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Re-examining information systems user performance: Using data mining to identify properties of IS that lead to highest levels of user performance

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ABSTRACT

As competitive pressures increase, managers try to realize every bit of productivity from people, business processes and new information technologies (IT). This leads one to ask, how can managers configure information systems to achieve higher levels of performance from end users? In this regard, managers continually seek advice on how to meet the promises and expectations of continued increases in productivity through the use of IT. However, results from research on how to achieve higher performance through the use of IT in organizations has been mixed. Consequently, it has been difficult for IS researchers to give managers any advice on investing in specific aspects of IS that would lead to the highest performance possible. We focus on this question in this research. We use a data mining approach to tease out information about specific characteristics of IS that managers can manipulate to achieve desired outcomes with regards to individual performance. Our findings offer both researchers and managers significant new knowledge that can make a difference to IT user performance research theory and the practice of user performance management. Further, our research method offers a novel approach to linking theory and practice in IS research, a problem that is of great concern to many IS researchers. The approach is generalized and can be implemented by academic or industry researchers who are interested in generating hypotheses from data for the purpose of theoretical or applied research.

1. Introduction

Achieving higher performance in the use of IT in organizations is a continuing problem within information systems research. While firms have continued to invest in information technology (IT), realizing the promises and expectations that IT would provide increasing productivity gains has been difficult (Ward, 2002). As competitive pressures increase, managers of all types are looking to wring every possible bit of productivity out of their investments in IT. The fundamental question for every manager is how to get better performance out of end-users of IT applications. While the question of end-user performance has been much researched, and some answers have been provided, the situation is still unclear. Information systems researchers continue to have difficulty telling managers what they need to do to achieve the highest level of performance from end users of IT applications. As a practical matter, managers want to be able to identify the characteristics of an information system that can be managed to obtain the highest end-user performance. Although this question is implied in user performance studies, it has not be been investigated directly. The answer requires identification and analysis of relationships that may exist between systems characteristics and individual performance. Previous studies of user performance have not systematically examined this issue. In this paper, we pursue the question by trying to identify those properties of IS which tend to lead to the highest levels of individual end-user performance. We apply a data mining-based approach in this investigation that involves the use of decision trees (e.g. Samoilenko & Osei-Bryson, 2008). Our reason for using this method is that we wanted a formal approach for reasoning from the data to derive both hypotheses for future testing and actionable rules that managers can use. In this paper, we use decision tree (DT) analysis of questionnaire data to explore the impact of certain properties of IS on individual performance.

2. Review of relevant research

There are many studies that have investigated end-user performance with information systems (Cf. Table 1). This body of literature can be divided into two types of inquiry, (a) Task-technology fit studies, and (b) User satisfaction studies, each category approaching the study of end-user performance from a different

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Table 1
Studies relating to end-user performance.

Focus of the study	Method of data collection	Method of data analysis	Citations
TTF: the effect of task demands and graphical format on information processing strategies	Experiment	ANOVA	Jarvenpaa (1989)
TTF: the fit between job and PC capabilities	Surveys (questionnaires)	Partial Least Square analysis	Thompson et al. (1991)
TTF: computer graphs and fit with question types and question complexity levels	Laboratory experiment	Two-way analysis of variance and Wilcoxon matched pairs signed-ranks test	Wilson (1994)
TTF:	Surveys (questionnaires)	Regression analysis	Goodhue (1995)
TTF: model validation	Surveys (questionnaires)	Regression analysis	Goodhue and Thompson (1995)
TTF	Surveys (questionnaires)	Establishing instrument validity	Goodhue (1998)
TTF	Laboratory experiment	Regression analysis	Mathieson and Keil (1998)
TTF and fitness-for-use (FFU)	Surveys (questionnaires)	Regression analysis and Path analysis	Dishaw and Strong (1998)
TTF and TAM	Surveys (questionnaires)	Path analytic technique	Dishaw and Strong (1999)
TTF	Experiment and questionnaire	Regression analysis and Logistic Regression	Goodhue et al. (2000)
TTF: CASE-task fit and software developer's performance	Surveys (questionnaires)	Hierarchical regression analysis	Lai (1999)
User satisfaction	Surveys (questionnaires)	Measurement development	Bailey and Pearson (1983)
User satisfaction	Surveys (questionnaires)	Measurement development	Ives et al. (1983)
User satisfaction	Surveys (questionnaires)	Measurement development	Doll and Torkzadeh (1988)
User satisfaction	Surveys (questionnaires)	Establishing instrument validity	Torkzadeh and Doll (1991)
User satisfaction	Surveys (questionnaires)	Establishing instrument validity	Doll et al. (1994)
User satisfaction	Surveys (questionnaires)	Establishing instrument validity	Hendrickson et al. (1994)
User satisfaction	Surveys (questionnaires)	Establishing instrument validity, structural equation model, regression analysis	Etezadi-Amoli and Farhoomand (1996)
User satisfaction	Surveys (questionnaires)	Partial Least Square Testing	Igbaria and Tan (1997)
User satisfaction	Surveys (questionnaires)	Structural equation based on Partial Least Square	Blili et al. (1998)
User satisfaction and TAM	Surveys (questionnaires)	Structural equation model using LISREL	Al-Gahtani and King (1999)
User satisfaction	Surveys (questionnaires) and observation through meta-monitoring system analysis that automatically, tracked and recorded users' activities.	Z-tests	Downing (1999)

perspective. The task technology fit approach postulates that when the user's task and the technology are congruent, user performance will be high (Dishaw & Strong, 1998; Goodhue, 1995; Goodhue & Thompson, 1995; Mathieson & Keil, 1998). Consequently, studies falling under this approach try to define task and technology characteristics and what is "*goodness of fit*" between specific technologies and end-user tasks (Dishaw & Strong, 1998; Goodhue, Klein, & March, 2000; Mathieson & Keil, 1998). On the other hand, user satisfaction studies investigate the extent to which certain IS properties, such as system quality, information quality, and system use and user satisfaction can influence user performance (Bailey & Pearson, 1983; Doll & Torkzadeh, 1988). Numerous user satisfaction studies have been conducted in the last decade which attempt to identify the factors of the information systems that lead to high user performance (DeLone & McLean, 1992; Doll, Xia, & Torkzadeh, 1994; Hendrickson, Glorfeld, & Cronan, 1994; Torkzadeh & Doll, 1991).

Our research question places this study at the intersection of TTF and user performance studies, because the constructs, "information systems characteristics" and "user performance", that we are interested in are commonly theorized in both categories of studies. In this regard, our review of the literature will focus on outlining those constructs (and variables) that are relevant to our investigation.

2.1. Task-technology fit

Several researchers have used the task-technology fit (TTF) model to explain the impact of information systems and task characteristics on individual performance (Dishaw & Strong, 1998; Ferratt & Vlahos, 1998; Goodhue & Thompson, 1995). This model is founded on the notion that when user task characteristics and characteristics of the information system fit well together, both utilization of the system and user performance will be high. As Goodhue and Thompson state; "...TTF is the correspondence between task requirements, individual abilities, and the functionality of the technology" (Goodhue & Thompson, 1995). In their study, they find empirical support for the relationships TTF and Performance, and Utilization and Performance, moderate support for the relationships Task Characteristics and TTF, and Technology Characteristics and TTF, and no support for the relationship TTF and Utilization (cf. Fig. 1). The specific information systems properties/technology characteristics they tested for were Information Quality, Locatability, Authorization, System Reliability and Ease of Use. While the TTF model does not tell us, what characteristics of information systems lead to highest levels of user performance, it does suggest some constructs relevant to the investigation of our question.

2.2. User satisfaction and performance

The second category of studies, user satisfaction, focuses on identifying the conditions under which users are satisfied with the systems. Doll and Torkzadeh (1988) define user satisfaction as "the affective attitude towards a specific computer application by someone who interacts with the application directly". The fundamental argument of the user satisfaction approach is that high levels of user satisfaction lead to high levels of user performance. Bailey and Pearson (1983) conducted a literature review in an early study to identify influencing factors. They developed and tested a questionnaire for investigating user satisfaction. Ives, Olson, and Baroudi (1983) replicated and extended Bailey and Pearson's