

Design for Supplier Performance Assessment Model of Information Technology Service Provider in Small Medium Enterprises in Indonesia

ElisaKusrini¹, Alfanugrah Hi Usman²

¹Department of Industrial Engineering & Magister of Industrial Engineering, Indonesia Islamic University, Jl Kaliurang Km 14,5Yogyakarta 55584, Indonesia

² Magister of Informatics Engineering, Indonesia Islamic University, Jl Kaliurang Km 14,5Yogyakarta 55584, Indonesia

Abstract. This study aims to design a supplier performance assessment model for information technology services provider in small medium enterprises (SME) in Indonesia. Supplier performance assessment is important to improve supplier performance and maintain long-term relationships between SME (buyer) and their suppliers. This supplier Assessment models are developed based on the review literature and interviews with procurement staff in SMEs. Performance assessment criteria are identified and tested for validity by providing a questionnaire to procurement section in SMEs. In order to obtain importance weight of each criteria toward performance score, a questionnaire to weighed the criteria are distributed to procurement staff and analyzed the answers using the Analytical Hierarchy Process (AHP) method. The final performance score is calculated based on the standardized value of each criteria multiplied by its weight. Based on the implementation of this model in SMEs, it is known that the proposed model is suitable to assess the supplier's performance and greatly help the SMEs in managing the performance of their suppliers.

1. Introduction

Today, companies tend to outsource their goods and services and focus on their core business. this resulted in the company increasingly dependent on suppliers. The company's performance is highly rely on supplier performance [1]. Based on [2], it was found that the contribution of procurement and supply chain cost is 30% to 70% of cost of good sold in some industries such as chemical and automotive. In managing vendors, many organizations reduce the number of suppliers and prefer to manage relationships with strategic suppliers in the long term [3]. Unfortunately, the company's dependence is not followed by a system of supplier performance assessment. Until now, many companies don't conduct the evaluation and monitoring of supplier performance regularly [4].

There are various types of vendors, one of the types is a vendor that specialized in information technology (IT) provider. Various services that can be provided by IT vendors include: system integration, system inspection, system management, internet management, software development, software verification, software maintenance, hardware maintenance, hardware operation, management of facilities, internet services. Information technology (IT) is very important for a company because through IT, companies can easily achieve competitive advantage and gain profit. The use of IT has evolved into 'commodities' where IT can be said to be a must-have for any company

[5]. Considering the importance of IT and its vendors within a company, then the company needs to manage the performance of IT vendors and companies need to perform supplier performance assessment.

Supplier performance assessment has been widely investigated by many researchers in previous study. They used different criteria and different criteria and methods to develop supplier assessment model and up to now there is no agreement what criteria can be used for vendor performance assessment. The focus of previous researchers more on assessing for vendor selection, while for monitoring and assessment of vendor performance is still very limited. Therefore, this research will propose a model for assessment and monitoring vendor performance especially vendor IT in small medium enterprises in Indonesia.

2. Literature review

There are many studies on the measurement of vendor selection criteria but very few for examining the model in measuring and monitoring supplier performance. Supplier performance assessment is a technique to measure the actual performance of suppliers and assesment based on predetermined criteria and give suppliers value based on the measurement results. This becomes important in maintaining relationships with suppliers and for consideration of the future relationship. While the vendor selection is a process of getting vendors with various

predetermined criteria [6]. Some research in vendor selection system is done on a large industry and the public procurement of goods and services but on SMEs and for special items of IT is still very limited. The assessment methods are varied and no agreement what method is most appropriate. Here are some researches on vendor selection methods by previous researchers with different methods.

The study of IT vendor selection criteria in SMEs is done by [7] which examines the criteria of vendor selection in SMEs Taiwan by using multivariate analysis. This study yields a conclusion of criteria that can be used in vendor selection. A hybrid model consist of five steps to support the vendor selection is proposed by [8] and this research using Multi criteria decision making (MCDM) approach. Analytic Network Process (ANP) approach is employed to obtain relative weighting of criteria and modified TOPSIS (Techniques for order preference by similarity to ideal solution) for vendor evaluation process. The proposed model also provides a framework for designing and improving adequate criteria and reducing risks in choosing unsuitable vendors. A study conducted by [9] aimed at developing criteria and providing a model for testing the relationships and impacts related to the selection of supplier by using Fuzzy DEMATEL method. The study was conducted using literature study and review some related articles and found 43 important criteria in selecting a vendor. The criteria were chosen according to the importance of using Delphi fuzzy method and obtained 14 important criteria and then made a dematel questionnaire and distributed among 11 experts and members in Islamic Azad University of Yazd. The Result of this study is that stable financial criteria have the greatest impact in optimal supplier selection and security is the lowest. A study focused on developing a decision support system for supplier selection strategies based on the AHP method using case study in automotive industry in Pakistan is conducted by [10]. A sensitivity analysis to check the strength of the vendor also has been done in this research. Another study carried out by [11] to propose voting methods using AHP to determine the final rankings of vendors. This method called Voting AHP (VAHP). The results of the study literature mentioned above will be used develop the criteria of supplier performance assessment models specifically for IT suppliers in SME Indonesia.

3. Research Methodology

The steps of this study consist of 6 stages as follows: identify criteria of supplier performance assessment, criteria screening , determining the weights of criteria using AHP, determining the rating scale, formulation of supplier assessment model, implementation of the model.

4. Result and Discussion

4.1. Identify criteria of supplier performance assessment

Based on literature review, it is found that some criteria are important and often used in vendor assessment. In this study, the model divided into two categories, that is model for Software & Hardware supplier assessment and model for Sistem Development supplier assessment. Table 1 shows criteria and its sources.

Table 1. Criteria and its Sources

Source (Articel Number)	Criteria	
	Software and Hardware	System Development
[6]	Quality, On time delivery, Low price	Quality, Timely development, Low cost, Problem-solving skill
[12]	Quality, On time delivery, Low price, Financial stability, Flexibility of payment and delivery time	Quality, Timely development, Low cost, Financial stability, Problem solving skill
[8]	Quality, On time delivery, Low price, Communication, Document completeness, Responsibility	Quality, Timely development, Low cost, Communication, Development tools and document completeness.
[14]	Quality, On time delivery, Low cost, Document completeness, Location, Reputation	Quality, Timely development, Low cost, Development tools and document completeness, Ability to manage projects, Location, Reputation
[11]	Quality, On time delivery, Financial stability,, Document completeness, Responsibility, Reputation, Honest and maintenance of confidentiality of business	Quality, Timely development, Financial stability,, Development tools document completeness, Ability to manage projects, Reputation, Honest and maintenance of confidentiality of business
[20]	Quality, On time delivery, Lawsuits with clients, Document completeness	Quality, Timely development, Lawsuits with clients, Development tools and document completeness
[19]	Quality, Low price, Document completeness, Honest and maintenance of confidentiality of business	Quality, Low cost, Development tools and document completeness, Honest and maintenance of confidentiality of business
[7]	Quality, Financial	Quality, Financial

	stability, Communication, Lawsuits with clients, Document completeness, Flexibility of payment and delivery time, Honest and maintenance of confidentiality of business	stability, Communication, Lawsuits with clients, Development tools and document completeness, Flexibility of contracts in relation to the deadline, Ability to manage projects, Honest and maintenance of confidentiality of business
[21]	Quality, On time delivery, Low price, Communication	Quality, Timely development, Low cost, Communication, Problem solving skill
[22]	Low price, Responsibility, Location	Low cost, Location
[16]	Quality, On time delivery, Low price, Communication, Location, Reputation	Quality, Timely development, Low cost, Communication, Problem solving skill, Location, Reputation
[13]	Quality, On time delivery, Low price, Lawsuits with clients, Flexibility of payment and delivery time, Location, Reputation, Honest and maintenance of confidentiality of business	Quality, Timely development, Low cost, Lawsuits with clients, Flexibility of contracts in relation to the deadline, Location, Reputation, Honest and maintenance of confidentiality of business

In this study, the criteria of previous research were modified and adapted to the needs of IT procurement in SME. the proposed criteria are based on the above review literature and interviews with the procurement staff in the SME, as given in Table 2.

4.2. Criteria Screening

At this stage, the questionnaires are distributed to 12 IT procurement experts and practitioners which aim to determining the importance level of criteria. Only criteria with a value greater than 3 will be used as performance measurement criteria in this study. Base on the screening result, The criteria financial stability, no legal problems are removed because the average value is less than 3.

4.3. Determining the weights of criteria using AHP

The importance weigh of criteria is determined using AHP methods by distributing AHP Questionnaire to 5 expert. The important weight Resulted from of the AHP analysis are given in Table 2.

4.4. Determining the rating scale

The rating scale of the assessment is ranging from 1-5, from poor to Very good.

4.5. Formulation of supplier assessment model

Vendor performance assessment models is formulate based on selected criteria and it's weight. The vendor's performance score is the multiplication of performance value with its importance weight. The Supplier performance assessment model for Software&Hardware Category is presented in Table 2

Table 2. Supplier performance assessment model for Software&Hardware Category

No	Criteria	Weighting	Assessment scale	Description
1	Quality	0,126	5	Very user friendly and there is no complaint at all and Defect free and no complaints at all
			4	User friendly and There is a defect in the hardware but no Non Conformity Report (NCR)
			3	Not user friendly but still perform and There is a defect in the hardware and Non Conformity Report (NCR) is released
			2	Very not user friendly but vendor willing to improve and More than 1 Non Conformity Report (NCR) are released but supplier is responsible
			1	Not user friendly and More than 1 Non Conformity Report (NCR) are released and supplier is not responsible
2	On time delivery	0,078	5	All of software and hardware is delivered on time
			4	Some can be delivered on time and others are delayed less than 3 days
			3	Delay for 3-5 days
			2	Delay more than 6-8 days
			1	Delay more than 8 days
3	Low price	0,055	5	31-40% price is lower than owner estimates
			4	21-30% price is lower than owner estimates
			3	11-20% price is lower than owner estimates
			2	5-10% price is lower than owner estimates
			1	1-4% price is lower than owner estimates

No	Criteria	Weighting	Assessment scale	Description
4	Communication	0,136	5	Proactive in communication
			4	it is easy to be contacted via phone, email or fax and good respond
			3	Easy to contact but takes a long time to respond
			2	Difficult to contact by phone, fax, email, etc.
			1	Cannot be contacted
5	Documents and administration	0,036	5	All documents have been completed before delivery date and document contents are clear and detailed
			4	All documents have been completed before delivery but document contents are not clear and detailed
			3	Documents have been completed after delivery date and document contents is clear and detail
			2	Documents have been completed after delivery date but document contents is not clear and detailed
			1	A warning letter is released to supplier because document incomplete
6	Flexibility of payment and delivery time	0,034	5	All changes requests are full filled in accordance with company policy
			4	All changes requests are full filled in accordance with both party policy
			3	All changes requests are full filled in accordance with supplier policy
			2	Accept change requests for payment system but dont accept for delivery time
			1	Dont accept change requests of payment system and delivery time
7	Responsibility	0,158	5	Responsible to resolve the complaint on the same day and complaints can be resolved
			4	Responsible to resolve the complaint within 1-3 days and complaint can be resolved
			3	Responsible resolve the complaint within more than 3 days and complaints can be resolved
			2	Responsible resolve the complaint within more than 3 days but difficult to

No	Criteria	Weighting	Assessment scale	Description				
			1	resolve complaints				
				Not responsible for resolving complaints				
				8	Vendor location	0,024	5	Located in an area and less or equal to 20km
							4	Located in an area more than 20km
							3	Supplier are in different area/city
2	Supplier are in different country but easy to communicate							
1	Supplier are in different country and difficult to communicate							
9	Vendor reputation	0,140	5	History of performance and service is excellent				
			4	History of performance and service is good				
			3	Bad performance history but good service				
			2	Good performance history but bad service				
			1	History of performance and service is not good				
10	Honest and maintenance of confidentiality of business	0,213	5	Very honest and transparent in giving information and Always have good commitment				
			4	Honest and transparent in giving information and have good Commitment				
			3	Sometimes honest and transparent and sometimes have commitment				
			2	Not transparent in giving information and do not have commitment				
1	Very not transparent in giving information and do not have commitment							

4.6. Model Implementation

The last stage is to implement the model on 2 IT vendors for software hardware vendors and system development. each vendor is assessed based on the proposed model. It is found that the model can assist in evaluating vendor's performance and facilitate objective assessment. Previously they do not have a scoring system and vendor assessment has been done subjectively.

5. Discussion

In general, this study has the same flow as the research conducted by [7] that generates an evaluation model that can be used to select IT vendors. The difference is that this study focuses on performance appraisal and vendor monitoring. the other difference is in the determination of

different rating scales as well as the different weights and types of criteria tailored to the needs of the SME IT vendors in Indonesia. Another difference is that the research is broader because the model in this study is divided into two categories, namely the vendor category of software & hardware providers and the vendor category of the system development service providers, while the model in the previous research only focus on IT outsourcing providers or system development. There are several common criteria, ie : System development tools and document completeness, ease of communication, vendor ability to solve problems, vendor's ability to manage projects, maintain confidentiality, flexibility of contract terms and time of system development and reputation. However, two criteria that are considered important by SMEs in Taiwan but considered not important by SME Indonesia, ie financial stability and no legal problems.

The four criteria of price, quality, delivery and service are the most widely used criteria in selecting or valuing vendors in general [6] and [10]. These four criteria are also the criteria used in this study. This indicates that price, quality, delivery and service are the criteria that can be used in assessing the various vendors of both vendors in general, vendors in the automotive industry and also IT vendors. Similarly, [12] describes some important criteria for selecting vendors in the food industry. Some of the criteria used to select vendors in the food industry are also important criteria for SME IT vendors, including price, quality, delivery time and flexibility. However, there is one important criterion for selecting vendors in the food industry but it is not important for the SME vendor, that is, the stable financial condition of vendors. This criterion according to [9] is also an important criterion in choosing a vendor for education (university). In this study, honest and confidential criteria are the most important criteria in assessing the performance of IT vendors for SMEs. This is in line with other research features such as [13], [11] and [7] the location of the vendor is one of several criteria considered important in the selection and assessment of the vendor. This is in line with the results of other researchers that close location will facilitate monitoring vendor performance [14], [13], [15]. Reputation criteria are important criteria in this research. It also agrees with [16] which in his research use reputation as one of the six criteria used in selecting vendors for IT and [17] who argue that reputation is one of seven important criteria related to outsourcing Information Systems. reputation criteria are also important in assessing or selecting common vendors such as those found in [18] and [19]. The criteria of ease of communication and responsibility in resolving complaints are the two important criteria found in this study. In previous studies, both criteria were also widely used in selecting and assessing vendor performance both in general and IT vendors. [8], [16] and [9].

6. Conclusion

There are several conclusions from this study. The most important criteria for performance assessment of software

& hardware vendors and system development is honest and can keep company secrets. while the least important criterion for vendor software & hardware assessment is vendor location and for system development category is system development cost. Criteria in vendor performance assessment for various industries are relatively similar, but with different importance level. The resulting model can be used by the SMEs in assessing the performance of vendor software & hardware providers and system development. The opportunity for further research is to examine the relationship between criteria to determine which criteria most influence other criteria. Interpretive structural modeling model and Equation Structural Modeling could be used for further research.

References

- [1] Nair, A., Jayaram, J., & Das, A. *Strategic purchasing participation, supplier selection, supplier evaluation and purchasing performance*. International Journal of Production Research, **53(20)** 6263-6278 (2015).
- [2] Quinn, F., "The Power of Procurement." *Supply Chain Management Review* 9 (9): 6-8 (2005)
- [3] Thorelli, H. B., "Networks: Between Markets and Hierarchies." *Strategic Management Journal* 7, 37-51 (1998)
- [4] Earnest D and Bamford J, *Your Alliances are Too Stable*. Harvard Business Review June (2005)
- [5] Schubert, P., & Leimstoll, U. *Importance and Use of Information Technology in Small and Medium-Sized Companies*. Electronic Markets, 17 (1), 38-55 (2007).
- [6] Amil, M. A, *Supplier performance assessment tool in automotive industry using multivariate analysis*. (2009).
- [7] Chang, S. I., Yen, D. C., Ng, C. S. P., & Chang, W. T, *An analysis of IT / IS outsourcing provider selection for small-and medium-sized enterprises in Taiwan*. *Information & Management*, 49 (5), 199-209 (2012).
- [8] Shyur, H. J., & Shih, H. S, *A hybrid MCDM model for strategic vendor selection*. *Mathematical and Computer Modeling*, 44 (7), 749-761 (2006).
- [9] Mirmousa, S., & Dehnavi, H. D, *Development of Criteria of Selecting the Supplier by Using the Fuzzy DEMATEL Method*. *Procedia-Social and Behavioral Sciences*, 230, 281-289 (2016).
- [10] Dweiri, F., Kumar, S., Khan, S. A., & Jain, V. *Designing an integrated AHP based decision support system for supplier selection in automotive industry*. *Expert Systems with Applications*, 62, 273-283 (2016).
- [11] Liu, F. H. F., & Hi, H. L. *The voting analytic hierarchy process method for supplier selecting*. *International journal of production economics*, 97 (3), 308-317 (2005).
- [12] Žak, J. *Comparative analysis of multiple criteria evaluations of suppliers in different industries*. *Transportation Research Procedia*, 10, 809-819 (2015).

- [13] Bush, A. A., Tiwana, A., & Tsuji, H. *An empirical investigation of the drivers of software outsourcing decisions in Japanese organizations*. *Information and Software Technology*, 50 (6), **499-510** (2008).
- [14] Weber, C. A., Current, J. R., & Benton, W. C. *Vendor selection criteria and methods*. *European journal of operational research*, 50 (1), **2-18** (1991).
- [15] Dargi, A., Anjomshoae, A., Galankashi, M. R., Memari, A., & Tap, M. B. M. *Supplier selection: A fuzzy-ANP approach*. *Procedia Computer Science*, 31, **691-700** (2014)
- [16] Büyüközkan, G., & şakir Ersoy, M. *Applying fuzzy decision making approach to IT outsourcing supplier selection*. *International Journal of Mechanical, Mechatronic and Manufacturing Engineering*, 3 (7), **815-819** (2009).
- [17] Chen, Y. H., Wang, T. C., & Wu, C. *Strategic decisions using the fuzzy PROMETHEE for IS outsourcing*. *Expert Systems with Applications*, 38 (10), **13216-13222** . (2011).
- [18] Sodenkamp, M. A., Tavana, M., & Di Caprio, D. *Modeling synergies in multi-criteria supplier selection and order allocation: An application to commodity trading*. *European Journal of Operational Research*, 254 (3), **859-874** (2016).
- [19] Wan, S. P., Xu, G. L., & Dong, J. Y. *Supplier selection using ANP and ELECTRE II in interval 2-tuple linguistic environment*. *Information Sciences*, 385, **19-38** (2017).
- [20] Nielsen, I. E., Banaeian, N., Golińska, P., Mobli, H., & Omid, M. *Green supplier selection criteria: from a literature review to a flexible framework for the determination of suitable criteria*. In *Logistics operations, supply chain management and sustainability* (pp. **79-99**). Springer International Publishing (2014).
- [21] Wang, J. J., & Yang, D. L. *Using a hybrid multi-criteria decision aid method for information systems outsourcing*. *Computers & Operations Research*, 34 (12), **3691-3700** (2007).
- [22] Udo, G. G. *Using analytic hierarchy process to analyze the information technology outsourcing decision*. *Industrial Management & Data Systems*, 100 (9), **421-429** (2000).