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Examining the effect of user satisfaction on system usage and individual performance with business intelligence systems: An empirical study of Taiwan's electronics industry

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ABSTRACT

The advent of new information technology has radically changed the end-user computing environment over the past decade. To enhance their management decision-making capability, many organizations have made significant investments in business intelligence (BI) systems. The realization of business benefits from BI investments depends on supporting effective use of BI systems and satisfying their end user requirements. Even though a lot of attention has been paid to the decision-making benefits of BI systems in practice, there is still a limited amount of empirical research that explores the nature of end-user satisfaction with BI systems. End-user satisfaction and system usage have been recognized by many researchers as critical determinants of the success of information systems (IS). As an increasing number of companies have adopted BI systems, there is a need to understand their impact on an individual end-user's performance. In recent years, researchers have considered assessing individual performance effects from IS use as a key area of concern. Therefore, this study aims to empirically test a framework identifying the relationships between end-user computing satisfaction (EUCS), system usage, and individual performance. Data gathered from 330 end users of BI systems in the Taiwanese electronics industry were used to test the relationships proposed in the framework using the structural equation modeling approach. The results provide strong support for our model. Our results indicate that higher levels of EUCS can lead to increased BI system usage and improved individual performance, and that higher levels of BI system usage will lead to higher levels of individual performance. In addition, this study's findings, consistent with DeLone and McLean's IS success model, confirm that there exists a significant positive relationship between EUCS and system usage. Theoretical and practical implications of the findings are discussed.

1. Introduction

Today, many organizations continue to increase their investment in implementing various types of information systems (IS), such as enterprise resource planning (ERP) and customer relationship management (CRM), primarily because of the belief that these investments will lead to increased productivity for employees (Jain & Kanungo, 2005). Evaluating individual employee performance from IS use has been an ongoing concern in IS research (Goodhue & Thompson, 1995). However, previous studies that examined the relationship between IS usage and individual performance effects have reported contradictory results that range from positive to non-significant, to even a negative relationship. For instance, Goodhue and Thompson (1995) explored the role of task-technology fit on individual performance effects and indicated a positive relationship between IS use and individual performance. Conversely, Pentland (1989) found a negative relationship between IS use and individual performance. Lucas and Spitler (1999) found that IS use has no impact on individual performance.

Many researchers have recognized user satisfaction as a critical determinant of the success of IS (Bailey & Pearson, 1983; DeLone & McLean, 1992; Doll & Torkzadeh, 1988; Igbaria & Tan, 1997). When data computing in organizations has transformed from transactional data processing into end-user computing (EUC), Doll and Torkzadeh (1988) have developed a 12-item and five-factor instrument for measuring end-user computing satisfaction (EUCS) in the EUC environment. Even though EUCS instrument has already been widely applied and validated for various IS applications (e.g., decision support systems (McHaney, Hightower, & White, 1999; Wang, Xi, & Huang, 2007), ERP systems (Somers, Nelson, & Karimi, 2003), and online banking systems (Pikkarainen, Pikkarainen, Karjaluoto, & Pahnila, 2006), it has not been validated

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with users of business intelligence (BI) systems. BI systems were designed to provide decision-makers with actionable information delivered at the right time, at the right place, and in the correct form to make the right decisions (Negash & Gray, 2004). Given these goals, attributes measured by EUCS such as timeliness, accuracy, content, etc., are relevant to an evaluation of BI systems. Since an increasing number of companies have adopted BI systems, there is a need to understand the impact of EUCS on individual job performance. DeLone and McLean (2003) propose that higher levels of individual satisfaction with using an IS will lead to higher levels of intention to use, which will subsequently affect the use of the system. Most studies investigating system usage at the individual level terminate at the user acceptance of the computer technology rather than at the performance outcome (Dasgupta, Granger, & McGarry, 2002). The main reason could be attributed to the conventional wisdom that more use leads to better performance. However, empirical studies that examined the relationship between IS usage and individual performance effects have reported contradictory results ranging from positive to non-significant, to even a negative relationship. Therefore, the purpose of this study is to investigate whether it is appropriate to adopt the EUCS instrument to measure user satisfaction with BI systems. Furthermore, this study also examines the following research question: How does EUCS influence system usage and individual job performance? In this paper, we present a model that identifies the relationships between EUCS, system usage, and individual performance. Drawing on Igbaria and Tan's (1997) nomological net model, we propose that EUCS has a positive impact on individual performance both directly and indirectly through system use. Operational measures for the constructs are developed and tested empirically, using data collected from 330 respondents in the Taiwanese electronics industry to a survey questionnaire. Structural equation modeling is used to test the hypothesized relationships. The structure of this paper is organized as follows. In Section 2, we review the related literature on BI systems, EUCS, and performance measures to provide the necessary background information for the study. Section 3 presents the research framework and develops the hypothesized relationships, while Section 4 describes the research methodology. Section 5 presents the data analysis and results, which are discussed in Section 6. Section 7 presents implications for practice and research, and the final section describes the limitations of the study.

2. Literature review

2.1. Business intelligence (BI) system

Today, many organizations have already implemented ERP systems, considered to be one of the most significant and necessary business software investments for firms. ERP systems offer organizations the advantage of providing a single, integrated software system that links their core business activities such as operations, manufacturing, sales, accounting, human resources, and inventory control (Lee, 2000; Newell, Huang, Galliers, & Pan, 2003; Parr & Shanks, 2000). As more companies implement ERP systems, they have accumulated massive amounts of data in their databases. Although ERP systems are good at capturing and storing data, they offer very limited planning and decision-making support capabilities (Chen, 2001). It is widely accepted that ERP should provide better analytical and reporting functions to aid decision-makers (Chou, Tripuramallu, & Chou, 2005). According to Aberdeen's survey report, business intelligence (BI) applications have the highest percentage of planned implementations by companies using ERP systems (AberdeenGroup, 2006).

As Mikroyannidis and Theodoulidis (2010) explain, the BI system is a "collection of techniques and tools, aimed at providing businesses with the necessary support for decision making" (p. 559). Moss and Atre (2003) also define BI as being a "collection of integrated operational as well as decision support applications and databases that provide the business community with easy access to business data" (p. 4). As such, BI systems can be regarded as the next generation of decision support systems (Arnott & Pervan, 2005). Therefore, BI systems can provide real-time information, create rich and precisely targeted analytics, monitor and manage business processes via dashboards that display key performance indicators, and display current or historical data relative to organizational or individual targets on scorecards.

In recent years, several major ERP software vendors such as SAP and Oracle have started to offer extended products, such as BI applications, because they have realized the shortcomings of their systems in providing decision-making support. According to results from the 2009 IT spending survey from Gartner, BI continues to be the top spending priority for chief information officers (CIOs) in order to raise enterprise visibility and transparency, particularly sales and operational performance (Gartner, 2008). Furthermore, more than half of the respondents in another survey by InformationAge (2006) stated that improving decision-making and better corporate performance management are the two main drivers of BI investment. Companies that adopt BI systems can empower their employees' decision-making capabilities in a faster and more reliable way. Therefore, BI can deliver better business information by offering a powerful grip on organizational data. Since a BI system includes technology for reporting, analysis, and sharing information, it can be integrated into ERP systems to maximize the return-on-investment (ROI) of ERP (Chou et al., 2005).

2.2. End-user computing satisfaction

Cotterman and Kumar (1989) defined an end user as any person who has an interaction with computer-based IS as a consumer of information. Turban et al. (2007) briefly discuss how the end-user can be at any level in an organization or in any functional area. Many researchers have emphasized user satisfaction as a measure of IS success in organizations (Bailey & Pearson, 1983; DeLone & McLean, 1992; Doll & Torkzadeh, 1988; Ives, Olson, & Baroudi, 1983). Of course, the definition of user satisfaction has evolved with the changes in the IS environment (Simmers & Andandarajan, 2001). Early research on user satisfaction was conducted in the transactional data processing environment (e.g., Bailey and Pearson, 1983; Ives et al., 1983), in which users interact with the computer indirectly with the assistance of an analyst or a programmer (Doll & Torkzadeh, 1988). User satisfaction was defined as "*the extent to which users believe that the information system available to them meets their information requirement*" (Ives et al., 1983, p. 785). Subsequent research on user satisfaction has been conducted in the end-user computing (EUC) environment, in which users interact directly with the application software to enter information or prepare output reports (Doll & Torkzadeh, 1988). In this context of EUC, user satisfaction has been defined as "*an affective attitude towards a specific computer application by someone who interacts with the application directly*" (Doll & Torkzadeh, 1988, p. 261).

The literature has developed several instruments to measure user satisfaction, including a 13-item user information satisfaction (UIS) instrument from Ives et al. (1983), Bailey and Pearson's (1983) 39-item computer user satisfaction instrument, and Doll and Torkzadeh's (1988) 12-item EUCS instrument. Based on the UIS instrument of Ives et al., Doll and Torkzadeh (1988) developed a 12-item and 5-factor instrument for measuring EUCS, which has been widely applied and validated, and found to be generalizable across several IS applications (Gelderman, 1998; Igbaria, 1990). For example, the instrument has been tested in an ERP environment