A Human Factors Model for Enterprise Resources Planning System Implementation

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Abstract. The implementation and adoption of enterprise resource planning (ERP) system is currently a key issue for companies. The critical problem of implementing and adopting ERP system is that the system architectures are quite complex. This study focuses on the integration of the human factors issues in the ERP implementation process. The mental or cognitive differences between information systems concerning people and end users are compared in this study based on information related theories. This paper proposes a human-centered system implementation and adoption model. The main purpose of this model is to assist the ERP system implementation and adoption and creates maximum customer value. The paper shows how to carry out the model step by step with the final goal of increasing the efficiency and acceptability of the system to be implemented and adopted.

Keywords: Enterprise resource planning, human factors, human-centered, information system.

1 Introduction

Business information systems are currently implemented through enterprise resource planning (ERP) systems, which are supposed to comprehensively deal with all concerned functions of a company. Nevertheless, the implementation and adoption of such enormous systems is still considered as a complex problem. One of the key points of the implementation and adoption is the appropriation of the system by its users [6], which is often difficult. The origin of this problem is often considered as related to business process definition, in which many human factors (HF) issues are implicated in the process.

Humans will become less willing to use difficult interfaces of ERP systems and search for alternatives when information systems development fails to meets users' requirements [10]. Numerous researches have suggested that the user is the most critical factor leading to information systems success ([1], [24]). The usability of user-interfaces can be seen as one of the critical factors that influences end-user satisfaction [23].

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Following the development of information technologies, the organization structure and production type have changed. Many companies tried to enhance its performance by adopting ERP systems. In fact, there are many failed cases in the past [8]. Generally, the communication between system developers and end-users is a key factor to the system success or not. So, using appropriate implementation approaches and consulting resources to ensure the system success is a challenge to many companies.

Although ERP provided standard business object and process, the design principle of ERP system is not completely suited to the target corporation ([5], [17]). Two points of view are demonstrated in this study. First, only few researches discussed the key causes and processes successfully implementing and adopting ERP to companies. ERP system is very important to companies. It is useful to discuss the utilization of ERP software. By improving the utility of ERP software, the failure rate of ERP will be decreased. Second, information systems implemented with human-centered consideration is important. When the ERP information systems are implemented in companies, the managers of these companies usually face much end user resistance. It is important to recognize that the end users are not supervisors or managers. They are the employers or operators of the systems. Therefore, an effective information system development will focus on how human users accept and use the system. So, ERP studies must also emphasize the human thinking or cognition problems.

ERP system researchers and developers believe that their system is developed based on practical business processes. The professional knowledge about how to use information technology enhances the management efficiency and should be included in ERP systems [7]. Many companies tried to adopt and implement ERP systems, but failed. There are usually several problems in ERP systems, including: (1) companies ignored ERP system and without enough investment; (2) companies excessively relied on consultant organizations; (3) consultants do not join improvement and maintenance activities.

This study discusses several causes to make ERP system implementation and adoption successfully, including: (1) to develop a formal planning system; (2) to approach consensus to a plan by the internal part of corporation; (3) to accurately acquire corporation data; (4) to enhance management planning changes; (5) to plan and manage excellent production ability; (6) to make sure that clients trust the ERP system; (7) to execute the system efficiently; (8) to consider the role of users while planning ERP system; (9) to make sure ERP systems were operated and maintained by entire company; (10) to use measurement tool to make sure and solve corporate problems.

2 Human-Centered ERP System

Compared to information systems research, theories of ERP system implementation and adoption have gained little attention and lack of theoretical support. This study reviews information systems literature to identify the theories which can be utilized to develop a human-centered ERP system implementation and adoption model.

2.1 Clients Technologies Accepted Level and Perception

An ERP system attempts to satisfy clients' information requirement. Thus, information and clients become the key factors of ERP systems. The theory of reasoned

action (TRA) is rooted in social psychology, usually used to discuss human behavior intent and predict human behavior ([11], [12]). Attitude, subjective thinking, and behavior intent composed the theory. Generally, attitudes and subjective variables are influenced by others variables. By adding perceived behavioral control to TRA theory, Ajzen and Madden [2][3][4] developed a theory of planned behavior (TPB). Davis [9] discussed perception and technology which use the TRA and developed technology acceptance model (TAM), which is usually utilized to understand how external factors influence clients' internal perceptions, attitudes, intents, and information uses.

2.2 External Factors on Technology Configuration and Acceptance

Social cognitive theory (SCT) explained human behavior based on interrelations between people, behaviors, and environments. Kwon and Zmud [18] believed that the principal efficiencies in information system execution are user characteristics, organizational characteristics, information technology characteristics, and environment characteristics. Thus, Diffusion of Innovations Theory (DIT) was generated based on the characteristics identified by Kwon and Zmud [18]. When the information provided by users of information systems meets user requirements, the degree of user satisfaction will be improved. Consequently, researchers have attempted to identify the relationship between ERP systems and user satisfaction based on a theoretical model of working—technique fitness [13][14][15]. In this model, different people may make different decisions based on the same information.

2.3 User Process Mode

Goodhue [15] proposed that the central features of a successful information system are user satisfaction and information system conditions (e.g., information identification, information gathered, information integrated, and information explanation). Leitheeiser and Wetherbe [19] discussed the central causes of a successful information system based on user perspectives. Summer [26] identified several factors of a successful information system based on a case study. Magal et al. [20] proposed 22 key factors to successful information system. Computer system acceptability is a combination of social acceptability and practical acceptability. There are several levels and types of consideration in practical acceptability-- cost, compatibility, usability, and reliability. Norman and Draper [22] proposed eight user-interface design principles: consistency; short-cuts used by users familiar with the interface; feedback (informing users on how to use the interface); efficient use of dialog windows, foolproof, cancel button, reducing memory loading.

2.4 End-Users Classification

The classifications of users can be identified as: novice or first-time users, knowledgeable intermittent users, and expert frequent users [25]. Novice or first-time users are those users who know the information about ERP system roughly. When the novice or first-time users first use the system, they will feel anxious and nervous. Sometimes, they may resist the system. To solve the above described problem, the related information should emphasize the principles, including: (a) to provide necessary

dialog windows design; (b) to provide on-line guide; (c) to provide system feedback design; (d) to provide mistake messages while users make a mistake; (e) to provide on-line assistance explanation.

Knowledgeable intermittent users have necessary knowledge to their task in the information system. However, knowledgeable intermittent users did not usually operate and use the information system. Therefore, the users do not easily remember the relative architectures, positions, and characteristics of menus. To solve the problem, the information should emphasize the principles, including: (a) menus should be well organized; (b) the jargon should be consistent; (c) message dialog should be meaningful; (d) the system movement should be consistency; (e) meaningful dialogs should be provided; (f) system organization should be emphasized.

Expert frequent users are familiar with system contents and task items. Therefore, the information should emphasize the principles, including: (a) to provide quick response system; (b) to avoid distraction feedback; (c) to provide hot-key mechanism; (d) to decrease necessary steps; (e) to provide short-cut design. These principles are related to users' satisfaction while using the ERP system based on the classifications of users. Based on these principles, this study proposed a human factors model for ERP system implementation, which was described detailed in the next section.

2.5 The Conceptual Framework Development

Five major stages are proposed in the process, including: (1) Planning; (2) Business process analysis; (3) System development; (4) On-line preparation; (5) Information system implementation. Based on the five implementation stages, this proposed design can help program team shorten ERP implemented schedule and help the ERP system solve users' problem (See Figure 1).

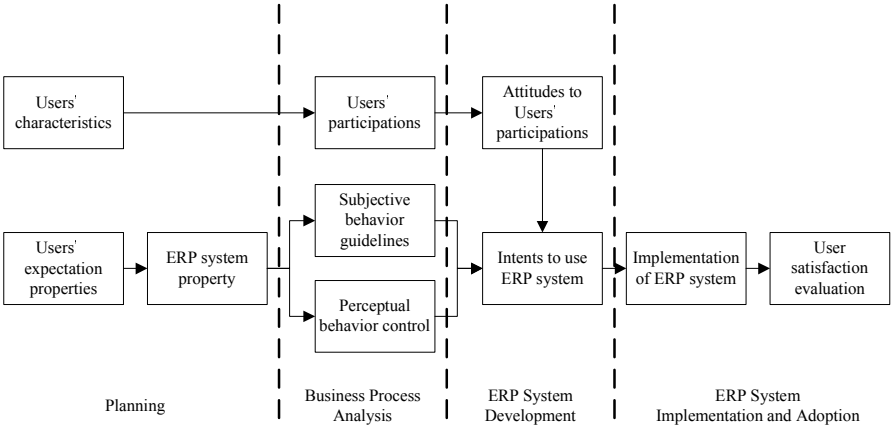

Fig. 1. The conceptual framework of a HF model for ERP system implementation

1) *Planning*: There are four steps in the planning stage. First, standards should be identified for planning management and development. Second, the planning team should consist of three categories of members. Third, education and training strategies

should be developed. Finally, the ERP system can satisfy system users. Generally, system users should be trained in software use.

2) *Business process analysis*: There are four elements in this phase. The first is the task analysis. In redesigning the operation process, customer requirements should be identified and met. The second is users' participation. User participation influences directly attitudes toward the ERP system. The third is the system integration. The ERP modules should be suited to business processes. The last but not the least element is the training program members. Absence of information and lack of understanding for a system are the major causes resulting in user resistance. Additionally, users usually have different perceptions of the system. Thus, an excellent ERP system should provide training that is tailored to user education.

3) *System development*: There are six elements in this phase. The first step is to understand the context of ERP system, to verify the human-machine interface, to make sure system hardware specification and data process of the system. The second step is to design the interface of ERP system by emphasizing the usability of user interface. Then, system designers should know that system acceptance and organization characteristics are the major causes resulted in information quality. The information quality was composed by several components. The fourth element is to change the business operation process usually result in users' resistance and complaint. Then, the commissioner of project management should be trained. Finally, sufficient managers' support can reduce the fear, worry, and animosity.

4) *On-line preparation*: There are five elements in this phase. The first element is training of users. Generally, training courses focus on software learning. Second, users will do a test to the ERP system in this phase. The third is to develop the system support team. The fourth is the on-line interchange formally. Finally, sufficient managers' support is important here.

5) *Information system implementation*: There are three elements in this phase [16]. The first is user support. Second, continued training should be provided. Third, sufficient managers' support in this phase again can reduce the fear, worry, and animosity of users.

3 Suggestions for System Implementation and Adoption

3.1 Suggestions to Information Department

Users' cooperation is the necessary conditions when developing or implementing a new information system. There are several causes in the information department. (1) Identifying the objective and scope of information system. (2) Service attitude should be kind and friendly. (3) Treat the important requirement from the users. (4) Let users' expectation updated with the system. (5) Let users take participation in the system. (6) To explain for the users that the system can help them finish more tasks. (7) To help users communicate with each other. (8) Understand different users' characteristics.

3.2 Suggestions to System Developer

System development should be user-centered. In this study, we proposed several causes which induced human errors: (1) Users cannot find appropriate object while

executing their tasks; (2) Icons or labels confused users, so users usually cannot find the required object correctly; (3) Users do not know how to describe or execute the required object clearly; (4) Users usually receive incorrect information or wrong message of system feedback. The proposed methodology provided effective assistance to programmers. The below descriptions will propose four levels top-down process to assist system designers [25], shown in Table 1.

Additionally, Norman and Nobel [21] clearly defined the differences between users' intention and activities. He proposed the seven differences of the human machine interaction, including: object identification, intention, output identification, execution, system situation acceptance, explanation and description of system situation, and results assessment [25]. Norman and Nobel [21] also proposed four items to assist ERP system designers while designing well-designed system. First, situation and activity choice must be obvious. Second, system should be consistent in concept. Third, interface should have good mapping to demonstrate the mapping between different levels. Fourth, users should continue to accept the system feedback [25].

3.3 Suggestions to Education and Training

Following system improvements, business implementing ERP systems increase their competition. However, each consulting team has its own educational and training course. We offer the following suggestions to ensure that courses meet business requirements. System developers should meet the requirement of different industries to meet requirement of different operation styles. Thus, developers should classify users into the following four classifications according to their familiarization with and perceptions of the system and task content [25].

Table 1. Font sizes of headings. Table captions should always be positioned *above* the tables.

Level	
Conceptual	In interactive system, the first layer is to make an architecture based on users' mind model.
Semantic	Transferring users' mind into linguistic to send meanings of system based on the input and output of computer system.
Syntactic	How to combine the linguistic architecture to the syntactic level task items, transmission to computer and execution.
Lexical	According to classification of vocabulary, let the users easily to complete their task items according to the lexical level.

3.4 Suggestions to Education and Training

The system designers should understand the users, including: age, sex, characteristics, educational background, culture, training, motivation, objects, and attitude. Computer use is important to most current competitive environments. ERP system is beneficial to corporations and typically improves task performance and effectiveness. Additionally, users should enhance their computer-based skills and understanding of system objects and functions. Most importantly, users should have confidence.

4 Conclusions

This study aims to improve understanding of critical human factors that affect ERP implementation and adoption success and develop a human-centered model to practice this concept. Qualitative methodology is used in this study. It is already clear that consideration of the interaction between human and human systems interface is an important step in system implementation. This study hopes that the proposed model can contribute to both the academic field and business industry. Therefore, this study proposed human factors suggestions to successfully implement and adopt ERP systems. The conceptual model could be used in business reengineering process (BRP) to test its applicability. Moreover, researchers could focus on more specific areas such as human resource management or organizational viewpoint impact within one corporation so that more detailed and in-depth information could be identified.

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