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Infusing with ERP Systems: A Longitudinal Investigation of the Impact of Control and Empowerment

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INFUSING WITH ERP SYSTEMS: A LONGITUDINAL INVESTIGATION OF THE IMPACT OF CONTROL AND EMPOWERMENT

Research-in-Progress

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Abstract

Organizations have made significant investments in ERP systems with the strategic expectation that employees will utilize this technology to enhance organizational performance. However, research indicates that ERP systems are under-utilized. In order to entangle the challenge of under-utilization, this paper addresses the impact of control and empowerment on infusion – the deep and comprehensive usage of an information system. We apply a longitudinal design with two measurements to research whether the level of infusion of ERP users changes over time, and if so to what extent. Moreover we hypothesize that 'soft' characteristics like the organizational position, organization commitment and trust influence the relation between control, empowerment and the level of infusion of the ERP user. A survey was conducted in a large public organization which has been using an ERP system for several years. A sample of 178 matched pairs (For T1 and T2) of ERP system users and their supervisors has been collected. In this research in progress we present the theoretical mechanisms and methodological framework we employed for the data collection.

Keywords: Control, Empowerment, Enterprise Resource Planning Systems, Infusion, Longitudinal Research, Organizational Commitment, Trust

Introduction

ERP systems are commercial software packages that integrate the information flowing through a company – financial, accounting and customer information. These systems offer organizations benefits such as improved integration of business processes, improved decision making and higher profitability (Dery, Grant et al. 2006). Estimates indicate that despite the high implementation rates of ERP systems (75% of all large organizations), ERP failures account for over 60 percent (Morris and Venkatesh 2010). While the stories about the large number of ERP failures continue to exist, Yu et al. (2009) argue that even if a system is implemented successfully, this does not automatically mean that the organizational will perform better. When the users of the technology do not use it to its full extent, the benefits of information systems are unlikely to be obtained and subsequent increases in performance will stay out (Cooper and Zmud 1990). In order to understand how full system usage can be increased, more should be known about factors influencing this type of system usage, namely infusion. Infusion is the deep and comprehensive usage of an information system (Cooper and Zmud 1990). More insight in these specific effects could help organizations manage these factors and subsequently improve and optimize infusion. An ERP system fundamentally changes the nature of tasks, workflows and, by extension, jobs themselves (Morris and Venkatesh 2010). One of these organizational changes is an increase in control and empowerment which employees may perceive when using an ERP system (Elmes, Strong et al. 2005). First, ERP systems are structured to support control in many ways. ERP systems promote organizational discipline through constraining users to follow prescribed processes and by limiting access to transactions to specific organizational roles. According to Elmes, Strong et al. (2005) this mirrors bureaucratic features such as the application of consistent rules to operations and a clear-cut division of labor with specialized experts in each position. In this way, ERP systems can be used to support organizational control because of their ability to standardize and integrate processes. Second, studies recognize the empowering aspect of ERP systems (Sehgal and Stewart 2004). Due to increased visibility of data and expanded job scope, employees can become more responsive to others within the organization. Therefore ERP systems can be empowering because they increase both user accountability and autonomy: users receive ownership of the system.

Prior research (Sia et al. 2002; Ng & Kim, 2009; Maas et al., 2012) has acknowledged that control and empowerment induced by an ERP system can lead to lower or higher levels of infusion, dependent on the way ERP users perceive the ERP system. However, it is still unknown in which way and to what extent usage behaviours of ERP users change over time (Tennant et al. 2010) and how personal characteristics of employees affect the relationship between control, empowerment and infusion. In order to cover this specific gap in the literature, we will apply a longitudinal research approach, including the effects of work commitment and organizational position of the ERP users on the relation between control, empowerment and infusion. In this paper we elaborate on the theoretical underpinnings and the methodological framework of this research in progress.

Innovating with ERP: Infusion

System usage can be captured by the six-stage model of Cooper and Zmud (1990). The first three phases (initiation, adoption, and adaptation) focus on initial acceptance of the new technology while the last three stages explain ERP system usage in the postacceptance stage. These last three stages of the six-stage model include Acceptance, which is reflected by the users' commitment to use the system. Routinization can be seen as the state where the users of the information system perceived the usage of the ERP system no longer as out-of-the-ordinary while Infusion relates to the deep and comprehensive usage of an information system. In this study we will focus on the latter post-acceptance IS usage behaviour called infusion and which refers to innovative ERP system usage. Ng and Kim (2009) relate infusion to the concept of organizational citizenship behaviour (OCB) as innovating with the ERP system is an extra-role behavior without any formal reward. Moreover, we argue that the level of infusion varies across employees. This post-acceptance behaviour may differ as employees exhibit significant variance in the extent to which they innovate with the ERP system and try to apply it in novel ways to their work tasks (Li et al. (2013). In this study, infusion is regarded as a multi-dimensional concept and consists of three subtypes. Extended use is defined as using most, if not all, of the system features to complete tasks (Wang

2005). Integrative use can be seen as using the system to establish, enhance or reinforce linkages among tasks (Ng and Kim 2009) while emergent use is defined as using the system in an innovative manner to support tasks (Saga and Zmud 1994).

Control and Infusion

Kayas et al. (2008) define organizational control as: 'attempts by the organization to increase the probability that individuals will behave in ways that will lead to the attainment of organizational objectives'. Assuming that organizations have objectives and that individuals working in organizations are purposeful and goal seeking, their goals may differ from the ideal state. Therefore controls are necessary to engage workers in instrumental rational action that is aligned with the firm's objectives.

The 'panoptic' characteristics of ERP allow management a greater ability to verify procedural adherence (Sia, Tang et al. 2002). This metaphorical panopticon is a circular building, mainly used within prisons, with an observation tower in the center, surrounded by cells for the incarceration of convicts. Due to this specific design the tower provides the ability to 'gaze': continuous surveillance that is hierarchical (the observers can observe prisoners and can themselves be observed by their superiors) and one-way (the prisoners cannot observe the observer, cannot observe each other and cannot know whether they are being observed). Due to the continuous surveillance individuals learn to self-discipline and 'control' themselves. Zuboff (1988) was the first author to consider IT as a form of an information panopticon which exerts the 'gaze' through IT-based representations. Since all user actions can be observed and information can be stored real-time within an integrated common database, ERP systems are able to provide a 'gaze' on a continuous basis (Zuboff 1988).

A growing body of work has demonstrated the capability of ERP systems to allow greater monitoring of users and the ability to enforce compliance and reduce trust between employees (Lowe and Locke 2008). When ERP users perceive a high level of control, the subordinates are less inclined to use the system extensively (Murphy, Chang et al. 2012), because the 'control aspects' of the ERP system would distract them from their work tasks. Also, when ERP users feel controlled extensively due to the ERP system tracking capability, they also perceive to be less trusted and relied on by the organization (Teoh and Teo 2010). This will lead to less motivation for users to appropriate all the functions of an ERP system or experiment with it in innovative ways. Hsieh and Wang (2007) indicate that although usage may be compulsory, employees still have the discretion about the level of use, or how to use the system to support their tasks. This means that control may lead to a certain level of usage but that it is detrimental to the extra role level of usage, namely infusion.

On the other hand a lower level of perceived control could also be detrimental to the level of system infusion because of a 'shortage' of discipline: users experience no feeling of being under control whatsoever and therefore do not engage in any extra role usage behaviour (Sia et al. 2002). Therefore we argue that a curvilinear or 'inverted U' relationship exists between the perceived control and the infusion of an ERP user. This means that a high level of perceived control during T1, will lead to users with a low level of infusion during T2. The same will happen when ERP users perceive a very low level of control during T1. However, we pose that an optimal, intermediate point of perceived control at T1 will lead to a higher level of infusion at T2. Therefore it is hypothesized:

H1A: The higher the level of control perceived by the ERP user during T1, the lower the level of infusion of the ERP user will be during T2.

H1B: The lower the level of control perceived by the ERP user during T1, the lower the level of infusion of the ERP user will be during T2.

H1C: An optimal (intermediate) level of control during T1, will induce a higher level of infusion of the ERP user during T2.

Empowerment and Infusion

Next to increases in control, others studies also highlight the potential of ERP to facilitate effectiveness aims by enabling decentralised decision-making, empowerment and job enrichment (Benders, Schouteten

et al. 2009). Murphy et al. (2012) indicate that although an ERP system can act as a way of management control, it can also offer ERP users a mighty tool. Empowerment can be seen as 'any increase in worker power that enables workers to achieve institutional objectives with greater efficiency and effectiveness' (Elmes et al. 2005: 5). It rationalizes the system by removing or minimizing organizational barriers and giving employees means (information, authority and autonomy) by which they can achieve institutional objectives more efficiently and effectively. ERP characteristics such as greater access to information, improved opportunities to utilise and manage data and the capacity to decentralise decision-making are likely to result in more autonomous working conditions for all users and are subsequently an enabler for empowerment for the users of such a system (Kayas, McLean et al. 2008).

The means of authority, autonomy and information that enable empowerment can all be provided by a range of specific ERP characteristics. Increases in both information and autonomy can emerge due to process-oriented job expansion of ERP systems (Sia, Tang et al. 2002). This promotes greater cross-functional integration like expanding a worker's job scope. It also allows them to make decisions that previously had to be formally referred upwards in the hierarchy or to another department. In this way, increases in information and knowledge will increase the power of users to get their work done. For example, a sales clerk in an ERP context where finance and material management are integrated, may simultaneously prepare sales invoices, receive cash, and order replacement inventory. The expanded job scope has thus made the jobs of some users more significant or 'powerful' than before, which directly contradicts the traditional control principle of 'segregation of duties' in the accounting and auditing literature. Ng and Kim (2009) denote that an empowered employee will exhibit extra role behavior like work proactivity, including innovative behaviors like infusion. Therefore it is hypothesized:

H2: The higher the level of empowerment a user of an ERP system experiences during T1, the higher the level of infusion of an ERP system user will be during T2.

Organizational Position

We pose that managerial and operational users moderate the relationship between control and infusion and empowerment and infusion. They have different tasks, and use different features of the ERP system; therefore they will be affected in different ways leading to variations in the amount of infusion they engage in (Benders et al. 2006; Murphy et al. 2012). We distinguish two types of ERP users, the managerial and the operational user. The former is mainly occupied with the analytical features of ERP, generating reports and accessing data from other functional areas. The operational user however, is responsible for actions like data capture, entry and processing. A case study conducted by Murphy et al. (2012: 159) indicated that during the usage of the same ERP system, operational users felt 'digitally handcuffed' by password controls, data entry protocols and process flow requirements while managerial users experienced cognitive growth since the ERP system offered them better decision making abilities and report availability. With regard to autonomy, Hall (2002) shows that operational users are likely to lose relatively more autonomy than their managerial counterparts due the introduction of an ERP system. Operational users were more restrained by their new levels of authorisation, while managerial users gained features like better audit capacity and user accountabilities. Due to these differences in tasks, used features and changes in autonomy we argue that the organizational position of the ERP users moderates the relation between control, empowerment and infusion. Therefore we hypothesize:

H3A: The organizational position of the ERP user moderates the relation between the level of perceived control of the ERP user and the level of infusion of the ERP user.

H3B: The organizational position of the ERP user moderates the relation between the level of empowerment of the ERP user and the level of infusion of the ERP user.

Work Commitment

Next to the concepts of control and empowerment, which are mainly determined by the design and configuration of the ERP system, we argue that individual characteristics of users moderate the relation between control, empowerment and infusion. In this study we include work commitment (Cooper-Hakim and Viswesvaran 2005) as a moderating variable, since it may affect the amount of control that is

tolerated by the ERP users and subsequently it may amplify the perceived level of empowerment experienced by the ERP users. Work commitment has been defined as 'the strength of an individual's identification with and involvement in a particular organization' (Porter et al. 1974, p. 604). A person who has a high level of work commitment wants to stay with his or her organization, work for the good of the organization, and adhere to the prominent values of the organization (Cooper-Hakim and Viswesvaran 2005). Employees who have high work commitment will be bothered less by higher amounts of control resulting an from ERP system than their less committed counterparts (Van Maanen 2010). After all, employees with a high level of work commitment are likely to adhere to the values of the organization and will be more tolerable towards the newly gained control and monitor capacities by the ERP system of the management than their less committed operational colleagues. This is also the case for empowerment. ERP users with high levels of work commitment are more likely to engage in empowerment than their counterparts with lower levels of commitment. Infusion is an extra-role behaviour that can not be induced by instrumental rewards (Ng and Kim, 2009). However, the effect of empowerment can be increased by intrinsic motivators like work commitment. Therefore we argue that work commitment moderates the relation between control, empowerment and infusion.

H4A: The level of work commitment of the ERP user moderates the relation between the level of perceived control of the ERP user and the level of infusion of the ERP user.

H4B: The level of work commitment of the ERP user moderates the relation between the level of empowerment of the ERP user and the level of infusion of the ERP user.

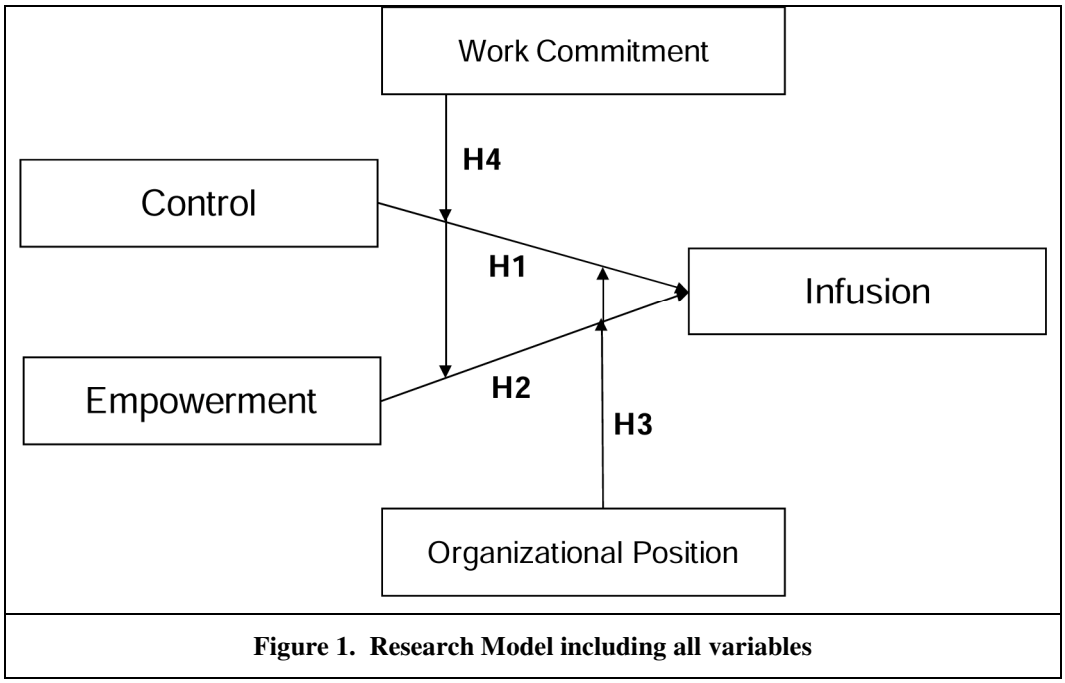

Figure 1. Research Model including all variables

Methodological Framework

Data Collection, Sample and Procedures

The data have been collected within a public-sector organization which employs around 60,000 people. The organization has implemented an organization-wide ERP system in order to integrate financial and logistics material management. In this longitudinal design we conducted two measurements, T1 and T2.

The first measurement has been conducted after the system has been live for one year (12 months) while the repeated measurement has been taken after the ERP system has been up and running for over two years (25 months).

During the first measurement (T1) 450 users out of the organization were randomly selected across functions and departments and approached with a request to answer the survey. A total of 289 complete responses were returned. The response rate of the sample of ERP users was 64.2%. From the respondents' units, all supervisors filled in a survey to rate the degree of infusion and performance of their employees. In total, 81 out of the 97 supervisors (83.5%) rated their subordinates, resulting in 226 matched pairs during of supervisors and ERP users at T1. During the second measurement (T2) we could match 178 of the 226 respondents of T1, resulting in a response rate of 78,2%. We were able to match the ERP users of T1 and T2 by linking their personnel identification numbers.

Although Li et al. (2013) state that infusion is hard-to-observe for others than the ERP users themselves, we argue that supervisors are more than able to rate the extent of innovative use of their subordinates. In the organization in this study the supervisors have direct supervision over only five ERP users on average. Next to that, the supervisors also have extensive reports about the features used by the ERP users and about the transactions they have executed. This made it possible for supervisors to provide a detailed rating about the level of infusion of their subordinates. By obtaining the measures of the predictor and criterion variable from different sources we could diminish common method variance (Podsakoff et al., 2003). Next to that, we also controlled for non-response bias by comparing the respondents with non-respondents and dropouts (in case of T2) and none of these comparisons revealed any sample bias.

Measures

Control Variables

Gender, age, tenure, job level and former IT experience have been included in the research model to control for their effects on infusion. Especially former IT experience is an important control variable. Ifinedo (2011) found that employees with computer/IT literacy or knowledge can work better with the new ERP system and are better at understanding the technical and semantic qualities of such systems. Next to that, perceived usefulness and perceived ease of use were included to control for their effects on infusion. These variables are deemed important to the initial acceptance of ERP systems (Davis 1989) and might influence the amount of infusion of the ERP user.

Control and Empowerment

Control has been measured using the control scale of Sia et al. (2002). This scale consists out of three dimensions: 'system tracking capability', 'enhanced visibility to peers' and 'enhanced visibility to management'. Empowerment has been measured using different dimensions from two separate empowerment scales. The dimension 'procedural formality' from Sia et al. (2002) has been used in the survey, next to the four dimensions of the empowerment scale (Ng and Kim 2009) consisting of 'user competence','usage meaning','usage impact' and 'user self-determination'.

Infusion (ERP User and Supervisor)

Infusion has been incorporated in both the survey for ERP users as their supervisors. The items for this scale originate from Saga and Zmud (1994). Still, the slightly adapted scales of Hsieh and Wang (2007) have been used since these scales have been found to be valid more recently. This scale consists of three dimensions: 'extended use, integrative use and emergent use'. A separate survey had to be filled in by the supervisor of each ERP user. The supervisors rated how 'infused' their subordinates are with the ERP system. The validity of this rating stems from supervisors' cooperation with their subordinates. Moreover, supervisors submitted reports about the system usage behavior of their subordinates. The questions for the supervisors were rephrased version of the scale the ERP users had to answer. For example 'I use the ERP system in novel ways to complete my tasks' was rephrased to 'The ERP user uses the ERP system in novel ways to complete his/her tasks' (See Appendix for the detailed survey).

Work Commitment and Organizational Position

Work commitment has been measured by using the different items developed by Mowday et al. (1982) and Cooper-Hakim and Viswesvaran (2005). We also included the distinction between operational users and managerial users. For the purpose of this research, a user is defined as someone working in a functional, operational or management unit of an organization. The main difference between these types of users is whether they supervise other ERP users and if they have authority to use reporting and monitoring features of the ERP system.

All items of the survey made use of a five-point Likert scale, with anchors ranging from Strongly Disagree (1) to Strongly Agree (5). After entering all questionnaires, the reliability of the scales have been tested by examining the Cronbach's alpha of the scales. All were higher than the recommended 0.700 (Bryman 2008).

Further Research

Momentarily we are analyzing the data using longitudinal techniques including structural equation modeling (SEM) in order to control for the measurement errors across the two measurements (Lang et al. 2011) and Hierarchical Linear Modeling (HLM, see Porter and Umbach, 2001). The preliminary results indicate that our hypotheses are initially confirmed, however more detailed analysis have yet to be completed in the coming months. The main goal of this study is to show that the post-acceptance usage behavior of infusion can change over time using a longitudinal approach. Moreover, we aim to indicate that the usage behavior of ERP users can be affected by both technological concepts like control and empowerment while these concepts are moderated by 'softer' aspects including organizational position and work commitment. This aim is in line with the notion of Tennant et al. (2010), who propose that more comprehensive research is necessary to further disentangle the concept of infusion.

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Appendix Measures

Variables	Items
Control: system tracking capability Sia et al. (2002)	1) The ERP system provides very complete information about how well or badly I have done my work. 2) The ERP system provides very accurate information about how well and badly I have done my work. 3) The ERP system provides very immediate information about how well and badly I have done my work. 4) The ERP system provides very reliable information about how well or badly I have done my work.
Control: enhanced visibility to management: Sia et al. (2002)	1) If there is an error in the ERP, it is very easy for my supervisor to trace when, where, and by whom it was committed. 2) The ERP system provides the supervisor with very detailed information on the source of error. 3) My supervisor is constantly updated on the status of my work performance. 4) My supervisor is highly aware of any mistakes I have committed in my work.
Control: enhanced visibility to peers: Sia et al. (2002)	1) There is great necessity to work with others on tasks. 2) Working with others as part of a team is a pressing requirement of my job. 3) It is very easy for coworkers from other departments to access the information system to see the status of my work performance. 4) It is very easy for my peers to detect mistakes in my work because errors in my work will have a great impact on their performance.
Empowerment: procedural formality (Sia et al., 2002)	1) Job descriptions in my organization are highly specific and very detailed. 2) The procedures to carry out a task are spelled out very clearly. 3) Employees are very closely supervised to ensure that they are conforming to the standard procedures established.
Empowerment: user competence (Ng & Kim, 2009)	1) I have complete knowledge in using the ERP system 2) I have mastered the skills necessary for using the ERP system 3) I am self-assured about my capabilities to use the ERP system 4) I am confident about my ability to use the ERP system
Empowerment: usage impact (Ng & Kim, 2009)	1) The ERP system usage highly affects task outcomes 2) The impact of my ERP system usage on task outcomes is large 3) My ERP system usage has significant influence over task outcomes 4) My ERP system usage has a great deal of control over task outcomes
Empowerment: usage meaning: (Ng & Kim, 2009)	1) Using the ERP system is very important to me. 2) Using the ERP system is meaningful to me. 3) I feel that using the ERP system is valuable. 4) ERP system usage activities are personally meaningful to me.
Empowerment: user self-determination: (Ng & Kim, 2009)	1) I have significant autonomy in determining how I use the ERP system 2) I can decide on my own how to go about using the ERP system 3) I have a lot of freedom to decide how I use the ERP system 4) I have considerable opportunity for independence in how I use the ERP system
Infusion: extended use. (Schwarz, 2003; Hsieh & Wang, 2007)	1) I often use most of the features of the ERP system installed in my organization to support my work. 2) I often use more features than the average user of the ERP system installed in my organization to support my work. 3) I fully use the available ERP system features to complete my tasks 4) I make use of the available ERP system features thoroughly to accommodate my tasks 5) I use all available ERP system features to help me in my tasks
Infusion: Integrative use (Hsieh & Wang, 2007)	1) I use the ERP system for better connections among tasks 2) I use the ERP system to organize various tasks in an integrative manner 3) I use the ERP system to coordinate multiple tasks 4) I use the ERP system to handle related-tasks
Infusion: emergent use (Hsieh & Wang, 2007)	1) I explore new uses of the ERP system to support my tasks 2) I often experiment with new ways of using the ERP system to accomplish my tasks 3) I often find new uses of the ERP system in performing my tasks 4) I use the ERP system in novel ways to complete my tasks
Work Commitment (Mowday et al. 1982; Cooper-Hakim and Viswesvaran, 2005)	1) I am quite proud to be able to tell people who it is I work for. 2) I sometimes feel like leaving this employment for good. 3) I'm not willing to put myself out just to help the organization. 4) Even if the firm were not doing too well financially, I would be reluctant to change to another employer. 5) I feel myself as apart of the organization. 6) In my work I like to feel I am making some effort, not just for myself but for the organization as well. 7) To know that my own work had made a contribution to the good of the organization would please me. 8) I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful. 9) I would accept almost any types of job assignment in order to keep working for this organization 10) I find that my values and the organization's values are very similar