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Method to reduce the gap between construction and IT companies to improve suitability before selecting an enterprise system

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ABSTRACT

This study proposes a method to reduce the perception gap between the system required by construction companies and the system proposed by information technology (IT) companies during the negotiation process before selecting an enterprise system. The goal of the proposed method is to increase the developed system's suitability to a construction company. First, a set of selection factors was determined and defined. The gap between construction companies' requirements and the IT companies' offerings was then analyzed. Then a method to reduce the gap to improve suitability before selecting the system was described. The applicability of the method was tested by comparing selected and non-selected cases from two previous projects. The analysis result showed that the method is highly applicable to both construction companies and IT companies. Construction companies can apply the method to select a preferred system on the basis of suitability; and during the negotiation process before system selection, IT companies can apply the method to analyze whether a system satisfies the specific requirements of a construction company. The set of defined selection factors is also applicable to the evaluation criteria of the enterprise system.

1. Introduction

An enterprise system is generally selected through four steps. In this study, the term "enterprise system" is used to refer specifically to the types of custom development IT systems that satisfy the requirements and unique work processes of a company rather than off-the-shelf computer tools, such as computer-aided design and analysis tools and office automation tools. Common examples of such custom-developed enterprise systems include enterprise resource planning (ERP) systems and project management information systems (PMIS). An ERP system is a process management system for effectively deploying and managing company resources, such as finance and human resources. A PMIS is used to manage project-specific information related to schedules, project participants, costs and other types of information associated with a project.

First, a company or, more specifically, its IT team collects and generates requirements for an enterprise system. Second, the company sends out a request for proposal (RFP) to IT companies (enterprise system developers). Third, the company receives proposals from IT companies and evaluates the suitability of the proposed system using the RFP for guidelines. Although the selected system proposal is the closest to the RFP among the submitted proposals, a perception gap often exists between this proposal and the RFP. The "perception gap" represents the difference between the system required by the construction company and the system developed by the IT company. Especially, the perception gap exists largely for construction companies because satisfying their requirements is a difficult task. This difficult occurs because the construction industry is fragmented, and because the organizational cultures of a headquarters and construction sites are often disconnected [1,2]. Reducing this gap is critical and is done during the last step. In the last step, the company negotiates the RFPs with the IT companies on a shortlist. However, this negotiation process is based more on experience than on data or the priority analysis of evaluation criteria.

This study proposes a method of reducing the gap (between the proposal and the RFP) in order to improve the suitability of an enterprise system before system selection. "Suitability" means the degree to which a system satisfies the characteristics of a company. The method is based on the importance and realizability of each system requirement during the negotiation process. "Importance" represents the construction company's view of the criticality of each criterion. "Realizability" represents the enterprise system developer's view of the possibility of satisfying the criteria.

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Importance and realizability were evaluated for individual enterprise system proposals based on the characteristics of a construction company.

However, evaluating proposals of enterprise system through conflicting importance and realizability values – factors with high importance and low realizability or *vice versa* – is difficult (Fig. 1), which represents a decision-making matrix, the two axes of which are the importance and the realizability of each system requirement. When both the importance and the realizability of each requirement are 1) high or 2) low, negotiations on whether to select an enterprise system are not difficult. However, when the importance is 3) high but the realizability is low, or when the importance is 4) low but the realizability is high, negotiations are difficult. When the method proposed in this study was applied to the third and fourth cases, the expected effect was larger than in the first and second cases.

Most previous research focused on the selection factors or utilization of IT systems in the construction industry [3–7] and the methods of selecting IT systems [8–12]. However, the previous studies did not focus on reducing the gap between the proposal and the RFP, or on improving the suitability of the system during the negotiation process before selection.

This paper is composed of two main sections. After the literature review, this paper describes the derivation of the selection factors used in the evaluation criteria and analyzes the perception gap between IT managers of construction companies and developers of IT companies. Then, this paper describes the proposed method of reducing this gap and improving the suitability of the initially selected enterprise system proposal, thus taking it closer to the required system. The applicability of the proposed method was tested by comparing the selected and non-selected cases in two previous projects to develop an ERP system and a PMIS.

2. Literature review

Previous studies were conducted in relation to the factors [3–7] and methods [8–12] associated with selecting enterprise systems. The previous studies on selection factors investigated the factors associated with various types of enterprise systems, including aspects such as the differences between user groups, the organizational perspective, and risk management [3–7]. However, these studies did not focus on analyzing the gap between construction companies' requirements and IT companies' developed systems.

Chung et al. [6] identified factors that affect project success as *user-related factors* and *project-related factors*, and analyzed the effect of the introduction of enterprise resource planning (ERP) on project success. Tatari et al. [7] drew valuation factors for investments in construction information integration to analyze the relationships between the valuation factors and expected benefits. Although previous studies are similar to this study in that they discussed factors affecting construction companies' IT introduction, Chung et al. [6] and Tatari et al. [7]. did not analyze the attributes of various impact factors, such as the importance of ITs. Instead, they analyzed the relationships between impact factors and expected benefits [7], or the effects of individual factors on IT introduction effects [6]. A study by Li [5] that analyzed differences in the perception of IT introduction impact factors between groups drew IT success factors from the viewpoints of system and person, and analyzed the importance of individual factors from the viewpoints of IT user groups and manager groups. Although Li's study is similar to this study in that the importance of individual impact factors were analyzed by group, it was not conducted for the construction industry; that study's impact factor classification system and analysis method are different from those of this study.

Many studies were also conducted on the methods used to select enterprise systems [8–12]. A few of these previous studies are closely related to this study [9–11]. Soffer et al. [9] proposed an object-process method for selecting an enterprise system, which is an iterative algorithm that identifies the best possible matches to a company's requirements. Wu et al. [10] proposed a selection method that is based on the task-technology fit theory for enterprise systems and that analyzes the misfit between candidate functions and a company's requirements. Karsak and Özogul [11] proposed a method for selecting an enterprise system that is based on quality function deployment, fuzzy linear regression, and zero-one goal programming. However, none of these selection methods included reducing the gap between construction companies and IT companies to improve suitability during the negotiation process before system selection. The gap is important because in practice, the selection results of an enterprise system change on the basis of the ability of IT companies to satisfy the construction company's additional requirements during the detailed negotiation process. This study analyzes the gap and proposes a method of reducing it to improve suitability using a predefined set of selection factors.

3. Analysis of the perception gap based on selection factors

3.1. Determination of selection factors

The factors that affect the selection of an enterprise system were determined on the basis of previous studies that analyzed these factors. These factors were then sent via e-mail to construction companies' IT managers and IT companies' developers for verification. Finally, the selection factors were determined on the basis of the responses to the e-mail. The participating IT managers and IT developers had a range of lengths of work experience (Table 1). All 44 respondents participated, and their experience with IT systems was between five and 24 years. Approximately 89% (39 out of 44) of the respondents had more than 10 years of experience.

The selection factors were divided into technical factors and non-technical factors (Table 2). The technical factors were then subdivided into functionality and usability factors, and the non-technical factors were subdivided into social, organizational, and resource-related factors. In the technical factors group, functionality factors represent the "goal" that makes an enterprise system function as it is designed, whereas usability factors are functions that can help improve the "goals" of an enterprise system. In the non-technical factors group, social factors are the socioeconomic factors surrounding organizations; organizational factors consist of factors that should be considered internally by an organization or those related to the organization; and resource factors consist of factors that support the smooth operation of an enterprise system.

Among the functionality factors, *performance* [13] is the ability to implement activities that are consistent with users' activities. *Conformity with current work processes* [14,15] is the degree to which processes changed by the established enterprise system reflect the current work. *Process innovativeness* [7,17–19] is the degree of improvement in the existing work caused by an established enterprise system's process in terms of efficiency. *System flexibility* [8,11,12,21,22] is the level of compatibility with other systems when enterprise systems are supplemented or updated after being established. *System diversity* [5,23,24] is the ability to display diversity depending on user characteristics or purposes. *System integration by work area* [5,25] is the level at which systems are not separated in the same job but are organized into a single instance. *A system's stability management* [14,24] indicates a system's technical stability and risk management, which is the degree to which stability devices and vaccines have been established.

Among the usability factors, *convenience in use* [5,11,12,17,22] is the degree to which users can easily use a system. *Information visibility* [22,27] is the ease of information acquisition and sharing,