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# The relation of interface usability characteristics, perceived usefulness, and perceived ease of use to end-user satisfaction with enterprise resource planning (ERP) systems

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## Abstract

Over the past few years, firms around the world have implemented enterprise resource planning (ERP) systems to have a standardized information system (IS) in their respective organizations and to reengineer their business processes. While millions of dollars have been spent on implementing ERP systems, previous research indicates that potential users may still not use them. This study, based on data from 51 end-users in 24 companies examines various usability factors affecting end-user satisfaction with ERP systems. The results indicate that both perceived usefulness and learnability are determinants of end-user satisfaction with ERP systems. In addition perceived ease of use and system capability affect perceived usefulness, while user guidance influences both perceived usefulness and learnability. Implications of these findings are discussed and further research opportunities described.

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*Keywords:* Enterprise resource planning; End-user satisfaction; Interface characteristics; Perceived usefulness; Perceived ease of use; Learnability

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## 1. Introduction

Over the past few years, firms around the world have implemented enterprise resource planning (ERP) systems since the use of ERP systems has been considered as a major determinant of competitive advantage. Gable (1998) defined ERP

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systems as comprehensive software packages that seek to integrate the complete range of a business process and functions in order to present a holistic view of the business from a single information and information technology architecture. The essential architecture of an ERP system builds upon one database, one application, and a standard interface across the entire enterprise (Al-Mashari Al-Mudimigh, & Zairi, 2003). Minahan (1998) explicated that ERP systems take into account every business transaction entered into the system no matter where the data is input and that ERP digitally records all these transactions. Data available to everyone in the organization at a global level is always up to date.

When ERP systems are fully realized in a business organization, they can yield significant benefits: reduce inventory, enable faster information transactions, facilitate better financial management, maintain tightened supply-chain links, increase productivity, reduce transportation and logistics costs, improve responsiveness to customers, increase flexibility, lay groundwork for e-commerce and make tacit knowledge explicit (Computer Technology Research Corporation, 1999; Davenport, 2000). Since the potential benefits are massive, many companies are willing to implement an ERP system. However, Mabert, Soni, and Venkataramanan (2000) indicated that an ERP implementation can take many years to accomplish, and cost tens of millions of dollars for a medium size firm and upwards of \$100 million for large international organizations. All of these factors make the ERP software the fastest growing market in the software business, as its eventual market size is projected to be around \$1 trillion by the year 2010 (Bingi, Sharma, & Godla, 1999).

Soh, Kien, and Tay-Yap (2000) stated that increased demand for ERP systems has not always led to significant organizational improvements. Some companies have had to downsize their initiatives and to accept minimum payoffs, or even decide to give up on ERP implementation. In some cases, problems in implementing ERP systems have led to a number of spectacular failures (Abdinnour-Helm, Lengnick-Hall, & Lengnick-Hall, 2003). In the past, ERP projects' failures are found to be the results of poorly defined business goals (Deloitte Consulting, 2000), inadequate training (Gupta, 2000), the lack of strong and adequate sponsorship (Deloitte Consulting, 2000), changes in project scope (Holland, Light, & Gibson, 1998), and incompatibility among the various computer hardware and software systems (Rajagopal, 2002). However, as investment in ERP systems continues to increase catastrophic failures continue to alarm the market and great cost to both developers and users. This suggests that the causes of failure are still poorly understood and solutions leading to success need to be found.

A number of researchers have suggested that user satisfaction is one of the key factors leading to IS success (Al-Khaldi & Wallace, 1999; Szajna & Scamell, 1993) and usability of interfaces can be seen as one of the factors that influences end-user satisfaction (Park and Lim, 1999). A usable ERP system can be defined as a comprehensive management software package that supports the effective and efficient completion of tasks in a given work context. Users will become less willing to put up with difficult interfaces of ERP systems and search for alternatives when centralized IS development fails to meet user needs (Eason, 1988). In highly competitive situations where many alternate software packages differ little in terms of functionality,

it may be the user interface that is the purchasing factor making end-user satisfaction a decisive factor (Henderson, Smith, Podd, & Varela-Alvarez, 1995).

Research studies also suggest that perceived usefulness and perceived ease of use are especially important as ways of measuring user satisfaction with IS (Davis, 1989; Venkatesh & Davis, 1996). Mawhinney and Lederer (1990) state that user satisfaction is strongly related to the perceived usefulness of the IS. A user who perceives an IS as providing value, is more likely to be satisfied with the IS than one who does not. Davis (1989) also states that, all else being equal, an application the end-user perceives as being easier to use than another one is more likely to be accepted.

It should be noted that no previous research attempted to demonstrate what factors influence end-user satisfaction with ERP systems. However, in order for ERP systems to be effectively used in the global business environment, a better understanding of what factors influence end-user satisfaction needs to be developed. To this end, this study was conducted to answer the questions: (1) Which, if any, interface usability characteristics influence end-user satisfaction with ERP systems? (2) Does perceived usefulness affect end-user satisfaction with ERP systems? (3) Does perceived ease of use have an effect on end-user satisfaction with ERP systems?

The next section discusses the methodology that is based on a survey of 51 end-users in 24 companies. This is followed by the results of the survey. This paper concludes with a discussion of the findings resulting in developing a model predicting end-users' satisfaction with ERP systems and recommendations for future research areas.

## 2. Methodology

### 2.1. Participants

The sample was almost evenly split between males (52%) and females (48%); the typical respondent was 29.4 years old; have used the system for approximately 3.2 years; and represented a wide range of positions within the organizations. The target group was ERP system end-users and all respondents indicated that they used the system several times a day.

### 2.2. Procedure

A survey methodology was used to gather data. A questionnaire was constructed based on an extensive review of the literature in the areas of information system implementation and computer system usability. Many survey questions were adopted from previous literature and suggestions from academics (Davis, 1989; Lewis, 1995; Lin, Choong, & Salvendy, 1997). The list of 24 companies was provided by ERP vendors. Representatives from 24 companies were identified and asked to participate in this study. The companies represented a diverse group of industries including manufacturing, health care, transportation, telecommunication, and consulting. Each representative was asked to distribute approximately three questionnaires to a

randomly selected group of ERP system end-users throughout their organization. The overall response rate was 70.8%, with 21 questionnaires being returned. This high return rate can most likely be attributed to the use of a corporate representative in the dissemination and collection of survey instrument.

### 2.3. Questionnaire items

The questionnaire consisted of three parts. The first part involved demographic questions designed to solicit information about the respondent, their organization, and the extent to which they use the ERP system. The second part involved a question about the respondent's satisfaction with the ERP system. This question used five-point Likert-type scale where 1= very dissatisfied to 5= very satisfied. The third part consisted of the items measuring six interface usability characteristics, namely, system capability, compatibility, flexibility, user guidance, learnability, minimal memory load, as well as perceived usefulness and perceived ease of use. A seven-point Likert-type scale was used where 1= strongly disagree to 7= strongly agree. The entire instrument is shown in [Appendix A](#).

## 3. Results

### 3.1. Instrument validity

The psychometric properties of the instrument were evaluated in terms of reliability and construct validity. Reliability was calculated for all multi-item variables. The entire instrument, as well as the individual variables, achieved high levels of reliability, as shown in [Table 1](#). Construct validity was assessed by principal component analysis. The analysis produced eight components accounting for 78% of the variance. All items loaded significantly higher on the variables they were designed to measure than on other variables. Furthermore, the factor loadings were greater than 0.50, with most of them above 0.70, indicating high construct validity ([Table 2](#)).

Table 1

Descriptive statistics and Cronbach's  $\alpha$  coefficients for the 28 item instrument (Number of items for each variable shown in parentheses)

Variables	Mean	S.D.	Cronbach's $\alpha$
1. System capability (3)	4.61	1.36	0.60
2. Compatibility (2)	4.76	1.49	0.68
3. Perceived ease of use (3)	5.02	1.24	0.65
4. Flexibility (4)	4.42	1.39	0.68
5. User guidance (5)	4.67	1.46	0.80
6. Learnability (2)	5.74	1.11	0.51
7. Minimal memory load (3)	4.84	1.22	0.59
8. Perceived usefulness (6)	5.29	1.59	0.96
Entire instrument (28 group items)			0.71



Table 3  
Multiple regression analysis

Dependent variables	R <sup>2</sup>	Independent variables	β	t	Sig.
Satisfaction	0.477	Perceived usefulness	0.447	5.899	0.000 <sup>b</sup>
		Learnability	0.179	2.364	0.022 <sup>a</sup>
Perceived usefulness	0.540	Perceived ease of use	0.381	3.529	0.001 <sup>b</sup>
		System capability	0.354	3.146	0.003 <sup>b</sup>
		User guidance	0.261	2.497	0.016 <sup>a</sup>
Learnability	0.087	User guidance	0.294	2.156	0.036 <sup>a</sup>

<sup>a</sup> P < 0.05.

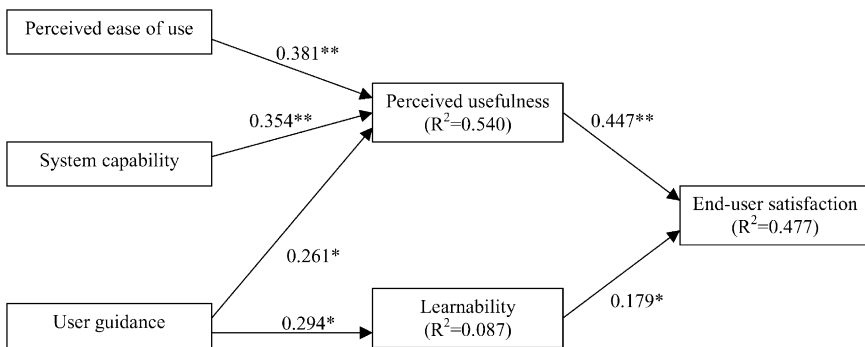
<sup>b</sup> P < 0.01.

Since perceived usefulness was the best predictor of end-user satisfaction, a multiple regression method was applied to determine the variables impacting perceived usefulness. This analysis yielded a regression function with a R<sup>2</sup> = 0.54 based on three significant variables: perceived ease of use, system capability, and user guidance. Perceived ease of use had the strongest impact with user guidance having a relatively smaller effect on perceived usefulness.

A multiple regression method was also applied to find out variables influencing learnability since learnability was the second best predictor of end-user satisfaction. Only user guidance turned out to be significant, explaining 9% of the total variance. The results are presented as a conceptual model as shown in Fig. 1.

#### 4. Discussion

This research examined the influence of interface usability characteristics, perceived usefulness, and perceived ease of use on end-user satisfaction with enterprise



\* P < 0.05.

\*\* P < 0.01.

Fig. 1. A conceptual model of factors affecting end-user satisfaction with ERP systems.

resource planning (ERP) systems. A conceptual model predicting end-user satisfaction with ERP systems was developed. The most noticeable aspect of this model is that both perceived usefulness and learnability are determinants of end-user satisfaction with ERP systems. Among them, perceived usefulness has the strongest impact on end-user satisfaction. The results of this study confirm many of the findings of the earlier studies indicating that perceived usefulness has an effect on end-user satisfaction (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Igbaria, Guimaraes, & Davis, 1995). End-users are likely to be more satisfied with IS if they believe that using the system will increase their performance and productivity (Mawhinney & Lederer, 1990; Vlahos & Ferratt, 1995).

Learnability has a relatively smaller but significant effect on end-user satisfaction with ERP systems. The design of an ERP system's interface should enable easy navigation among different modules. Navigation aids can be provided to users to prevent disorientation. To help users understand the logic flow of the system, broad and shallow menu structures should be preferred to narrow and deep ones. The removal of unnecessary or redundant screens will also help to keep the navigation flow uncomplicated (Thong, Hong, & Tam, 2002). In addition, availability of function keys for frequent control entries may help to increase end-user satisfaction with ERP systems.

Another noticeable aspect of the results was that perceived ease of use exerted an indirect effect on end-user satisfaction via perceived usefulness, which indicates that end-users tend to rate ERP systems as less useful if they find them difficult to use. This is consistent with Thong et al.'s (2002) finding of an indirect effect from perceived ease of use to user acceptance of digital libraries via perceived usefulness. Therefore, for ERP systems to be successful, developers need to focus their attention on designing both useful and easy to use systems.

System capability also has a strong impact on perceived usefulness of ERP systems. In addition to developing useful and easy to systems, ERP system designers should pay more attention to user requirements analysis to determine their expectations and requirements for the content of ERP systems, and then incorporate relevant materials and functions into the systems. With the background of users becoming more and more diverse, the differences in the domain knowledge need to be accommodated for a system successful. Apparently, designing ERP systems with multiple interfaces for different levels of users would be useful.

Another significant finding of this study relates to the effects of user guidance on perceived usefulness and learnability. The importance of this factor is supported by Lin et al. (1997), who indicate that a strong relationship exists between user guidance and usability of software systems. The results of this study also indicate that, as suggested by Lin et al. (1997), a computer system with a good user guidance scheme will improve the learnability of the system as well as reduce the mental workload of the users since no extra effort will be needed for the users to carry out designated tasks. These results strengthens the argument that easy-to-understand error messages, possible to do useful work with program before having learned all of it, availability of undo to reverse control actions, and confirming questions before

execution of risky commands may help to increase both perceived usefulness and learnability.

Although the findings of the present study contribute to a better understanding of the factors that affect end-user satisfaction with ERP systems, there are several limitations to this study. First, regardless of the significance of the relationships between factors in the regression model, we cannot ignore the fact that these relationships may not apply to specific industries. Therefore, research that targets specific industries would be useful to determine whether the relationships in the conceptual model would be different if the data came from a specific industry.

Second, this study focused on the end-user evaluation of commercial off-the-shelf ERP systems. A similar study assessing the end-user evaluation and importance of interface usability characteristics for the ERP systems developed in-house would also be useful.

Third, it should be noted that the model variables explained 48% of the variance on satisfaction with ERP systems. That a large percentage of the satisfaction remains unexplained suggests the need for additional research incorporating potential unmeasured variables in the current study.

Forth, the results of this study are far from reaching implications for other countries. A similar study examining this subject in an even broader sample of companies located in a variety of different countries could serve to further extend and enhance these findings.

Finally, a longitudinal research design is essential to confirm the linkages among the study variables.

## Appendix A. Questionnaire items

### Part I: Demography Questions

1. What is your age?
2. What is your gender?
3. How long have you been using the ERP system?
4. How often do you use the system?
  - a. Several times a day
  - b. About once a day
  - c. 2 or 3 times a week
  - d. About once a week

### Part II: Satisfaction with the ERP system

1= Very dissatisfied, 2= Dissatisfied, 3= Neutral, 4= Satisfied, 5= Very satisfied

### Part III: Interface usability, perceived ease of use, and perceived usefulness

*Instruction:* This part contains 28 questions about your ERP system. Please indicate your level of agreement with the following statements.



Scale:

1= Strongly disagree, 2= Somewhat disagree, 3= Disagree, 4= Neutral, 5= Agree, 6= Somewhat agree, 7= Strongly agree.

1. System capability
  1. System is fast.
  2. System is reliable.
  3. System is designed for all levels of users.
2. Compatibility
  1. The results of control entry are compatible with my expectations.
  2. The wording is familiar.
3. Perceived ease of use
  1. I found it easy to get the system to do what I wanted it to do.
  2. It was easy for me to become skillful at using the system.
  3. I found the system easy to use.
4. Flexibility
  1. It provides flexible user guidance.
  2. I can name displays and elements according to my needs.
  3. It provides good training for different users.
  4. It allows me to customize windows.
5. User guidance
  1. Error messages are helpful.
  2. It provides CANCEL option.
  3. HELP is provided.
  4. It provides UNDO to reverse control actions.
  5. Whenever I make a mistake using the system, I recover easily and quickly
6. Learnability
  1. The ordering of menu options is logical.
  2. It provides function keys for frequent control entries.
7. Minimal memory load
  1. Abbreviations and acronyms are used.
  2. The guidance information is always available.
  3. Selected data are highlighted.
8. Perceived usefulness
  1. Using the system in my job enabled to accomplish tasks more quickly.
  2. Using the system improved my job performance
  3. Using the system in my job increased my productivity.
  4. Using the system enhanced my effectiveness on the job.

5. Using the system made it easier to do my job.
6. I found the system useful in my job.

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