Examining information systems infusion from a user commitment perspective

Hee-Woong Kim
Graduate School of Information, Yonsei University, Seoul, Korea
Hock Chuan Chan
School of Computing, National University of Singapore, Singapore, and
Sumeet Gupta
Operations and Systems Department, Indian Institute of Management Raipur, Raipur, India

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Abstract

Purpose – The purpose of this paper is to : first, examine information systems (IS) infusion from a user commitment perspective, and second, examine the formation of user commitment toward the use of IS in terms of job design.
Design/methodology/approach – This study adopts a survey approach with structural equation modeling to test the developed research model and hypotheses.
Findings – A survey of 236 enterprise system users shows that user commitment has a positive effect on IS infusion. User commitment, in turn, is influenced by task technology fit, technology self-efficacy, and task autonomy. Further mediation and direct effects to IS infusion are explored.
Research limitations/implications – This study offers implications for research, such as explaining a driver of IS infusion; and extending commitment theory by finding antecedents of user commitment.
Practical/implications – The results of this study offer suggestions to management on how to improve IS infusion in terms of user commitment and, consequently, how to develop user commitment based on the socio-technical system (STS) design.
Social/implications – The study highlights the critical impact of technology autonomy on IS infusion. An individual user's authority in using and regulating the system is required for IS infusion.
Originality/value – This study has proposed a theoretical model of IS infusion based on commitment and socio-technical job design factors.

Keywords Socio-technical theory, Structural equation modeling, Adoption, Information system effectiveness
Paper type Research paper

1. Introduction

Companies invest huge amount of capital to establish information systems (IS), including enterprise systems. Enterprise systems refer to software packages that enable the integration of transaction-oriented data and business processes throughout the organization (Markus and Tanis, 2000). Examples include supply chain management, enterprise resource planning (ERP), and customer relationship management. The enterprise system market totaled US$245 billion in 2010[1] and reached US$342 billion by 2012[2]. IS implementation projects, however, historically have been plagued by high failure rates or have remained a challenge for organizations (Bala and Venkatesh, 2013; Goatham, 2009; Morris and

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Venkatesh, 2010). Studies estimate that up to 70 percent of large-scale IS projects fail to meet their objectives or they remain underutilized (Bloch *et al.*, 2012; Kim, 2011; Hsieh and Wang, 2007; Ramdani *et al.*, 2013). Even in cases of successful IS implementation, organizations find it difficult to extract full value from their enterprise system (Schrage, 2006; Sousa and Goodhue, 2003).

Hsieh and Wang (2007) argue that the effective usage of ERP systems is not just mandatory or basic use, but an exploratory and exploitative use of its features that enhances organizations' productivity (Sousa and Goodhue, 2003). Underutilization of implemented systems is a major factor underlying the productivity paradox that results in lackluster returns on organizational investments in IS (Saeed and Abdinnour-Helm, 2013; Sundaram *et al.*, 2007; Venkatesh and Davis, 2000). A systems integration company, Green Beacon (www.greenbeacon.com), found that around 80 percent of its client companies had underutilized their enterprise systems (Morphy, 2006). Furthermore, the value of information technology (IT) has not been fully appreciated, although its power and ubiquity have grown exponentially (Carr, 2003).

According to the six-stage IT implementation model (Cooper and Zmud, 1990), IS implementation and usage vary over six different stages: initiation, adoption, adaptation, acceptance, routinization, and infusion. Although previous IS research has paid much attention to technology acceptance for several decades, technology acceptance is not a good indicator of IS success, especially in the mandated system usage context (Deng and Chi, 2012/2013; Hsieh *et al.*, 2011). Organizations are able to fully leverage their IS investments only at the IS infusion stage, which refers to using the enterprise system to its full potential (Deng and Chi, 2012/2013; Hsieh *et al.*, 2011; Saga and Zmud, 1994). Even though the importance of IS infusion has been emphasized over the past several decades, it is still understudied and not fully explained.

Previous IS research has focused on IS adoption and post-adoption, such as the development of the IS continuance model (Bhattacherjee, 2001). A few extant studies on IS infusion have examined IS infusion from the perspective of technology acceptance (Jones *et al.*, 2002; Saeed and Abdinnour-Helm, 2008, 2013; Thatcher *et al.*, 2011), the IS continuance model (Koo *et al.*, 2015; Hsieh and Wang, 2007; Wang and Hsieh, 2006), and the theory of reasoned action (TRA) (Ke *et al.*, 2012/2013; Sundaram *et al.*, 2007). IS infusion is a form of proactivity (i.e. proactive behavior) (Kirkman and Rosen, 1999) and organizational citizenship behavior (OCB) (Organ, 1988), because the full utilization of IS requires voluntary IS use and not just mandated use. In contrast to IS infusion, technology acceptance or IS continuance are not necessarily a form of proactivity or OCB because users can use the system out of mandated usage during acceptance and continuance stages. That is, technology acceptance or IS continuance does not necessarily require full utilization of the target system (i.e. IS infusion) beyond its mandated usage. Therefore, we need a different theoretical perspective for examining IS infusion. Commitment is a key antecedent of proactivity and OCB (Meyer and Allen, 1991; Meyer *et al.*, 2002; Pare and Tremblay, 2007). We therefore adopt commitment theory (Allen and Meyer, 1990; Meyer and Allen, 1991).

This study has two purposes: first, to examine IS infusion from a user commitment perspective, and second, to examine the formation of user commitment toward the use of IS in terms of job design. This study proposes various work system design factors as the antecedents of commitment because job design can affect the development of psychological states (i.e. commitment) (Hackman and Oldham, 1976). In the context of IS use, socio-technical system design can affect psychological states and work outcomes (Bostrom and Heinen, 1977; Hackman and Oldham, 1976). We test our theoretical model through a field study that focuses on individual usage of an enterprise system.

The rest of the paper is organized as follows. In Section 2, we discuss the theoretical and conceptual underpinnings of this study from IS infusion, User Commitment and STS theory perspective. In Section 3, we present the research model based on the conceptual and theoretical background and propose hypotheses. In Section 4, we describe the methodology (instrument development and data collection) for collecting the data followed by the analysis of the data in Section 5. Finally, in Section 6, we conclude with a discussion on the findings of this study, their implications for theory and practice and future research directions.

2. Conceptual background

2.1 IS infusion

Cooper and Zmud (1990) introduced the six-stage IT implementation model: initiation, adoption, adaptation, acceptance, routinization, and infusion. The purpose of the six-stage IT implementation model is to facilitate the interpretation of connections between empirical results of different stages. The model begins with initiation, which identifies a match between an innovation and its application in an organization. This is followed by adoption, when a decision is reached to invest resources to accommodate the implementation effort. Adaptation occurs when a better fit is achieved by the modification processes that are directed towards individuals or organizations and the technology.

The post-adoption stages are acceptance, routinization, and infusion (see Table I). Acceptance refers to the efforts taken to induce organizational members to submit to the use of IT applications (Cooper and Zmud, 1990). Routinization is the routine and regular use of IT applications. When employees are able to utilize the IS in a way that extends beyond routine and standardized usage, they achieve a higher level of usage that allows them to exploit the fullest potential of the system (i.e. IS infusion). While acceptance of a technology can be forced upon the user (through organizational mandates and procedures), routinization can be obtained as the user becomes familiar with organizational processes. In contrast, infusion requires deeper usage of technology as compared to acceptance and routinization. Infusion therefore requires deeper commitment and willingness on the part of the individual to experiment with the technology and put it to varying usages in the organization thus opening and extending the frontiers of technology use.

	Acceptance	Routinization	Infusion
Definition	Efforts undertaken to induce organizational members to submit to the use of IT applications	Alterations that occur within work systems to account for IT applications such that these applications are no longer perceived as new or out-of-the ordinary	Occurs as IT applications become more deeply embedded with the organization's work systems
Level of use	Beginning level use either voluntary or mandated	Routine use as the practices become standardized	Usage beyond routine where technology is experimented with for new frontiers of usage
Representing variables	Technology acceptance (Venkatesh *et al.*, 2003)	IS continuance (Bhattacherjee, 2001), routinization (Sundaram *et al.*, 2007)	Infusion (Jones *et al.*, 2002; Sundaram *et al.*, 2007), adaptive system use (Sun, 2012); deep usage (Burton-Jones and Straub, 2006)

Table I. Conceptual differences between acceptance, routinization and infusion

IS infusion can occur in different ways, such as through extended use, integrative use, and emergent use (Saga and Zmud, 1994) in the IS infusion stage, users go beyond the prescribed and mandated use of IS. With discretionary and voluntary usage, employees are able to further utilize the technology, even in ways that may not have been envisaged in the initial technology acceptance. Employees can fully leverage the technology to improve performance, resulting in more positive organizational consequences at the infusion stage (Cooper and Zmud, 1990; Hsieh *et al.*, 2011; Sundaram *et al.*, 2007; Wang and Hsieh, 2006).

IS infusion has been examined as either a single dimensional construct (Jones *et al.*, 2002; Sundaram *et al.*, 2007) or multi-dimensional construct (Saga and Zmud, 1994). By conceptualizing IS infusion as a single dimensional construct, previous research (Jones *et al.*, 2002; Sundaram *et al.*, 2007) examined IS infusion based on the technology acceptance model (TAM) and the theory of planned behavior (TPB). In contrast, by considering IS infusion as a multi-dimensional construct, other research examined partial aspect of IS infusion, such as extended use (Hsieh and Wang, 2007; Hsieh *et al.*, 2011; Koo *et al.*, 2015; Saeed and Abdinnour-Helm, 2008), emergent use (Ahuja and Thatcher, 2005; Ke *et al.*, 2012/2013; Thatcher *et al.*, 2011), and integrative use (Kim and Gupta, 2014).

A few recent studies have examined IS infusion in different forms. Sun (2012) proposed a new concept, adaptive system use as a second order formative construct. Adaptive system use consists of two features (revising the content and revising the spirit) similar to extended and emergent use which are two of the characteristics of IS infusion. In essence, adaptive system use discusses about revision of one's use of the system usage in the organization in an adaptive manner. Another study by Burton-Jones and Straub (2006) contends that to fully understand the impact of IS use on organizational performance, investigators need to look beyond a lean measure of IS use (e.g. duration, extent of use) and pay more attention to "deep structure usage" that relates closely to one's productivity.

As for the theoretical lens in examining IS infusion, most previous research adopted the TAM and the TPB (Jones *et al.*, 2002; Sundaram *et al.*, 2007). Similarly, Thatcher *et al.* (2011) applied the TAM in examining emergent use (i.e. intent to explore). Saeed and Abdinnour-Helm (2008) also examined extended use based on the TAM. Wang and Hsieh (2006), Hsieh and Wang (2007), and Koo *et al.* (2015) examined IS infusion based on the IS continuance model and TAM. Previous research on IS infusion reveals the significant role of perceived usefulness and satisfaction in leading to IS infusion. Other studies have examined IS infusion in terms of the work environment. For example, Ahuja and Thatcher (2005) examined the influence of the work environment on trying to innovate with IS, grounded in the theory of trying[3] and the theory of planned behavior. Similarly, Hsieh *et al.* (2011) examined the effect of work environment and feedback mechanisms on the extended use of IS. Sun (2012) also examined adaptive system use in terms of triggers in the work environment.

While it is meaningful to examine IS infusion based on the theoretical lenses commonly used in technology acceptance and IS continuance, it limits the generation of new knowledge. Further, IS infusion requires users to extend the mandated use of IS in order to exploit the full potential of the system. The voluntary and discretionary extension or exploitation of IS is a form of proactivity and OCB (Organ *et al.*, 2006). Proactivity refers to the "individual's actions effecting environmental change through their scanning for opportunities, showing initiative, taking action on and solving problems, and persevering until changes are made" (Kirkman and Rosen, 1999, p. 61). Organ (1988, p. 4) defined OCB as an "individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and that in the aggregate promotes the effective functioning of the organization."

There are three key characteristics in the conceptualization of OCB. First, OCBs are discretionary behaviors and are performed by employees as a result of personal choice. Second, OCBs go beyond job requirements. Third, OCBs contribute positively to the performance of the incumbent organization. OCB includes not only intra-role, but also extra-role behavior (Organ *et al.*, 2006) that motivate employees to perform at their own discretion. Similar to the characteristics of OCB and proactivity, IS infusion requires an individual user's discretionary behavior by going beyond the mandated IS usage, which contributes positively to the performance of the organization. While IS infusion is a form of proactivity and OCB, technology acceptance and IS continuance as defined by contemporary literature are not. Therefore, IS infusion research needs a new theoretical lens that can be used in examining OCB. Previous research (e.g. Meyer and Allen, 1991; Morrison, 1994; Pare and Tremblay, 2007) has adopted the commitment theory as the theoretical lens in examining proactivity and OCB, and therefore, we adopt the same in examining IS infusion.

2.2 User commitment

Commitment is "a force that binds an individual to a course of action of relevance to one or more targets" (Meyer and Herscovitch, 2001, p. 301) and is experienced by an individual as a mindset (i.e. a psychological state that compels an individual toward a course of action). There are two targets of commitment: commitment to a course of action and commitment to a relationship (Li *et al.*, 2006). Commitment to a course of action is "a state of being in which an individual becomes bound by his actions and through these actions to beliefs that sustain the activities and his own involvement" (Salancik, 1977, p. 62). Commitment to a relationship explains an individual's attitude toward a social or business relationship and his motivation to remain in the relationship. Commitment to a relationship has been used in examining relationship marketing (e.g. Bansal *et al.*, 2004) and employee management (e.g. Meyer *et al.*, 1993). We focus on an individual's commitment to a course of action in this study because IS infusion represents a type of IS usage action.

Commitment has three subtypes: affective commitment, normative commitment, and continuance commitment (Meyer and Allen, 1991). Affective commitment is an emotional attachment or affective orientation toward the target of commitment (Meyer and Allen, 1991). Normative commitment is an obligation to maintain the relationship with the target of commitment (Meyer and Allen, 1991). Continuance commitment means maintaining a relationship with the target of commitment as a result of the perception of discontinuance costs (Meyer and Allen, 1991). Among the three subtypes of commitment, affective commitment is shown to have the strongest positive relation with desirable work behaviors (e.g. OCB) (Meyer *et al.*, 2002). In contrast, continuance commitment (i.e. discontinuance costs) is expected to be unrelated and normative continuance (i.e. obligation) is expected to have a weak effect on OCB. Morrison (1994) further highlights that a strong affective commitment motivates individuals to view their roles as extending beyond formally prescribed tasks, and this encourages them to adopt extra-role behaviors. For this reason, this study defines user commitment in terms of affective commitment as an individual user's psychological attachment towards using the system in performing tasks.

Previous IS research using commitment theory has examined the effect of commitment on IS continuance intention (Li *et al.*, 2006; Wang and Datta, 2010), user satisfaction (Doll and Torkzadeh, 1989), and performance (Chang *et al.*, 2010). For example, Malhotra and Galletta (2005) examined the effect of commitment on system adoption and usage behavior as well as perceived beliefs such as usefulness and ease of use. Regarding antecedents of commitment, Shaw and Edwards (2005) explored potential antecedents of user commitment in the context of knowledge management strategy implementation. Additionally, Doll and Torkzadeh (1989) proposed trust and sense of control as antecedents of commitment. However, Chang *et al.* (2010) proposed ability and extrinsic motivation as antecedents of user commitment. Although several studies have examined varying aspects of commitment, there has been insufficient understanding about the development of commitment and the role of commitment in IS infusion. Furthermore, most previous researches examining user commitment are literature-driven (Chang *et al.*, 2010; Doll and Torkzadeh, 1989; Li *et al.*, 2006) or characterized by exploratory findings (Newman and Sabherwal, 1996; Shaw and Edwards, 2005). There is a lack of theoretically grounded approach in identifying the antecedents of user commitment.

The main premise of commitment theory is that employees with commitment will exhibit proactivity or OCB, such as extra-role behaviors that are beyond the mandated behaviors (Meyer and Allen, 1991; Meyer *et al.*, 2002; Pare and Tremblay, 2007). In the same vein, user commitment is a motivational force for users to assume extra-role behaviors (i.e. voluntarily using the system beyond the management's prescribed and standardized usages) as well as intra-role behaviors (i.e. the management's prescribed and standardized usages) in using IS to its full potential at work (i.e. IS infusion). User commitment then serves as the motivation (i.e. the degree to which an individual wants to engage in certain specific behavior) (Mitchell, 1982). Motivation initiates the behavior and determines its direction and intensity (Pinder, 1998). Based on user commitment as motivation, users allocate their resources (e.g. time and efforts) toward the target behavior. Regarding the development of user commitment, previous research explains that affective commitment is strongly influenced by job characteristics, whereas continuance commitment is influenced by the associated costs and normative commitment is influenced by the internalization of normative pressures (Meyer and Allen, 1991). Especially, previous research (Hackman and Oldham, 1976) explains that job design, including job characteristics, can affect commitment. In the IS context, the STS approach has been used for work system design (Bostrom and Heinen, 1977). We therefore examine user commitment in terms of a socio-technical system.

2.3 STS

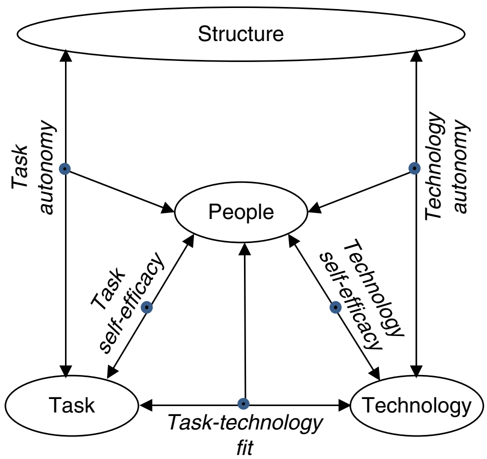
STS Theory has been considered as an effective tool for designing work system in organizations (Bostrom and Heinen, 1977). The STS is thus a perspective on an organization's work system and it comprises two interacting subsystems: social and technical (Bostrom and Heinen, 1977). The technical system is composed of technology and structure; the social system consists of people and task, who use the technical system to accomplish the task of the organization. Leavitt (1989) further explained each of the four elements. Task refers to the work or function to be performed; people refer to the actors performing a task; technology refers to the body of knowledge and tools that can be applied to the task; and structure includes the systems of communication, authority or other roles, and workflow.

STS theory explains that work design should jointly optimize the social and technical systems of an organization. This holistic approach to work and organization design emphasizes fit and interdependence between the elements across the two subsystems, social system and technical system. The technological configuration chosen by organization designers affects the operation of the social system by shaping the behaviors required to operate it. The level of variety, challenge, feedback, control, decision-making and integration provided for social system members is largely a function of the way in which the technical system is arranged (Davis and Taylor, 1979). Joint optimization of the social and technical elements of the work environment is thus considered more desirable than optimization of either system at the expense of the other.

The important implication of the STS approach is thus that the output of this work system results from the joint interaction between the two sub-systems (Bostrom and Heinen, 1977). A major cause of low work system capability is that the enabling technology is not effectively integrated within the work system (Armstrong and Sambamurthy, 1999; Purvis *et al.*, 2001). That is, the four elements of the STS interact with each other and the level of fit between elements can affect the development of commitment and then the performance of the work system.

Figure 1 shows the interactions between elements and the identification of five constructs from the interactions. This study identified five factors from the interactions considering people who are the primary actor for performance in the organization as a common entity in all the interactions, namely, people-task, people-technology, people-task-technology, people-task-structure, and people-technology-structure. The primary reason for considering people as common entity is that people only drive the organization to performance and in our context of examining IS infusion, it is the people who would be the primary actors for infusion of IS to happen in an organization. That people matter in organizational performance as the primary entity has been supported by previous studies (e.g. Bostrom and Heinen, 1977).

From the employee perspectives, how he/she interacts with the task and the technology separately leads to two factors: task self-efficacy (i.e. people-task) and technology self-efficacy (i.e. people-technology). How he/she interacts with both task and technology together leads to another factor: task-technology fit



Notes: Arrows indicate interactions among the elements of the STS. Text in italics shows the factors identified based on the interactions

Figure 1.
Identification of job design factors based on the socio-technical system

(i.e. people-task-technology). The organization structure is important for infusion mainly based on how much self-determination the employee has for his task and technology. This leads to two more factors: task autonomy (i.e. people-task-structure) and technology autonomy (i.e. people-technology-structure). The identified five factors represent job characteristics used for job design (Hackman and Oldham, 1976). These factors are explained in detail below.

2.3.1 People-task interaction: task self-efficacy. People-task interaction refers to the fit between an individual and the task that is performed by the individual. According to STS theory, interaction between people and task should be properly aligned for an organization to deliver good results. The mismatch between them would lead to poor results. Therefore, to perform the tasks effectively, an individual should possess the relevant knowledge, skills and confidence. Perceived self-confidence, knowledge, and skills are all necessary abilities to make effective task-related decisions and execution. We propose task self-efficacy as a corresponding factor of the people-task interaction. Task self-efficacy means the perceived degree to which an individual has relevant knowledge, skills, confidence, and ability to perform the task (Ritter and Gemunden, 2004). Task self-efficacy thus refers to the level of an individual's competence in performing the task.

2.3.2 People-technology interaction: technology self-efficacy. People-technology interaction refers to the fit between an individual and the technology used by the person. According to STS theory, interaction between people and technology should also be properly aligned for an organization to deliver good results. To use technology effectively, an individual should have the relevant skills and knowledge as well as confidence in his or her ability to use the technology. Previous studies have shown the importance of people-technology interaction in promoting managerial effectiveness and innovative behavior in the technology usage context (Blili *et al.*, 1998, Munro *et al.*, 1997, Spreitzer, 1995). If the technology is complex and new then people need to be trained in using the technology. We therefore propose technology self-efficacy as a corresponding factor of the people-technology interaction by considering computer self-efficacy (Compeau and Higgins, 1995) in IS literature. Technology self-efficacy means the perceived degree to which an individual has relevant knowledge, skills and confidence in his or her ability to use the system (Munro *et al.*, 1997). Technology self-efficacy thus refers to the level of an individual's competence in using the technology. Technology self-efficacy is not necessarily constrained by task self-efficacy. For example, a person can know how to use the technology beyond what he needs for his current task.

2.3.3 People-task-technology interaction: task-technology fit. People-task-technology interaction refers to the fit between the task to be performed by the person and the technology to be used by the person for the task[4]. Bostrom and Heinen (1977) explained that IS failures occurred because the introduction of new IS to an organization changes the interrelated task element thus affecting employees' performance at work. The effect of people-task-technology interaction is partially supported by other studies that have found that successful innovation and adoption occurs when the task and the technology are compatible (Cooper and Zmud, 1990). As a factor corresponding to the task-technology interaction of the person, task-technology fit explains the interaction between task requirements of a person and the functionality of target technology (Goodhue and Thompson, 1995). At a micro level, the task-technology fit examines how a specific component of a technology helps an individual perform a specific task or subtask. Because the STS highlights the interaction of social and technical systems and the consequence of that on an individual's performance of organizational tasks in general, assessing task-technology fit at a micro level is not appropriate. We therefore propose *task-technology fit* as a corresponding factor of the people-task-technology interaction from a more general perspective. Task-technology fit means the degree to which an individual believes that using the target technology can enhance the performance of his or her job (Thompson *et al.*, 1991). Task-technology fit at a macro level thus similarly refers to job fit (Thompson *et al.*, 1991) in IS literature.

2.3.4 People-structure-task interaction: task autonomy. Because this study centers on interactions at the individual level instead of the organizational level, we focus on a specific component of structure: the authority system[5]. The authority system reflects how much power and control is delegated to individual employees. The degree of autonomy granted to employees in performing their tasks may affect their attitude toward the task. For example, Ke *et al.* (2012/2013) examined how job autonomy affects exploratory system usage through intrinsic motivation development. People-structure-task interactions refer to the level of fit among the individual, the structure (i.e. authority), and the task. By considering autonomy in general work context (Ahuja and Thatcher, 2005) in IS literature, we propose task autonomy as the factor corresponding to the people-structure-task interaction. Task autonomy means an individual's sense of having a choice in regulating and performing tasks (Deci *et al.*, 1989). Task autonomy thus refers to the level of an individual's self-determination in performing the task.

2.3.5 People-structure-technology interaction: technology autonomy. People-structure-technology interaction refers to the level of fit among the individual, the structure (i.e. authority), and the technology. With basic training and as the users started adopting the technology, they became aware of its potential and its applicability to their work further (Bostrom and Heinen, 1977). For example, big data analytics requires considerable familiarity with the technology. To have people become familiar with big data analytics, organizations need to grant certain autonomy to people to experiment with the technology behind it. The degree of permissible authority of an individual in using technology may thus affect the individual's attitude in using the technology at work. By considering autonomy in general work context (Ahuja and Thatcher, 2005) in IS literature, we propose technology autonomy to be a factor corresponding to the people-structure-technology interaction. Technology autonomy means an individual's sense of having a choice in using and regulating the technology (Deci *et al.*, 1989). Technology autonomy thus refers to the level of an individual's self-determination in using technology.

3. Research model and hypotheses

The commitment of employees that must be present for internally motivated work behavior can be instilled among employees through proper design of the job (i.e. job characteristics) (Hackman and Oldham, 1976), which forms the theoretical framework used in developing our research model (see Figure 2). We select the STS design approach for job design and propose five constructs representing different interactions between the social and technical systems within the STS. Job design, including job characteristics, can be used for developing employee commitment (Hackman and Oldham, 1976). The internally motivated work behavior which is the focus of our research is IS infusion as a form of proactivity and OCB.

Previous research (Meyer and Allen, 1991; Meyer *et al.*, 2002, Pare and Tremblay, 2007) has explained that commitment has a strong relationship with OCB. In particular, affective commitment has been proposed as a key antecedent of OCB in comparison to

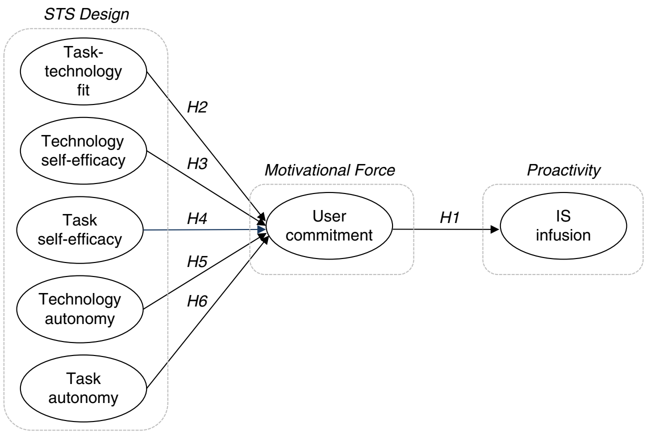


Figure 2.
Research model

normative commitment and continuance commitment (Meyer *et al.*, 2002). A strong affective commitment motivates employees to consider their work role as extending beyond the tasks formally prescribed, which in turn encourages them to adopt extra-role behaviors (Morrison, 1994). Users are typically mandated to adopt and use information systems in organizational settings, especially in the use of enterprise systems. Because most enterprise systems (e.g. ERP and customer relationship management systems) are tightly integrated with tasks over workflows, employees have to use the systems in performing their tasks (e.g. monitoring, analysis, decision making, reporting, and communicating). However, if employees are not highly motivated, they may not try to use the system beyond the prescribed manner. In contrast, a strong motivational force (i.e. user commitment) may inspire users to use the system beyond the prescribed manners. IS infusion is essentially voluntary for the user, even in the context of enterprise systems (Hsieh and Wang, 2007; Hsieh *et al.*, 2011). User commitment should therefore motivate the user to use the system to its full potential by exploring more features of the technology and discovering innovative ways of system usage in performing tasks:

H1. User commitment has a positive impact on IS infusion.

A number of studies identify the role of person-situation fit on commitment (e.g. Werbel *et al.*, 1996). Person-situation fit is essential for people in selecting their job (Holland, 1985). Werbel *et al.* (1996) argue that person-task-technology fit is the compatibility of a person's skills, knowledge, abilities, and interests with the job requirements. Perceptions of person-task-technology fit is positively related organizational commitment (Vandenberg and Scarpello, 1990). Following previous studies, we argue that person-situation fit should lead to user commitment. In our study, the situation arises from the elements of STS such as structure, task, and technology.

Task-technology fit refers to how well the technology of interest supports the user in performing his tasks and in enhancing job performance (Speier and Venkatesh, 2002; Thompson *et al.*, 1991). Task-technology fit as a root construct of performance expectancy can directly affect target behavior in the use of IS (Venkatesh *et al.*, 2003). Performance expectancy, the expectation of high work performance and outcomes, can also influence an employee's psychological state at work (Chang *et al.*, 2010). Bandura (1989) explained that outcome expectation influences an individual's affective reaction to the target technology. With a higher expectation of achieving their goals, people will be more committed (Bandura, 1989). As the level of task-technology fit increases and users are able to produce better outcomes, they may develop stronger psychological attachments to the use of technology in performing tasks (Speier and Venkatesh, 2002). Similarly, previous research (Malhotra and Galletta, 2005) has examined the relationship between performance expectancy (i.e. perceived usefulness) and commitment to system use. Therefore, task-technology fit should increase user commitment:

H2. Task-technology fit has a positive impact on user commitment.

Self-efficacy (i.e. competence) beliefs operate on behavior and actions through motivation and affective processes. High level of technology self-efficacy first motivates an individual's interest and involvement in the use of technology (Deci and Ryan, 1987). Thus, self-efficacy is related to intrinsic motivation. Bandura (1989) also explained that technology self-efficacy influences an individual's affective reactions to the target technology. The stronger the people believe in their capabilities, the greater and more persistent will be their efforts (Bandura, 1989). As an individual's technology self-efficacy increases, the person may develop stronger psychological attachment to the use of technology. Similarly, previous research (Chang *et al.*, 2010; Malhotra and Galletta, 2005) has examined the relationship between effort expectancy (i.e. ability and perceived ease of use) and commitment. Therefore, technology self-efficacy of a user should increase his commitment toward the use of IS:

H3. Technology self-efficacy has a positive impact on user commitment.

Similar to technology self-efficacy, high level of task self-efficacy motivates an individual's interest and involvement in the target tasks (Deci and Ryan, 1987). According to Bandura (1989) self-efficacy influences an individual's affective reactions to target tasks. Self-efficacy beliefs are important determinants of human self-regulation in that people are more comfortable attempting tasks they consider themselves capable of performing (Bandura, 1995). Especially, self-efficacy reduces anxiety and increases the ease of performing the target behavior (Venkatesh and Davis, 2000). Thus, individuals with high level of task self-efficacy tend to demonstrate superior performance at work (Compeau and Higgins, 1995).

Self-efficacy beliefs also play a key role in influencing the types of activities and environments people choose to get into. Those with greater self-efficacy would tend to utilize enterprise systems more to gain competitive advantage over others and be known as superior within their peer circle. Moreover, people tend to maximize their value by doing things they know they can succeed at (Thaler, 1985). According to social cognitive theory (Bandura, 1989), competency experience leads to increased self-efficacy, which in turn, leads the person to be more committed and willing to spend time and effort on the task. Thus, task self-efficacy may develop a stronger motivational force toward the task (i.e. performing tasks) in the enterprise system usage context of our study, performing tasks requires employees to use IS. Task self-efficacy of an individual, therefore, should increase the user's psychological attachment (i.e. user commitment to the use of IS in performing tasks):

H4. Task self-efficacy has a positive impact on user commitment.

In addition to technology self-efficacy, autonomy in the use of technology can motivate an individual's interest and involvement in the use of technology (Deci and Ryan, 1987). Autonomy in the use of technology contributes to a higher level of technological determination. Technology autonomy with high level of self-determination may thus develop a motivational force toward the use of technology by resulting in learning, interest in the target activities, and resilience even in the face of adversity (Deci and Ryan, 1987). Previous research (Doll and Torkzadeh, 1989) also suggests that there is a relationship between sense of control and commitment. Spreitzer (1995) also explained that autonomy has an effect on employee commitment in an organization work context. Therefore, an individual's technology autonomy should increase the person's commitment to the use of IS in performing tasks:

H5. Technology autonomy has a positive impact on user commitment.

As another type of autonomy, task autonomy may motivate an individual's interest and involvement in performing the target task (Deci and Ryan, 1987). Similar to the effect of technology autonomy, autonomy in performing a task contributes to a higher level of task determination. Performing tasks, however, require employees to use IS. Thus, task autonomy may develop motivational force regarding performing tasks using IS. Task autonomy of an individual should therefore increase his commitment to the use of IS in performing tasks:

H6. Task autonomy has a positive impact on user commitment.

4. Research methodology

4.1 Instrument development

Existing validated scales were adopted where possible and new scales were developed based on the literature. Previous research has measured IS infusion as either a single dimensional construct (Jones *et al.*, 2002; Sundaram *et al.*, 2007) or its partial aspect, such as extended use (Hsieh *et al.*, 2011), emergent use (Thatcher *et al.*, 2011), integrative use (Kim and Gupta, 2014), and adaptive use (Sun, 2012). Because we are more interested in examining the effect of user motivation on the overall aspect of IS infusion, this study measures IS infusion as a single dimensional construct. We therefore adopted four items from Jones *et al.* (2002) to measure IS infusion. To measure user commitment, we adapted three items ("happy," "personal meaning," and "emotionally attached") of affective commitment from Allen and Meyer (1990) and one item ("enthusiastic") from Meyer and Allen (1991) to the context of IS use in performing tasks. We adopted five items for measuring task-technology fit from Thompson *et al.* (1991). To measure task self-efficacy and technology self-efficacy, we adapted three items ("mastered," "confident," and "self-assured") from Spreitzer (1995) and one item ("capable") from Stone and Stone (1984) by considering the context of performing task and using technology respectively. Similarly, to measure task autonomy and technology autonomy, we adapted three items ("autonomy," "decide on my own," and "opportunity for independence") from Spreitzer (1995) to the context of task and technology respectively. All items used a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

The measurement items were checked by IS researchers and practitioners. Two IS scholars reviewed the instrument for face validity. Four graduate students were invited to participate in the sorting exercise. Overall, the four sorters correctly placed the items onto the intended constructs. Next, the measurement instrument was reviewed by a focus group of 15 employees working in the target company to check for ambiguity in wording or format. The measurement instrument is presented in the Appendix.

4.2 Data collection

To test our hypotheses, we targeted employees of an organization that is currently using an enterprise system. To be eligible for the study, an organization needs to have at least two years of experience in using their system so as to ensure sufficient time for IS infusion to take place. The target organization was an IT service company with more than 1,200 employees. The company provides a full range of IT services to client organizations, including IS consulting, IT solutions, and IS development. The company developed a proprietary enterprise system that was put into operation in 2008. The company has been using the system to assist their operations in customer management, sales channel management, marketing, human resource management, and finance and accounting management. The organization has been using the system for more than five years, making it a suitable case for examining IS infusion. In the target organization, all employees use the system for their daily work. Although it is mandatory for employees to use the basic functions of the system for their tasks (e.g. reporting), it is voluntary for them to use the advanced functions for their tasks (e.g. business intelligence).

Some users, however, do not have to use the system beyond the mandatory requirement. Other users are not able to use the system in any extended way because of authority control, depending on their organization units and positions. We excluded those users from the survey data collection. With the help from the company, we distributed the survey questionnaire to 500 randomly selected employees across different business units and different organizational positions. A total of 236 complete and valid responses (47.2 percent response rate) were collected over two weeks (see Table II). The descriptive statistics of the respondents indicate that the majority of them were male (75.8 percent), the average age was 32.2 years (SD = 4.7) and the average tenure was 4.6 years (SD = 3.8) at the company.

We also tested for non-response bias by comparing between early respondents and late respondents, i.e. those who replied during the first week and respondents during the last week (Armstrong and Overton, 1977). We found no significant differences between the two respondent groups based on the sample attributes (gender, age, tenure, and position). The sample's representativeness was also supported because no significant demographic differences were found between the sample and population figures provided by the target company's human resources department.

Demographic variable	Frequency (%)
Gender	
Male	179 (75.8)
Female	57 (24.2)
Age (years) (mean = 32.2, SD = 4.7)	
20-29	98 (41.5)
30-39	96 (40.7)
40-49	40 (16.9)
> 50	2 (0.8)
Position	
Frontline employee	165 (69.9)
Middle manager	44 (18.6)
Manager	27 (11.4)
Total	236 (100.0)

Table II. Descriptive statistics of respondents

5. Data analysis and results

5.1 Instrument validation

All the factors were modelled as first order reflective constructs. We first conducted an exploratory factor analysis involving all measures using a principal component analysis (PCA) with varimax rotation using SPSS. We identified seven factors with eigenvalues greater than 1.0. All the items were loaded into distinct factors. When compared across factors, all items were loaded highest into their own factor. Together, these factors explained 82.3 percent of the total variance.

Data analysis was conducted using the partial least squares (PLS) technique with SmartPLS. According to Haenlein and Kaplan (2004), PLS is useful when the number of indicators per variable is quite large while in co-variance based SEM estimation the reduction in the number of indicators has to be carried out, even though the indicators may be relevant to the study. Second, PLS uses a more complex, two-step estimation process to determine the weights, and therefore, the results tend to be more stable unlike in co-variance based analysis, where results change with the number of cases and indicators. Since, in this study the data was collected from organizational employees, the stability of result was necessary. Third, the population of an organization being finite may affect the normality assumption, which is a must for co-variance based analysis. PLS fits well even when the normal distribution of collected data is not justified.

Fourth, a large number of researchers have gradually adopted PLS for analysis of their results as with PLS, the measurement model and structural model are estimated simultaneously, which allows for an assessment of both the psychometric properties and the structural results (e.g. Venkatesh and Windeler, 2012). Additionally, PLS is not as restrictive on the sample as covariance-based structural equation modeling methods that require relatively large sample sizes and multivariate normal data distributions (Jöreskog and Sörbom, 1989). Furthermore, PLS is considered an appropriate statistical tool when the research model is in the exploratory stage, and where content and variables have not been extensively tested (Gefen *et al.*, 2003). As we discussed in our study, the research on IS infusion is in the exploratory stage. For these reasons, we have employed PLS for data analysis.

We first assessed the validity of the measurement instrument and then tested the hypotheses. We conducted a confirmatory factor analysis to assess the convergent and discriminant validities of the survey instrument using PLS. As shown in Table III, the standardized path loadings were all significant (t-value > 1.96) and greater than 0.7. The composite reliability (CR) and the Cronbach's α for all constructs exceeded 0.7. The average variance extracted (AVE) for each construct was greater than 0.5. The convergent validity for the constructs was supported.

Table III. Results of convergent validity testing

Construct	Item loadings	AVE	CR	α
Task-technology fit	0.90, 0.86, 0.92, 0.90, 0.88	0.80	0.95	0.93
Technology self-efficacy	0.91, 0.90, 0.90, 0.92, 0.94	0.84	0.96	0.95
Task self-efficacy	0.82, 0.85, 0.78, 0.86, 0.88	0.70	0.92	0.89
Task autonomy	0.94, 0.84, 0.80	0.74	0.90	0.89
Technology autonomy	0.91, 0.93, 0.88	0.82	0.93	0.93
User commitment	0.89, 0.89, 0.88, 0.91	0.80	0.94	0.92
IS infusion	0.88, 0.85, 0.87, 0.85	0.92	0.74	0.89

Next, we assessed the discriminant validity of the measurement model. As shown in Table IV, the square root of AVE for each construct exceeded the correlations between the construct and other constructs (off-diagonal terms). Because of the high correlation between IS infusion and user commitment (correlation coefficient = 0.70), we conducted a second test of discriminant validity using a process of constrained testing (Anderson and Gerbing, 1988). A χ^2 difference test is used to compare the results between the constrained model and the original model. Discriminant validity is established if the χ^2 difference is significant. Based on this approach, the pairwise constrained test is conducted. The χ^2 difference is found to be significant ($\Delta\chi^2 = 136.37$, $\Delta df = 1$, $p < 0.001$). Hence, discriminant validity of the measurement model is established. We further tested our data for common method variance using the Harman's single-factor test (Harman, 1960), where the threat of common method bias is high, if a single factor accounts for more than 50 percent of the variance. The first factor explained 41.07 percent. The test showed that common method bias is not likely to be an issue in our sample.

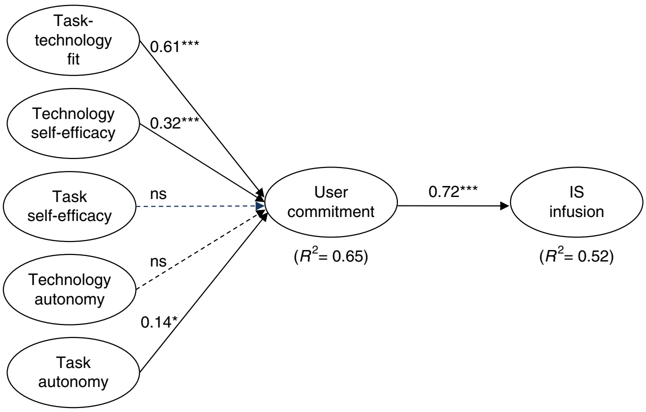
5.2 Hypothesis testing

We tested the hypotheses by applying the bootstrapping re-sampling technique. Figure 3 shows the results of the structural model. User commitment has a significant

	Mean (SD)	TTF	TCF	TSF	TST	TCT	CMM	INF
TTF	4.88 (1.25)	*0.89*						
TCF	4.97 (0.98)	0.36	*0.92*					
TSF	4.82 (0.99)	0.33	0.42	*0.84*				
TST	4.37 (1.23)	0.09	0.43	0.53	*0.86*			
TCT	4.39 (1.25)	0.31	0.66	0.30	0.45	*0.91*		
CMM	4.7 (1.27)	0.71	0.56	0.38	0.23	0.42	*0.89*	
INF	4.4 (1.14)	0.57	0.65	0.33	0.28	0.55	0.70	*0.86*

Notes: TTF, task-technology fit; TCF, technology self-efficacy; TSF, task self-efficacy; TST, task autonomy; TCT, technology autonomy; CMM, user commitment; and INF, IS infusion. Leading diagonal in italics font shows the square root of AVE of each construct

Table IV. Correlations between latent variables



Notes: ns, insignificant at the 0.05 level. *$p<0.05$; **$p<0.01$; ***$p<0.001$

Figure 3. Structural model testing results

effect on IS infusion (*H1*), explaining 52 percent of its variance. Task-technology fit (*H2*), technology self-efficacy (*H3*), and task autonomy (*H6*) have significant effects on user commitment, explaining 65 percent of its variance. However, we could not find significant effects of task self-efficacy (*H4*) and technology autonomy (*H5*) on user commitment. We further tested for multi-collinearity among the constructs. In each case, the variance inflation factor was below 10 and the condition index was less than 30, indicating that multi-collinearity is not likely to distort the testing results of our study (Hair *et al.*, 1998).

We conducted a *post hoc* analysis to check for the mediating effect of user commitment on the relationships between the STS design factors and IS infusion following the Baron and Kenny (1986)'s approach (see Table V). We tested the main effects of the five STS design factors on IS infusion in Model 1. We then tested the main effects of the job design factors and the mediator, user commitment, on IS infusion in Model 2. After adding the mediator, the path coefficients of task-technology fit and technology self-efficacy were still significant. The path coefficients were reduced after adding the mediator, which explains the partial mediation effect of user commitment for task-technology fit and technology self-efficacy.

We further conducted Sobel tests to examine the significant level of mediation effects (Sobel, 1982). Regarding task-technology fit, its decrease in path coefficient from Model 1 (0.37) to Model 2 (0.13) was significant at the 0.001 level ($z = 4.94$). Regarding technology self-efficacy, its decrease in path coefficient from Model 1 (0.42) to Model 2 (0.29) was significant at the 0.001 level ($z = 3.58$). This study, however, did not find any directly significant effect of the other two STS design factors, task self-efficacy and task autonomy, on IS infusion. Although we did not find a significant relationship between technology autonomy and user commitment, a *post hoc* analysis shows the direct significant effect of technology autonomy on IS infusion.

We have further identified an alternative model by considering the mediation test results and potential relationships between the STS design factors. The direct relationships of the three STS design factors with IS infusion are proposed based on the mediation test results. Regarding the relationships between the STS design factors, an individual who exhibits autonomy (i.e. self-determination) fully endorses the actions in which he is engaged (Deci and Ryan, 1987). Autonomy therefore leads an individual to feel responsible for his or her assignment. Employees tend to increase skills and knowledge in their assignment to achieve better performance. For this reason, autonomy in task and technology should increase self-efficacy (i.e. competence) in task and technology, respectively. Both task self-efficacy and technology self-efficacy

Table V.
Mediation test

Independent variable	Path coefficient (Model 1, main effects on user commitment)	Path coefficient (Model 2, main effects on IS infusion)	Path coefficient (Model 3, main effects on IS infusion)	Sobel test (z-value)
Task-technology fit	0.61***	0.37***	0.13*	4.94***
Technology self-efficacy	0.32***	0.42***	0.29***	3.58***
Task self-efficacy	ns	ns	ns	ns
Task autonomy	0.14*	ns	ns	ns
Technology autonomy	ns	0.16*	0.16*	ns
User commitment	–	–	0.40***	–
R^2		0.57	0.64	

Notes: ns, insignificant at the 0.05 level. *$p < 0.05$; ***$p < 0.001$

should then increase an individual's job performance based on the use of technology in performing task (i.e. task-technology fit). The alternative model explains that task related factors (task self-efficacy and task autonomy) affect IS infusion only indirectly through user commitment while technology related factors (technology autonomy and technology self-efficacy) affect IS infusion directly and indirectly through user commitment.

We also conducted a power effect analysis using G*Power software for ascertaining the robustness of the original and the alternative model. The power effect analysis results explain that the effect size obtained are much greater than the required effect size (0.055 for the original model and 0.047 for the alternative model).

6. Discussion and implications

6.1 Discussion of findings

This research has several salient findings. One key finding in this study is the significant role of user commitment (i.e. affective commitment) in explaining IS infusion. User commitment as a psychological attachment to the use of IS in performing tasks had a positive effect on IS infusion, using the system to its full potential beyond the mandated usage, as a type of OCB and proactivity. This finding is in line with previous research explaining commitment as a key antecedent of OCB (Meyer and Allen, 1991; Morrison, 1994; Pare and Tremblay, 2007). User commitment as a heightened motivation state inspires employees to go beyond the mandated use of IS to further exploit the full potential of the system and use more system features and using the system more innovatively. Motivated employees with user commitment thus perform not only intra-role behaviors (i.e. customary use of IS) but also extra-role behaviors volitionally in the use of IS.

The other key finding is the identification of antecedents of user commitment. In particular, this study identified the antecedents of user commitment from the STS design perspective. The survey results indicate that three STS design factors (task-technology fit, technology self-efficacy, and task autonomy) significantly affect user commitment. This finding conforms to the theoretical argument of previous research (Hackman and Oldham, 1976). The effect of task-technology fit on user commitment in this study is similar to the effect of task-technology fit on organizational commitment (Speier and Venkatesh, 2002) and the relationship between perceived usefulness and user commitment to system use (Malhotra and Galletta, 2005). Both perceived usefulness and task-technology fit (i.e. job fit) are root constructs of performance expectancy in the unified theory of acceptance and use of technology (UTAUT) (Venkatesh *et al.*, 2003). The effect of technology self-efficacy on user commitment in this study is similar to the effect of an individual's ability at work on the commitment toward the work (Chang *et al.*, 2010). The effect of task autonomy on user commitment is also in conformation to the theoretical argument of Deci and Ryan (1987). Because IS usage is essential for performing tasks, task autonomy motivates an individual's interest and involvement in using the target system.

However, this study did not find a significant effect of technology autonomy on user commitment. The *post hoc* analysis (see Figure 4) revealed the significant direct effect of technology autonomy (path coefficient = 0.16, $p < 0.01$) on IS infusion and its indirect influence on user commitment through technology self-efficacy (path coefficient = 0.66, $p < 0.001$). The additional finding of direct effect of technology self-efficacy on IS infusion is in line with the previous research (Koo *et al.*, 2015) demonstrating the significant effect of user competence on the subtypes of IS infusion. Additionally, this study did not find a significant relationship between task self-efficacy on user commitment. The *post hoc* analysis (see Figure 4) revealed that task-self efficacy affects user commitment indirectly

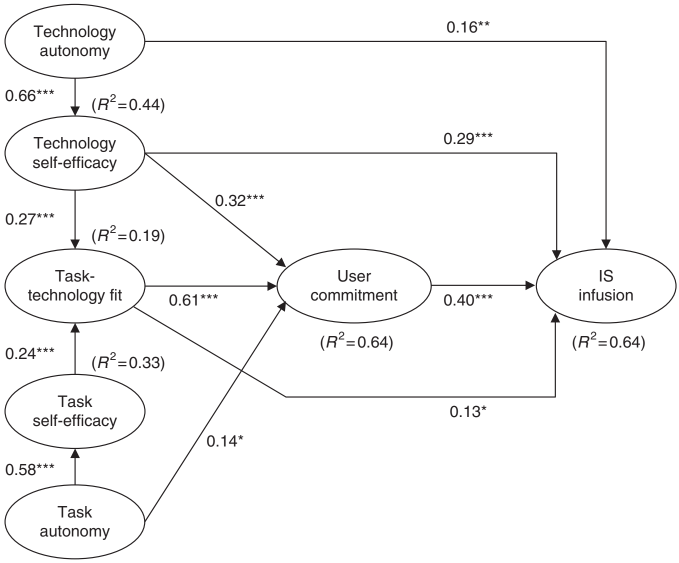


Figure 4.
Alternative model testing results

Notes: ns, insignificant at the 0.05 level. $*p<0.05$; $**p<0.01$; $***p<0.001$

though task-technology fit (path coefficient = 0.24, $p < 0.001$). These findings explain that IS infusion is mainly influenced by technology related STS design factors (technology autonomy and technology self-efficacy) as well as user commitment directly. A potential reason for technology related factors influencing IS infusion directly could be the prevalence of IT artifact in organizations implementing Information Systems. Because IS allows users (particularly curious ones) to experiment and continuously learn and update, the autonomy in using technology would lead to IS infusion. In contrast, task related STS design factors (task self-efficacy and task autonomy) influence IS infusion indirectly through user commitment. The interaction factor between task and technology, task-technology fit, influences both user commitment and IS infusion. For IS representing an IT artifact, unless there is a fit between the task, the technology and the user, there will not be user commitment. In other words, even if a person is an expert in performing various tasks, the support of technology is needed for the task to be performed better resulting in user commitment.

6.2 Limitations and future research directions

The results of this study should be interpreted in the context of its limitations. First, the data for this study was collected from a single organization with a specific enterprise system. It would be useful to replicate this study across other enterprise systems in organizations in different sectors to establish the robustness of the results. Second, this study adopted IS infusion as a single dimensional construct. Saga and Zmud (1994) explained there are three subtypes of IS infusion: extended use, emergent use, and integrative use. This might have led to over-simplification of IS infusion construct which is a multi-dimensional one. No research, however, has tested the validity of the concept concerning the true nature of IS infusion. Future research could examine the nature of IS infusion (i.e. its subtypes). Future research could also collect objective data regarding IS infusion; only subjective perception data was used in this study. Third, this study measured user commitment, primarily in terms of affective commitment. Future research may measure commitment as a second order construct based on normative, continuance and affective commitment or measure it separately and examine the relative importance of the three types of commitments. Lastly, our research shows that technology related factors lead to IS infusion directly, but task related factor do so through task-technology-fit and user commitment which highlights the importance of IT artifact in influencing IS infusion. Future research may look into applying the alternative model to different varieties of IS and find out the importance of IT artifact in influencing IS infusion.

6.3 Implications for research

This study offers a few interesting implications for research. First, this study provides a key theoretical implication in terms of the application of commitment theory in examining IS infusion. Previous research examined IS infusion based on background theories used for explaining technology adoption (Jones *et al.*, 2002; Saeed and Abdinnour-Helm, 2008, 2013; Thatcher *et al.*, 2011), IS continuance (Hsieh and Wang, 2007; Wang and Hsieh, 2006), and the theory of reasoned action (Ke *et al.*, 2012/2013; Sundaram *et al.*, 2007) and found several significant antecedents such as satisfaction (Wang and Hsieh, 2006), perceived usefulness (Hsieh and Wang, 2007; Saeed and Abdinnour-Helm, 2008; Wang and Hsieh, 2006), personal innovativeness (Jones *et al.*, 2002), attitude (Jones *et al.*, 2002), and facilitating conditions (Jones *et al.*, 2002). Using the system to its full potential (i.e. IS infusion) requires IS use beyond the prescribed or mandated usage. IS infusion, however, requires each user to engage in extra-role behaviors as well as intra-role behaviors related to system usage at work. On the contrary, IS adoption and continuance does not necessarily require extra-role behaviors. Users can use the system by only following the management's prescribed and standardized usages. Therefore, there is a limitation in explaining IS infusion based on the current theoretical lenses used for technology acceptance and IS continuance.

Organizational citizenship behavior can be caused by commitment (Meyer and Allen, 1991; Morrison, 1994; Pare and Tremblay, 2007). The main contribution of this study is thus the application of commitment theory in examining IS infusion as a type of organizational citizenship behavior. We have further proposed user commitment (i.e. affective commitment) as the main antecedent of IS infusion because continuance commitment and normative commitment have weak or insignificant effects on organizational citizenship behavior (Meyer *et al.*, 2002; Morrison, 1994). Our findings explain that user commitment as a psychological attachment to the use of IS in performing tasks increases IS infusion. While previous research on IS infusion has identified some antecedents of IS infusion including attitude (Jones *et al.*, 2002), novel situations and discrepancies (Sun, 2012), and work system cooridination (Hsieh *et al.*, 2011), no research has considered user commitment to the use of IS.

This study also contributes to current literature by examining user commitment from the STS design perspective. Most previous researches on examining antecedents of user commitment are characterized by exploratory findings (Chang *et al.*, 2010; Doll and Torkzadeh, 1989; Li *et al.*, 2006; Newman and Sabherwal, 1996; Shaw and Edwards, 2005). There has been a lack of theoretical approach in identifying antecedents of user commitment. Going beyond previous research, this study has adopted the STS design perspective (Bostrom and Heinen, 1977; Leavitt, 1989). Job design has been a key approach used in promoting employees' commitment (Hackman and Oldham, 1976). Because of user commitment regarding the use of IS in performing tasks, job design should consider not only task but also technology elements. We have thus adopted the STS for job design and then examined the effect of STS design on user commitment. STS has been used for explaining the organizational design for achieving the success of IS (Bostrom and Heinen, 1977). This study thus adds value to the literature by identifying five constructs representing the STS design and demonstrating their effects on user commitment and IS infusion and relationships between the STS design factors.

This study also contributes to the theoretical knowledge of the application of STS design. The STS is based on Levitt's organization model (Levitt, 1968), which explains that an organization consists of four main elements: task, people, structure, and technology. By separating the organization model (Levitt, 1968) into two subsystems (i.e. a social system composed of people and structure and a technical system composed of technology and tasks), Bostrom and Heinen (1977) highlighted the importance of joint interaction between the two systems in producing better results of the work system, especially in the context of IS. The key implication of the STS is thus the management of joint interactions among elements. However, there has been little research on the use of STS in job design and testing the effects of interactions on user behavior in the IS literature. This study therefore contributes to the application of the STS, especially in the interactions among elements, in examining user behavior. In summary, this study proposes and validates a new model for user commitment and IS infusion based on the application of commitment theory and the STS.

We also identified an alternative model based on mediation test results regarding the influence of STS design factors on commitment and infusion. The alternative model reveals that IS infusion is mainly influenced by technology related STS design factors (technology autonomy and technology self-efficacy) as well as user commitment directly, whereas task-related factors influence through task-technology fit and user commitment. In other words, the presence of IT artifact is important for IS infusion to occur.

6.4 Implications for practice

The results of this study offer suggestions to management for improving IS infusion in terms of User commitment and, consequently, how to develop user commitment based on the STS design. First, management should be aware of the critical effect of user commitment on IS infusion. Many IS development projects tend to focus on finishing the project by developing an easy-to-use and useful system. Development of such a system, however, does not guarantee the full utilization of the system by users (Malhotra and Galletta, 2004). Using the system to its full potential requires employees to use the system beyond its prescribed use. This study explains that user commitment is essential for IS infusion. Management should therefore focus on developing user commitment.

Second, management should be aware of the effect of the STS design on user commitment. Our results indicate that the three STS design factors (task-technology fit, technology self-efficacy, and task autonomy) are essential for the development of user commitment directly. Task-technology fit represents the joint interaction between task and technology. This study explains that task-technology fit increases IS infusion directly and indirectly through user commitment. Management should therefore enhance the fit between organizational tasks, people, and IS during the IS development project or even after the development. The project team also needs to collect and analyze user requirements and preferences for task specifications and reflect them correctly in the system design for increasing task-technology fit.

Technology self-efficacy represents the interaction between people and technology. Management should enhance the fit between them (i.e. users' technical skills in using the system). This study explains that technology self-efficacy increases IS infusion directly and indirectly through user commitment. Methods of improving employees' knowledge, skills, and confidence include training, participation in system acquisition, and increased exposure (Saga and Zmud, 1994). Educational efforts can also inform employees throughout the organization about the potential applications of technology to achieve better performance and results. Many IS development teams tend to provide system training that is very specific to users when the new system is put into operation. However, to encourage fuller utilization of the technology, more general and advanced training should be provided for increasing technology self-efficacy.

Task autonomy represents the interaction among people, structure, and task. Management should provide authority for users to regulate and perform tasks. Many IS development projects do not consider such task authority issues. The results of this study, however, suggest that task authority design is important for enhancing user commitment and consequently, IS infusion. The development team should therefore collaborate with the management team in task authority design during the system development project.

Finally, the *post hoc* analyses highlight the critical impact of technology autonomy on IS infusion and its indirect impact on user commitment through technology self-efficacy. An individual user's authority in using and regulating the system is required for IS infusion depending on the type of task (e.g. data analytics). Hence, the project development team should design technology authority for each user by considering the user's task type during the project. To reduce ambiguity and increase autonomy at work including both task and technology, organizations should have a clear yet slightly flexible structure that informs employees of their authority. A clear organizational structure for authority reduces role ambiguity and increases employees' senses of responsibility and confidence in their work, and some flexibility allows employees the freedom to utilize their creativity to enhance their work. It clearly empowers employees and contributes to IS infusion.

Notes

1. www.gartner.com/newsroom/id/1668214
2. www.idc.com/getdoc.jsp?containerId=prUS24078113
3. Theory of Trying (Bagozzi and Warsaw, 1990) focuses on the assessment of trying to act rather than the act itself.
4. The meaning of interaction between task and technology will change depending on the people component. For some employees, the fit between task and technology can be high. For others, the fit between task and technology can be low. The interaction between task and technology will therefore have clearer meaning if we consider people component additionally. For this reason, we added people component to the interaction between task and technology, people-technology-task.
5. The authority may have different meaning depending on the domain. If the domain of authority is task, an individual can have an authority in performing the tasks. If the domain of authority is technology, an individual can have an authority in using the information system. For this reason, we consider the application domain of authority additionally to the interaction between people and structure, people-structure-task and people-structure-technology.

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Appendix

Construct	Item	Wording
Task-technology fit (TTF)	TTF1	Use of the system can decrease the time needed for my important job responsibilities
	TTF2	Use of the system can significantly increase the quality of output of my job
	TTF3	Use of the system can increase the effectiveness of performing my job tasks
	TTF4	Use of the system can increase the productivity in my job for the same amount of effort
	TTF5	Considering all tasks, the general extent to which use of the system could assist on my job is very high.
Technology self-efficacy (TCF)	TCF1	I have complete knowledge for using the system
	TCF2	I am very capable in using the system
	TCF3	I have mastered the skills necessary for using the system
	TCF4	I am confident about my ability to use the system
	TCF5	I am self-assured about my capabilities to use the system
Task self-efficacy (TSF)	TSF1	I have complete knowledge for performing my tasks
	TSF2	I am very capable in performing my tasks
	TSF3	I have mastered the skills necessary for performing my tasks
	TSF4	I am confident about my ability to perform tasks
	TSF5	I am self-assured about my capabilities to perform tasks
Task autonomy (TST)	TST1	I can decide on my own how to go about doing my tasks
	TST2	I have significant autonomy in determining how to perform my tasks
	TST3	I have considerable opportunity for independence in how I perform my tasks
Technology autonomy (TCT)	TCT1	I can decide on my own how to use the system
	TCT2	I have significant autonomy in determining how to use the system
	TCT3	I have considerable opportunity for independence in how I use the system
User commitment (CMM)	CMM1	I am enthusiastic about using the system in my tasks
	CMM2	I am very happy to use the system in my tasks
	CMM3	I feel emotionally attached to the system usage in performing tasks
	CMM4	System usage in performing my tasks has a great deal of personal meaning for me
IS infusion (INF)	INF1	I make the best use of the system to support my tasks
	INF2	I use the system to its fullest potential in performing my tasks
	INF3	I use all capabilities of the system in best fashion to complete my tasks
	INF4	I doubt that there are any better ways for me to use the system in performing my tasks

Table AI. Measurement instrument

Corresponding author
Hock Chuan Chan can be contacted at: chanhc@comp.nus.edu.sg