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Stephen C. Wingreen
University of Canterbury, stephen.wingreen@canterbury.ac.nz

Maryam Mahdavian
Shahid Beheshti University, mahdavian.maryam@gmail.com

Hritik Gupta
University of Canterbury, hritik.gupta@canterbury.ac.nz

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Stephen C. Wingreen, Department of Accounting and Information Systems, University of Canterbury, Christchurch, New Zealand, stephen.wingreen@canterbury.ac.nz

Maryam Mahdavian, Department of Information Technology Management, Shahid Beheshti University, Tehran, Iran, mahdavian.maryam@gmail.com

Hritik Gupta, Department of Accounting and Information Systems, University of Canterbury, Christchurch, New Zealand, hritik.gupta@canterbury.ac.nz

Abstract

Enterprise resource planning systems are adopted to improve productivity and overall business performance in organizations. Implementation of these systems requires considerable financial and labour investment and therefore, the managers must understand the benefits of the system and the aspects of the system which need improvement. An approach to evaluate and track an ERP system's success in corporate organizations is therefore, important. In this study, the success of ERP system is measured through the Ifinedo model and a comparison between private and public organizations is made. Interviews conducted by the researchers introduce factors influencing ERP implementation success in organizations. In addition, to understand why some organizations have achieved more ERP success than others, questionnaire responses to some identified critical success factors for ERP implementation are analyzed.

Keywords: Enterprise Resource Planning, ERP implementation success, Private organizations, Public organizations.

1 INTRODUCTION

Many organizations have implemented enterprise resource planning (ERP) systems to enhance their competitiveness (Wei 2007). The literature suggests several potential benefits of ERP system implementation: improved coordination across functional departments, increased efficiency, reduced operating costs, facilitation of day-to-day management, rapid access to information for decision making and managerial control and support for strategic planning (Maditinos et al. 2011). The literature also reports a high rate of failures in ERP implementations (Davenport 1998). As an example, organizations such as Fox–Meyer Drug, Mobile Europe, Dell Computers, Whirlpool, Hershey Whirlpool, Hershey Foods, Boeing, Applied Materials, Kelloggs, and Nestle have had failures in ERP system implementation or have suffered from ERP ineffectiveness (Bradley 2008; Yu 2005). Therefore, management needs mechanisms to evaluate the success of ERP implementation (Wu and Wang 2005). Over the past three decades, evaluating the value and success of IT systems has been an issue for organisations (Delone and McLean 1992; Gable et al. 2003; Ifinedo 2006). One of the most significant challenges faced by information managers today is measuring the performance of the adopted ERP system and to understand its contribution to accomplishing organization's missions (Wei et al. 2008). Without a means to assess the performance of the ERP system, managers cannot evaluate its status and monitor its improvement (Wei 2007). The measurement of ERP system success is critical to an understanding of the value and efficacy of ERP investment and managerial actions (Chien and Tsaur 2007). Considering the widespread applications of ERP systems, the evaluation of its performance is particularly necessary in order to constantly improve its implementation (Zhao et al. 2012).

The success of ERP implementation projects requires considerable financial and human resources (Chien and Tsaur 2007). Managers need to know which part of the ERP system needs improvement, and whether the system's overall performance is increasing with time (Wei et al. 2008). ERP touches all business processes and operations of an organization, and even affects future business strategy (Wei 2007), thus making evaluation even more critical. Performance evaluation is also an important component that helps organizations make the best use of ERP, deepen the understanding of the system, and facilitate the integration of ERP management information systems and enterprise management (Zhao et al. 2012). Although during recent years both private and public sectors are increasingly moving towards implementing ERP implementation, It is interesting to know whether private organizations have achieved the same success in ERP implementation as public organizations and the key issues which make ERP implementation successful in private organizations? Over the last decade, both public and private organizations in Iran have attempted to implement an ERP system. Therefore, in the present study, ERP success is measured in private and public organizations and a comparison is made. The major research questions for this research are:

RQ1: Is the degree of ERP implementation success between Iranian private and public organizations equal?

RQ2: Is there a difference between private and public organizations along the six dimensions (table 1) of ERP success?

In the next section, the researchers outline the relevant literature and their research framework. This is followed by their methodological approach for data collection and an analysis and discussion of the research findings. In the last section, the researchers draw some conclusions from this research and suggest directions for future research.

2   LITERATURE REVIEW AND RESEARCH FRAMEWORK

Success is understood as a favorable or satisfactory result or outcome (Saarinen 1996). In practice, the success of an ERP system is achieved when the organization is able to perform all its business processes well and the ERP system achieves the desired objectives (Wei et al. 2008). The development of an ERP performance measurement process should establish a feedback mechanism between the desired objectives of ERP adoption and the substantial effects of ERP execution (Mashari et al. 2003). ERP project performance evaluation is a broader concept, which involves multiple aspects and needs to combine the qualitative and quantitative analysis (Zhao et al. 2012).

Prior research suggests models for both ERP success measurement and IS/IT success measurement in general. Each model has its own area of application and is sometimes based on a specific measurement approach such as evaluation of systems or different stakeholders involved (Kronbichler et al. 2010). The present study adopts Ifinedo's (2006) model (Table 1) to measure ERP success factors. Ifinedo (2006) extends Gable and Stewart's (1999) model and adds two important dimensions: Vendor/Consultant Quality (VQ) and Workgroup Impact (WI) to measure ERP system success. Ifinedo (2006) was therefore deemed to be suitable for this research.

Dimension	Relevant Literature	Description
Systems Quality (SQ)	Gable et al. (2003), Sedera et al. (2003), DeLone and McLean (1992)	Performance characteristics of the ERP system with regard to ease of use, accuracy, reliability and efficiency.
Information Quality (IQ)	Gable et al. (2003), Sedera et al. (2003), DeLone and McLean (1992)	Characteristics of the output provided by the ERP system with respect to timeliness, relevance, availability and understandability.
Vendor/Consultant Quality (VQ)	Thong et al. (1996), Pitt et al. (1995), Ko et al. (2005)	Support that the organization receives from the ERP provider, often operationalized by reliability, dependability and quality of expertise.
Individual Impact (II)	Gable et al. (2003), Sedera et al. (2003), DeLone and McLean (1992)	Concerned with the effect of ERP on the individual, often assessed through increased individual productivity, improved decision-making capability.
Workgroup Impact (WI)	Myers et al. (1997)	The impact of the ERP system on sub-units or departments within the organization often assessed through improved inter-departmental coordination, communication and productivity.
Organizational Impact (OI)	Gable et al. (2003), Sedera et al. (2003), DeLone and McLean (1992)	The benefits that the organization derives from its ERP system, often measured in terms of customer service and decision-making processes.

Table 1.   The Success Dimensions, Sources, and Description (Adapted from: Ifinedo, 2006)

3   RESEARCH METHODOLOGY

This study was conducted across six Iranian organizations from steel, printing, energy, chemical and mining industries. Two sample organisations were classified as public organizations and the rest as private organisations. The organisations were selected according to the criteria for private and public organisations. The researchers had little evidence to interpret that the difference in ERP success between private and public organizations is different for sample organizations than it is for the general population, so they proceed as if the results may be generalizable to the larger population. In order to measure the success of the ERP system, a questionnaire was designed based on Ifinedo (2006), representing the factors in Table 1(see Appendix 1). The questionnaire was distributed to key users, end users, project managers and consultants of ERP implementation. The respondents were asked to rate it on a scale of "Very Low-Low-Average-High-Very High". Eight responses were rejected on account of incompleteness or missing data and this left the researchers with n = 88 useful responses. 58 responses were from two public sector organizations and 30 responses from four private sector

organizations. More responses from public sector organizations ensured that the collected data was reliable and balanced the overall results in light of the unequal number of participating organizations (4 private and 2 public). This ensured that the research findings are not biased when a comparison between public and private sector organizations is made (RQ1).10 follow-up interviews were conducted with ERP project managers, ERP counsellors and key users across these six organizations in order to get more details. Finally, a questionnaire based on 14 critical success factors (Francoise et al. 2009; Gargeya and Brady 2005; Nah et al. 2001) was sent to the consultants who implemented the ERP system in sample firms. The researchers now propose their research hypotheses:

To answer RQ1, the following hypotheses are proposed:

$$H_{0:}\ \mu_{\text{Public}} = \mu_{\text{Private}} \qquad \text{(a)}$$
$$H_{1:}\ \mu_{\text{Public}} \neq \mu_{\text{Private}}$$

μ_{Public} is the mean of degree of ERP implementation success in public organizations.
μ_{Private} is the mean of degree of ERP implementation success in private organisations.
The degree of "ERP Success" is the mean of the six dimensions mentioned in Table 1.

The following hypotheses aimed at addressing RQ2:

$$H_{0:}\ \mu_{i\ \text{Public}} = \mu_{i\ \text{Private}} \qquad i = 1, \ldots, 6 \qquad \text{(b)}$$
$$H_{1:}\ \mu_{i\ \text{Public}} \neq \mu_{i\ \text{Private}}$$

$\mu_{i\ \text{Public}}$ is the mean of degree of ERP implementation success for dimension i in public organizations.
$\mu_{i\ \text{Private}}$ is the mean of degree of ERP implementation success for dimension i in private organisations.

Based on the hypotheses, a research model for this study is shown in figure 1.
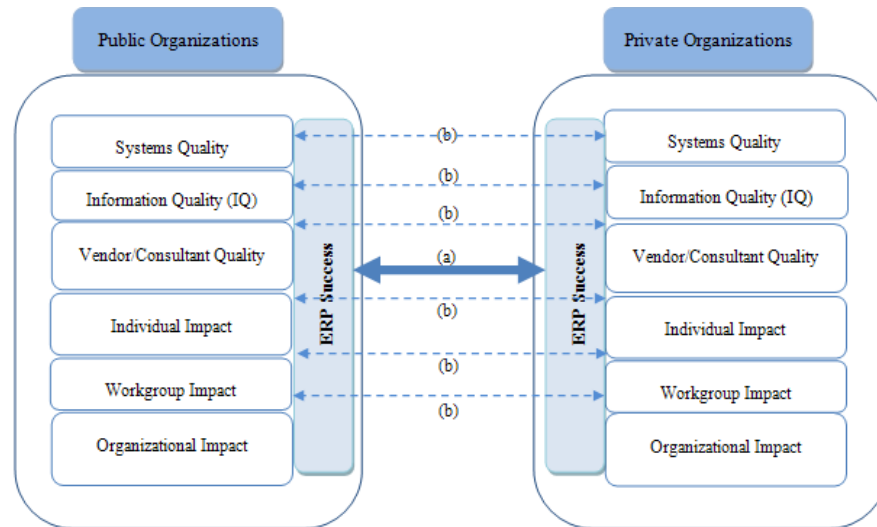
Figure 1.   Research Model

4   RESEARCH FINDINGS

A global t-test was performed to determine hypothesis (a), that private organisations are different than public organizations. The mean for each group is computed as the simple arithmetic mean of the aggregate of all ERP success dimensions. The p-value = 0.002 confirms that the two aggregate means are not equal. For private organisations, $\mu = 3.74$, and for public organizations, $\mu = 3.46$, indicating that private organisations in this study were, in aggregate, more successful in their ERP implementations than their public organization peers.

Next, given the goals of the study to determine whether ERP success was different between private and public organizations across a range of dependent variables (hypothesis b), the data were analysed by either the MANCOVA or MANOVA procedure, depending on whether or not it was necessary to

control for the effects of "company" on the dependent variables. Since the p-value = 0.19 for "company" was insignificant when specified in MANCOVA, indicating that there were no differences between companies, the analysis proceeded to specify a straightforward MANOVA model. The MANOVA F-test of p = 0.004 is significant, which means that at least one of the main effects is significant.

Figure 2 reports the means of private and public organizations in each of the dimensions of ERP success. Table 2 reports the p-values for the respective dimensions, and descriptive statistics for public and private firms for each ERP success dimension.
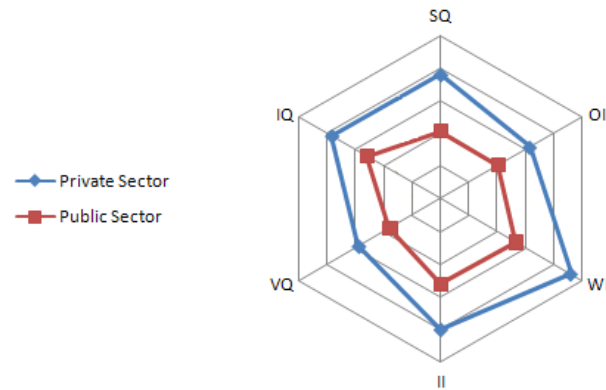

Figure 2.   Comparison of Private and Public organizations in each dimension

The MANOVA procedure controls global type-1 error, so p-values < 0.05 were judged to be significant, and the null hypothesis is rejected. Although, according to figure 2, private organizations achieved higher mean scores in all dimensions of ERP success than public organizations, the individual t-tests performed for hypothesis (b) reveal that we fail to reject the null hypothesis for OI, at p = 0.146, and VQ, at p = 0.111. Table 2 reports MANOVA p-values, adjusted r-square, and descriptive statistics for the dependent variables, by private vs public organizations. The results of the test reveal that System Quality, Information Quality, Individual Impact, and Workgroup Impact differ between private and public organizations. Additionally, based on descriptive statistics (Table 2), both private and public organizations have achieved the highest score in Workgroup Impact and the lowest score in Vendor/Consultant Quality.

	Public Organizations			**Private Organizations**				
	N	Mean	Std. dev.	N	Mean	Std. dev	p-value	Adj R^2
SQ	58	3.41	0.64	30	3.76	0.24	**0.002**	**0.096**
IQ	58	3.52	0.58	30	3.77	0.33	**0.024**	**0.047**
VQ	58	3.36	0.74	30	3.58	0.50	0.111	0.018
II	58	3.52	0.75	30	3.80	0.46	**0.043**	**0.036**
WI	58	3.53	0.70	30	3.92	0.44	**0.005**	**0.078**
OI	58	3.41	0.76	30	3.63	0.46	0.146	0.013

Table 2.   MANOVA p-values, Adj R^2, and Descriptive statistics: N, mean, std dev by dimension

Paired Samples Test was used to confirm the difference between WI and VQ in private and public organizations. Test results are illustrated in table 3.

Hypothesis	**Pair**	**Sig. (2-tailed)**
(c)	WI – VQ (Public organizations)	0.023

| (d) | WI – VQ (Private organizations) | 0.001 |

Table 3.   Results of paired samples test

Therefore, existence of significant difference between WI and VQ in private and public organizations is confirmed at significance level 0.05 given to p-value amounts.

The researchers separated the questionnaires received from each participating organization and then found out the means along each of the six dimensions for every sample organization. Finally, the researchers took an arithmetic mean of the means of these 6 dimensions to calculate the average amount of ERP implementation success achieved in each organization, which is reported in table 4.

	Public Organizations		**Private Organizations**			
	Company A	Company B	Company C	Company D	Company E	Company F
Success	3.49	3.18	3.69	3.92	3.66	3.77

Table 4.   Average amount of ERP implementation success achieved in each organization

Table 4. shows that the degree of ERP implementation success was more in private organizations than their public counterparts.

5   DISCUSSION

Due to the importance of evaluating ERP success, using a complete model to measure ERP systems seems critical. Bradford and Sandy (2002) reported that 57% of the interviewed organizations had no assessment criteria for measuring the performance of ERP systems owing to a lack of empirically effective evaluation model. Building upon Ifinedo (2006)'s model, our data analysis, revealed that private organizations had achieved more success in ERP implementation compared to public organizations in our sample. Data analysis showed that organizations have achieved the highest score in Workgroup Impact and the lowest score in Vendor/Consultant Quality along the success dimensions mentioned in Table 2. Workgroup impact refers to the impact of the system on sub-units and/or departments within the organization and is assessed by improved inter-departmental coordination, communication and productivity. Myers et al. (1997) suggest that any IS success model should incorporate Workgroup Impact (WI) because of the contributions made by work teams/groups towards organizational productivity. In this study, WI was marginally insignificant between private and public organizations in this study. Essentially, the underlying philosophy of ERP systems underscores the arguments of Myers et al. (1997). Namely, ERP systems are usually chosen to enhance cross-functional operations within the adopting organization (Ifinedo 2006). ERP software solutions address the issues facing some organizations having a "functional structure". In these organizations, each functional unit works towards their own goals and objectives, rather than the organizational goals. Moreover, information flow is restricted by functions because functional units might not have the required information to undertake a systemic view (Nazemi et al. 2012).

The role and quality of vendors/consultants is an imperative for any ERP implementation (Davenport 2000; Hallikainen et al. 2004; Ifinedo 2006; Ko 2005). Markus and Tanis (2000) and Wu and Wang (2005) highlighted "dependence on vendors" as a key issue with ERP implementations that differentiates these systems from traditional in-house or custom development systems. Studies have shown that the engagement of external expertise is essential for the effectiveness of ERP systems in adopting organizations (Ifinedo 2006). The literature (Ifinedo 2006) suggests that if the ERP vendor/consultant provides adequate technical support and has a good relationship with the adopting firm, the transfer of relevant information and knowledge to the client is improved.

The researchers conducted 10 follow-up interviews to determine the reasons which influence complete implementation success in organizations and also to understand why private organizations outperformed the public organizations in their sample. The researchers conducted interviews with ERP project managers, ERP counsellors and key users and identified 7 main factors.

Factor	Description
Organizational Factors	Number of management and decision making levels. Flexibility to change organizational structure. Bureaucracy in organizations. Public/Private sector organization. Resistance towards the system. Change Management. Organisational readiness to adopt the system.
Environmental Factors	Accessibility to post-implementation support. Accessibility to required products. Regulations. Political and economic stability/instability. Inflation.
Human Resource Factors	Lack of reward/motivation. Untimely notification of user's needs. Lack of system skills. Individual focus (Task Oriented/Process Oriented) Perceptions about the system.
System Related Factors	System does not meet requirements. Complexity of the system.
Lack of Control and Optimization Related Factors	Lack of accuracy in data-entry. Lack of process ownership.
Management Factors	Incorrect choice of product/counsellors. Lack of good management. Management's understanding of the system. Lack of co-ordination between manager and ERP managers.
Technical Infrastructure	Lack of suitable technical infrastructure.

Table 5.   Factors accounting for ERP success difference in Private and Public organizations

The interview results revealed that higher level of bureaucracy in public organizations and more number of decision making levels in public organizations posed challenges to effective ERP implementation. Further, the public organizations posed problems such as lack of purposeful investment and caused top management instability due to increased engagement with the government ministries. In public organizations, there was a problem to change the work processes since, these had been institutionalized over a long period of time. The organizational workers in public organizations resisted the implementation of ERP in the fear of losing their job. Further, "task-oriented" nature dominated these organizations which was conflicting with an ERP system, which is more "process-oriented". The size of the public organizations also presented challenges in the form of gathering relevant data for ERP implementation and lack of a "complete" implementation of the ERP system.

In contrast to the public organizations, the private organizations were more flexible towards change as managing change and promoting "new culture" in private organizations is easier than in public organizations. Private organizations invested significantly to improve their productivity and process efficiency. The private organizations in our sample were sensitive to variability in their productivity and therefore were more likely to see productivity as a critical success factor (CSF). Finally, moving from the "As Is" state towards the "To Be" state is easier for private organizations. Process owners in private organizations are more comfortable with the standard and optimized processes of ERP.

Contrary to what the researchers expected, the managers of public organizations were "satisfied" with the ERP performance as they saw ERP as a treatment for a kind of treatment for many "diseases" in the organization. Since, public organizations suffer more from acute diseases than private

organizations, ERP implementation in public organizations is more effective and more valuable, because it directly addresses serious problems in public organizations.

The interviews also revealed that although support from consultants, and their expertise and commitment levels are critical to the success of ERP, there were problems with the consultant group's lack of adequate knowledge about ERP, the organization's systems, the organization's processes and complexity of processes. The consultant group's inexperience, poor educational courses held by the consulting company and the consultant group's inability to foster appropriate culture also presented challenges. Hence, even with a small sample size, the researchers were able to determine the ERP implementation success in public and private sector organizations, and the major factors responsible for the difference in the ERP implementation success, by using a combination of quantitative and qualitative research methods (Creswell 2014).

Further, the researchers designed a questionnaire based on 14 critical ERP success factors (Francoise et al. 2009; Gargeya and Brady 2005; Nah et al. 2001) and distributed it to the consultants. The responses were collected from consultants who had implemented the ERP system in the sample firms. They were asked to indicate the extent of their agreement that private organizations have performed better than public organizations for each critical success factor. (Agreement scale: "strongly agree", "agree", "somewhat agree", "neither agree nor disagree", "somewhat disagree", "disagree", and "strongly disagree"). 17 questionnaires were collected, all of which were from one consulting firm, which had implemented ERP systems in 5 sample organizations (2 public, 3 private). All 17 respondents who had answered to the questionnaire had experience with implementing ERP in both private and public sector organizations. In the only remaining private organization a different consulting company had implemented the ERP system. Table 6 shows the results.

	Critical success factor (CSF)	N	Mean
1	Top management support	17	1.29
2	ERP teamwork	16	1.63
3	Organizational culture and change management	17	.94
4	Effective communication	16	.81
5	Project management	17	.88
6	Business process re-engineering and minimum customization	16	1.12
7	User involvement	17	1.41
8	Testing and troubleshooting	17	.88
9	Organizational structure	17	.88
10	Monitoring and evaluation of performance	17	.47
11	Business plan and vision	16	.56
12	User training	16	1.19
13	Meeting the costs	17	.06
14	IT infrastructure	17	.18

Table 6.   Descriptive statistics: N and mean by critical success factors

Based on table 6, the means of CSFs which are positive (>0) show that private organizations have performed better than public organizations. Means of CSFs which are negative (=<0) show public organizations have had better or at least equal performance to private organizations in relation to those critical success factors. It is clear that private organizations have responded to all critical success factors better than public organizations and maybe that is the reason why private organizations have achieved more success than public organizations.

6   CONCLUSION

This paper compared the success of ERP implementation in public organizations and private organizations using a sample of organisations in Iran. The study revealed that private organizations

have achieved more "overall" success in ERP implementation compared to public organizations in our sample. This was attributed to the private organizations being more flexible to change, managing change effectively, better Systems Quality (SQ), better Workgroup Impact (WI) and better response to critical success factors (CSFs) than the public organizations. The research findings demonstrate significant differences between private and public organizations in the areas of System Quality, Workgroup Impact, Information Quality and Individual Impact. In addition, both private and public organizations achieved the highest score in Workgroup Impact and the lowest score in Vendor/Consultant Quality.

This research has contributed some useful insights regarding the amount of ERP success achieved, the response to CSFs' and the factors influencing ERP implementation success in organizations. The practical contribution of this research is in the form of guidelines for ERP consultants and corporate managers to achieve higher success rate in ERP implementations. The success level studied in this article is current success level within private and public organizations which might be a limitation. Another limitation of this research is that the sample size was small. Directions for future research include a more rational measurement of success, which compares the current state of organizations (the state that organizations are currently using ERP system) with the state that these organizations have not implemented ERP yet. Future research might also consider more dimensions while measuring ERP success and the combined effect of these dimensions in assessing ERP success. Further, the researchers might consider studying specific focus groups to achieve a higher response rate.

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Appendix 1. Questionnaire

No.	System quality					
1	Our ERP has accurate data	Very low	Low	Average	High	Very high
2	Our ERP is flexible	Very low	Low	Average	High	Very high
3	Our ERP is easy to use	Very low	Low	Average	High	Very high
4	Our ERP is easy to learn	Very low	Low	Average	High	Very high
5	Our ERP is reliable	Very low	Low	Average	High	Very high
6	Our ERP allows data integration	Very low	Low	Average	High	Very high
7	Our ERP is efficient	Very low	Low	Average	High	Very high
8	Our ERP allows for customization	Very low	Low	Average	High	Very high
9	Our ERP database content is good	Very low	Low	Average	High	Very high
10	Our ERP allows for integration with other IT systems	Very low	Low	Average	High	Very high
11	Our ERP meets users' requirements	Very low	Low	Average	High	Very high
No.	**Information quality**					
1	Our ERP provides timely information	Very low	Low	Average	High	Very high
2	The information on our ERP is understandable	Very low	Low	Average	High	Very high
3	The information on our ERP is important	Very low	Low	Average	High	Very high
4	The information on our ERP is brief/concise	Very low	Low	Average	High	Very high
5	The information on our ERP is relevant	Very low	Low	Average	High	Very high
6	The information on our ERP is usable	Very low	Low	Average	High	Very high
7	The information on our ERP is available	Very low	Low	Average	High	Very high
8	The information on our ERP is accurate	Very low	Low	Average	High	Very high
No.	**Service quality**					
1	Our ERP provides prompt information to users	Very low	Low	Average	High	Very high
2	Our ERP system has a good interface	Very low	Low	Average	High	Very high
3	Our ERP has visually appealing features	Very low	Low	Average	High	Very high
4	Our ERP provides the right solution to requests	Very low	Low	Average	High	Very high
5	Our ERP service provider is dependable	Very low	Low	Average	High	Very high
6	Our ERP service provider has up-to-date facilities	Very low	Low	Average	High	Very high
7	Our ERP service provider is experienced and provides quality training and services	Very low	Low	Average	High	Very high
No.	**Individual impact**					
1	Our ERP enhances individual creativity	Very low	Low	Average	High	Very high
2	Our ERP enhances organizational learning and recall for individual worker	Very low	Low	Average	High	Very high
3	Our ERP improves individual productivity	Very low	Low	Average	High	Very high
4	Our ERP is beneficial for individual's tasks	Very low	Low	Average	High	Very high
5	Our ERP enhances higher-quality of decision making	Very low	Low	Average	High	Very high
6	Our ERP saves time for individual tasks/duties	Very low	Low	Average	High	Very high
No.	**Workgroup impact**					
1	Our ERP helps to improve workers' participation in the organization	Very low	Low	Average	High	Very high
2	Our ERP improves organizational-wide communication	Very low	Low	Average	High	Very high
3	Our ERP improves inter-departmental coordination	Very low	Low	Average	High	Very high
4	Our ERP create a sense of responsibility	Very low	Low	Average	High	Very high
5	Our ERP improves the efficiency of sub-units in the organization	Very low	Low	Average	High	Very high
6	Our ERP improves work-groups productivity	Very low	Low	Average	High	Very high
7	Our ERP enhances solution effectiveness	Very low	Low	Average	High	Very high
No.	**Organizational impact**					
1	Our ERP reduces organizational costs	Very low	Low	Average	High	Very high

2	Our ERP improves overall productivity	Very low	Low	Average	High	Very high
3	Our ERP enables e-business/e-commerce	Very low	Low	Average	High	Very high
4	Our ERP provides us with competitive advantage	Very low	Low	Average	High	Very high
5	Our ERP increases customer service/satisfaction	Very low	Low	Average	High	Very high
6	Our ERP facilitates business process change	Very low	Low	Average	High	Very high
7	Our ERP supports decision making	Very low	Low	Average	High	Very high
8	Our ERP allows for better use of organizational data resource	Very low	Low	Average	High	Very high