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USER ACCEPTANCE CRITERIA FOR ENTERPRISE RESOURCE PLANNING SOFTWARE SYSTEMS

Roba Khaled Alsoub[1], Thamer Ahmad Alrawashdeh[2] and Ahmad Althunibat[2]

[1]Computer Science Department
Mutah University
P.O. Box Mutah Karak 61710, Jordan
roba_soub@yahoo.com

[2]Software Engineering Department
Al-Zaytoonah University of Jordan
P.O. Box 130 Amman 11733, Jordan
{ thamer.r; A.thunibat }@zuj.edu.jo

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Abstract. *Enterprise resource planning (ERP) software systems have become progressively more vital for private and public organizations' operations, and one of the most important applications among computer information systems. However, the implementation of ERP software systems is a complex issue, as it contains different types of the end users. Therefore, this study investigated and identified several factors with focusing more on the software characteristics that contribute to shape the user acceptance of ERP software, in which the developers could pay more attention to ERP software implementation from early development stages. The research model was constructed, based on the unified theory of acceptance and use of technology (UTAUT). The findings revealed that the acceptance of ERP software is affected by performance expectancy, effort expectancy, social influence, software interoperability, software cost, and software security.*
Keywords: User acceptance criteria, Acceptance testing, ERP software acceptance, Software interoperability, Software cost

1. **Introduction.** The software engineering is defined as a discipline that is concerned with all processes of the software development, which has become an advanced field in the technological sector [28]. These processes are divided into various sub-processes. One of the most important sub-processes is the user acceptance testing. This sub-process is conducted on the user side to determine whether a software achieves the acceptance criteria or not, in which the end user would accept or reject such software. With growing the information systems and increasing failure of its implementation, user acceptance becomes a research field of interest for many scholars. In ERP software context, the organizations award the fact that the use of ERP software will improve their functions (accounting, administrative, etc.) and make it manageable and more transparent across the globe [4]. Interestingly, ERP software systems have integrated information systems that support and control all business operations by using unified information. These integrated systems bind all organization units and functions to meet the business needs. By implementing such software, organizations anticipate improving efficiency, profitability, quality, and productivity of their business functions [4]. However, despite the promises for improving organizations and more effective management in the companies, a number of research activities have shown a rather high failure rate in the implementation of ERP software, due to a low users acceptance rate [27]. Many factors were reported

as reasons for such acceptance problem, including software complexity, software interoperability, software cost, and software security [7,14,17,38]. The social factors were also introduced as the reasons for the failure of ERP software [8,22].

There is no any research activity conducted to combine all previous software characteristics and social factors in one acceptance model. Moreover, software interoperability and its software cost were never examined as a factor that could affect the acceptance of this type of software. According to [17], ERP software systems are not only expensive in the implementation stage, but its cost continually rises in the maintenance stage. With the large expenditures on the ERP software systems and significant risk of failure, managers and developers should ensure the success of ERP software systems implementation. Thus, managers (stakeholders) and software developers need to recognize the factors that impact the acceptance of ERP software systems. It makes them considering the acceptance of ERP software from early stages of developing, preparing their employee to face the new challenges, to learn how to make a good use of a new ERP software system to reap the tangible benefit, and to avoid failing implementation of the ERP software systems.

Different ways have been utilized by the academic research community to contribute in the field of ERP. The study has analyzed the user acceptance criteria for the enterprise resource planning software systems. The study has contributed to enabling the researchers to comprehend the recent trends in the field of ERP and proved effectual for businesses and industries sectors as well. Therefore, this study has been conducted to identify performance expectancy, software complexity, software interoperability, software cost, software security, social influence, facilitating conditions as key components of ERP software and then examines the influence of these characteristics on the acceptance of such software. More importantly, this study integrated the software characteristics with unified theory of acceptance and use of technology (UTAUT) and developed a new research model for acceptance ERP software systems by confirming the convergent, discriminant, and internal validity of the proposed model via structural equation modeling (SEM).

The notion of ERP has been observed growing and expanding in various sectors with the passage of time. It would be effective for the companies to understand the use of ERP system and ways to cope up with the challenges and transformations that pose ahead with the use of ERP systems. Therefore, the study has effectively contributed to assessing the practical implications of the ERP systems. Academicians can also take advantage from the present study to identify the user acceptance criteria for enterprise resource planning software systems.

The rest of this study is structured as follows. Section 2 reviews the related works on acceptance of computer information systems. Section 3 discusses key characteristics of ERP software and examines their effects on user acceptance by developing an integrated research model. Section 4 presents the research methodology and findings. Section 5 introduces a discussion of the theoretical and practical implications of the study findings. In Section 6, the conclusion of this study is discussed.

2. Literature Review.

2.1. Prior research.

The software acceptance is a widely studied research topic, whereas a lot of research studies have been conducted to analyze the software acceptance from different points of view (e.g., [25,27,34,36]). These studies are concerned with defining factors that affect the acceptance of information system, such as social factors, infrastructure factors, management support, satisfaction, experience, and self-efficacy, among other many factors.

Few studies had been conducted to address factors that affect the acceptance of ERP software. Mayeh et al. [27] argued that despite the high cost and effort necessary in implementing ERP systems, its success rate is very low due to low-end users' acceptance levels. These authors also added that software friendly and its utility support the acceptance of ERP software. Furthermore, the absorptive capacity emphasizes the user-friendly of such software. Although the authors indicated to the cost and complexity problems, they had not investigated the impact of such factors on the ERP acceptance. Besides, [31] examined acceptance of ERP software and the role of gender and experience differences. This study revealed that behavioral intention is influenced by performance expectancy, convenience from online access, innovativeness in information technology, and effort expectancy, while the usage behavior is influenced by facilitating condition and behavioral intention. Hsu et al. [30] modified DeLone and McLean's model to determine post-implementation success factors for ERP software. They concluded that service quality, information quality, and system quality have a positive impact on the post-implementation success in terms of end-user satisfaction. Authors added that service quality might emphasize the system and information quality to support the ERP software post-implementation. Rajan and Baral [8] proposed a conceptual framework that integrated some of the individual, organizational, and technical factors that might affect acceptance of ERP software. Their study resulted that the acceptance of ERP software is influenced by many factors including self-efficacy, compatibility, training, and organizational support. This research work also did not study the impact of the implementation cost, software interoperability, and software security on the user acceptance of ERP system. Additionally, it did not consider the actual usage of ERP software systems.

The concentration of all previous and more than 20 other studies was of the individual and organization factors rather than on the software itself and its characteristics. There is no study investigating the effect of software characteristics such as software interoperability, software security, and software implementation costs on the acceptance of ERP software. This comes in contrary to the Rogers findings which revealed that software characteristics are important for assessing the rate of software acceptance. Furthermore, the validity of UTAUT and actual usage are not considered in the ERP software systems field.

Insufficiencies in user acceptance affect the return on investment for expensive ERP systems. This deficiency of acceptance models obstructs the predicted savings of efforts and time in business operations and the possible advancement in information quality. Therefore, there is a need to conduct future investigations, based on the acceptance of complicated systems including ERP systems [31]. The factors that influence the user acceptance of ERP systems must be elaborated that may increase the corporate social responsibilities and productivity. It may also enhance the worth and development of individuals within an organization.

2.2. **Unified theory of acceptance and use of technology (UTAUT).** Many theories have been used in the literature to analyze the acceptance and usage of information systems. These theories include theory of reasoned action (TRA) by Fishbein and Ajzen in 1981 [26]; technology acceptance model (TAM) by Davis et al. in 1989 [16]; theory of planned behavior (TPB) by Ajzen in 1991 [21]; and unified theory of acceptance and use of technology (UTAUT) by Venkatesh et al. in 2003 [40].

The modern and comprehensive theory is UTAUT. It allows analyzing information systems acceptance and actual use using six constructs namely performance expectancy, effort expectancy, social influence, facilitating conditions, behavioral intention, and actual

use. This theory considered also set of moderators that could affect the relationships between its constructs namely age, gender, experience and voluntariness [40].

Although recent research studies showed that UTAUT is a suitable theoretical framework to examine the acceptance of information systems in many contexts, it still needs further testing in the context of ERP systems [18].

3. **ERP Systems Acceptance Model.** The objective of the study is to identify the ERP software characteristics that would lead to accepting such software by end users. In order to achieve this goal, the constructs of UTAUT and three software characteristics are used to create the conceptual model and to form the hypotheses of this study. Alshehri [2] used this model to measure the use of UTAUT to estimate the factors influencing the acceptance. This was the reason that the present study also adopted the conceptual model that involved the nine constructs. Thus, the conceptual model involves nine constructs namely: performance expectancy (PE), effort expectancy (EE) (software complexity), social influence (SI), facilitating conditions (FC), behavioral intention (BI), actual use (AU), software interoperability (SIN), software cost (SC), and software security (SS). Figure 1 shows the proposed model constructs.

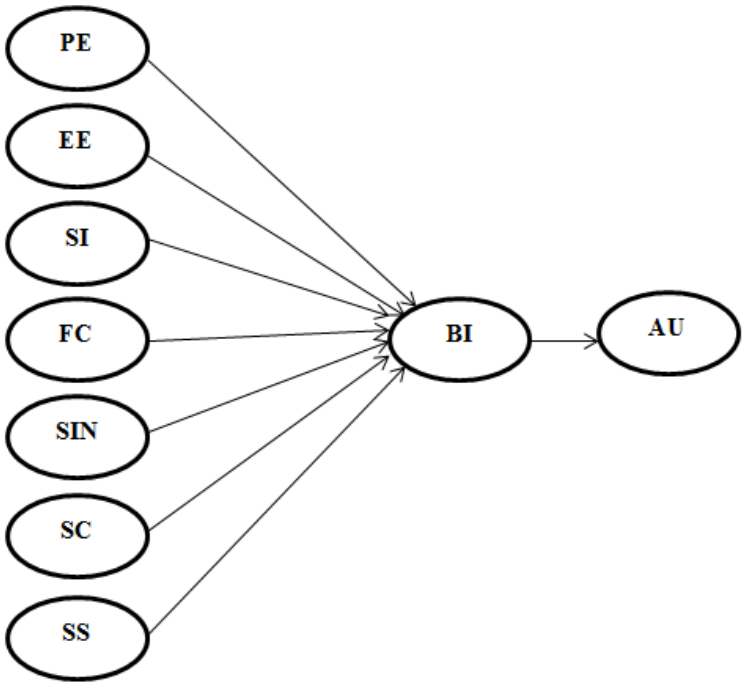

FIGURE 1. Conceptual framework of ERP software systems acceptance

3.1. **Performance expectancy.** It is the degree to which the end-user believes that software systems would provide benefits in performing his/her work activities [40]. Compeau and Higgins [9] mentioned that the individuals would use the computer technology if they believe that such technology is beneficial. Reflect that on using ERP systems measures such as integrated information, customer service, and reporting. Many scholars found that the performance expectancy strongly affects users' intention to use information systems [18,40,41]. Thus, the following hypothesis has been formulated.

H1: Performance expectancy has a positive influence on the acceptance of ERP software.

3.2. **Effort expectancy (software complexity).** It refers to the degree to which users believe that using software systems would be free of effort [40]. If the software is perceived to be hard to understand and use, users will look for other software applications [25]. Thus, software complexity could be stumbling block to accept a software system. In the ERP software context, end-users will use ERP system if and only if they realize that they could use such software with free effort. Several studies show that there is a strong relationship between effort expectancy (software complexity) and acceptance of information systems [18,20,25].

H2: Effort expectancy has a positive influence on the acceptance of ERP software.

3.3. **Facilitating conditions.** It refers to the degree to which end-users believe that organizational and technical infrastructures exist to support the use of software systems [41]. Using ERP software requires skills and knowledge, such as using smart phones, and personal computers connecting to the Internet, installing some applications, as well as knowledge on how to access and use the ERP software. Individuals who have access to the Internet, access to the user manual of ERP software will have a greater intention to use the software. In the same respect, many empirical studies concluded that facilitating condition has a positive impact on the intention of software usage [18,31,35]. This leads to formulating the hypothesis:

H3: There is a positive relationship between the facilitating condition and the acceptance of ERP software.

3.4. **Social influence.** It is defined as the extent to which end-users perceive that the important people, especially managers believe, they should use software systems [40]. Several empirical research studies have shown that social influence is one of the factors that could influence the acceptance of information systems [18,33,38]. Thus, the following hypothesis has been formulated.

H4: There is a positive relationship between social influence and the acceptance of ERP software.

3.5. **Software interoperability.** It refers to the extent to which end-users believe that the components of ERP software systems can exchange information with each other and with the components of external software systems [15]. ERP software is designed as a set of modules each module presented as a system, and to be connected to other applications, such as, a legacy system [1]. Thus, interoperability should be considered in the early stage of ERP software development. In the context of the acceptance of ERP system, end-users would accept the ERP system if they perceive that it is interoperable and can exchange information with other application systems (e.g., legacy systems). Therefore, the following hypothesis has been proposed.

H5: There is a positive relationship between the software interoperability and the acceptance of ERP software.

3.6. **Perceived software cost.** It refers to the extent to which stakeholders believe that they have enough financial resources required to implement and use software [5]. This is applicable to the ERP software, since it is expensive than other types of information systems, due to the cost of development and learning effort [30]. Therefore, organizations and individuals are required not only implementing expensive software, but also to have suitable devices and services (e.g., servers with premium features and high-speed communications). Software cost may impact the acceptance of ERP software [5,41]. The acceptance decision may vary from an individual to another depending on the financial resources. Thus, the following hypothesis has been proposed.

H6: Software cost has a negative influence on the acceptance of ERP software.

3.7. **Software security.** Although the integrity, intelligence, collaboration and web-enabling are key strengths of ERP software, these characteristics also raise increasing concerns related to the security of operations via ERP software. Perceived software security defined as the extent to which individuals believe that software is secure [13]. Additionally, many scholars reported that perceived software security plays an important role in determining the behavioral intention to use information systems [11,13]. By reflecting that on the ERP software, the perceived software security will influence the ways in which individuals accept and implement ERP software. Thus, this study has defined and examined the following hypothesis.

H7: Software security has a positive impact on the acceptance of ERP software.

3.8. **Behavioral intention.** It is defined as the willing of the individual to perform a particular behavior [40]. According to the common theories of acceptance information systems, behavioral intention is a most important indicator for actual use of information systems [9,40]. Therefore, the following hypothesis has been proposed.

H8: Behavioral intention has a positive effect on the actual use of ERP software.

4. **Research Methodology.** This study used a questionnaire to quantitatively assess the proposed research model for collecting data. This questionnaire was designed and distributed in the period from September 2016 to February 2017. Participants in the survey were employees, working in organizations that are implementing ERP software or other types of information systems. Total 150 questionnaires had been distributed, 110 of which returned back in response rate 73%. Four answers were dropped due to incomplete information. The sample involved 60% male and 40% female. Approximately, 50% were aged under 30 years and 82% had 1 year or more of ERP systems or information systems experience.

In order to keep it consistent with prior research works, the instrument questions have been adapted from information systems literature [18,41]. The questionnaire was developed with nine sections. The first one is to collect demographic details including age, gender, and experience. The remaining sections have 30 questions that are related to the variables of the proposed model, performance expectancy, effort expectancy, facilitating conditions, social influence, software interoperability, software cost, software security, intention to use ERP software, and actual use of ERP software. Three measures had been applied to testing the adequacy of measurement model namely, a reliability test, a confirmatory factor analysis (convergent and discriminant validities), and model fit test.

4.1. **Reliability test.** In order to assess the internal consistency of results, Cronbach's α test was applied for the items of the instrument. This test found that the reliability of each item was above the recommended value 0.7 [12] (Table 1). Thus, the instrument items were reliable for the proposed model's constructs. This reveals that the constructs of the proposed model show adequate discriminant validity.

4.2. **Convergent validity.** The item reliability of each item, composite reliability of each construct, and average variance extracted were used to analyze the convergent validity [6]. An exploratory factor analysis (EFA) was applied for each construct of the proposed model. Seven items (PE1, EE3, FC4, SI3, IO4, COS4, SEC4) had been removed from the model due to low factor loading. The rest factors loading were above the recommended value 0.7 (Table 1) [6] confirming a good indicator reliability of the instrument. The convergence validity was assessed using the average variance extracted (AVE). Each construct ranged from 0.92 to 0.97 considerable above the recommended value 0.7 [3].

TABLE 1. Summary of measurement scales

Construct	Mean	Std. Dev	Factor loading	Composite reliability	AVE	Cronbach's Alpha
Performance expectancy				0.95	0.95	0.96
PE2	4.86	2.16	0.96			
PE3	5.22	2.21	0.92			
PE4	4.89	2.15	0.73			
Effort Expectancy				0.95	0.96	0.98
EE1	4.80	2.15	0.89			
EE2	4.76	2.13	0.95			
EE4	4.80	2.11	0.97			
Facilitating Conditions				0.93	0.93	0.92
FC1	4.79	1.99	0.83			
FC2	4.95	1.87	0.81			
FC3	4.99	1.92	0.86			
Social Influence				0.92	0.93	0.91
SI1	4.69	1.95	0.74			
SI2	4.79	1.96	0.96			
SI4	4.85	1.89	0.96			
Software Interoperability				0.96	0.97	0.96
IO1	4.90	2.01	0.97			
IO2	4.92	2.00	0.88			
IO3	4.86	2.04	0.95			
Software Cost				0.93	0.94	0.90
COS1	2.49	2.13	0.92			
COS2	2.82	2.13	0.74			
COS3	2.42	2.04	0.89			
Software security				0.95	0.96	0.96
SEC1	4.55	1.83	0.74			
SEC2	4.69	1.82	0.96			
SEC3	4.45	1.98	0.96			
Behavioral Intention				0.95	0.96	0.94
BI1	4.81	1.93	0.93			
BI2	5.01	1.79	0.84			
BI3	4.91	1.84	0.93			
BI4	5.10	1.81	0.95			

4.3. **Discriminate validity.** The discriminant validity was analyzed using the correlation matrix of the constructs. Table 1 shows the square root of AVE along with the diagonal elements. The results have satisfied the condition that the variance extracted should be greater than the correlation between constructs [20].

4.4. **Model fit.** The model fit of the proposed model was assessed using the following indices: Chi-square/degree of freedom (X2/f.d), Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMSR), Normed Fit Index (NFI), Non-Normed Index (NNI), Comparative Fit Index (CFI), and Incremental Fit Index (IFI). As shown in Table 2, all previous indices gained the acceptable values. Therefore, the proposed model strongly fits the collected data.

Table 2. Overall fits of models

Fit index	Results	Recommended value	Source
v2/grade of freedom	1.312	< 5	Shin and Shin (2011) [10]
Normed Fit Index (NFI)	0.914	$>= 0.90$	Bentler and Bonett (1980) [29]
Non-Normed Fit Index (NNFI)	0.901	$>= 0.90$	Bentler and Bonett (1980) [29]
Comparative Fit Index (CFI)	0.978	$>= 0.90$	Fornell and Larcker (1981) [6]
Adjusted Goodness-of-Fit Index (AGFI)	0.821	$>= 0.80$	Fornell and Larcker (1981) [6]
Root Mean Square Error of Approximation (RMSEA)	0.054	$<= 0.06$	Bagozzi and Yi (1988) [32]
Goodness-of-Fit Index (GFI)	0.911	$>= 0.90$	Bagozzi and Yi (1988) [32]
Incremental Fit Index (IFI)	0.973	$>= 0.90$	Widaman and Thompson (2003) [24]

4.5. **Structural model and hypotheses test.** Structural equation modeling (SEM) had been applied to analyzing data and examining the constructs relationships based on the examination of standardized paths. The results are summarized in Table 3.

Table 3. Summary of hypotheses tests

Hypotheses	Standardized coefficient	SE	CR	Supported
H1. PE-BI	0.161**	0.063	2.55	YES
H2. EE-PE	0.648***	0.087	7.46	YES
H3. FC-BI	−0.101	0.066	−1.51	NO
H4. SI-BI	0.22**	0.088	2.55	YES
H5. INT-BI	0.325***	0.077	4.24	YES
H6. COS-BI	−0.174**	0.059	−2.97	YES
H7. SEC-BI	0.242*	0.098	2.36	YES
H8. BI-ACT	0.144***	0.043	3.30	YES

*P < 0.05, **P < 0.01, ***P < 0.001

5. **Discussion.** This research work tested the hypotheses on the influence of ERP software characteristics factors, social influence factors, organization factors on the user acceptance. The findings have several theoretical and practical implications for software developers, stakeholders, and academic researchers. User-acceptance such as this research model is substantial for understanding and successfully implementing ERP software. As summarized in Table 3, the integrated research model shows that the performance expectancy, effort expectancy, social influence, software interoperability, software security, and software cost explained the behavioral intention to use the ERP software systems, while the behavioral intention explained the actual use. All of these results statistically explained that this research model successfully creates valid relationships among key characteristics of the ERP software (software interoperability, software security, and software cost), and the constructs from original UTAUT (performance expectancy, effort expectancy, facilitating conditions, social influence, behavioral intention, and actual use), thereby extending acceptance theory on ERP software systems.

More specifically, software interoperability, software cost, software security, and social influence emerged as strong motivational factors of the behavioral intention to use ERP software systems. Given that increasing emphasis is being placed on immediate connectedness to the subsystems and external systems to exchange the significant information, reducing the cost of development and implementation of the software, and guaranteed that the security of private and worthy information from unauthorized access. The findings provide statistical evidence showing the importance of these factors. Furthermore, effort expectancy was found to be a good indicator for performance expectancy, which then significantly impacted user intention and actual use of ERP software. It is worth mentioning that these findings come compatible with the prior studies results [13,18,19,24,37,39]. The research work results add to the existing literature in that these factors rendered as effective determinants for ERP software systems. The implication is that the user acceptance is critical to failure and success of the ERP software systems, engorging the developers to develop cheap, full functions, interoperable, secure, and easy to use ERP software that guarantees improving the acceptance of such software. Therefore, the organizations can use the proposed model to create a strategic plan for the implementation of their software. To do so, organizations should pay more attention to how end-users acceptance is shaped.

6. **Conclusion.** In addition to the social factors, many technical factors make the enterprise resource planning software systems differ from other innovations. Such these factors are software implantation cost, software complexity, and its ability to exchange information with other software systems (software interoperability). This study has implications for developers, organizations, and its managers (stakeholders). The findings offer guide for managers to efficiently manage the implementation of enterprise resource planning systems across their organizations. They should understand and identify social and technical factors that affect implementation of such complex information systems. This study has identified the influence of social, organizational, and technical factors on the end user acceptance of ERP. Managers should not only make a decision to implement and use ERP systems, but also make other managers and employees satisfied using the systems for enhancing their productivity and decisions. Additionally, developers should consider the software characteristics that impact the acceptance of ERP software systems in the early stages of software developing to avoid failing the implementation of such software systems. Further research works could be conducted to investigate the impact of other factors on the acceptance of ERP software system, e.g., employees' culture. Furthermore, other research could be done to support the findings especially in terms of the system interoperability and implementation cost. Few limitations have appeared; the study should

be conducted with a large sample size, but the sample size was small. Therefore, the research work did not investigate the variance between groups, such as the variance in the relationship of software implementation cost and software systems acceptance between managers and employees. The managers could give more care to the cost than other employees. Thus, future work could consider the employee's position as a moderator that could affect the relationship between the software implementation cost and the acceptance of ERP software systems.

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