test common method bias. And the results indicate that common method is not likely to be a serious concern in this study.

<table>
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<th></th>
<th>CR</th>
<th>Alpha</th>
<th>Mean</th>
<th>S.D.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td>2.</td>
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<td>3.</td>
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<td>0.899</td>
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<td>4.</td>
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Note: CR-Composite Reliability; Alpha-Cronbach’s Alpha; S.D.-Standard Deviation; EXUS-Extended Use; ITSE-System Self-efficacy; LMX-Leader-Member Exchange; PEOU-Perceived Ease of Use; PU-Perceived Usefulness; SYMO-System Modularity; TKAU-Task Autonomy. The values on the diagonal line are the square roots of AVE.

Table 1 Statistics and Correlations

4.2 Structural Model

Table 2 depicts the results for the hypothesized effects shown in Figure 1. First, some significant direct effects of the focused three antecedents were observed. Specifically, IT self-efficacy ($\beta = 0.430, p < 0.01$) and system modularity ($\beta = 0.129, p < 0.05$) had significant impacts upon extended use. Therefore, H1 and H2 were supported. However, leader-member exchange could not significantly influence extended use ($\beta = 0.088, p > 0.1$), H3 was thus not supported. All of the antecedents (including both control variables and the focused IVs) together can explain 36.2% of the variance in extended use. Further, following Cohen (1988), we calculated the effect size by comparing Model 2 (with both control variables and the focused IVs) with Model 1 (with only control variables). As shown in Table 2, it can be concluded that adding the focused IVs ($\Delta R^2 = 0.203$, $\chi^2$-statistics $= 0.318$) can significantly increase the effect size of the antecedents of extended use (Cohen, 1988).
The three moderating effects were justified by testing Model 3-5. In Model 3, the interaction item (i.e. ITSE*LMX) was added in, and the result indicated that the path coefficient for the moderation effect of leader-member exchange was positive and significant (β = 0.202, p < 0.01). Therefore, H4 was supported. Similarly, H5 and H6 were justified via testing Model 4 and 5 respectively. As shown in Table 3, the results showed that the path coefficients for the moderating effects were positive and significant (β = 0.250, p < 0.01 for SYMO*LMX; β = 0.250, p < 0.01 for ITSE*SYMO), H5 and H6 were thus supported. Further, following Cohen (1988), we calculated the effect size by comparing Model 4-6 (with interaction effect) with Model 2 (with IVs’ direct effects) respectively. The results in Table 3 (ΔR² = 0.039, f²-statistics = 0.065 for Model 3; ΔR² = 0.055, f²-statistics = 0.094 for Model 4; ΔR² = 0.48, f²-statistics = 0.081 for Model 5) indicated that adding the moderating effects can significantly improve the predicting power of the research model (Chin et al., 2003).

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variable - Extended Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td>0.162*</td>
</tr>
<tr>
<td>Perceived Ease of Use (PEOU)</td>
<td>0.132</td>
</tr>
<tr>
<td>Task Autonomy (TKAU)</td>
<td>0.197**</td>
</tr>
<tr>
<td>System Self-Efficacy (ITSE)</td>
<td>0.430**</td>
</tr>
<tr>
<td>System Modularity (SYMO)</td>
<td>0.129*</td>
</tr>
<tr>
<td>Leader-Member Exchange (LMX)</td>
<td>0.088</td>
</tr>
<tr>
<td>ITSE * LMX</td>
<td>0.202**</td>
</tr>
<tr>
<td>SYMO * LMX</td>
<td>0.250**</td>
</tr>
<tr>
<td>ITSE * SYMO</td>
<td>0.245**</td>
</tr>
<tr>
<td>R²</td>
<td>0.159</td>
</tr>
<tr>
<td>ΔR²</td>
<td>0.203</td>
</tr>
<tr>
<td>f²-statistics</td>
<td>0.318</td>
</tr>
</tbody>
</table>

Note: Following prior research (Cohen, 1988), Cohen’s f²-statistics was employed to test model effect size. Specifically, f²-statistics = (RAB² - RA²)/(1-RAB²), where RA² is the variance explained by a set of independent variables A, and RAB² is the the combined variance explained by A and another set of independent variables B.

*p < 0.1; *p < 0.05; **p < 0.01

Table 2 Summary of PLS Results

5 DISCUSSION AND IMPLICATIONS

5.1 Discussion of Findings

The results support five of the six hypotheses, yielding meaningful findings. As expected, the result indicates that employees’ system self-efficacy can directly and positively affect extended use. This finding is consistent with prior research on proactive behaviour which has justified that self-efficacy is predictive for proactive behaviour (Parker, et al., 2010; Raub & Liao, 2012), and suggests that employees’ system self-efficacy is prerequisite for extended use. Also, the result shows that system modularity can positively and directly impact on employees’ extended use of enterprise systems. This finding extends our understanding of extended use by justifying a critical antecedent at infrastructure level, and particularly suggests that technology per se can actually generate influence on employees’ extended use behaviour. Different from our expectation, leader-member exchange can not directly impact on extended use. Possible explanations is that, we measure leader-member exchange in a
general way other than “technology-specific”, such that it is ambiguous for employees to decide what should be exchanged. Employees’ immediate reaction is more likely to be general return for the provision of their supervisors, such as better performance, innovation in task, other than the technology-specific extended use.

More importantly, the results indicate that the three antecedents can interact with each other and thus further predict employees’ extended use. Specifically, as hypothesized, it is found that leader-member exchange can positively moderate the effect of employees’ system self-efficacy on their extended use. This finding is generally consistent with person-environment fit perspective which states that individual’s behavior are determined by the extent to which the fit between person and surrounded environment (e.g., Kristof-Brown & Guay, 2010; Lewin, 1951). Also as expected, system modularity can positively moderate the effect of employees’ system self-efficacy on extended use. Considering the fact that system modularity can potentially reduced the complexity of job tasks and technology usage, this finding keeps consistency with prior research which suggests that the effect of self-efficacy on performance is contingent upon task complexity (Chen et al., 2001). In all, the above two findings suggest that employees’ system self-efficacy alone can not guarantee full potential of the introduced system, only with high quality leader-member relationship and system modularity can the firm transit employees’ ability to real returns from IT investment.

Besides, consistent with our expectation, leader-member exchange can strengthen the relationship between system modularity and employees’ extended use. Prior research has justified that employees’ proactive behaviours is likely to involve a deliberate decision process in which they assess the likely outcomes of these behaviours (Parker, et al., 2006), and only with enough perceived control of situation (i.e., control appraisal) can employees engage in proactive behaviour (Frese & Fay, 2001). The finding implies that we need to avoid technology determinism with regard to extended use. That is, although technology per se is important, its effect on extended use is contingent upon whether the work context is supportive.

5.2 Limitations and Future Research

The interpretation of our research findings should take into consideration several limitations. First, despite prior research has suggested that many organizational factors can shape proactive behaviour (e.g., Parker, et al., 2010; Parker, et al., 2006; Raub & Liao, 2012; Settoon, et al., 1996), we emphasize the relational nature of enterprise systems, and underline the role of leader-member exchange. Obviously, future research can step forward by integrating more relevant organizational factors in the research frame, such that a more comprehensive understanding of extended use would be achieved. Particularly considering the critical role of top management in enterprise system implementation (Leonard-Barton & Deschamps, 1988), it would be interesting to investigate the impacts of organizational policy (such as compensation or promotion) or organizational culture, which are promoted by top management. Second, the involvement of only one type of enterprise systems, i.e., ERP, may limit the generalisability of this research. Future studies may extend the generalizability of this study by replicating it with involving more types of enterprise systems. It is even possible that, by scrutinizing the differences among a couple of enterprise systems, future studies would draw a more comprehensive picture of system exploration and use.

5.3 Theoretical Implications

This study makes several key theoretical contributions. First, we extend literature by theoretically re-conceptualizing extended use as proactive behavior, proposing and empirically validating a research model to predict employees’ extended use. Particularly considering that extended use is not required by the organization, the re-conceptualization of proactive behavior and justification of relevant critical antecedents have gone beyond the innovative feature of extended use (Ahuja & Thatcher, 2005;
Second, by involving leader-member exchange in this study, we contribute to both technology adoption and leadership literature. Specifically, drawing upon the relational nature of enterprise systems, i.e., the systems imply relationships between employees and the organization (e.g., Joshi, 1991; Orlikowski, 1992), we both theoretically and empirically justify that leader-member exchange can interact with personal and technological factors so as to predict employees’ extended use. These findings confirm that relational characteristics of information systems do generate influence upon technology acceptance and use. Further, while prior literature has pointed that how the unique person-supervisor fit operates in organization is unclear (Oh et al., 2013), and suggested further investigation of the dyadic relationship between employees and supervisors (Graen & Uhl-Bien, 1995), we particularly extend leader-member exchange into the enterprise system implementation context. By doing so, we can to some extent achieve the conclusion that supervisors can practically generate influence upon employees’ behaviour based on their quality relationship with subordinates.

Besides, this study can extend literature by investigating the role of the well-known but greatly-neglected concept of system modularity. On one hand, going beyond well-established technological antecedents, such as perceived ease of use and perceived usefulness, we find that system use can be directly influenced by IT feature (i.e., system modularity in this study) at infrastructure level (Duncan, 1995). Particularly, the interaction effect between system modularity and leader-member exchange suggests that technology alone can not comprehensively explain use behaviour, it is necessary to involve work context so as to further explain the impact of technology. On the other hand, the effects of system modularity also extend proactive behaviour literature. Specifically, in ES implementation context, system modularity is a dual-role antecedent, i.e., system modularity is “can do” motivation due to its role of reducing perceived cost of extended use, and “work context” due to its contingent effect with regard to extended use. This theoretical framing may also be extended to exploring the impacts of other contextual factors when concerning for proactive behaviour.

5.4 Practical Implications

This study has important practical implications for practitioners concerning returns from enterprise system investment. And due to the significant either direct or moderation effects, it is necessary for firms to take managerial actions to increase employees’ system self-efficacy, leader-member exchange, and system modularity. First, in practice, training sessions can be employed to effectively enhance employees’ abilities with regard to system use in a relevant short time (Compeau & Higgins, 1995a). With regard to developing leader-member exchange, firms can provide leadership training to supervisors, which in turn can nurture high-quality relationships with employees (Liao, et al., 2010). Also, supervisors need to actively communicate with employees, recognize employees’ potential and contribution, and cares about employees’ welfare (Settoon, et al., 1996), by doing so, employees would likely to reciprocate with positive evaluation of the dyadic relationship. Third, both technological and managerial methods can be applied to enhancing system modularity. Technologically, both inside and outside (e.g., system provider) IT professionals need to scrutinize the “best practice” of the firm, and actually embed these best practices in the modules at the system design stage. And they also need to write out operation manual for employees in a simple and easy way, with particular illustration of the potential applications of the modules. Managerially, since top management participation can enhance system assimilation (Liang, et al., 2007), it is possible that top management can take some measures to enhance system modularity. Considering that system modules are interlinked with employees’ tasks, top management may initiate task redesign so as to better appropriate technological modules for tasks, which in turn would make employees perceive that the system modules is flexible for work tasks.
6 CONCLUSION

Employees’ extended use is critical for contemporary firms to reap benefits from enterprise systems investment. Going beyond previous research, this study re-conceptualizes extended use as proactive behaviour, and theoretically develops a research model for predicting employees’ extended use, involving system self-efficacy, leader-member exchange, and system modularity as critical antecedents. A survey study was conducted, and several interesting findings were obtained. In all, this study can significantly contribute to IS literature by: (1) re-conceptualizing extended use, and developing a comprehensive research model which theoretically integrates critical antecedents based on theory of proactive behaviour, and (2) revealing that these antecedents can both directly, and interact with each other to, affect employees’ extended use of the introduced system. Particularly, the study’s attempt to explore the moderating role of contextual factors opens a new window for future research to more comprehensively investigate the focused phenomenon, which in turn can advance our knowledge and understanding of technology acceptance and use.

7 ACKNOWLEDGEMENT

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References


Appendix A. Loadings-Cross Loadings

<table>
<thead>
<tr>
<th></th>
<th>EXUS</th>
<th>ITSE</th>
<th>LMX</th>
<th>PEOU</th>
<th>PU</th>
<th>SYMO</th>
<th>TKAU</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXUS1</td>
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<tr>
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<td>PU3</td>
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</tr>
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Note: 1. After deleting LMX2, results significance keeps similar, and the p-value for the item loading is significant (p<.005). For the completeness of the construct, we thus keep this item in this study.