
Users' service quality satisfaction and performance improvement of ERP consultant selections

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Abstract: Recently, companies have developed Enterprise Resource Planning (ERP) systems. ERP systems will integrate business processes and provide information. However, successful ERP implementation is costly and requires a long time to complete. Companies usually use outside consultants to ensure a successful ERP project. ERP consultant selection is a difficult task for an ERP project implementation. This study examined the users' service quality satisfaction in the ERP consultant selection and investigated performance improvement of ERP systems. We illustrated how to apply the Analytical Hierarchy Process (AHP) to set priority weights for consultant alternatives in order to solve the ERP consultant selection problems.

Keywords: information systems; enterprise resource planning systems; ERP consultant selection; information system success model; service quality; analytical hierarchy process; AHP.

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1 Introduction

As the world becomes more fluid, networked and complex, companies will continue to be more mobile than ever before (e.g. Liebowitz, 2007). In response to growing global competition, many companies have developed new information systems. Most of these new systems are Enterprise Resource Planning (ERP) systems (e.g. Lee et al., 2006; Mabert et al., 2000; Tsai et al., 2005b). ERP system is a packaged software which designed to integrate the business processes of an enterprise. An ERP applications in the modern e-Business world include Supply Chain Management (SCM), Customer Relationship Management (CRM), Product Lifecycle Management (PLM),

E-procurement and Financial Management (FM), etc. (e.g. Barthorpe et al., 2004; Cheng et al., 2007; Tsai et al., 2006a). Numerous companies have adopted ERP systems to integrate their Information Technology (IT) and seek out greater process efficiency (e.g. Raymond et al., 2006). In addition, ERP systems can increase competitiveness, promote the ability of quick responsiveness, enable easy access information and rapid retrieval of information or reports, improve the quality of information used for strategic planning and operational controls and achieve other benefits (e.g. Mirani and Lederer, 1998; Olson et al., 2005). Implementing ERP systems can bring benefits for companies, such as reducing cycle time, improving flow efficiency, rapidly generating financial information, contributing to e-business and assisting in the development of new organisational strategies. Implementing ERP also involves the entire business and requires changes throughout the firm (e.g. Kocakulah et al., 2006).

However, a successful ERP project is usually costly and takes a long time to implement (e.g. Mabert et al., 2000). Some enterprises are under estimating or misunderstanding the risks in ERP project (e.g. Al-Mashari et al., 2006; Tsai et al., 2005a). Holland and Light (1999) and Davenport (1998) also indicated that ERP projects were failure due to cost and organisation changing problems. There are 65% managers consider that ERP project's failure will lead to damage of company (e.g. Scott, 1999). In addition, an unsuccessful ERP project will cause company's bankruptcy such as FoxMeyer Drug Company (e.g. Dong, 2001; Volkoff and Sawyer, 2001). FoxMeyer Drug Company sets up SAP R/3 system and hires Andersen Consulting Company to help ERP project implementation. Dell Company also abandons their implementation project for over budget (e.g. Bingi et al., 1999). Because of ERP projects require significant expenditures, ensuring a successful ERP project is essential. Wei et al. (2005) showed that a successful ERP project involves business process change management, ERP software system and cooperative vendor's selection, system implementation and investigation on practicality of the new system. Stefanou (2000) also indicated that a successful ERP implementation process needs to consider company financial condition, system vendor training and specialised ability of consultant companies. Companies usually use outside consultants during the ERP implementation stage to ensure the successful ERP implementation. Outside consultants can use their experience, detailed knowledge of certain modules and experience with the software application to help companies to set-up, install and customise their software (e.g. Dolmetsch et al., 1998; Piturro, 1999). Consultants also use the requirement analysis as the tool to recommend company clients for some suitable solutions. In ERP implementation stage, consultants play an essential role during the latter stages (e.g. Thong et al., 1994).

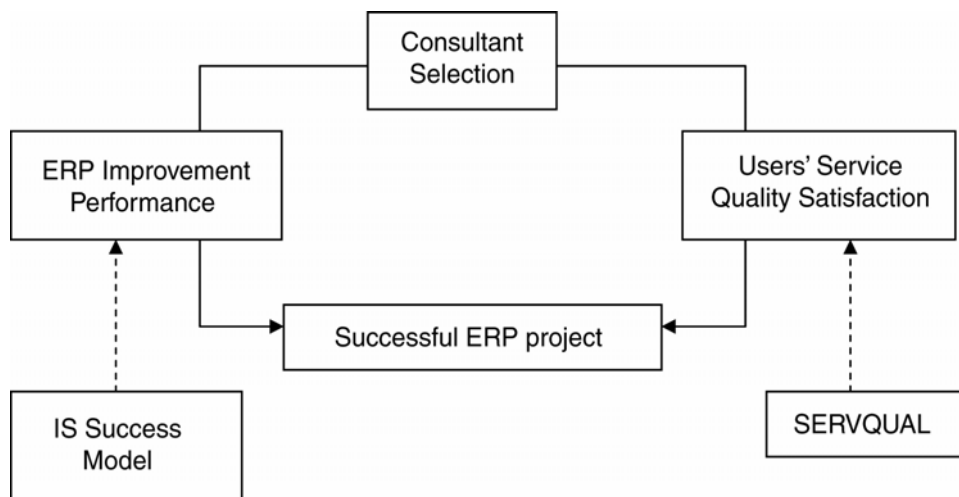
ERP consultant selection needs to identify some alternative projects and achieve net benefit for companies. However, these consultant selection problems are multicriteria decision problems. Selecting the best set of ERP consultants is difficult because the existence of lots of multiple factors, such as consultant's experience, consultant's reputation, consulting firm background, comprehensive knowledge of certain modules and experience with the software applications. If the variously interdependent factors among the ERP consultants are not considered, the selection of the ERP consultant may result in bad ERP implementation. As a consequence, a lot of models and methodologies for dealing with multicriteria decision problems are developed.

As business became global, many management consultancy offered their services internationally (e.g. Caruana et al., 1998). Recently, ERP consultants also provide professional services in intensely competitive environments. Service quality is the most

researched area of services marketing (e.g. Fisk et al., 1993). DeLone and McLean (2003) also incorporated 'Service Quality' into their updated information system success model. Zeithaml and Binter (1996) indicated that service quality affects user's satisfaction. Consultant's service quality affects user's satisfaction of Information Systems (e.g. Bailey and Pearson, 1983). Employees use ERP system frequently as they have high satisfaction with system. A successful ERP project was costly and requires a long time to complete. Employees use ERP system frequently means ERP project's success. Therefore, we use the aspect of service quality to examine user's satisfaction of ERP consultant selection. Consultant firms can use their domain knowledge and experience to solve business problems, and their ability will directly affect the project performance. Bingi et al. (1999) stated that the consultant selection problem will affect a successful ERP implementation. We also used DeLone and McLean's (1992) information system success model to develop ERP performance measures (e.g. Tsai et al., forthcoming) in order to explore the important factors, in the ERP consultant selection, affecting ERP performance improvement.

In this study, we examined the users' service quality satisfaction and business performance of consultant selection by using the questionnaire survey and ANOVA analysis. In this questionnaire, SERVQUAL measured user's service quality with consultants (Figure 1). ERP consultant selection is a multicriteria problem. To solve this problem, we also illustrated how to apply Saaty's (1980) Analytical Hierarchy Process (AHP) to set priorities for multiple criteria or objectives and for consultant alternatives. The evaluation criteria in the AHP hierarchic framework were selected according to the results of questionnaire survey.

Figure 1 Research framework



We organise the remainder of this paper as follows. In the next section we review the relevant literature. We describe data selection and methodology in Section 3, and we report the results in Section 4. In Section 5, we present an example of the AHP application. Finally, in Section 6 we offer concluding remarks.

2 Literature review

2.1 Service quality

Service quality is the most researched area of services marketing (e.g. Fisk et al., 1993). In ERP implementation stage, ERP consulting firms provide their offering and focus on service quality to gain competitive advantage. ERP consultants also provide their professional services which include IT strategy planning, software evaluation, ERP system implementation, training and change management. Professional consultant services are often delayed, and usage is often irregular (e.g. Hite and Fraser, 1988). Definitions of service quality are result of the comparison that customers make between their service prospect and service conception (e.g. Gronroos, 1984; Lehtinen and Lehtinen, 1982; Lewis and Booms, 1983; Parasuraman et al., 1985, 1988).

The concept of service quality was investigated in an extensive series of focus group interviews conducted by Parasuraman et al. (1985). Numerous authors assumed that perceived service quality is 'the degree and direction of discrepancy between the consumers' perceptions and expectations'. Service quality has enabled the development of SERVQUAL (e.g. Parasuraman et al., 1988) which includes five dimensions:

- 1 *Tangibles*: physical facilities, infrastructure, equipment, appearance and personnel.
- 2 *Reliability*: ability to ensure reliable, proper service.
- 3 *Responsiveness*: willingness to help customers and provide prompt service.
- 4 *Assurance*: knowledge and courtesy of employees and their ability to inspire trust and confidence.
- 5 *Empathy*: care for the client, attention to individual clients, individualisation of service.

In this study, we used service quality to examine the users' satisfaction in the ERP consultant selection.

2.2 Consultant selection

Cheung et al. (2002) used the AHP multicriteria evaluation model to examine problems of architectural consultant selection. They used following five selection criteria: firm background, past performance, capacity to accomplish the works, project approach and consultant fee. Firm background includes company reputation, technical competence/qualification and experience with similar projects. Past performance includes cost control, quality of work and time control. Capacity to accomplish the work includes present workload, availability of qualified personnel and professional qualification/experience. In relation to project approach, the selection criteria included approaches to time schedule, approaches to quality and design approach/methodology. The last selection criterion was consultant fee. To ensure successful ERP implementation, companies should select appropriate consultants to help in this area.

3 Methodology

3.1 Sample and data collection

To explore the status of ERP implementation, this study examines the ERP implementation experiences of the Top 5000 Largest Corporations in Taiwan. Our questionnaire survey includes ERP systems' problems and resolutions in implementation stage, the considerable selection factors of ERP system vendors and consultants. We mailed 4300 questionnaires and received 625 usable responses with 14.53% response rate. In this study, we use part of survey data in this questionnaire to examine users' service quality satisfaction in ERP consultant selection and investigate performance improvement of ERP systems. In 625 useable responses, we analysed the survey data from 304 companies that have implemented all the planned modules or the partial planned modules. In 304 company responses, we analysed the survey data from 253 companies that have implemented ERP software package. SERVQUAL measured users' service quality satisfaction with vendors and consultants. Finally, we use DeLone and McLean's (1992) information success measurement category to develop ERP performance.

3.2 Users' service quality satisfaction

This study uses ANOVA analysis to examine the users' service quality satisfaction in the ERP consultant selection. To examine the users' satisfaction, this study uses SERVQUAL to determine the service quality with five dimensions (see Table 1):

- 1 training materials offered by consultants
- 2 reliability of consultants' service
- 3 response to users' demand in time
- 4 trusted professional knowledge offered by consultants
- 5 understanding users' demand.

Table 1 SERVQUAL scale dimensions

<i>Dimension</i>	<i>Questionnaire description</i>
Tangibles	Training materials offered by consultant
Reliability	Reliability of consultants' service
Responsiveness	Response to users' demand in time
Assurance	Trusted professional knowledge offered by consultant
Empathy	Understanding users' demand

3.3 DeLone and McLean information system success model

We also used DeLone and McLean's (1992) information system success measurement category to develop ERP performance measures in order to explore the important factors, in the ERP consultant selection, affecting the ERP performance improvement. Table 2 gives the schema.

We used following equations to determine the performance improvement levels of the six dimensions: system quality, information quality, system use, user satisfaction, individual impact and organisational impact.

The composite performance improvement and performance improvement level of the j th dimension for the i th respondent's company:

$$P_{ij} = \sum_{k=1}^{lj} P_{ijk} \times \frac{\bar{W}_{jk}}{\sum_{k=1}^{lj} \bar{W}_{jk}}, \quad i = 1 \text{ to } N \text{ and } j = 1 \text{ to } 6 \tag{1}$$

$$\bar{W}_{jk} = \frac{\left(\sum_{i=1}^N W_{ijk}\right)}{N} \tag{2}$$

$$P_i = \sum_{j=1}^6 \left(\frac{P_{ij} \times \sum_{k=1}^{lj} \bar{W}_{jk}}{\sum_{j=1}^6 \sum_{k=1}^{lj} \bar{W}_{jk}} \right), \quad i = 1 \text{ to } N \tag{3}$$

P_{ij} is the performance improvement level of the j th dimension for the i th respondent's company. In Equation (1), \bar{W}_{jk} is the average importance level score of the k th measure of the j th dimension as perceived by N respondents, P_{ijk} is the performance improvement level score (1 to 7) of the k th measure of the j th dimension for the i th respondent's company and l th is the number of chosen measures for the j th dimension.

P_i is the composite performance improvement level for the i th respondent's company, whose equation is shown in Equation (3). In Equation (3), P_{ij} , \bar{W}_{jk} and l th are defined as above.

Table 2 Measurement category of ERP systems effectiveness

<i>System quality</i>		<i>Information quality</i>	
1.1	Data accuracy	2.1	Reliability
1.2	Database content	2.2	Timeliness
1.3	Data currency	2.3	Usableness
1.4	System accuracy	2.4	Understandability
1.5	Response time	2.5	Relevance
<i>Using ERP systems</i>		<i>User satisfaction</i>	
3.1	Amount of use/duration of use	4.1	Information satisfaction
3.2	Charge for system use	4.2	Software satisfaction
3.3	Number of reports generated	4.3	Software interface satisfaction
3.4	Number of inquiries	4.4	Overall system satisfaction
3.5	Amount of connect time	4.5	ERP project satisfaction

Table 2 Measurement category of ERP systems effectiveness (continued)

<i>Individual impact</i>			
5.1	Individual performance		
5.2	Individual productivity		
5.3	Individual decision quality		
5.4	Problem identification		
5.5	Accurate interpretation		
<i>Organisational impact</i>			
Financial perspective		Internal-business-process perspective	
6.1	Inventory cost	6.7	Inter-departments data transmission
6.2	Purchasing cost	6.8	Inter-department interaction
6.3	Inventory turnover ratio	6.9	Response time to environment change
Customer perspective		Learning and growth perspective	
6.4	On-time delivery of products/service	6.10	Understanding of workflows
6.5	Response time to customer complains	6.11	Employee satisfaction
6.6	On-time delivery of invoice	6.12	New product development

3.4 Analytical hierarchy process

AHP is a multicriteria decision-aid method designed by Saaty (1980, 1985, 1990) and Saaty and Kearns (1991). It is a method of solving socio-economic decision-making problems which is used to solve numerous problems (e.g. Dweiri and Al-Oqla, 2006; Tsai et al., 2006b; Wei et al., 2005). Partovi (1992) demonstrated that it is a 'decision-aiding tool for dealing with complex and multicriteria decisions'. The AHP helps with making appropriate choices in the face of multiobjective, multifactor and multicriteria decisions. Saaty (1980, 1985, 1990) and Saaty and Kearns (1991) also outlined seven steps for applying the AHP.¹

4 Results of questionnaire survey

This section has two parts. First part presents users' service quality satisfaction in the ERP consultant selection. The second part presents the performance improvement of the consultant selection in the ERP project implementation.

4.1 Users' service quality satisfaction in the ERP consultant selection

In ERP project implementation stage, the ERP consultant plays an important role. This study uses ANOVA analysis to examine the users' service quality satisfaction in the ERP consultant selection. Table 3 considered frequencies of consultant selection criteria in questionnaire survey data. There are 253 companies in our survey data. About 78.7%

companies consider that consultant's ERP implementation experience is important. About 64.4% and 60.9% companies consider that consultant's ERP implementation experience in similar industry and consultant's domain knowledge are important. Only 30% companies consider that consultant's implementation approaches and tools are important in ERP consultant selection process.

To examine the users' service quality satisfaction, this study adopts SERVQUAL scale dimensions as dependent variable and consultant selection criteria as independent variable. The analysis result is shown in Table 4. From Table 4, we know that the consultant's domain knowledge, his/her ERP implementation experience, and his/her ERP implementation approaches and tools are significantly related to the users' service quality satisfaction. The result also means that companies which consider consultant's domain knowledge, experience in ERP implementation and consultant's ERP implementation approaches and tools in consultant selection will have better service quality satisfaction.

Table 3 Considered frequencies of consultant selection criteria

<i>Consultant selection criteria</i>		<i>Frequencies</i>	<i>Percent (%)</i>
Consultant's fee	Consider	94	37.2
	(Not Consider)	(159)	(62.8)
Consultant's ability of project management	Consider	135	53.4
	(Not Consider)	(118)	(46.6)
Consultant's domain knowledge	Consider	154	60.9
	(Not Consider)	(99)	(39.1)
Consultant's ERP implementation experience	Consider	199	78.7
	(Not Consider)	(54)	(21.3)
Consultant's ERP implementation experience in similar industry	Consider	163	64.4
	(Not Consider)	(90)	(35.6)
Consultant's ERP implementation approaches and tools ²	Consider	76	30.0
	(Not Consider)	(177)	(70.0)
Consultant's online support	Consider	94	37.2
	(Not Consider)	(159)	(62.8)
Total		253	

Table 4 Users' service quality satisfaction^a in the ERP consultant selection

<i>Variable</i>	<i>Standard error</i>	<i>F test</i>	<i>p-value^b</i>
Consultant's fee	0.4261	0.4320	0.5117
Consultant's ability of project management	0.1167	0.1181	0.7314
Consultant's domain knowledge	4.2619	4.4023	0.0371**
Consultant's ERP implementation experience	4.1084	4.2405	0.0407**
Consultant's ERP implementation experience in similar industry	0.9286	0.9436	0.3325
Consultant's ERP implementation approaches and tools	4.7570	4.9258	0.0275**
Consultant's online support	0.2939	0.2977	0.5859

^aDependent variable was SERVQUAL scale dimensions.

^b* p < 10%; ** p < 5%; *** p < 1%

During the ERP implementation, companies usually use outside consultants for setup, installation and customisation of their software. Companies are getting advantage from consultants' experience, comprehensive knowledge of certain modules and experience

with the software applications (e.g. Piturro, 1999). As Jang and Lee (1998) pointed out, consultants should assume five basic roles:

- 1 *Expert*: the consultant should provide the skills and knowledge to client.
- 2 *Manager*: the consultant requires special skills to manage or control the project.
- 3 *Researcher*: the consultant accepts the responsibility for obtaining, analysing, and interpreting objective data in a scientific manner.
- 4 *Counsellor*: the consultant requires formal methods and knowledge to client in learning process.
- 5 *Politician*: the consultant should become more politically sophisticated and active in order to increase the success of management consulting projects.

These factors are critical for the successful completion of the management consulting project.

Jang and Lee (1998) state that the consultant is the provider of skills and knowledge for ERP setup, installation and implementation. Consultant's domain knowledge also affects users' satisfaction (e.g. Lapierre, 1998). Clients would expect the consultant with appropriate experience in their ERP project implementation. The consultant's domain knowledge, ERP implementation experience, and ERP implementation approaches and tools will lead to a successful ERP project and better service quality satisfaction.

4.2 Consultant selection and performance

In this section, we explore the performance of companies that consider the consultant selection criteria. We use DeLone and McLean's (1992) information system success model as dependent variable to construct an ERP effectiveness measurement. The following seven consultant selection factors were independent variables: consultant's fee, ability of project management, domain knowledge, ERP implementation experience, implementation experience in similar industry, ERP implementation approaches and tools and consultant's online support.

Since our questionnaire response variables concerning consultant selection factors are dichotomous (considering consultant factors versus do not consider consultant factors). In this study, companies that consider consultant factors in ERP implementation phase are 1, and companies that do not consider consultant factors in ERP implementation phase are 0. For example, we want to know whether consultant's domain knowledge affect companies performance in ERP implementation. Companies that consider consultant's domain knowledge in ERP consultant selection are 1 (variable = 1), and companies that do not consider consultant's domain knowledge are 0 (variable = 0). Then, this study uses ANOVA analysis to examine the relationship of companies' performance and consultant selection factors.

The ANOVA analysis result is shown in Table 5. From Table 5, we know that the consultant's fee, domain knowledge, implementation experience in similar industry and the consultant's ability of project management are significantly related to the ERP performance improvement. The result obviously shows that companies that consider the consultant's domain knowledge and implementation experience in similar industry in the consultant selection have better ERP performance.

Table 5 ANOVA Analysis of the consultant selection factors

<i>Measures of ERP system effectiveness^a</i>	<i>System quality</i>	<i>Information quality</i>	<i>Use</i>	<i>User satisfaction</i>	<i>Individual impact</i>	<i>Organisation impact</i>	<i>Composite</i>
<i>Consultant selection criteria</i>							
Consultant's fee	0.7218 ^b	0.0927*	0.5463	0.3824	0.7775	0.6957	0.6327
Consultant's ability of project management	0.1555	0.0961*	0.1352	0.3603	0.0883*	0.1712	0.1099
Consultant's domain knowledge	0.0038***	0.0025***	0.0001***	0.0056***	0.0008***	0.0007***	0.0003***
Consultant's ERP implementation experience	0.0903*	0.6895	0.2060	0.5480	0.4599	0.3667	0.3458
Consultant's implementation experience in similar industry	0.2414	0.2975	0.0988*	0.0619*	0.0567*	0.0869*	0.0725*
Consultant's ERP implementation approaches and tools	0.5920	0.3644	0.4159	0.5984	0.7428	0.6326	0.7407
Consultant's online support	0.5316	0.5855	0.7873	0.3732	0.4274	0.2642	0.3761

^aDependent variable was companies' performance improvement in ERP implementation.

^b* $p < 10\%$; ** $p < 5\%$; *** $p < 1\%$.

Also from Table 5, we know that companies which consider consultant's fee in the consultant selection have better ERP performance, especially in 'Information Quality'. Companies that consider ability of project management in the consultant selection have better ERP performance, especially in 'Information Quality' and 'Individual Impact'. Table 5 also shows that companies which consider consultant's domain knowledge in consultant selection have better ERP performance in 'System Quality', 'Information Quality', 'Use', 'Use Satisfaction', 'Individual Impact' and 'Organisation Impact'. Finally, companies that consider consultant's implementation experience in similar industry in the consultant selection have better ERP performance, especially in 'Use', 'Use Satisfaction', 'Individual Impact' and 'Organisation Impact'.

From Tables 4 and 5 results, we find that companies which consider the consultant's domain knowledge in the consultant selection achieve better users' service quality satisfaction and better ERP performance. This result is consistent with Jang and Lee (1998) and Bingi et al. (1999) findings, that is, the consultant requires specialised knowledge to client in learning process and plays a technical role to solve client's problem. We also find that companies which consider the consultant's ERP implementation experience and ERP implementation approaches and tools in consultant selection have better service quality satisfaction and have insignificant ERP performance. We conclude that companies tend to acquire better service quality satisfaction through considering the consultant's ERP implementation experience and ERP implementation approaches and tools in consultant selection. In order to acquire better ERP implementation performance, companies should consider more factors like the consultant's fee, consultant's implementation experience in similar industry and consultant's ability of project management in consultant selection.

5 An ERP consultant selection example – an AHP approach

In this section, we use one example to illustrate the ERP consultant selection to represent how to use AHP approach for making an appropriate selection. Cheung et al. (2002) suggested that AHP goes through three stages:

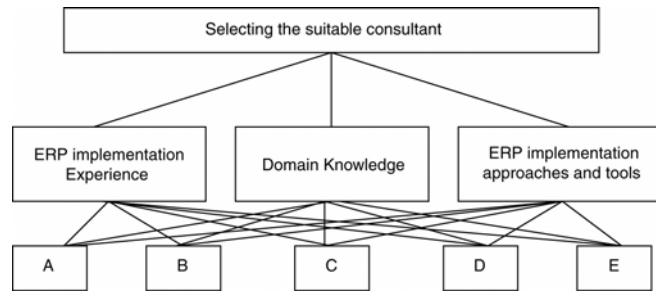
- 1 constructing the hierarchy for criteria and subcriteria
- 2 comparing the weight of criteria and subcriteria
- 3 evaluating the alternatives by computation of the relative weights of criteria subcriteria.

Using the AHP procedure, the problem hierarchy can be developed as illustrated in Figure 2. A two-level hierarchy is presented in Figure 2.

The first step is to define the problem and determining the problem objectives. In this illustrative example, we define the problem objective is how to select the suitable consultant company in ERP implementation. The zero level is the selection goal. Then, we define the consultant selection criteria as first level. The consultant selection criteria, selected from Table 3, are 'ERP implementation experience', 'Consultant's domain knowledge' and 'ERP implementation approaches and tools'. The second level is consultant companies which are selected by user. There are five consultant Companies (A–E) which have different characteristic. In order to find the weight of the degree of

influence among three criteria, we will show the procedure in Appendix. This procedure will be helpful to researchers who want to understand and study AHP method of interdependence relationship.

Figure 2 Proposed AHP criteria for ERP consultants



In the first level, the weight matrix of criteria as (ERP implementation experience, domain knowledge, ERP implementation approaches and tools) = (0.5662, 0.2416, 0.1922). The Consistency Ratio (CR) value is acceptable. In the second level, the final results of the AHP phase are (A, B, C, D, E) = (0.2078, 0.2079, 0.1791, 0.2099, 0.1952) in Appendix. The sum of weight equals one in each level. These AHP results are expressed as follows. The ranking results show that Company D is the best consultant company for ERP implementation. Next are Companies B, A, E and C.

6 Conclusion

ERP projects require significant investment. However, bad ERP project investments can create a crisis for a firm. Therefore, ensuring successful ERP implementation is crucial. ERP consultants can help firms to solve implementation problems. Sirosky (1989) suggested that consultants fall into numerous professional service categories. Consulting firms can use their domain knowledge and experience to solve business problems. However, ERP consultant selection involves complex decision situations. Bingi et al. (1999) also identified that consultant selection decisions affect the success of ERP implementation. It is difficult to identify suitable consulting firms for ERP project implementation.

Based on previously researches on service quality, this investigation empirically examined the users' service quality satisfaction with ERP consultant selection. The research results demonstrate that companies that consider consultant domain knowledge, ERP implementation experience, and ERP implementation approaches and tools in consultant selection achieve higher levels of service quality satisfaction. This finding is consistent with the findings of Dolmetsch et al. (1998) and Piturro (1999) that outside consultants can use their experience, detailed knowledge of certain modules and experience with software applications to help organisations set-up, install, and customise their software. This finding is also consistent with the findings of Kole (1983) and Gable (1991) that consultant ability and working experience play an important role in Information System implementation. Consultant companies with abundant experience and knowledge can offer better and specialised resolution to their customers (e.g. Basil et al., 1997). Since ERP consultants have specialised abilities, user satisfaction with ERP

consultants is greater than their satisfaction with other consultants. This finding is consistent with the finding of Lapierre (1998) that consultant's ability affects their service quality.

This study also utilised the information system success model of DeLone and McLean (1992) to develop ERP performance measures. The research results demonstrate that companies that consider consultant's fee, domain knowledge, implementation experience in similar industries and consultant's ability of project management in consultant selection achieve better ERP performance. This study identifies several interesting phenomenon, as follows. Firstly, companies that consider consultant's domain knowledge achieve better users' satisfaction and ERP performance improvement. This result agreed with the finding of Welti (1999) that setting up an integral software is complex, and that consultant's ability influences the quality and success of ERP project. Covin and Fisher (1991) and Franks et al. (1992) also indicated that the specialised ability of consultants is an important factor in their success. As Jang and Lee (1998) and Bingi et al. (1999) suggested, ERP project consultants are required to provide specialised knowledge to clients during the learning process, and play a technical role in solving client problems. The study results demonstrate that the consultant's domain knowledge used in consultant selection not only achieves greater service quality satisfaction but also better ERP performance. Companies thus should consider consultant's domain knowledge in the consultant selection process to ensure successful ERP project implementation.

Secondly, companies that consider consultant's ERP implementation experience achieve better service quality and insignificant ERP performance. Besides, companies that consider consultant's ERP implementation in similar industry have better ERP performance. Consultants have acquired more critical knowledge in similar industry experience. Jang and Lee (1998) indicated that consultants use their specific experience and knowledge to resolve problems and achieve success.

Thirdly, companies that consider consultant's implementation approaches and tools in consultant selection have better service quality satisfaction and have insignificant ERP performance. There are 253 companies in Table 3. About 78.7% companies consider that consultant's ERP implementation experience is important. Next are 64.4% and 60.9% companies that consider consultant's ERP implementation experience in similar industry and consultant's domain knowledge. Only 30% companies consider that consultant's implementation approaches and tools are important. This study infers that contents of ERP projects are more important than ERP implementation approaches. Consultant's domain knowledge and implementation experience are more helpful to ERP project contents than implementation approaches and tools. To obtain better ERP implementation performance, companies should consider more factors which helpful to contents of ERP projects during consultant selection.

Finally, this study applied the AHP approach as a decision-making method to the multicriteria ERP consultant selection setting. This study has identified three criteria which can help better select the ERP consultant: 'ERP implementation experience' 'Consultant's domain knowledge' and 'ERP implementation approaches and tools'. The final results of the AHP phase are (A, B, C, D, E) = (0.2078, 0.2079, 0.1791, 0.2099, 0.1952). The ranking results show that Company D is the best consultant company for ERP implementation. Next are Companies B, A, E and C. The illustration of AHP procedure will be helpful to researchers who want to understand and study AHP method of interdependence relationship.

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Notes

¹Saaty (1980, 1985, 1990) and Saaty and Kearns (1991) outlined seven steps for applying the AHP as described below: The first step is to define the problem and determine its goal. The second step is to structure the hierarchy from the top level to the lowest level. The third step is to establish a set of pair-wise comparison matrices. The fourth step is to weigh the eigenvectors. The fifth step is to make the pair-wise comparisons. The sixth step is to check the consistency, which is determined by using the eigenvalue, λ_{\max} , to calculate the consistency index, CI as follows: $CI = (\lambda_{\max} - n)/(n - 1)$, where n denotes the matrix size. CR of CI is used to evaluate consistency using the appropriate value. CR exceeding 10% is considered acceptable, while lower values indicated an inconsistent judgment matrix. Judgments should be reviewed and improved to obtain a consistent matrix. The seventh step is to make the final decision to select the best option.

²In ERP project implementation, companies with their ERP system vendors and consultants have different approaches and tools to ensure ERP project success. Consultants offer their specialised service helping companies to design business process and fit for system process. Consultants' implementation project approaches follow ERP implementation stages and offer various support to their customer. For instance, consultants help companies understanding what they needs ERP systems in pre-implementation stage; consultants help companies setting their system in implementation stage. Recently, many consultant companies adopt their implementation approaches which are similar to Accelerated SAP (ASAP) and Application

Implementation Methodology (AIM). ASAP model includes five phases: project preparation, business blueprint, realisation, final preparation and continuous change. AIM includes seven phases: implementation strategy, operation analysis, solution design, solution build, documentation, transition and on-production.

Appendix

This study identified the multicriteria decision technique known as the AHP to be the most appropriate for solving complicated problems. In the AHP procedure, the pair-wise comparison matrix should show in Equation (A1).

$$A = \begin{bmatrix} 1 & a_{12} & a_{13} & a_{14} & a_{15} \\ 1/a_{12} & 1 & a_{23} & a_{24} & a_{25} \\ 1/a_{13} & 1/a_{23} & 1 & a_{34} & a_{35} \\ 1/a_{14} & 1/a_{24} & 1/a_{34} & 1 & 1/a_{45} \\ 1/a_{15} & 1/a_{25} & 1/a_{35} & 1/a_{45} & 1 \end{bmatrix} \tag{A1}$$

Following Equation (A1), an example pair-wise comparison matrix for firm’s ERP implementation experience is listed in Table A1.

Table A1 Pair-wise comparison matrix for the consultant’s ERP implementation experience

<i>Consultant’s ERP implementation experience</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
A	1	1/2	1	1	4
B	2	1	1	2	1
C	1	1	1	1/2	1
D	1	1/2	2	1	1/2
E	1/4	1	1	2	1

This example applied the following Al-Harbi’s (2001) seven step AHP approach:

Step 1 Synthesise the pair-wise comparison matrix. Specially, this example shows the consultant’s ERP implementation experience, which are the criteria used for the ERP consultant selection. In Table A2, the priority vector is obtained based on row average.

Table A2 Synthesised matrix for consultant’s ERP implementation experience

<i>Consultant’s ERP implementation experience</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>Priority vector</i>
A	0.1905	0.1250	0.1667	0.1538	0.5333	0.2339
B	0.3810	0.2500	0.1667	0.3077	0.1333	0.2477
C	0.1905	0.2500	0.1667	0.0769	0.1333	0.1635
D	0.1905	0.1250	0.3333	0.1538	0.0667	0.1739
E	0.0476	0.2500	0.1667	0.3077	0.1333	0.1811

Note: $\lambda_{max} = 5.3523$, $CI = 0.0881$, $RI = 1.12$, $CR = 0.0786 < 0.1$.

Step 2 Calculate the criterion priority vector.

$$0.2339 \begin{bmatrix} 1 \\ 2 \\ 1 \\ 1 \\ 1/4 \end{bmatrix} + 0.2477 \begin{bmatrix} 1/2 \\ 1 \\ 1 \\ 1/2 \\ 1 \end{bmatrix} + 0.1635 \begin{bmatrix} 1 \\ 1 \\ 1 \\ 2 \\ 1 \end{bmatrix} + 0.1739 \begin{bmatrix} 1 \\ 2 \\ 1/2 \\ 1 \\ 2 \end{bmatrix} + 0.1811 \begin{bmatrix} 4 \\ 1 \\ 1 \\ 1/2 \\ 1 \end{bmatrix} = \begin{bmatrix} 1.0572 \\ 1.4077 \\ 0.9131 \\ 0.9491 \\ 0.9985 \end{bmatrix} \quad (A2)$$

Step 3 Calculate the CR. In decision-making problems, decisions regarding consistency were extremely important. This example uses the weight sum matrix obtained from the priority vector, and to obtain the following:

$$\begin{aligned} \frac{1.0572}{0.2339} &= 4.5206, & \frac{1.4077}{0.2477} &= 5.6825, & \frac{0.9131}{0.1635} &= 5.5852, \\ \frac{0.9491}{0.1739} &= 5.4587 & \frac{0.9985}{0.1811} &= 5.5144 \end{aligned} \quad (A3)$$

Step 4 Calculate λ_{max} .

$$\lambda_{max} = \frac{(4.5206 + 5.6825 + 5.5852 + 5.4587 + 5.5144)}{5} = 5.3523 \quad (A4)$$

Step 5 Calculate the consistency index, CI. The ratio of CI to the average RI for the same order matrix is called the CR. The CR needs to be kept 'small', for example; below 10%, indicating deviations from nonrandom entries (informed judgements) of less than an order of magnitude (Saaty, 2000).

$$CI = \frac{\lambda_{max} - n}{n - 1} = \frac{5.3523 - 5}{5 - 1} = 0.0881 \quad (A5)$$

Step 6 Select appropriate value of the random CR. Saaty (1980) examined the random index for each size of matrix, as listed in Table A3.

$$CR = \frac{CI}{RI} = \frac{0.0881}{1.12} = 0.0786 \quad (A6)$$

In Equation (A6), the CR of the consultant's background is 0.0786 (below 10%), indicating that the comparison matrix falls within the rational range, and thus the decision continues.

Table A3 Random index

<i>n</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

As with the AHP approach, other criteria of ERP consultant selection are also examined. Table A4 shows the consultant's domain knowledge, which is a criteria for ERP consultant selection. This example shows that the CR of the consultant's past performance is 0.0814 (less than 10%). Table A5 shows the consultant's ERP implementation approaches and tools. This example shows that the CR is 0.0572 (less than 10%).

Table A4 Synthesised matrix for consultant’s domain knowledge

<i>Consultant’s domain knowledge</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>Priority vector</i>
A	1	1	1/2	1	2	0.2051
B	1	1	1	1/2	1	0.1646
C	2	1	1	1	1/2	0.2051
D	1	2	1	1	1	0.2202
E	1/2	1	2	1	1	0.2051

Note: $\lambda_{max} = 5.3648$, CI = 0.0912, RI = 1.12, CR = 0.0814 < 0.1.

Table A5 Synthesised matrix for consultant’s ERP implementation approaches and tools

<i>ERP implementation approaches and tools</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>Priority vector</i>
A	1	1	1/2	1/3	1	0.1347
B	1	1	1/2	1/2	1	0.1447
C	2	2	1	1/2	1/2	0.1927
D	3	2	2	1	1	0.3033
E	1	1	2	1	1	0.2247

Note: $\lambda_{max} = 5.2564$, CI = 0.0641, RI = 1.12, CR = 0.0572 < 0.1.

Step 7 Check the consistency of the pair-wise comparison matrix. In Table A6, the CR is 0.0988 (less than 10%) for three criteria (Consultant’s ERP implementation experience, Consultant’s domain knowledge and Consultant’s ERP implementation approaches and tools).

Table A6 Synthesised matrix for the three criteria

	<i>ERP implementation experience</i>	<i>Consultant’s domain knowledge</i>	<i>ERP implementation approaches and tools</i>	<i>Priority vector</i>
ERP implementation experience	1	4	2	0.5662
Consultant’s domain knowledge	1/4	1	2	0.2416
ERP implementation approaches and tools	1/2	1/2	1	0.1922

Note: $\lambda_{max} = 3.2214$, CI = 0.1107, RI = 1.12, CR = 0.0988 < 0.1.

Moreover, the overall priority is calculated for all consultant companies. In Equations (A7)–(A11), D, B, A, E and C are ranked according to their priorities. The ranking results show that company D is the best consultant company for ERP implementation.

$$\begin{aligned} \text{Overall priority of consultant A} &= 0.5662(0.2339) + 0.2416(0.2051) \\ &+ 0.1922(0.1347) && \text{(A7)} \\ &= 0.2078 \end{aligned}$$

$$\begin{aligned} \text{Overall priority of consultant B} &= 0.5662(0.2477) + 0.2416(0.1646) \\ &+ 0.1922(0.1447) && \text{(A8)} \\ &= 0.2079 \end{aligned}$$

$$\begin{aligned} \text{Overall priority of consultant C} &= 0.5662(0.1635) + 0.2416(0.2051) \\ &+ 0.1922(0.1927) && \text{(A9)} \\ &= 0.1791 \end{aligned}$$

$$\begin{aligned} \text{Overall priority of consultant D} &= 0.5662(0.1739) + 0.2416(0.2202) \\ &+ 0.1922(0.3033) && \text{(A10)} \\ &= 0.2099 \end{aligned}$$

$$\begin{aligned} \text{Overall priority of consultant E} &= 0.5662(0.1811) + 0.2416(0.2051) \\ &+ 0.1922(0.2247) && \text{(A11)} \\ &= 0.1952 \end{aligned}$$