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E-government system evaluation

The case of users' performance using ERP systems in higher education

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Abstract

Purpose – Enterprise resource planning (ERP) systems are complex and comprehensive software designed to integrate business processes and functions. Despite the difficulties and risk, the adoption of ERP systems is expanding rapidly. Universities make large investments in information systems and expect positive impacts. However, universities are facing serious challenges in implementing new technology. Therefore, this research aims to evaluate the impact of ERP systems on higher education (HE) from the perspective of stakeholders' performance.

Design/methodology/approach – This research paper conducted a case study of an ERP system in a Saudi university to explore the impact of ERP system on the performance of the system's stakeholders among the university's employees.

Findings – The system quality factors (flexibility, compatibility, availability of right data, availability of currency, ease of use and timeliness) were found to affect performance positively, as were service quality factors (tangibility, reliability, responsiveness and assurance). This research further found that factors from pre-implementation, implementation and post-implementation phases had a direct effect on stakeholders' performance.

Research limitations/implications – Future research would be useful during the maturity phase to include all stakeholders in several Saudi universities. In addition, more research can be beneficial to test the applicability of the impact of the ERP system on stakeholders' performance in other public sector organisations and in the private sector.

Practical implications – The results suggest that organisations in general and HE institutions in particular should focus on the early stages and the implementation phase if they wish to achieve high standards of stakeholder performance.

Originality/value – This research makes a novel contribution by attempting to evaluate the impact of service quality on stakeholder performance in the ERP environment. The contribution uses service quality as a dimension consisting of four factors – reliability, assurance, tangibility and responsiveness. All four factors were found to be significant on ERP stakeholders' performance.

Keywords Higher education, Performance, Stakeholders, ERPs, Post implementation

Paper type Research paper

1. Introduction

Enterprise resource planning (ERP) systems are complex and comprehensive software packages designed to integrate business processes and functions. Despite the difficulties and risks involved in adopting them, organisations spend millions of dollars on information systems (ISs) to improve organisational and individual performance. Such systems were a breakthrough, particularly in industrialized nations where they were applied by a vast

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majority of manufacturing companies (Jutras, 2010; Tenhiäläa and Helkiö, 2015). Swartz and Orgill (2000), major proponents of ERP systems, argue that there are many encouraging reasons to implement these systems, including those to improve information access and the effectiveness of workflow. Other reasons to consider ERP are its ability to improve controls and its ease of use for stakeholders. According to Petter *et al.* (2008), ISs are developed using information technology (IT) to help individuals, practitioners and researchers understand and measure the success of investments (Goodhue, 1995). However, Sedera *et al.* (2003) argue that the success of large ISs, particularly ERP systems, is itself difficult to measure, as their benefits, while substantial, are often intangible and the systems have numerous users (stakeholders), ranging from top executives to data entry operators, with each group defining success differently. However, Shen *et al.* (2016) state that it is worth measuring ERP system performance based on its impact on critical performance of an organisation. The hierarchical balanced scorecard model with respect to multiple criteria decision-making is one such systematic approach that was developed to bridge ERP performance measurement and key organisational performance. Galy and Sauceda (2014) consider the time essential to promote and receive profits following an ERP implementation system. Therefore, there is a great need for continued improvement and assessment, as ERP use evolves over time, and one of the most important issues in measuring ERP success is when measurement is accrued.

According to Elmes *et al.* (2005), organisations adopt enterprise systems for a variety of reasons, both technical and organisational. Therefore, it is important to theorise the technical aspects of IT and how design decisions affect the emergence of a socio-technical infrastructure and its accompanying work practices. Indeed, it is essential to conceptualise the limitations of such technology and the ways in which human behaviour fits within its restraints (Scott and Wagner, 2003).

Universities in particular make large investments in ISs, expecting positive outcomes. Despite the potential benefits, universities face serious challenges in implementing this new technology. As highlighted by Irani (2002) several challenges including, human and organisational management. Universities are unique organisations; meeting stakeholders' expectations is a particular challenge. Effectiveness subsequent to the implementation of ERP systems has become an essential indicator of success; effective selection, development and improvement of ISs require a systematic evaluation tool.

Although researchers and practitioners consider user satisfaction to be a fundamental indicator of ISs' success (Aladwani, 2003), the literature has revealed a number of key weaknesses in this assumption, including that ISs can be viewed from two distinct perspectives: the organisational, focusing on the quality of the interface and the information provided by the system to help employees fulfil their tasks, and the socio-technical, which is concerned with individual needs (Au *et al.*, 2002). Furthermore, while adopting ISs represents a major investment and a significant financial risk (Irani, 2010; Sharif and Irani, 2006), with ERP systems being described as expensive, risky and difficult, ISs/ERP projects are nonetheless often evaluated using traditional techniques. Thus, there is an urgent need to evaluate these systems from the perspective of the stakeholders. Such an approach to evaluation would provide researchers and practitioners with a guide as to how to assess the impact of new technology on employee performance.

Traditionally, higher education (HE) institutions have tended to be advocates and proactive adopters of new technology (Rabaa©i *et al.*, 2009). At present, several Saudi Arabian universities intend to adopt or develop new ISs/ERP systems to improve the HE process. In response to the serious challenges that they face in doing so, they need to

improve the integration of administrative functions into a more systematic approach, giving them a strategic advantage.

The organisation of this paper is as follows: the research problem is illustrated, and then there is a review of the literature on the evaluation of stakeholders' performance and ERP systems in HE. The theoretical framework is then developed and the research hypotheses is outlined. The next section concerns the methodology and the case study selected for studying this phenomenon. Subsequently, the data are analysed and the findings set out, followed by a discussion of issues raised in the research and the conclusions drawn from the study.

2. Enterprise resource planning systems and user performance

According to Helo *et al.* (2008), the history of ERP systems can be traced back to material requirements planning (MRP), developed in the 1960s-1970s by Joseph Orlicky. A subsequent version, manufacturing resource planning (MRPII), developed in 1983 by Oliver Wight, was better adapted to commercial implementation. The vision for MRP and MRPII was to centralise and integrate business information in a way that would facilitate decision-making for production managers and increase the efficiency of the production line overall. While MRP was primarily concerned with materials, MRPII addressed the integration of all aspects of manufacturing, including materials, finance and human relations. Like today's ERP systems, MRPII was designed to integrate large amounts of information by way of a centralised database. However, the hardware, software and relational database technology of the 1980s was not advanced enough to provide the speed and capacity to run these systems in real time (Shum and Lin, 2003), their cost was also prohibitive for most businesses. Nonetheless, the vision had been established, and shifts in the underlying business processes along with rapid advances in technology led to the more affordable enterprise and application integration systems that many enterprises use today (Monk and Wagner, 2006). The term "enterprise resource planning" was coined in the early 1990s by the Gartner Group (Wylie, 1990). ERP has since been defined by various authors (Gable *et al.*, 1998; Rosemann and Wiese, 1999; Almashari *et al.*, 2003; Sane, 2005; Wu and Wang, 2006) without significant differences. This paper adopts the definition developed by Zhu *et al.* (2010): "configurable information systems/packages that integrate information and information-based processes within and across functional areas in an organisation". ERP systems have been increasingly adopted by large- and medium-sized organisations in both the private and public sectors for a variety of technical and organisational reasons, which can be summarised as addressing the limitations, defragmentation and incompatibility associated with existing (legacy) systems (Elmes *et al.*, 2005; Robey *et al.*, 2002). Khoo and Robey (2007) and Khoo *et al.* (2011) list the advantages for organisations of adopting packaged software solutions as – costs saving, improving use capabilities, reducing system development time, boosting competitive advantages and enhancing productivity improvement. According to Tenhiälää and Helkiö (2015), some authors argued that an ERP system can be beneficial for the organisations that operate in stable market requirements. However, these systems are definitely detrimental to organisations facing dynamic conditions. This can be contributed to the fact that ERP systems impose constraints and procedures on organisations that reduce the flexibility in changing business processes (Tenhiälää and Helkiö, 2015). On the other hand, other authors stressed that information-processing capabilities of ERP systems are crucial for organisations that operate in dynamic conditions and constrain the process of reengineering. Tenhiälää and Helkiö, (2015) strongly favour the use of ERP systems in organisations that face dynamic market requirements. On this basis, an ERP software package has become a universal technology for both personal

users and large organisations (Khoo and Robey, 2007). Hence, ERP has a significant role to play in IT management, including in the HE sector.

Within an HE context, ERP systems have multiple functions, "tracking a range of activities that include human resources systems, student information systems and financial systems" (Robert, 2004). While there are many similarities between the HE and industrial sectors, as far as implementing ERP software is concerned, universities can be seen as distinct in combining certain characteristics, identified by Okunoye and Frolick (2006) as "complexity of purpose, limited measurability of outputs, both autonomy from and dependency on wider society, diffuse structure of authority, and internal fragmentation". Another fundamental factor considered to distinguish HE institutions from other organisations is their stakeholders. Notwithstanding these differences, Bradley and Lee (2007) assert that universities have similar problems to other organisations, such as coordinating resources, controlling costs, motivating faculty and staff members, and facilitating their use of ERP. Therefore, evaluation of the systems is important, especially that the implementation is challenging and expensive task that places tremendous demands on organisation time and resources. These challenges make most of ERP implementations classified as failures because they did not achieve predetermined organisation goals (Babaei *et al.*, 2015). A number of universities have spent more than US$20m each on implementing ERP projects, which can take two or three years (Swartz and Orgill, 2000). However, while the literature on ERP systems has considered manufacturing industries and noted that ERP is currently experiencing rapid growth, few studies have discussed ERP in an academic context, particularly its implementation by HE institutions (Rabaa©i *et al.*, 2009, Abugabah and Sanzogni, 2010; Kalema *et al.*, 2014). The present study offers a valuable contribution in this respect.

2.1 Evaluation of stakeholders' performance

The evaluation of ISs more generally has been the concern of many researchers (Farbey *et al.*, 1993; Irani, 1998; Land, 2001; Adelakun and Jennex, 2002; Irani and Love, 2008). Despite the variety of ISs' success evaluation studies, there is no consensus on the appropriate way to conduct these so as to maximise organisations' return on their ISs' investments. Previous studies have focused on user satisfaction, but there has been less attention to ERP systems and stakeholder performance. Especially, measures of expected performance differ from one project to another, and these depend on the domain of the application and negotiation of multiple stakeholders (Duhamel *et al.*, 2013). Despite the importance of ISs' evaluation, there is a lack of an accepted framework for ISs' evaluation in general and specifically of ERP in HE, which this study addresses. This section outlines three ISs models and considers their potential for evaluating the performance of ERP system stakeholders in HE.

2.1.1 Task–technology fit. According to Chang (2008), the task–technology fit (TTF) model, proposed by Goodhue (1995), considers the degree to which the capabilities of the technology match the demands of the task. Alternatively, Goodhue and Thompson (1995) define TTF as "the degree to which a technology assists an individual in performing his or her portfolio of tasks". The model has four main constructs. Three of these – task characteristics, technology characteristics and individual characteristics – together affect the fourth construct, TTF, which in turn affects either utilisation or performance (Dishaw *et al.*, 2002). Additionally, Goodhue *et al.* (2000) state that the model assumes that performance affects the relationships among technology characteristics, task requirements and individual abilities.

2.1.2 Information systems' success model. DeLone and McLean's (1992) ISs success model (the D&M model) is the most widely cited and valued contribution to the literature on

ISs success measurement, as it was the first study that tried to impose some order and to develop a comprehensive ISs model for a particular context (Gable *et al.*, 2008). DeLone and McLean (1992) analysed a large number of academic studies from 1981 to 1987, attempting to identify the key factors contributing to ISs' success. Based on these studies, they identified six major dimensions or categories of ISs success: systems quality, information quality, use, user satisfaction, individual impact and organisational impact. The performance of the D&M model has been assessed by Nripendra *et al.* (2013) who emphasized that several studies, like Garrity and Sanders (1998) and Rai *et al.* (2002), have either adopted or expanded the D&M model with some modifications.

2.1.3 End user computing satisfaction. The end user computing satisfaction (EUCS) model, designed by Doll and Torkzadeh (1988), is a potentially measurable surrogate as a utility in decision-making. It interacts directly with the application software to enter information or prepare output reports. The end user's decision-making ability is enhanced when the output meets the user's requirements (Doll and Torkzadeh, 1988).

When applied separately, the TTF, EUCS and D&M models do not provide effective evaluation of stakeholder performance, as TTF and EUCS evaluate the technical aspects of systems, while the individual impact in the D&M model focuses on the human/social aspects. In response, this paper aims to integrate all three models to effectively evaluate ERP stakeholder performance in an HE environment. The new synthesised framework adopts the conceptual model developed by Gable *et al.* (2008), thus combining impact and quality and selecting the appropriate factors. This offers a more comprehensive view of the most important factors that affect stakeholder performance, the consequence of the factors in the D&M model. The factors gathered from the TTF model and EUCS consider quality as a half measure, which will be used to evaluate stakeholders' performance, whereas individual performance is an essential indicator of organisational performance. Studying the impact of ERP systems on stakeholders' performance is a significant way to assess the utility of this software in HE, and how it contributes to performance, efficiency and effectiveness.

2.2 Theoretical framework and hypothesis building

According to Quattrone and Hopper (2006), technologies are neither external/independent of human beings nor are they "out there" simply waiting to be appropriated, but rather emerge from people's repeated and situated interactions with particular technologies. The implementation of ERP systems presents a number of challenges, many of which are anchored in people's responses to new technologies. If implementation is unsuccessful, organisations suffer heavy costs while failing to achieve the expected benefits. The academic literature has thus paid significant attention to the factors contributing to successful implementation. Table I lists the key factors of the theoretical model developed for this study, showing their derivation from the D&M, TTF and EUCS models. When combined, they are assumed to affect stakeholders' performance positively. These factors were selected as being the most suitable in the ERP environment, with the aim of measuring how ERP systems enhance individual performance. The derivation of the performance factors which are presented in the D&M model – time taken to complete task, improving stakeholders' productivity, immediate recall of information, stakeholders' confidence and performance and ability to identify problem and solution – was initially based on a comprehensive study conducted by DeLone and McLean (1992) under the dimension of individual impact.

Many researchers have focused on performance evaluation in the managerial motivation literature (Kominis and Emmanuel, 2007); employees have different expectations and levels of confidence regarding their capabilities (Eerde and Thierry, 1996). This paper focuses on

Performance	Systems quality		Service quality
D&M ISS	TTF	EUCS	D&M ISs
Time taken to complete task	Lack of confusion	Content	Reliability
Improve stakeholders' productivity	Right data	Format	Assurance
Immediate recall of information	Accessibility	Timeliness	Responsiveness
Stakeholders' confidence and performance	Assistance		Tangible
Ability to identify problem and solutions	Authorisation		
Computer awareness	Ease of use		
	Flexibility		
	Training		
	Accuracy		
	Compatibility		
	Currency		

Table I.
The selection factors from the three models

stakeholders' outcomes and suggests that individuals consider alternative outcomes, while analysing the costs and benefits of each, and then select an outcome with optimum utility (Woodroof and Kasper, 1998). Because this research is concerned with the post-implementation phase of ERP systems, it is essential to evaluate stakeholder performance, measuring whether the systems have a significant impact on performance and meet stakeholders' expectations.

Au *et al.* (2008) define performance in ISs' environments as "the perceived outcome from IS use"; higher performance levels of ERP systems will lead to higher levels of stakeholder performance. For an ISs to be considered successful, it must be both effective in terms of outcome and efficient in terms of process. Both process and outcome are considered to be essential in meeting users' needs. Expectable ERP performance refers to stakeholders' expectations and needs, such as developing performance and functional effectiveness that can be enabled by using an ERP system in the workplace.

As illustrated in the following Section 3, there are two main hypotheses; the first main hypothesis is thus that higher ERP system quality leads to higher stakeholder performance. In addition, there are 14 sub-hypotheses related to the first main hypothesis and their factors' 14 correlations are illustrated in the Table I. All factors are based on D&M, TTF and EUCS models, and Pitt *et al.* (1995), among others, found it important to include service quality as a measure of ISs' success, which was considered by DeLone and McLean (2003). The service support that stakeholders receive from their ERP system team, in answering their questions, solving any problems they may face and providing the latest hardware and software, can result in higher performance.

This leads to the second main hypothesis that higher service quality leads to higher levels of ERP stakeholder performance. In addition, there are four sub-hypotheses related to the second main hypothesis and their factors' four correlations are illustrated in the Table I.

These hypotheses are restated in more specific form in the following section, after an account of the empirical context of the study.

3. Research methodology

This research is considered as a developing research because the factors contributing to high-quality ERP systems and to service quality were identified by reviewing the existing literature. Then, the questionnaire and interviews were used to evaluate the impact of ERP systems in HE from the perspective of stakeholders' performance. In data collection, descriptive survey research is applied because it identifies the traits of the population under

investigation in terms of the nature of the situations and relationship. Finally, as the study was conducted at King Saud University (KSU), as a dynamic and live institution, the present applied research and its findings can be used practically.

3.1 Research setting

This research selects KSU in Riyadh, Saudi Arabia, as a research setting. To develop the understanding of ERP systems in the HE sector and to provide researchers and practitioners with a new technique to enhance their evaluation of ERP stakeholders' performance in HE, this study examines the impact of the MADAR ERP system on the performance of stakeholders in the KSU in Riyadh, Saudi Arabia. The study identifies the factors contributing to high-quality ERP systems and to service quality, which in turn improve stakeholders' performance.

3.1.1 King Saud University. The progress of any nation has always been strongly associated with knowledge and learning. KSU, the premier HE institution in Saudi Arabia and the first university in the Kingdom, was established in 1957 to enhance the nation's growth and respond to the educational needs of a new generation. KSU aims to provide skilled professionals and academicians required to meet the nation's growing needs in the areas of medicine, engineering, agriculture, science and development, humanities and language. KSU aims to become a leader in educational and technological innovation, scientific discovery and creativity, by fostering an atmosphere of intellectual inspiration and partnership. Among its many departments, the Department of Computer and Information Science, Architecture and Planning was established in 1984 (King Saud University's History, 2012). The rationale for selecting KSU was based on their adoption of ERP; KSU is the first and leading Saudi university adopting ERP. The population of this study consists of the 8,582 employees of KSU in the departments from which employees (stakeholders) were selected as a sample based on the following three criteria:

(1) as MADAR implementation was carried out in phases and the selected stakeholders are working in departments that already implemented the system;

(2) stakeholders' experience of more than three years; and

(3) stakeholders already received sufficient training on MADAR system.

3.1.2 The MADAR system. MADAR is an enterprise system used by KSU to meet all of its administrative software needs (Alshamlan and Almudimigh, 2011). The MADAR project is responsible for developing, implementing and maintaining ERP projects within KSU, and it has experience in implementing many projects for other organisations in Saudi Arabia. Its strengths are integration and collaboration, and these organisations are reported to be mostly content with the results of the integration (Al-Mudimigh and Ullah, 2011). Table II lists the functions at KSU that have implemented the MADAR system.

A single case study was conducted at KSU, based on the need to evaluate such a system and examine the impact from the stakeholders' perspective. Reasons for selecting KSU as a

Table II.
Reliability test KSU

Constructs	No. of items	Cronbach's alpha	Type
Total KSU questionnaire	24	0.931	Excellent reliability
Performance	6	0.899	High reliability
System Quality	14	0.865	High reliability
Service Quality	4	0.792	High reliability

suitable case study are discussed in Section 5. The case study is a research method commonly used in the social sciences to examine a phenomenon in its natural setting (Yin, 2009). Case study research is well suited to the investigation of the post-implementation phase of ISs/ERP systems, especially when context is important and the phenomenon is a contemporary one which the researchers have no control over.

3.2 Measures

A combined methodology of 60 structured questionnaires and 8 semi-structured interviews were used to collect the data from MADAR system users at KSU. The content and format of the questionnaire were developed from a review of the relevant literature. The questionnaire was adapted from one previously used in the general ISs context, to make it suitable for examining ERP use in particular. Researchers found it useful to use five-item Likert scales (e.g. strongly agree, agree, don't know, disagree and strongly disagree) in the questionnaire items, which designed to understand and measure the opinions of ERP end-users regarding the impact of the systems on their performance.

The questionnaire consisted of four parts: Part 1 comprised demographic questions designed to solicit general information about the respondents, their organisations (universities) and the extent of their roles in the systems; Part 2 concerned stakeholders' impact and Part 3 addressed systems quality and Part 4 was about technical support. The questionnaire can be described as semi-structured, comprising 31 items, including 3 open questions at the end of each part, while the remainder required responses on a five-point Likert-type scale where 1 = strongly disagree and 5 = strongly agree.

Most measurement factors were adopted from previous studies of ISs and ERP systems to ensure adequate reliability and validity. Thus, questions concerning the D&M model were adapted from Gable *et al.* (2008) and Kositanurit *et al.* (2006) for individual performance, while questions on service quality (technical support) were adapted from the D&M update (2003). For EUCS (Doll and Torkzadeh, 1988), questionnaire items were adapted from the work of Somers *et al.* (2003). Finally, items from the questionnaire on the TTF model by Goodhue (1995) were adapted to address systems quality.

A pilot study was conducted on six users familiar with the MADAR system. Questionnaire data were analysed using SPSS (version 20) (Bernstein and Ruth, 1999). Statistical methods, multiple regressions that are more powerful tests and appropriate methods to predict the changes in the dependent variable in response to the changes in independent variables (Hair *et al.*, 2010). Therefore, multiple regressions were used to test the following hypotheses and to explore the relationships of perceptions of ERP systems quality and service quality with six outcomes of stakeholder performance:

H1. MADAR systems quality variables have a significant impact on KSU stakeholders' performance variables.

H2. MADAR service quality variables have a significant impact on KSU stakeholders' performance variables.

4. Findings

This section outlines the empirical findings of the case study of the KSU MADAR system. From the outset, the aim was to tightly integrate theoretical assumptions with the empirical evidence, thereby avoiding abstract concepts detached from social reality.

4.1 Questionnaire

4.1.1 Reliability test. Internal consistency within the research instrument is assessed by measuring the reliability coefficient known as Cronbach's alpha (α), which refers to the level of homogeneity among the measured items in one or more sets. The items were clustered into a particular dimensional group and α was calculated. The total questionnaire, consisting of 24 questions, had a coefficient score of 0.931, which is considered high internal consistency. In addition, the performance, system quality and service quality constructs had reliability coefficients of 0.899, 0.865 and 0.792, respectively, indicating strongly acceptable levels of internal consistency. According to Nunnally and Bernstein (1978), reliability coefficients of 0.5 and above are considered sufficient for research that is exploratory in nature. The Cronbach's α results are shown in Table II.

To more thoroughly test *H1*, multiple regressions were used to assess the relative importance of the system quality variables in explaining differences in attitudes towards stakeholder performance. Standard multiple regressions (enter method) were conducted, with the 6 stakeholder performance variables posited as the dependent variables and the 14 ERP system quality variables posited as the independent variables. The R^2 values show that the system quality variables, as a group, explained 50.4 per cent of the variation in improving stakeholders' productivity, 68.5 per cent of the variation in time taken to complete task, 63.8 per cent in stakeholder confidence and performance, 64.8 per cent in computer awareness, 48.3 per cent in immediate recall of information and 59.9 per cent in ability to identify problem and solution. According to Pallant (2010), these are acceptable levels of accuracy for academic research, which rarely reach the high levels of variance required in real-world research (e.g. medicine or marketing).

The F values show that there were highly significant relationships ($p < 0.001$) between the 14 ERP system quality variables and all stakeholder performance variables. The model for time taken to complete task had the largest F value, $F(14, 59) = 7.004$, $p < 0.001$, indicating that it was the most significant model, followed by computer awareness, $F(14, 59) = 5.906$, $p < 0.001$, stakeholder confidence and performance, $F(14, 59) = 5.656$, $p < 0.001$, then ability to identify a problem and solution, $F(14, 59) = 4.808$, $p < 0.001$, improving stakeholders' productivity $F(14, 59) = 3.269$, $p < 0.01$ and finally immediate recall of information, $F(14, 59) = 2.999$, $p < 0.01$.

Turning now to the importance of each predictor, we need to look at the standardised beta coefficient (β) statistics. These tell us the unique contribution of each predictor to the outcome and what effect an increase of one standard deviation in each predictor would have on the outcome.

4.1.2 Improving stakeholders' productivity. Table III shows that among all the 14 variables of system quality, only timeliness had a significant impact on improving stakeholder productivity, with $\beta = 0.501$ at $p < 0.01$. Thus, for every one standard deviation increase in timeliness, improving stakeholder productivity increased by 0.501 points. Consequently, the regression equation to predict improvement in stakeholders' productivity is:

$$B_1\ Timeliness = 0.561\ \ Timeliness$$

Time taken to complete task: Table III shows that only timeliness had a significant impact on time taken to complete task ($\beta = 0.588$). Thus, the regression equation to predict time taken to complete task is:

$$B_1\ Timeliness = 0.691\ \ Timeliness$$

Stakeholder confidence and performance: Table IV shows that only two of the system quality variables, timeliness ($\beta = 0.399$) and flexibility ($\beta = 0.393$), had a significant and negative

Table III. Regression models for improved stakeholder productivity and time taken to complete task influenced by system quality at KSU

Model	USTD CO		STD CO			Model	USTD CO		STD CO		
ISP	B	SE	Beta	*t*	Significance	TCT	B	SE	Beta	*t*	Significance
(Constant)	0.186	0.751		0.248	0.805	(Constant)	−0.796	0.627		−1.269	0.211
Accessibility	−0.222	0.204	−0.226	−1.089	0.282	Accessibility	−0.154	0.17	−0.149	−0.904	0.371
Assistance	−0.084	0.159	−0.082	−0.529	0.599	Assistance	−0.148	0.132	−0.138	−1.119	0.269
Ease of use	0.29	0.178	0.245	1.629	0.11	Ease of use	0.079	0.149	0.064	0.534	0.596
Accuracy	0.227	0.168	0.23	1.351	0.184	Accuracy	0.186	0.14	0.18	1.327	0.191
Currency	0.155	0.146	0.152	1.059	0.295	Currency	0.132	0.122	0.124	1.084	0.284
Content	−0.055	0.207	−0.048	−0.266	0.791	Content	0.335	0.173	0.277	1.935	0.059
Format	−0.164	0.213	−0.137	−0.771	0.445	Format	−0.160	0.178	−0.127	−0.900	0.373
Timeliness	0.561	0.2	0.501	2.807	0.007	Timeliness	0.691	0.167	0.588	4.139	0
Authorisation	−0.029	0.108	−0.034	−0.264	0.793	Authorisation	−0.119	0.09	−0.133	−1.315	0.195
Training	0.04	0.12	0.045	0.331	0.742	Training	−0.074	0.1	−0.080	−0.738	0.465
Right data	0.049	0.177	0.054	0.279	0.781	Right data	0.09	0.148	0.094	0.609	0.545
Lack of confusion	0.054	0.142	0.062	0.384	0.703	Lack of confusion	−0.097	0.118	−0.105	−0.822	0.415
Compatibility	0.048	0.207	0.041	0.232	0.817	Compatibility	0.244	0.173	0.198	1.415	0.164
Flexibility	0.157	0.149	0.174	1.053	0.298	Flexibility	0.237	0.125	0.25	1.901	0.064

Notes: UNSTD CO = unstandardized coefficient; STD CO = standardized coefficients; ISP = improve stakeholders' productivity; TCT = time taken to complete task

Table IV.
Regression models for confidence and performance and computer awareness influenced by system quality at KSU

Model CP	USTD CO B	USTD CO SE	STD CO Beta	*t*	Significance	Model CA	USTD CO B	USTD CO SE	STD CO Beta	*t*	Significance
(Constant)	−0.083	0.659		−0.126	0.9	(Constant)	−0.317	0.704		−0.450	0.655
Accessibility	0.018	0.179	0.018	0.101	0.92	Accessibility	0.358	0.191	0.328	1.876	0.067
Assistance	−0.154	0.139	−0.147	−1.110	0.273	Assistance	−0.168	0.149	−0.148	−1.128	0.265
Ease of use	0.252	0.156	0.207	1.61	0.114	Ease of use	0.177	0.167	0.135	1.064	0.293
Accuracy	−0.018	0.148	−0.017	−0.119	0.906	Accuracy	0.245	0.158	0.224	1.556	0.127
Currency	0.217	0.128	0.207	1.691	0.098	Currency	0.312	0.137	0.275	2.276	0.028
Content	0.206	0.182	0.174	1.134	0.263	Content	0.395	0.194	0.308	2.034	0.048
Format	−0.179	0.187	−0.145	−0.958	0.343	Format	−0.571	0.199	−0.429	−2.866-	0.006
Timeliness	0.459	0.176	0.399	2.616	0.012	Timeliness	0.209	0.187	0.168	1.118	0.269
Authorisation	−0.173	0.095	−0.197	−1.816	0.076	Authorisation	−0.155	0.102	−0.163	−1.523	0.135
Training	−0.117	0.105	−0.130	−1.112	0.272	Training	−0.184	0.112	−0.189	−1.638	0.108
Right data	0.153	0.156	0.162	0.982	0.331	Right data	−0.031	0.166	−0.030	−0.184	0.855
Lack of confusion	−0.148	0.124	−0.163	−1.189	0.241	Lack of confusion	−0.148	0.133	−0.150	−1.111	0.272
Compatibility	0.17	0.182	0.141	0.939	0.353	Compatibility	0.289	0.194	0.221	1.491	0.143
Flexibility	0.364	0.131	0.393	2.782	0.008	Flexibility	0.263	0.14	0.262	1.885	0.066

Notes: UNSTD CO = unstandardized coefficient; STD CO = standardized coefficients; CP = confidence and performance; CA = computer awareness

impact on stakeholder confidence and performance. Accordingly, the regression equation to predict stakeholder confidence and performance is:

$$B_1\ Timeliness + B_2\ Flexibility = 0.459\ Timeliness + 0.364\ Flexibility$$

Computer Awareness: Table IV shows that content and currency had significant positive impacts on computer awareness, whereas format had a significant negative impact on it, with $\beta = 0.308$, 0.275 and –0.429, respectively at $p < 0.05$. Hence, the regression equation to predict computer awareness is:

$$B_1\ Content + B_2\ Currency + B_3\ Format = 0.395\ Content + 0.312\ Currency - 0.571\ Format$$

Immediate recall of information: Table V shows that only system ease of use had a significant impact on immediate recall of information ($\beta = 0.329$). Thus, the regression equation to predict immediate recall of information is: $B_1\ Ease\ of\ use = 0.402\ Ease\ of\ use$.

Ability to identify problem and solution: Table V shows that none of the system quality variables had a significant impact on stakeholders' ability to identify problems and solutions. Hence, there were no influential predictors among them.

4.1.3 Service quality (H2). To more thoroughly test *H2*, multiple regressions were used to assess the relative importance of the service quality variables in explaining differences in attitudes towards stakeholder performance. Standard multiple regressions (enter method) were conducted, with the six stakeholder performance variables posited as the dependent variables and the four ERP service quality variables as the independent variables.

The R^2 values show that the service quality variables together explained 30.5 per cent of the variation in improving stakeholders' productivity, 44.4 per cent of the variation in time taken to complete task, 49.25 per cent in stakeholder confidence and performance, 47.0 per cent in computer awareness, 16.6 per cent in immediate recall of information and 50.2 per cent in the ability to identify problems and solutions. The percentage of variance explained by service quality variables was thus substantially lower than that for the systems quality variables reported above. As discussed earlier, part of the variance may be due to measurement error, but the lower percentage of variance explained suggests that other unknown factors must play a part in determining these stakeholder performance attitudes (Field, 2009).

The F values reveal highly significant relationships at the $p < 0.05$ level between the four ERP service quality variables and all stakeholder performance variables. The model for ability to identify problems and solutions had the largest F value, F (4, 59) = 13.885, $p < 0.001$, indicating that this was the most significant model, followed by stakeholders' confidence and performance, $F(4, 59) = 13.479\ p < 0.001$; then computer awareness, $F(4, 59) = 12.204$, $p < 0.001$; time taken to complete task, $F(4, 59) = 10.990$, $p < 0.001$; improving stakeholder productivity, $F(4, 59) = 6.030$, $p < 0.001$ and finally immediate recall of information, $F(4, 59) = 2.730, p < 0.05$.

As for system quality above, it is now necessary to examine the unique contribution of each predictor on the outcome by calculating the β statistics.

Improving stakeholders' productivity: Table VI shows that among the variables of service quality, only tangibility had a significant impact on improving stakeholder productivity, with $\beta = 0.356$ at $p < 0.05$. Thus, the regression equation to predict improvement in stakeholders' productivity is:

$$B_0 + B_1\ Tangibility = 2.113 + 0.330\ Tangibility$$

Table V. Regression models for ability to identify problems and solutions and immediate recall of information influenced by system quality at KSU

Model AIP	USTD CO B	USTD CO SE	STD CO Beta	t	Significance	Model IMI	USTD CO B	USTD CO SE	STD CO Beta	t	Significance
(Constant)	−0.235	0.631		−0.373	0.711	(Constant)	0.488	0.792		0.616	0.541
Accessibility	0.138	0.171	0.15	0.805	0.425	Accessibility	−0.011	0.215	−0.011	−0.051	0.96
Assistance	−0.008	0.133	−0.009	−0.062	0.95	Assistance	−0.021	0.167	−0.020	−0.126	0.9
Ease of use	0.01	0.15	0.009	0.07	0.944	Ease of use	0.402	0.188	0.329	2.14	0.038
Accuracy	0.057	0.141	0.062	0.404	0.688	Accuracy	0.17	0.177	0.167	0.96	0.342
Currency	0.211	0.123	0.222	1.717	0.093	Currency	0.205	0.154	0.195	1.327	0.191
Content	0.236	0.174	0.219	1.354	0.182	Content	0.344	0.219	0.289	1.571	0.123
Format	−0.036	0.179	−0.032	−0.199	0.843	Format	−0.377	0.225	−0.304	−1.677	0.1
Timeliness	0.12	0.168	0.115	0.715	0.478	Timeliness	0.349	0.211	0.301	1.653	0.105
Authorisation	−0.123	0.091	−0.154	−1.353	0.183	Authorisation	0.005	0.114	0.005	0.042	0.967
Training	0.016	0.101	0.02	0.16	0.873	Training	−0.194	0.126	−0.214	−1.533	0.132
Right data	−0.015	0.149	−0.018	−0.101	0.92	Right data	−0.257	0.187	−0.270	−1.371	0.177
Lack of confusion	0.097	0.119	0.118	0.817	0.418	Lack of confusion	0.097	0.15	0.107	0.652	0.518
Compatibility	0.11	0.174	0.1	0.633	0.53	Compatibility	0.146	0.218	0.12	0.67	0.506
Flexibility	0.191	0.125	0.226	1.524	0.134	Flexibility	0.087	0.157	0.093	0.55	0.585

Notes: UNSTD CO = unstandardized coefficients; STD CO = standardized coefficients; AIP = ability to identify problem; IMI = immediate recall of information

Table VI. Regression models for improved stakeholder productivity and time taken to complete task influenced by service quality at KSU

Model	USTD CO		STD CO			Model	USTD CO		STD CO		
ISP	B	SE	Beta	*t*	Significance	TCT	B	SE	Beta	*t*	Significance
(Constant)	2.113	0.462		4.575	0	(Constant)	1.318	0.433		3.044	0.004
Tangible	0.33	0.135	0.356	2.448	0.018	Tangible	0.135	0.126	0.139	1.07	0.289
Reliability	0.296	0.154	0.317	1.926	0.059	Reliability	0.438	0.144	0.447	3.036	0.004
Responsiveness	−0.062	0.115	−0.084	−0.540	0.591	Responsiveness	0.151	0.108	0.195	1.403	0.166
Assurance	−0.046	0.128	−0.051	−0.362	0.719	Assurance	−0.018	0.12	−0.019	−0.152	0.88

Notes: UNSTD CO = unstandardized coefficient; STD CO = standardized coefficients; ISP = improve stakeholders' productivity; TCT = time taken to complete task

Time taken to complete task: Table VI shows that only one variable of service quality, reliability, had a significant impact on time taken to complete task, with $\beta = 0.447$ at $p < 0.01$. Thus, the regression equation to predict time taken to complete task is:

$$B_0 + B_1\, Reliability = 1.318 + 0.438\, Reliability$$

Stakeholder confidence and performance: Table VII shows that only tangibility and responsiveness among the service quality variables had a significant impact on stakeholder confidence and performance, with $\beta = 0.345$ and 0.287, respectively, at $p < 0.05$. The regression equation to predict stakeholder confidence and performance is:

$$B_0 + B_1\, Tangibility + B_2\, Responsiveness = 1.374 + 0.329\, Tangibility + 0.218\, Responsiveness$$

Computer awareness: Table VII shows that tangibility and responsiveness were the only service quality variables having a significant impact on stakeholders' computer awareness, with $\beta = 0.265$ and 0.304, respectively, at $p < 0.05$. Therefore, the regression equation to predict computer awareness is:

$$B_1\ Tangibility + B_2\ Responsiveness = 0.273\ Tangibility + 0.250\ \ Responsiveness$$

Immediate recall of information: The analysis revealed that none of the service quality variables was significant, so none was an influential predictor of the immediate recall of information, as Table VIII shows.

Ability to identify problem and solution: Table VIII shows that the only service quality variables having a significant impact on the ability to identify problems and solutions were reliability and assurance, with $\beta = 0.340$ and 0.364 at $p < 0.05$. Thus, the regression equation to predict stakeholders' ability to identify problems and solutions is:

$$B_1\, Reliability + B_2\ Assurance = 0.297\ Reliability + 0.307\ Assurance$$

The above results are shown graphically in Figure 1, a conceptual model of relationships between ERP system quality variables, ERP service quality variables and stakeholder performance.

4.2 Interviews

The model in Figure 1 is based on the quantitative part of this research. The authors believe that there is a need for additional qualitative data to complement the proposed model. According to Skok and Legge (2002), in complex ERP projects involving multiple stakeholders and the interrelationships between them, a single data collection technique is unlikely to provide a clear picture of the impact of the system on stakeholders' performance. There is thus a need for an in-depth analysis to determine the precise situation. Here, an interpretive and qualitative approach is suitable, as it helps the researcher to identify the key issues of concern among the stakeholders who have actually been involved in the ERP system in their daily work.

Interviews were therefore conducted with project managers of the MADAR system and KSU employees, focusing on the following specific points, which were considered to be essential from the managerial point of view and to have a direct impact on all phases or levels of implementation.

Table VII. Regression models for confidence and performance and computer awareness influenced by service quality at KSU

Model	USTD CO		STD CO			Model	USTD CO		STD CO		
CP	B	SE	Beta	*t*	Significance	CA	B	SE	Beta	*t*	Significance
(Constant)	1.374	0.404		3.399	0.001	(Constant)	0.817	0.448		1.824	0.074
Tangible	0.329	0.118	0.345	2.784	0.007	Tangible	0.273	0.131	0.265	2.085	0.042
Reliability	0.261	0.135	0.272	1.94	0.057	Reliability	0.267	0.149	0.256	1.786	0.08
Responsiveness	0.218	0.101	0.287	2.169	0.034	Responsiveness	0.25	0.112	0.304	2.241	0.029
Assurance	−0.094	0.112	−0.102	−0.840	0.404	Assurance	0.001	0.124	0.001	0.011	0.991

Notes: UNSTD CO = unstandardized coefficients; STD CO = standardized coefficients; CP = confidence and performance; CA = computer awareness

Table VIII. Regression models for ability to identify problems and solutions and immediate recall of information influenced by service quality at KSU

Model	USTD CO		STD CO			Model	USTD CO		STD CO		
AIP	B	SE	Beta	t	Significance	IMI	B	SE	Beta	t	Significance
(Constant)	0.632	0.365			0.089	(Constant)	2.558	0.523		4.894	0
Tangible	0.182	0.107	0.21	1.709	0.093	Tangible	0.17	0.153	0.178	1.114	0.27
Reliability	0.297	0.122	0.34	2.442	0.018	Reliability	0.21	0.174	0.217	1.206	0.233
Responsiveness	−0.026	0.091	−0.037	−0.283	0.778	Responsiveness	0.007	0.13	0.009	0.05	0.96
Assurance	0.307	0.101	0.364	3.031	0.004	Assurance	0.082	0.145	0.088	0.563	0.576

Notes: UNSTD CO = unstandardized coefficient; STD CO = standardized coefficients; AIP = ability to identify problem; IMI = immediate recall of information

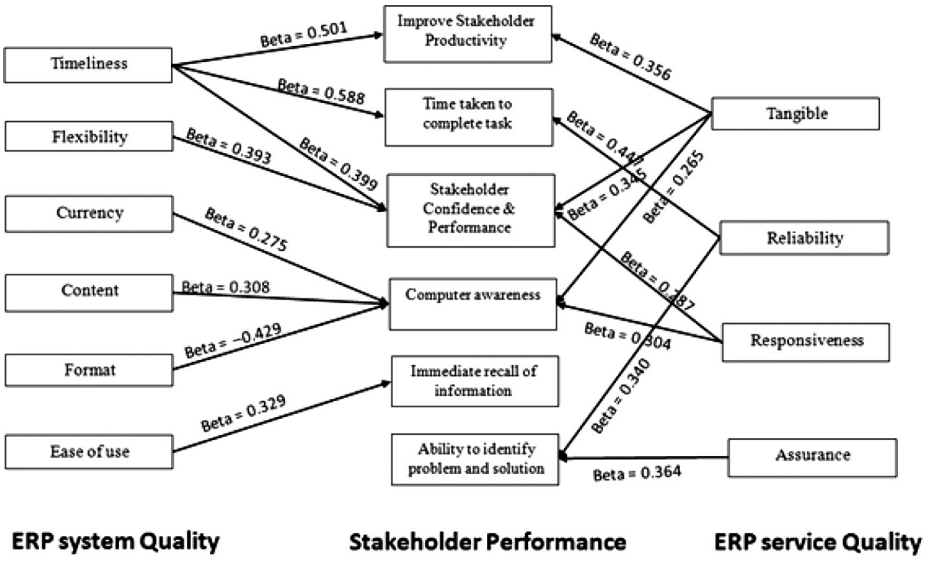

Figure 1.
System quality and service quality – significant factors

Source: The researchers

4.2.1 Contextual factors

4.2.1.1 Employee resistance. ISs/ERP implementations often fail owing to strong resistance from users. This problem should be addressed, especially in the case of the public sector. Managers A and E stated that although users were aware that the new system could help them with their performance in different ways, older users who had spent most of their careers in the same place preferred to work with the legacy system, rather than spend time learning how to work with the new system, which they considered complex compared to the old one. Out of the five, four project managers identified resistance to change as the major problem that they faced during the implementation phase:

> It was really hard for us to convince the employees to use the new system, those employees who'd spent their careers working with the legacy system, especially when it came to the old users who didn't have many years left until their retirement. (Manager A).

Most Saudi universities operate in the public sector, receiving funding and support from the government, so the majority of personnel are government employees. This explains why KSU employees thought that their jobs were secure, according to Manager D:

> Dealing with government employees leads us as managers to another problem, which is job security. The employees thought that using the new system was not compulsory and by law nobody can fire them, therefore we have to take other action to solve this problem by linking attendance at courses and using the new system effectively with promotion for all the employees. (Manager D).

4.2.1.2 Customisation. Although packaged applications are designed to work in different organisations, or even in different industries, they often do not provide all the functionality needed in a specific business. Although ERP as a software application is designed to work in different organisations or industries, or at different levels, some degree of system customisation is required.

According to Manager A, KSU configured its system to its needs by selecting appropriate components, and by setting parameters that allowed the university to modify the system within the boundaries set by the developers of the application. MADAR was designed in house by a local firm. KSU management decided to choose a local company, rather than a global one, for many reasons including cost effectiveness, ease of contact and the ability to address changes or configurations based on the university's needs:

> Choosing a local company wasn't a bad decision. Of course there is no comparison between a local and a global one, but the local one we can ask for any modification or changes we need on the system, so customisation wasn't a serious issue at KSU. (Manager A and C).

During the planning phase, KSU received many global and local implementation proposals for the ERP project. Manager C believed that local companies were found to be a good choice owing to their enhanced understanding of the university, in addition to the financial efficiency offered by using a local firm and applying its expertise in different departments.

MADAR Managers B and E said that customisation of the system to meet the university's needs was not a barrier for them. This was attributable to the company's flexibility and its direct connection with the university, eliminating the need for an intermediary company.

4.2.1.3 Weakness of project leadership. Manager A believed that effective administration during and after implementation was one of the serious problems that KSU managers faced. This was owing to an assumption that the university administration was committed to supporting the project, especially the MADAR package, which had already been selected and implemented. As the ERP system was considered a new phenomenon and a major change for any university, it was essential to focus on preparatory courses for administrative and managerial personnel rather than on the operational level of implementation activities.

Manager D added that the role of the management was to oversee pre-implementation preparation and facilitation during the implementation; they needed to be involved in every step of the project until the ERP system was implemented. In any such project, the management should continually monitor the progress of the project and provide direction to the implementation teams:

> Having an effective leadership is crucial – leaders who are willing to allow for a huge attitude change by accepting that a lot of learning has to be done at all levels, including themselves, because their attitude will affect other employees as well, which will help the implementation go smoothly and easily. (Manager D).

MADAR project managers realised that the support of the university administration was essential at all levels. This was identified as one of the most important and crucial success factors in any ERP implementation, as the management can deal with many aspects of the project including planning, organisation, ISs acquisition, employee selection and the management and monitoring of software implementation. KSU project managers found that motivating managers and administrators to cooperate during all stages of the implementation promoted successful and effective decisions.

4.2.1.4 Weakness of legacy system. Manager A explained that MADAR was intended to replace legacy systems, each of which provided support for a specific functional area. Its implementation involved a complex transition from legacy ISs and business processes to an integrated ERP infrastructure and common processes throughout the organisation, dependent on sophisticated IT infrastructure. Transferring from one system to the other was costly, as information was spread across many different computers in the legacy

systems. This was not the only difficulty faced in transition, as exemplified in the following statement:

> There is no doubt that changing from the current legacy system to the ERP system is difficult, but when the current system has a bad data structure it makes it even more difficult and it takes a long time to do it. (Manager E).

The managers were aware that KSU, one of the largest universities in the country, had hitherto functioned with an ill-structured system, making it increasingly difficult to conduct data clean-up and transfer from the legacy system to the ERP system. Despite this weakness of the legacy system, the transition had to be efficient, as mistakes could cause multiple problems that would be difficult to rectify but which had to be solved before the implementation could proceed.

4.2.2 Improving stakeholders' productivity and performance. The economic rationale of implementing a new system is to achieve the highest productivity in stakeholders' output. To clarify and supplement the questionnaire data, the interviews examined this question from the stakeholders' point of view. It was found that the results of the qualitative phase were similar to those of the earlier quantitative phase of data collection, with limited changes from a managerial point of view.

4.2.2.1 Training programme. The majority of KSU employees were aware that training plays a major role in ERP implementation, which generally requires profound reengineering of any organisation. Indeed, practical training is an important factor that affects the success or failure of implementation. Employee A believed that training offers a good opportunity for users to adjust to the changes introduced by the ERP system, and helps to build positive attitudes towards the new system. It also provides experience for users, so that they can appreciate the attributes and potential benefits of the new system. Employees believed that they did not have adequate training to enable them to understand the system in general or to operate it effectively.

Employees B, C and D explained that the majority of employees were unaware of the concept of ERP and how the system would help them to relate their work to other departments functionally. As such, it was important to build users' initial conceptual understanding of the new system, then introduce other courses gradually thereafter. This might have helped employees to understand the system and make it more user-friendly:

> There is a difference between a full, strong training course and a short session. I think what was provided for us was a session, more than an appropriate training course. As employees, we need intensive courses to build our confidence in terms of using the system. (Employee B).

Employees appeared to be aware of how important training was, and that it could help them to improve their work and increase their productivity. Therefore, there was a demand for adequate training courses before, during and after implementation.

4.2.2.2 Ease of use. Although any ERP system is considered to be complex, participants found MADAR easy to use, which was a significant factor in its adoption by KSU employees, despite their need for more intensive training. The majority of the interviewees agreed that they found ERP easier to use than the legacy system. Furthermore, MADAR had a positive impact both on completing the task effectively and on increasing their productivity:

> The most important benefit of the MADAR system is that it is easy to use it compared to the legacy system, in terms of the ability to do the work easily and make faster information transactions. If I had known it was that easy I wouldn't have resisted in the beginning. (Employee B).

The presentation, format and content of the MADAR system were reported to make it even easier to use, so that users could access any information that they needed and improve the

quality of their work. Overall, employees believed that MADAR implementation had made their jobs significantly easier.

4.2.2.3 Timeliness. Both managers and employees listed timeliness as one of the benefits of using the ERP system. Employees A, B and D stated that timeliness was considered an important factor in two ways: accessing the information that the user needed on time and helping users to do their work in a shorter time. Both of these assisted users to fulfil the needs and requirements of their jobs:

> As a financial employee, working with the MADAR system is affecting my work positively. For example, it improves efficiency, reduces data errors and avoids duplication of information. In both functional and application domains it saves me many hours in my work. (Employee A).

According to Employees B, C and D, the MADAR system allowed administrative and managerial personnel and faculty members to check their salaries and promotions. It also made it possible to transfer easily, accurately and quickly to other individual management functions within the system, such as procurement and distribution.

4.2.2.4 Flexibility. Interviewees gave varying answers regarding the flexibility of the MADAR system. Employees A, B and C, described as end-users, found the system flexible, while making transactions faster. This degree of flexibility was provided at the time of implementation:

> The level of flexibility in the MADAR system is really obvious, which has improved my ability to respond effectively, changing user interface, changing underlying data, and its effect is to change performance positively. (Employee B).

In contrast, Managers A, B and D believed that flexibility could and should be improved by upgrading the system to meet their future needs and to match the planned expansion of the system:

> I agree that MADAR has a high degree of flexibility when using the system daily, but as managers we look to have a higher degree of flexibility by updating the system in the future. (Manager A).

To conclude, Employees A, B, C and D agreed that flexibility, timeliness and ease of use were the most important factors, and believed that these factors had a significant impact by increasing their productivity and accuracy while reducing the time they spent on each job.

4.2.2.5 Service quality. Service quality was found to be a major area of concern for all five project managers, as it had a strong impact in facilitating the successful operation of the system and optimising employee/user performance. If the MADAR system was successfully implemented, the links between different departments of the university would not be adequate. Internal support from the service quality department would also be required. Interviewees felt that it was time to build a strong technical support service to help the system flow smoothly and to reduce the barriers to effective use of the system.

The four employees agreed that the service quality department at KSU, which was linked with the MADAR system, was extremely important in facilitating their use of the system and solving problems. Therefore, it was important to implement a new system in parallel with the service.

Service quality was seen to lie in the communications between users and the technical department, in terms of how quickly and accurately it delivered answers to users' enquiries. Interviewees perceived a strong link between speed of response and the accuracy of their own work. In this way, the MADAR system promoted a high degree of reliability and trust among users in a short time:

> With the latest hardware and software, the service quality team are showing a high level of understanding and experience dealing with the MADAR system's difficulties. It's also obvious that they're making efforts to provide quick responses to system enquiries. (Employee A).

It was widely perceived by the interviewees that the implementation of the MADAR system at KSU was intended to enforce or reinforce changes in both financial and administrative aspects of the university's operations. The majority of the employees asserted that they would not have resisted the change if they had known that changes were likely to have positive implications for themselves and the university, including non-financial benefits, as it was clear that the MADAR system resulted in greater productivity at work and better performance in general.

5. Discussion

On the basis of the above analysis, the authors are able to identify six key success factors for high stakeholder performance: understanding resistance to change, appropriate customisation, effective management support, intensive training schedule, better system quality and better service quality.

5.1 Understanding resistance to change

ERP systems are known to suffer high failure rates for many reasons, with one of the most important being employees' resistance to change (Hong and Kim, 2002). Aladwani (2001) offers two fundamental reasons for this: perceived risk, which is a managerial issue, and users' habits. Clearly, the attitudes of users can determine whether they decide to support or resist such a change.

While the human aspect has been given fair attention throughout the ISs literature, resistance to change has not received the same level of attention in regards to ERP systems. It is essential to investigate the causes of resistance to change, whether these lie in the organisations, employees, new systems or all of these. The present research is notable in focusing on the importance of social environmental factors in determining ERP stakeholders' performance in the post-implementation phase. It has examined the impact of ERP systems on stakeholders' performance and productivity, on the understanding that when a new system is introduced, the organisation and its members will welcome or resist the associated change, which will generate either a positive or a negative impact on users' performance.

The findings of the current research reveal four main categories of reasons for employees to resist such change in their organisations: employees' characteristics, additional responsibility, loss of authority and lack of preparation. Each of these is discussed below.

5.2 Employees' characteristics

KSU is a university in the public sector, where dealing with employee resistance tends to be more difficult than in the private sector, owing to differences in job security. As private employees do not enjoy the enhanced job security of their public-sector counterparts, they will tend to be more motivated to accept change, such as the use of a new system. The majority of MADAR stakeholders at KSU, being employed in the public sector, considered their jobs to be secure.

5.3 Additional responsibility

Despite being discontented with the legacy system and considering it inadequate for their needs, users were still reluctant to change, as they experienced a degree of comfort with the

old system and were worried about having to assume additional responsibility or having to work harder under the new system (Huq *et al.*, 2006). Employees might also resist a new system because they are worried about the extra payments they may receive (Dent and Goldberg, 1999).

5.4 Loss of authority

The research also detected that loss of authority was an important element of resistance to change, in line with the findings of Huq *et al.* (2006) that loss of status or authority among employees can constitute a barrier to change. This is especially true in Saudi culture, where superiority and authority are treated synonymously. Potential loss of power is thus an important factor in employees' resistance to change.

An extraordinary example was set by KSU managers, who adopted the successful solution of linking employees' effective use of the ERP system with their promotion. At the same time, to discover which employees were using the system effectively, they also tracked their operations. This policy helped to encourage employees to attend training sessions and operate the new system effectively. Silva and Fulk (2012) argue that users may turn to acts of resistance if their view of the new system is different from that of management. For instance, while managers may see the adoption of the ERP system as a necessary tool to establish control, users may view it as a means of changing their work practices or as a threat to their jobs. Furthermore, they may not find it user-friendly and/or view it as a managerial tool for dominating the user (Quattrone and Hopper, 2006).

5.5 Lack of preparation

As highlighted by Kwahk and Lee (2008), it is essential to ensure that users are prepared for any change in the organisation. Gargeya and Brady (2005) agree that if users are not ready or willing to change, change will not succeed or simply will not occur. Hence, organisations planning to change from one system to another should be prepared for a long process, going beyond a technical transfer, so that the technical and social planning phases run in parallel. For instance, managers must be charged with the responsibility of encouraging, controlling and training employees to be prepared for the new system (Aladwani, 2001). To facilitate successful ERP implementation, organisations should have a capable and effective change management team responsible for introducing the changes and resolving any problems. This includes employee resistance, which requires a clear plan of user preparation before and during implementation (Aladwani, 2001). This opinion is supported by a study of a successful ERP implementation, in which Kim *et al.* (2005) found a lack of organisational change management expertise to be a critical barrier to implementation.

5.6 Effective management support

Successful ERP implementation is achievable only when the organisation gives due consideration to many important points, including the support offered by top management. Al-Mudimigh *et al.* (2001) define this support as the "willingness of top management to provide the necessary resources and authority or power for project success". Many authors, such as Somers and Nelson (2004) and Finney and Corbett (2007), consider effective top management a crucial element in determining the success or failure of ERP implementation.

For other authors, such as Soja (2006) and Yusuf *et al.* (2004), the success of any ERP project depends on two parties. The first is the project team, whose members are internal specialist managers and employees having vital knowledge of cross-functional business relationships and experience of the old internal system. This team is responsible for introducing ERP into the organisation, in collaboration with the second party, which

comprises experts from the external outsourcing company, representing the system suppliers on site.

It was widely perceived by the managers interviewed for the case study that these essential elements of the implementation phase were missing. The executive managers demanded more support from middle managers and project teams, while middle managers required more knowledge and training, as the majority of them were not familiar with the details of the new ERP system. In practice, the skills and knowledge of the project team are important in providing expertise in areas where team members lack knowledge (Somers and Nelson, 2004). Based on the interview data, it is apparent that KSU had tended to neglect a very important part of the transformation phase. As noted by Kim *et al.* (2005), any IT transformation requires a comprehensive approach to the large-scale process and system changes associated with ERP implementation. In other words, without appropriate change or top management support, the enterprise may not be able to adapt to the new system and realise the desired performance gains.

It was apparent that managers at KSU had paid little attention to these critical factors during pre-implementation and implementation, which explained the high degree of employee resistance to the new system. The problem was a large gap in the preparation phase, concerning the role that top management should play during implementation. Al-Mudimigh *et al.* (2001) assert that an active top management is important for ensuring adequate resources, fast decisions and acceptance of the project throughout the organisation. Furthermore, they contend that the top management must be involved in every step of ERP implementation. Similarly, Kim *et al.* (2005) argue that top managers' involvement in the various phases of implementation is important in developing and promoting the vision of the organisation's IT infrastructure and the role of the ERP system. Finney and Corbett (2007) emphasise that project management refers to ongoing management of the implementation plan, including not only the planning stage but also the allocation of responsibilities to the various players. To enable successful ERP implementation, Beheshti and Beheshti (2010) state that top management involvement as leaders and facilitators of change is critical, ensuring that the scope of the project is not restricted. Inadequate top management commitment is considered a major reason for the failure of implementation (Ligus, 2009).

Qualitative data collected during interviews with project managers indicate that deficient management was the most problematic area for ERP implementation at KSU. The case study found that the purchase of an ERP system had brought the university into a complex implementation relationship with the ERP itself and with a system integration partner. A possible explanation for the lack of management support was a gap between decision makers and managers, who should be involved in all steps, from comparing potential suppliers and choosing between them, to the preparation and implementation phases. By encouraging such involvement, universities would help to explain and facilitate their new systems and avoid potential resistance from employees.

5.7 Appropriate industry customisation

While the decision to implement an ERP system is an important one for any organisation, it is also important to ensure that the implementation is successful. The system should match the organisation's needs and suit the required tasks. A degree of customisation is required between the ERP system and the organisational processes it supports, which can be achieved through reciprocal adaptation of the ERP system and of the organisation's processes (Holsapple *et al.*, 2005). Rothenberger and Srite (2009) define customisation as "building custom features by using standard programming language, changing the ERP

code and or including third party packages that require some degree of programming to implement". Other practitioners and researchers have attempted to explain the difference between customisation and standardisation (Rothenberger and Srite, 2009; Holsapple *et al.*, 2005), but the concept of customisation as applied to ERP systems has not been authoritatively defined (Giff *et al.*, 2009).

Nevertheless, customising these systems to match organisational needs is clearly an essential step for improving the implementation process. The second step of upgrading the system is significant, although it is difficult to assess its impact (Khoo *et al.*, 2011). Khoo and Robey (2007) note that an organisation's strategic orientation towards new technology could influence its decision to upgrade. Khoo *et al.* (2011) also believe that organisations choose to use packaged rather than custom software for many reasons, including to reduce development cost, shorten implementation time, achieve state-of-the-art best practice, reduce maintenance and obtain extended functionality.

In the case of universities, each of which is a unique organisation with its own characteristics, customisation would be the most efficient option. Indeed, KSU, the case studied in this research, is distinct in terms of the customisation it required, while its relationships with potential ERP vendors were determined by the vendor companies themselves, which were responsible for the packages and services offered to the university.

KSU had chosen to adopt a locally sourced system (MADAR), and the customisation process consisted of the system being configured and modified to meet the university's demands. KSU was planning to implement the system in all departments, based on their needs and requirements. The choice of a local company to supply the ERP software meant that it was cheaper than global competitors. Consequently, any configuration or modification requested by the university would be done by the vendor company. From KSU's perspective, it was apparent that the ERP vendor played an essential role during adoption and adaptation.

Beatty and Williams (2006) state that during the initial implementation of an ERP system, many organisations choose to customise the standard software modules to meet implementation dates and match their unique business requirements. Although most organisations that implement ERP, undertake some customisation of the vendor's basic product offering, many make the mistake of over-customising their application modules in an attempt to appease all members of their ERP upgrade project teams.

As this research focuses on the human aspect of implementation, i.e. the ERP stakeholders, it is useful here to return to the recommendations reported above concerning the involvement of managers in all stages of implementation, as well as the importance of planning and preparation. Khoo *et al.* (2011) support this idea and assert that users also create idiosyncratic adaptations and workarounds to overcome limitations in customised software. Furthermore, Giff *et al.* (2009) states that the main challenge to ERP customisation is to understand the system itself, as managers will need to consult experts on specific modules if customisation becomes complex. Park *et al.* (2007) report that users often ask for customisation when their tasks and business needs are different from those envisaged by the design of the standardised package. This explains why so many ERP installations fail, as consultants' technical know-how and users' business knowledge sometimes collide during implementation. Therefore, organisations in general and universities in particular find that ERP customisation and the upgrading of systems to match individual universities' needs represent the most severe technological headaches (Beatty and Williams, 2006).

To conclude, vendors can play a significant role in supporting universities' continual investment in their new systems, by upgrading, adding functionality, achieving a better fit between each university and its adopted system and being aware of each university's

strategic values. Vendor support should thus include extended technical assistance, emergency maintenance and updating. All of these factors can be seen to be linked to training. This is examined in the following section, where it will be argued that with packaged software, special user training is an important factor during the post-implementation phase.

5.8 Intensive training schedule

Choosing the right system is important, but the most important is choosing a system capable of integrating the existing work applications and data archives to make migration easy for users, to reduce the costs associated with transferring data and avoid interruption due to training (Lassila and Brancheau, 1999). Training plays a major role in ERP implementation and use, which generally requires major re-engineering of the organisation (Bradley and Lee, 2007). Similarly, Umble, Haft and Umble (2003) assert that as user understanding is so important, education and training are among the most widely recognised critical success factors. ERP implementation requires a critical mass of knowledge to help users solve problems. It is important for employees to understand how the system works; otherwise they may discover their own suboptimal ways of using those parts of the system that they are able to operate.

In general, the literature reveals the importance of ERP system training. Chien and Hu (2009), for instance, state that education and training constitute an essential process for providing managers and employees with an understanding of the logic and overall concept of the ERP system, including teaching many groups of users how to operate the system efficiently in their daily work activities. According to Zhang *et al.* (2005), intensive training can provide users with a better understanding of how their work is related to other functional areas in the same organisation. Hence, any user who produces results should be held responsible for making the system perform to expectations.

Significantly, most of our knowledge about IT learning focuses on the efficacy of training or support during implementation (i.e. before the application becomes operational). In this phase, training is typically considered "preparation for use", and previous studies have shown that implementation training has a significant impact on ERP success (Chien and Hu, 2009). It is therefore regrettable that ERP training is often compressed because implementation projects are running out of time and money. Organisations tend to cut training costs when adopting expensive systems, resulting in negative user attitudes and low integration equilibrium. In the case of Saudi public universities, which enjoy the support of the government and correspondingly generous budgets, time and money are not major concerns. Notwithstanding this comfortable financial position, this research shows that training is still a critical issue for them.

Surprisingly, the results of the quantitative phase of this research indicated that training was not one of the most significant factors. In contrast, the majority of interviewees emphasised the need for continuous training on the new system to help them do their work effectively. KSU employees voiced a widespread belief that they had not received appropriate training in terms of how to use the ERP system, asserting that they would prefer continuous training to help users obtain sufficient knowledge of the new system and its added functionality. Unfortunately, managers often heavily underestimate the degree of education and training necessary to implement an ERP system, as well as the associated costs. Top management must be totally committed to spending enough money on end-user training and incorporate it as part of the ERP budget (Umble *et al.*, 2003).

Although case study data revealed that KSU employees felt the need for more intensive and continuous training, the university did appear to have achieved progress in its training

policy. Large numbers of users were trained to implement the system in various departments, largely through a "train the trainer" approach. There was greater awareness of how the ERP system affected the work of university's staff. There is a heavy responsibility on managers, who should know and understand the implications of the system and must come to a consensus on the changes that will take place in each university. If managers agree that change is necessary and possible, they can be charged with distributing this information to their support managers. On the other hand, if they are not in agreement or fail to collaborate, the enthusiasm to buy and implement the system will suffer, resulting in some cases in active resistance. As stated by Marshall *et al.* (2002), education and training are major tools to improve human performance and encourage better decision-making. Finally, while improving ERP stakeholders' performance remains a primary goal of modern Saudi universities for increasing competitiveness, analysis of the quantitative data revealed that not all constructs of the final research framework proved to be significant in achieving such an improvement. Despite the fact that training was not a significant factor according to the quantitative results, nearly all of the interviewees believed that well planned intensive training would have a significant impact on their performance.

5.9 Better system quality

Using stakeholders' performance in the evaluation of ERP system effectiveness is certainly well established in the literature (Umble *et al.*, 2003). However, several elements prompt concern. A major dimension used in the ISs/ERP literature is system quality, comprising factors such as accuracy, flexibility, ease of use and timeliness. This research was designed to investigate the impact of system quality and service quality on stakeholder performance. A finding of the quantitative phase was that 6 of the 14 system quality factors were significant: content, timeliness, format, ease of use, flexibility and currency. As to the qualitative findings, the majority of interviewees agreed that these factors all had a significant impact on their performance.

5.10 Flexibility

The flexibility of an ERP system in dealing with change in its environment is important, so any change in the degree of flexibility is certain to affect users' performance in time. The flexibility of certain system processes can be used as a surrogate measure of the level of stakeholders' performance. The literature has largely concentrated on the three aspects of flexibility mentioned earlier: user satisfaction, organisational performance and technical performance.

Gebauer and Lee (2008) describe flexibility as the "capacity of an information system to adapt and to support and enable organisational change", noting that it "has been linked to operational efficiency and to organisational nimbleness". More simply, Gong and Janssen (2010) define flexibility as the "ability to respond effectively to changing circumstances".

The case study data reveal that both types of flexibility were important to KSU stakeholders, but the ways in which participants viewed flexibility varied slightly. End users were pleased about the degree of flexibility they had in their daily work compared to the legacy systems, whereas managers (key users) were concerned with both types of flexibility and looked forward to upgrading the systems in the hope of achieving a higher degree of flexibility. In sum, the stakeholders at KSU found that the ERP systems implemented there were flexible, which significantly impacted performance. In other words, the flexibility of these systems contributed to the more efficient performance of given tasks and processes.

5.11 Ease of use

As highlighted by Ifinedo and Nahar (2007), system quality refers to the performance characteristics of an ERP system, and is concerned with the ease with which it can be learned and then used. The models most widely used to assess ISs/ERP systems have also been used to examine how ease of use affects users' culture and user satisfaction (D&M and EUCS).

The present research considered ease of use to be an important element of system quality, evaluating its impact on stakeholders' performance. Both primary and secondary findings show it to be one of the most significant factors affecting users' productivity and performance. Without a doubt, ERP systems are complex, yet large numbers of participants found them easy to use. Before ERP implementation, employees of KSU had long suffered from conflict between departments, difficulties in performing tasks and lack of integration, which caused difficulties in communicating with other platforms. The results of the case study show that the accessibility of the ERP systems adopted by the university improved stakeholders' working environment and helped them to process their transactions efficiently, thus improving their productivity.

5.12 Timeliness

The primary reasons for any organisation to implement an ERP system are to improve stakeholders' productivity and increase their work efficiency, which are necessary if the organisation is to improve its competitive position. To achieve these goals, timeliness is considered an important factor in two ways: accessing the information that the users need on time and helping them to do their work in a shorter time.

As discussed in the literature review, among the most important benefits of ERP systems are saving time, reducing redundancy and improving productivity. Similarly to flexibility and ease of use, the effect of timeliness has been examined on user satisfaction (D&M and EUCS), organisational performance and technical performance (Zhang *et al.*, 2005; Nelson and Somers, 2001; Somers *et al.*, 2003; Torkzadeh and Doll, 1999). This paper considers it essential to include timeliness in the framework, as it provided a clear indication of stakeholder performance and productivity.

The results relating to timeliness show that employees at KSU were aware of the importance of the ERP system and how it would enable them to perform more effectively, accurately and on time. In this context, stakeholders compared the time they spent completing tasks before and after ERP implementation, reporting that they saved time, which could then be spent on performing other tasks.

5.13 Content

A key challenge in ISs design is to provide sufficient information without overloading system users. Therefore, it is important that an ERP system should contain exactly the information that users need to complete tasks efficiently and effectively. Content refers to the provision of precise information and the production of final reports. Among the different aspects of content, widely discussed in the literature are user satisfaction and the evaluation of ERP system performance. It is also a feature of one of the important ISs models, namely, EUCS. This research has considered the content factor by integrating EUCS with D&M and TTF, while focusing on stakeholder performance and productivity. Both qualitative and quantitative results indicate that a wide range of participants found their ERP systems to be providing employees with barely sufficient information to perform their tasks.

5.14 Currency and format

One of the earliest studies still referred to by many recent studies of ISs/ERP systems is that of Bailey and Pearson (1983), who discuss currency and format as elements of system quality. It is important that the system should provide the latest information relevant to the work process in question. The literature reports a large number of studies addressing currency in ISs/ERP, ranging widely across aspects such as user satisfaction and the evaluation of ERP system performance. Currency is also a component of two of the most important ISs' models, namely, TTF and D&M (Strong and Olga, 2010; Smith and Mentzer, 2010; Zigurs and Buckland, 1998; Goodhue and Thompson, 1995). Evaluating ERP stakeholders' performance at KSU is a new development, in that it focuses on the impact of the system on stakeholders in this particular environment. The results of this research reveal that employees believed that the ERP systems were providing data suitable for the intended purposes. Moreover, the degree of currency in the ERP system's environment met their needs and had a significant impact.

5.15 Better service quality

The final important dimension to be considered when evaluating an ISs/ERP system is service quality, as it is a key dimension in determining the success or failure of such a system (Seth *et al.*, 2004). Therefore, researchers have recognised the importance of service quality and the effects it may have on ISs' users. Indeed, some have called for more research to measure service quality (Chang and King, 2005). Petter *et al.* (2008) define service quality as "the quality of the support that system users receive from the ISs department and IT support personnel".

Despite the importance of service quality and its effect on system users, there is limited reference to it in the empirical literature and few frameworks have included it. Indeed, none of the original models integrated in this research has service quality as one of its dimensions. The model of DeLone and McLean (1992), for example, which is the most widely cited in ISs' studies, does not take service quality into account. Several researchers have subsequently attempted to test and modify the D&M model, while others have called for its further development and validation. The contribution of Pitt *et al.* (1995) was to modify the model by including service quality as a measure of ISs' success, arguing that it needed to be expanded to reflect the service role of the IS department. In addition, Myers *et al.* (1997) highlight the importance of providing service quality to customers.

While the few studies of ISs' service quality focus on a number of different aspects, including user satisfaction and measuring system performance, the present study makes a novel contribution by attempting to evaluate the impact of service quality on stakeholder performance in the ERP environment. It does so by treating service quality as a dimension consisting of four factors: reliability, assurance, tangibility and responsiveness. All four factors were found to be significant. The qualitative results are consistent with the quantitative ones in terms of the importance of service quality and its effect on performance.

The majority of interviewees emphasised two aspects of service quality. Firstly, stakeholders felt that it was important for the system they were using to be dependable and trustworthy, so that they could complete tasks and improve productivity. Secondly, they expressed willingness to provide a timely service, thus indicating that timeliness provides a significant connection between system quality and service quality.

The findings of this research are consistent with the literature in terms of the importance of service quality, while the novel contribution made by including service quality in the model demonstrates that it has a significant impact on stakeholder performance, in addition to the essential role played by effective and efficient service quality in increasing productivity.

The above discussion allows conclusions to be drawn, regarding the factors that have a significant impact on the performance of ERP stakeholders. Both the system quality and service quality dimensions have been identified in many studies reported in the literature, covering various aspects, perspectives and ERP implementation phases. The role of management, however, has been identified only in studies of the implementation phase.

Figure 2 shows the final model representing the findings of the present study in the form of a model of ERP system impact on stakeholder performance. It reflects the conclusion that factors from the pre-implementation phase, the implementation phase (the management quality dimension) and the post-implementation phase (the system quality and service quality dimensions) had a direct impact on stakeholders' performance. In ERP implementation, each phase has a direct impact on the following phase; in other words, all phases are linked and interconnected. Consequently, organisations in general, and HE institutions in particular, should focus on the early stages and the implementation phase if they wish to achieve high stakeholder performance.

6. Conclusion

The aim of this study was to evaluate the impact of ERP systems in HE from the perspective of stakeholders' performance. The theoretical framework was derived from the integration of three widely used models (D&M, TTF and EUCS), which measure different factors affecting individual performance in an ERP system environment. The empirical data were collected in the case study of the MADAR system implemented at the KSU. A questionnaire comprising five-point Likert scale items was developed to test the proposed model. Two independent variables, system quality and service quality, were anticipated to affect positively the performance of MADAR system stakeholders at KSU.

The findings are consistent with the literature in terms of the importance of service quality, while a novel contribution was made by including service quality in the model and demonstrating significant impact on stakeholders' performance, as well as highlighting the essential role played by effective and efficient service quality in increasing productivity. The analysis allows conclusions to be drawn as to the factors having a significant impact on the performance of ERP stakeholders.

The adoption of an ERP system is a long-term programme that may take several years to implement; evaluating its success is thus not an easy task, as sufficient time is needed to gather meaningful post-implementation data. Factors affecting stakeholders' performance are complex and plentiful; therefore, case study was considered an appropriate and effective way to identify the specific factors positively influencing stakeholders' performance. While both system quality and service quality have been identified in many studies, the role of management has been identified only in studies of the implementation phase. The present study found that stakeholders' performance was significantly affected by system quality factors, namely, flexibility, compatibility, right data, currency, ease of use and timeliness. In addition, service quality factors had a positive impact on stakeholders' performance. This research further found that factors from the pre-implementation, implementation and post-implementation phases had a direct effect on stakeholders' performance. In ERP implementation, each phase has a direct impact on the following phase; in other words, all phases are linked and interconnected. Therefore, organisations in general, and HE institutions in particular, should focus on the early stages and the implementation phase if they wish to achieve high standards of stakeholders' performance. Future research would be useful during the maturity phase to include all stakeholders in several Saudi universities. In addition, more research can be beneficial to test the applicability of ERP system impact on stakeholders' performance in other public and private sectors.

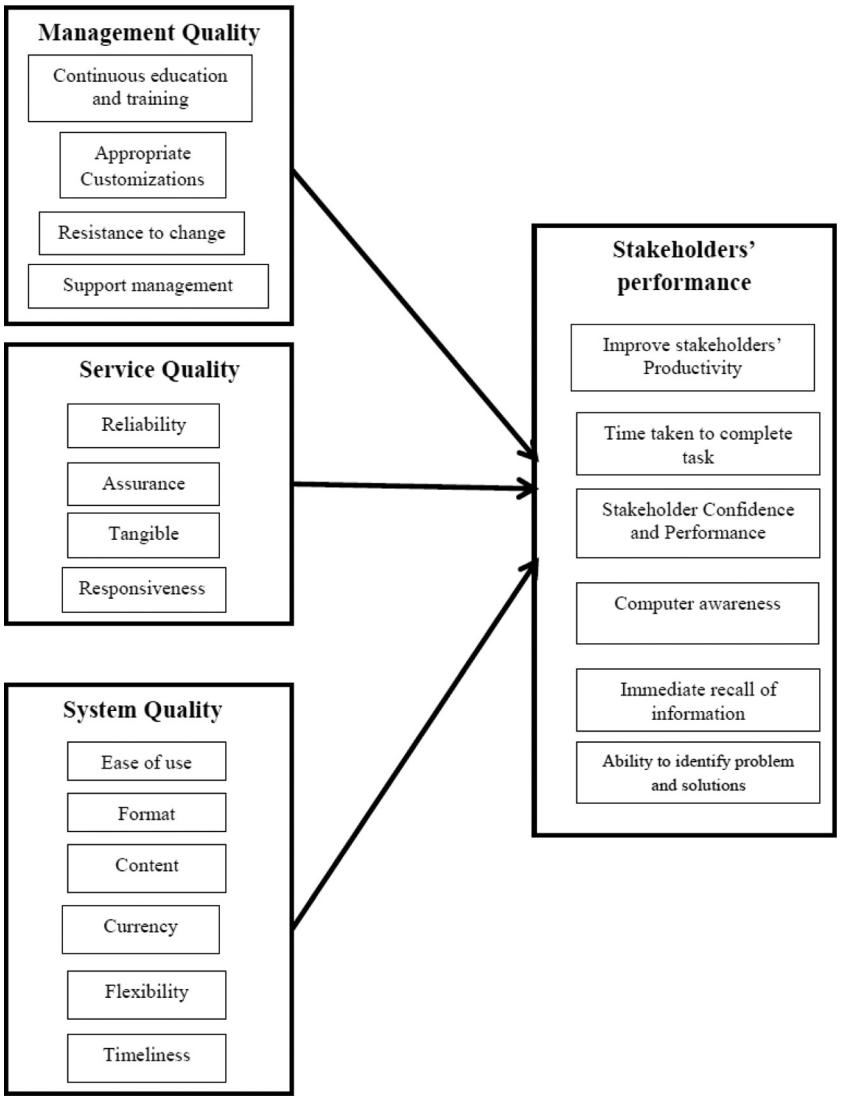

Figure 2.
Model of ERP system impact on stakeholder performance

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