

An Application of AHP to Developing Weights for Hierarchical Criteria System of ASP Vendor Selection: Using SME in Taiwan as an Example

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ABSTRACT

Since the 1980's, outsourcing of business activities has become a trend worldwide. Outsourcing not only increases economic benefits for SMEs (small- and medium-size enterprises), but also enhances their core competencies. Outsourcing does have some drawbacks, such as lacking of control and losing learning opportunities. The information management activity of a firm is an appropriate candidate for outsourcing, since it usually involves heavy capital investments on computer hardware and software, which is unaffordable to SMEs. Therefore, selecting a reliable outsourcing vendor to fairly work with is an important issue for companies to survive, especially for SMEs. In this paper, we apply an analytical hierarchical process (AHP) to evaluating application services providers (ASP) according to a hierarchical criteria system. We ask some SMEs of various industries to compare criteria pair-wisely and derive weights for the hierarchical criteria system based on these comparisons. Through the application of AHP, we find that security and price are the main concerns of SME for selecting an ASP in Taiwan.

1. Introduction

During the past decade, firms have relied on outsourcing as a major mode for their

information technology (IT) services. Recent reports suggested that this trend is likely to continue with IT outsourcing contracts reaching US\$ 156 billion in 2004.[21]To outsource operating activities, a firm expects to obtain benefits such as being more flexible, saving costs, improving service quality, and enjoying the state-of-the-art technology. However, outsourcing also involves some drawbacks, such as losing control power over outsourced activities, losing opportunities of learning new technology, etc. [2][3][10] Thus, it is necessary to develop a systematic vendor selection process to carefully evaluate possible outsourcing vendors.

Vendor selection is a multi-criteria problem. The criteria include both qualitative and quantitative factors. A firm has to make a trade off between these factors when evaluating vendors. Over the years, the significance of vendor selection has been long recognized and emphasized. For vendor selection, two issues are particularly important. The first one is involves what criteria should be used, and the second one is related to what methods should be used to make comparisons. [31] Dickson [8] first identified 23 supplier selection criteria, and then the Weber [30] reviewed and annotated them, classified 74 related articles which had appeared since 1966.

In this study, we use the AHP approach (analytic hierarchy process, by Saaty, [27]) as a

vendor selection method. It is a powerful and flexible multi-criteria decision-making tool for complex problems where both quantitative and qualitative aspects need to be considered. We focus on the IT outsourcing activities of SMEs in Taiwan. These IT outsourcing activities are provided by domestic application service providers (ASP). Because of flexibility and lower cost for getting the IT technology and software license, the employment of ASP has gradually become a trend for SMEs who usually are unable to afford heavy capital investment on IT technology and software.

The purposes of this study are three-fold: (1) highlighting the importance of the IT outsourcing and vendor selection and reviewing vendor selection approaches; (2) establishing a hierarchical criteria system for evaluating ASPs in Taiwan from SMEs' aspect; (3) using AHP approach to derive weights for the hierarchical criteria system based on comparisons made by sampled SMEs in Taiwan. The remaining part of this paper is structured as follows. In Section 2, we provide a review on IT outsourcing and vendor selection research issues. A hierarchical criteria system for evaluating ASPs is then derived. In Section 3, we introduce the AHP approach and apply it to determine the weights of the hierarchical criteria system for evaluating ASPs by SMEs in Taiwan. In the last section, we render some concluding remarks, management implications and suggestions for future research.

2. Literature Review

2-1 IT Outsourcing

In the late 1980's, large facilities management firms and major equipment vendors offered

facilities management and other outsourcing services to industries. At the same time, managers were tired of information systems (IS) budget growth year by year and viewed outsourcing as a opportunity to cut information technology (IT) costs as well as downsize the IS function. Besides, small- and medium-enterprises can exploit IT technology and concentrate on their core competencies through outsourcing.

Many researches have focused on the sourcing decision to explore why and what kind of companies, operations and businesses to proceed with. Many authors showed their interests in economic and financial aspects and paid great attention to cost analysis, especially for hidden costs and moral hazards. [12]Some other authors focused on risks and advantages which can arise from the practice of outsourcing, and pointed out the importance of contract management. [8][10][11]

Though the outsourcing has many advantages, it still contains some undesirable results. [10]. While firms enter outsourcing agreements with the objective of cutting costs and improving the level of service rendered to users, the outcome of some contracts may be disappointed. In view of such undesirable consequences, many researchers have argued for adopting a risk management approach to studying and managing IT outsourcing. [2][8][10] In general, common outsourcing management issues include identifying what kind of activities to be outsourced, specifying standards of performance to be achieved, appraising suppliers or providers, and negotiating service provision levels of price, quality and delivery, etc. [1] In order to maximize potential advantages and minimize

risks resulting from adoption of outsourcing policies, a firm should select a “right” vendor. Thus, it is necessary to develop the selection criteria and benchmarking activities to evaluate and analyze their capabilities. [24]

2-2 Vendor Selection Criteria

In general, the selection criteria for evaluating vendors include geographical position, perceived quality of goods and services, contract flexibility, technological excellence, leadership, plant-specific know-how and experience, and low price. [24] Dickson [9] first identified 23 supplier selection criteria in 1966. Since then, many scholars started to explore the vendor selection issue. Weber [29] reviewed Dickson’s criteria and classified 74 related articles appeared since 1966. Khurram [20] use manufacturing costs, quality, technology being used and service offered into AHP (analytical hierarchy process) method and TCO (total cost of ownership) concept to compare their difference when selecting a vendor. Anjana [1] suggests that criteria are needed to judge abilities to meet the specification at acceptable prices, supplier’s reputation for delivery on similar contracts, flexibility in dealing with difficulties, supplier’s credit terms, and financial soundness.

Following, Desai [8] indicates that key drivers of outsourcing in e-business should include speed, focus, flexibility, scalability, security, cost, and managing change. Kannan [17] provide a research that conducts an empirical study of attitudes towards vendor selection and assessment of American and European companies and their impact on business performance. They use thirty selection criteria, including vendors’ performance and ethical side.

No matter what criteria when they choosing an appropriate vendor, the most important issues are the performance, state-of-art technology, flexibility, price, experience and security. These are the common issues for outsourcing, and they could be different levels of importance according the company needs.

2-3 AHP

The decision methods for problem definition are methods that support the decision-maker in carefully questioning the need for a decision and the alternatives that seem to be available. In the case of supplier selection it thus involves determining what the critical problem is and why selecting one or more suppliers seems the best way to handle it. Whenever a vendor selection decision is made, the customer normally establishes a set of evaluation criteria that can be used to compare potential sources. [5] AHP (analytical hierarchy process) is a multi-criteria decision making method that provides a framework to cope with multiple criteria. [28] It first structures the problem in the form of a hierarchy to capture the criteria, subcriteria, and alternatives. All the criteria are compared fairly to determine their relative weights. Based on them, the decision maker can evaluate alternatives according to their priority of ranking. AHP results in a score for each alternative. AHP uses pair-wise comparisons to different alternatives.

The process of AHP comprises the following steps: [15]

1. Structure a problem with a model that shows the problem's key elements and their relationships;
2. Elicit judgments that reflect knowledge,

- feelings, or emotions;
3. Represent those judgments with meaningful numbers;
 4. Use these numbers to calculate the priorities of the elements of the hierarchy;
 5. Synthesize these results to determine an overall outcome;
 6. Analyze sensitivity to changes in judgment.

3. The decision structure

3-1 ASP selecting criteria and hierarchy

Selective outsourcing of IT services industry has evolved to provide increasing levels for its customers in recently years. Instead of handing over their complete IT infrastructure to an outside provider, organizations have selectively outsourced specific IT functions, ranging from data networking to application management. [22] Most ASPs have invested heavily in security systems to assure that business information remains confidential. In addition, some ASPs have state-of-the-art encryption—biometric authentication or digital certificates that control access to servers, networks or other client devices. Many ASPs also have back-up capabilities including detailed disaster recovery plans for each piece of equipment. The better ASPs are selective inhiring and assure that application programmers are separated from data managers. [7][11]

In an addition, growth or declines in firm size could limit the usefulness of the ASP's software and lead to higher prices or a loss of service. The size of companies, capability and offering of the ASP, and the type of application sourced all seemed to influence the fitness of application to an ASP. [17][18][19] Therefore, we make up

these criteria in Table 1 with listing important contents, and the Figure 1 shows its hierarchy of ASP selecting criteria.

Table 1 ASP selecting criteria [19]

Criteria	Components
Security [6]	Physical security of datacenter, security of data applications, back-up and restore procedures, disaster recovery plan
Integration [16]	Integration of heterogeneous Applications across multiple platforms/sites/environments and management infrastructure, interaction of applications to allow end-to-end analysis, ability to deliver business needs through integration, ability to provide customization if required by the customer, migration of exciting data
Pricing [13]	Effect on TCO, hidden costs/charges, return in investment, different charging through competition and flexibility
Customer service [19]	Help desk and training, support for administration of accounts.
Service level monitoring and management [19]	Clearly defined performance metrics and measurement, defined procedures for opening, closing of accounts, flexibility
Reliability, availability and scalability (RAS) [19]	Reliability, availability, scalability
Company & Financial position [9]	

3-2 Empirical example

After considering a problem of selecting a vendor for ASP and demonstrating how the model can be applied, we have to consider of factors, definite criteria and sub criteria shown in table 1 as appropriate in evaluating deterrent vendor systems and in selecting the best vendor.

Our sample target is the SME of Taiwan industries, including the entertainment, manufactory, printing, retailer, service, medical appliances industries, conventional industries and the electronics industry. The table 2 shows the result of our questionnaire and the priority of the ASP selecting criteria for these 15 SMEs We also make a chart to realize the rank of main criteria and subcriteria (Chart 1).

Table 2 The result of criteria priority and weight for selecting ASP in Taiwan SME

		Average	Standard deviation
Security		0.2099	0.1360
	Physical security of datacenter	0.2907	0.2125
	Security of data applications	0.2515	0.1607
	Back-up and restore procedures	0.2139	0.0847
	Disaster recovery plan	0.2437	0.2029
		0.1413	0.0857
	Integration of heterogeneous applications	0.2473	0.1694
Integration	Integration of applications to allow end-to-end analysis	0.2032	0.1320
	Ability to deliver business needs through integration	0.1593	0.0972
	Ability to provide customization	0.1970	0.1006
	Migration of exciting data	0.1931	0.1507
		0.1665	0.0935
Price	Reduce TCO	0.2343	0.1474
	Minimal hidden costs/charges	0.2115	0.1563
	ROI	0.3662	0.2331
		0.1665	0.0935

	Different charging through competition and flexibility	0.1871	0.1775
Customer service		0.1125	0.0735
	Help desk and training	0.4667	0.2979
	Support for administration of accounts	0.5333	0.2979
Service level monitoring and management		0.1308	0.0776
	Clearly defined performance metrics and measurement	0.3320	0.2067
	Flexibility	0.3637	0.2331
	Worldwide application	0.3043	0.2390
Reliability, availability and scalability		0.1123	0.0691
	Reliability	0.5087	0.2239
	Availability	0.2537	0.1033
	Scalability	0.2101	0.1407
Company & Financial position		0.1391	0.1543

Note: 1. The sample number is 15, the criteria and classify was seen in table 2&3.

2. The boldface word is the maximum number of the item.

3. The sum of every item is equal 1, and the blue number is the global weight of the items.

4. The weight of selecting criteria was calculated by Expert Choice software

Figure 1 the hierarchy of ASP criteria

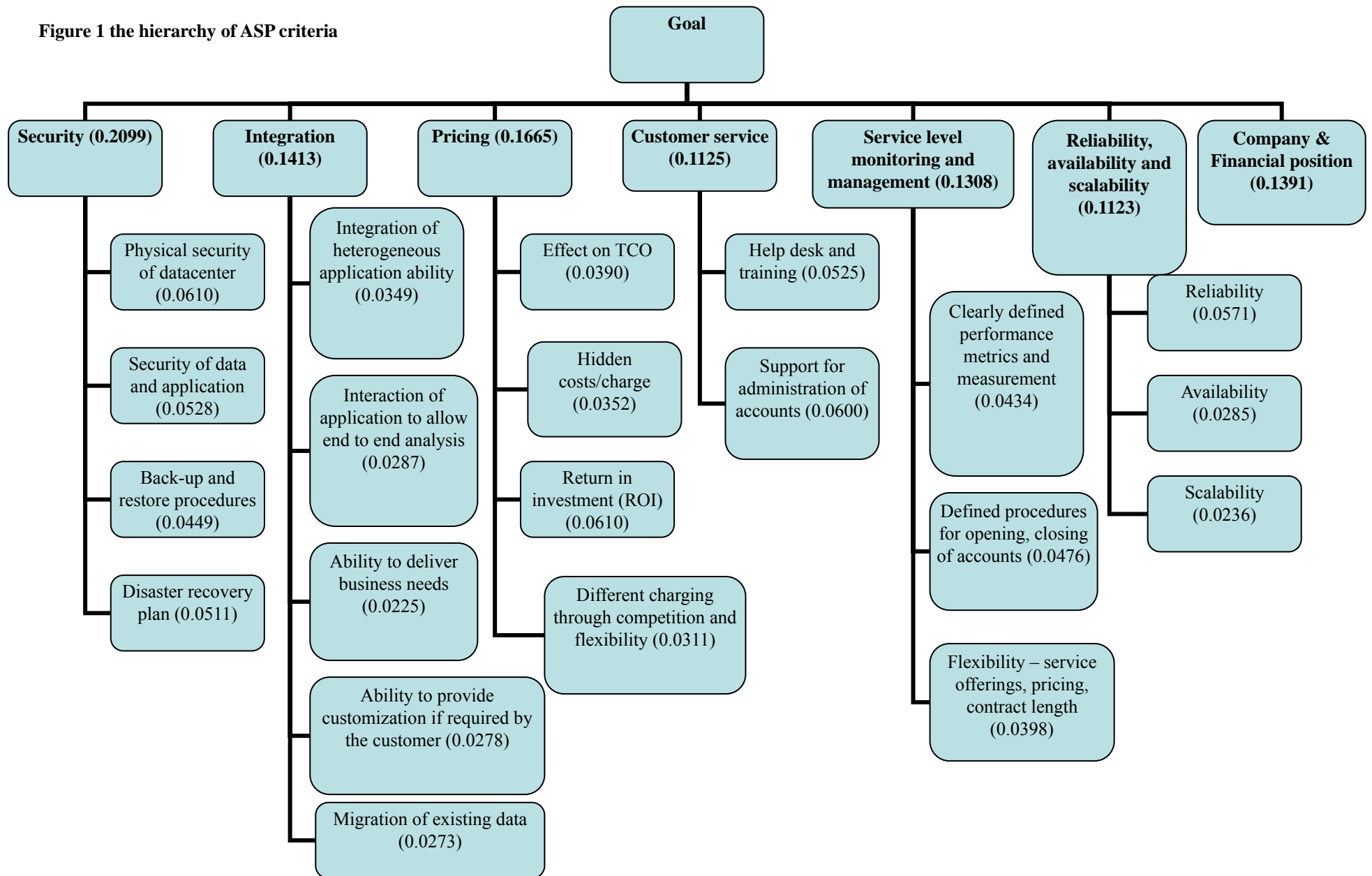


Chart 1 The chart of the criteria for selecting ASP in Taiwan SME

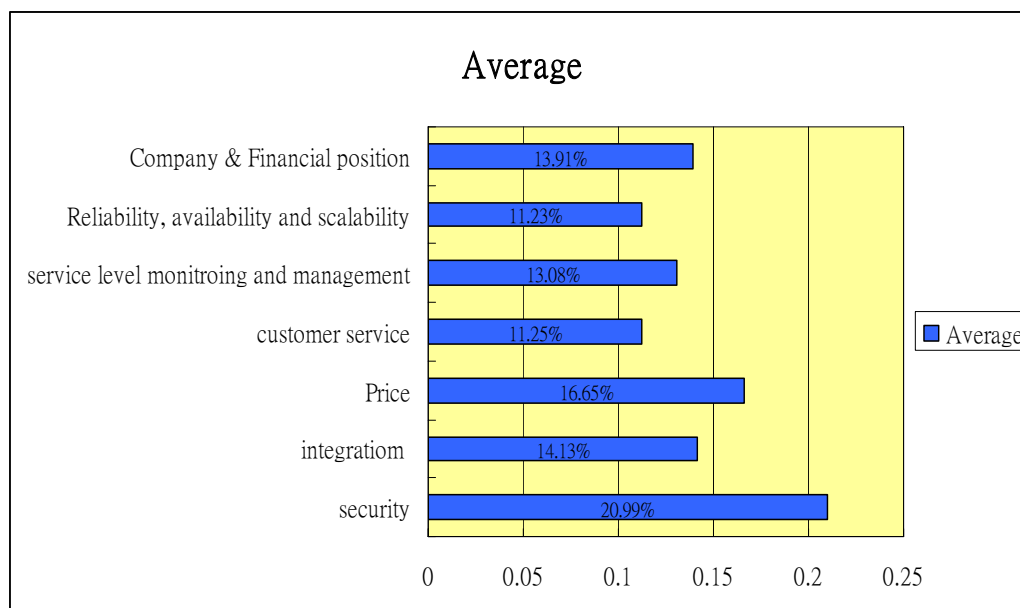


Table 3 The rank of the sub-criteria

Rank	Sub-criteria	Global Weight
1	Physical security of datacenter	0.06102
2	ROI	0.06096
3	Support for administration of accounts	0.06002
4	Reliability	0.05711
5	Security of data applications	0.05279
6	Help desk and training	0.05252
7	Disaster recovery plan	0.05114
8	Flexibility	0.04757
9	Back-up and restore procedures	0.04490
10	Clearly defined performance metrics and measurement	0.04343
11	Worldwide application	0.03981
12	Reduce TCO	0.03900
13	Minimal hidden costs/charges	0.03520
14	Integration of heterogeneous applications	0.03494
15	Different charging through competition and flexibility	0.03114
16	Integration of applications to allow end-to-end analysis	0.02871
17	Availability	0.02849
18	Ability to provide customization	0.02783
19	Migration of exciting data	0.02728

20	Scalability	0.02358
21	Ability to deliver business needs through integration	0.02250

The results show the selecting criteria of ASP in Taiwan industry in Figure 2 and Table 3. The ranking of importance are security, price, integration, company and financial position. We can understand that the security and price are the primary consideration when selecting application service providers. For its sub-criteria, the top one is the physical security of datacenter. The four sub-criteria of security were all included in top ten global weights. Besides, the second one is price. We can know that the cost is also the main consideration of selecting vendors because of limited capital and investment of SME. Next one is company and financial situation, the background of vendors is important because of its financial situation and reputation will affect the outcome of outsourcing activity directly. These results are consistent with some research paper that point out the importance of vendor selecting, the most important one is cost, and then quality and service.

[14]

For standard deviation, company and financial position is the most differentiating one, which means that the importance were depended on the consideration of decision maker. If the manager who considers the item is very important, its weight will be really high. By the contract, if the manager thinks the item is not important, its weight will be low. We can see the details of the result, evaluating its importance for ASP selection criteria, and applying them for the further research. Such as take a company as a sample, using these criteria and make alternatives in practice. It is the one working purpose of our future research.

This result also shows that the AHP approach can come up with the same successful vendor selection decision. By the AHP approach, the criteria for ASP vendor selection are clearly defined and the problem was structured systematically. It enables decision-makers to examine the strengths and weaknesses of vendor systems by comparing them with respect to appropriate criteria, and hence, it is easier for the evaluation team to arrive at a consensus decision. Based on these priority weights, we can select the best vendor. Thus, we can conclude that the usage of the proposed AHP model can help the decision making and significantly reduce the time taken for selecting vendor. Also, we hope that these applications would be useful for the company in their future vendor selection problems.

4. Conclusion and future work

The important relationship between the IT outsourcing and vendor selection is pointed out in this research, making up previous academics' research of vendor selection criteria, and conducting them into IT outsourcing issue. After comprising the selection method, AHP approach is used to make the ASP selecting criteria in Taiwan as an example. The previous researches were

all discussing about what kind of business activities should be outsourced, or how to choose them to be outsourced. But none of them was discussing about how to select the outsourcing provider. There are, however, some papers mentioned about vendor selection. Outsourcing and vendor selection, these two concepts are combined with AHP which is taken as a method to modify it, concluding the selection criteria and calculate its weight in this research.

After evaluating the result, there is a conclusion that the security and price are the two top considerations for ASP selecting, and we also can rank other sub-criteria. It will be helpful to evaluate the ASP, and therefore managers can make decisions more correctly. In the future work, these results may be useful when taking a company as an example, conducting these criteria and choosing an ASP in practice. It will be more realistic in real world.

Reference:

- [1] Anjana, S., Anitesh, B. and Andrew, B.W. "Understanding the emergence of Application Service Providers: An Empirical Analysis of the ASP Outsourcing Decision", McCombs School of Business, Center for Research in Electronic Commerce Department of MSIS, U.S.A Texas, 2001.
- [2] Bahli B. & Rivard S. "Validating measures of information technology outsourcing risk factors", *Omega*, 2005, 33, 175-187.
- [3] Bertolini M., Bevilacqua M., Braglia M., Frosolini M. "An analytical method for maintenance outsourcing service selection", *International journal of quality and reliability management*, 2004, 21(7), 772-788.
- [4] Boer L., Labro E., Morlacchi "A review of methods supporting supplier selection", *European Journal of Purchasing & Supply Management*, 2001, 7, 75-89.
- [5] Cathy O.S. "Preferences for single sourcing and supplier selection criteria", *Journal of business research*,

1995, 32, 105-111.

[6] Currie, W.L. & Seltsikas, P. "A market segmentation strategy for developing ASP business", *Proceedings of the international conference of information system*, 2001, Bayreuth, Jun, p.22-23.

[7] Dennis, D. and Peter, W. "How to help your client/firm make an informed ASP decision?" *Ohio CPA Journal*, 2002, Jul-Sep, 62 (3), 58-61.

[8] Desai, B. and Currie, W. "Application service providers: A model in evolution", *ICEC*, 2003, p.174-180.

[9] Dickson G.W. "An analysis of vendor selection systems and decisions", *Journal of Purchasing*, 1966, 2(1), 5-17.

[10] Earl M.J. "The risks of outsourcing IT", *Sloan management review*, 1996, Spring, 37(3), 26-32.

[11] Ekanayaka, Y., Currie, W.L. and Seltsikas, P. "Evaluating application service providers," *Benchmarking*, 2003, 10 (4), 3430-353.

[12] Franceschini, F., Galetto, M., Pignatelli, A. and Varetto, M. "Outsourcing: guidelines for a structured approach", *Benchmarking*, 2003, 10 (3), 246-260.

[13] Gerrit, T. & Gunther, O. "Business models for ASP marketplaces", paper presented at the Proceedings of the 8th European Conference on information systems, 2000, Vienna, July, 3-5.

[14] Ghodsypour S.H. & Brien C.O. "A decision support system for supplier selection using an integrated analytic hierarchy and linear programming", *International journal of production economics*, 1998, 56-57, 199-212.

[15] Godwin G.U. "Using analytic hierarchy process to analyze the information technology outsourcing decision", *Industrial management & Data systems*, 2000, 100(9), 421-429.

[16] Greg, G. "The next gold rush: application service providers stake their claims in a red hot market", *IEEE Software*, 2000, 93(4), 44-50.

[17] Kannan, V.R. & Tan, K.C. "Attitudes of US and

European managers to supplier selection and assessment and implications for business performance", *Benchmarking*, 2003, 10(5), 472-489.

[18] Kern T., Kreijer J. and Willcocks L. "Exploring ASP as sourcing strategy: theoretical perspectives, propositions for practice", *Journal of strategic information systems*, 2002, 11, 153-177.

[19] Kern, T. & Lacity, M., Willcocks, L. *Netsourcing: renting business application and services over a network*, Prentice-Hall, New York, 2002.

[20] Khurram, S.B. & Faizul, H. "Supplier selection problem: a comparison of the total cost of ownership and analytic hierarchy process approaches", *Supply Chain Management*, 2002, 7(3), 126-135.

[21] L.C. Leung & D. Cao "On consistency and ranking of alternatives in fuzzy AHP", *European Journal of Operational Research*, 2000, 124, 102-113.

[22] Lixin, T. "Shifting paradigms with the application service provider model", *Computer*, October, 2001, 34 (10), p.32-38.

[23] Maggie, C.Y. Tam & V.M. Rao Tummala "An application of the AHP in vendor selection of a telecommunications system", *Omega, the international journal of management science*, 2001, 29, 171-182.

[24] Massimo B., Maurizio B., Marcello B. and Marco, F. "An analytical method for maintenance outsourcing service selection", *International journal of quality and reliability management*, 2004, 21(7), 772-788.

[25] Michell V. and Fitzgerald, G. "The IT outsourcing market-place: vendors and their selection", *Journal of information technology*, 1997, 12, 223-237.

[26] Natalia L., Janne W. R. "From the vendor's perspective: exploring the value proposition in information technology outsourcing", *MIS quarterly*, 2003, 27 (3), 331-364.

[27] Saaty T.L., *the analytic Hierarchy Process*, McGraw-Hill, New York, NY, 1980.

[28] Saaty T.L., "How to make a decision: the analytic

hierarchy process”, *European Journal of Operational research*, 1990, 48(6), 9-26.

[29] Weber C.A., Current, J.R. ” A multi-objective approach to vendor selection”, *European journal of operational research*, 1993, 68, 173-184.

[30] Yau C. and Davis T., “Using analytic hierarchy process (AHP) to prioritize auditing tasks for large-scale software systems”, *Journal of Systems Management*, 1993, 26-31.

[31] Zhiming Z., Jiasu L., Ning C., Kinman T., Kengpo N. “Evolution of supplier selection criteria methods”, 2003.

