

The Effectiveness of Decision Support System for the Supplier Selection in e-Marketplace: A Case Study

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ABSTRACT

Despite the fact that the sourcing process in B2B e-Marketplaces is one of the most important tasks, the evaluation and selection process of suppliers have been ad-hoc based and mainly dependent on the experience of sourcing managers' subjective knowledge. To remedy the problem, we developed a decision support System (called Wise-D) that helps sourcing managers evaluate suppliers in a more systematic way. The system reflects company's strategy and know-how by adopting company enforced weighted scores for different factors and employing a more scientific method of considering factors other than price and on-time delivery rate, utilizing the AHP method. This paper reports the effectiveness of the system as well as the detailed description of the system. To investigate the effectiveness of the system, we collected information through interview and questionnaire survey. The information was also augmented through the firm key index system, which monitors average delivery lead time and on-time delivery rate. The result indicates that the system leads to the efficiency of purchasing section and the transparency of buying process, therefore reduces delivery time and cost.

Keywords: Supplier Selection, e-Marketplace, AHP, Decision Support System

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1. INTRODUCTION

As the market for electronic B2B is growing fast [10], we need to address many issues including business models and ways to facilitate business-to-business transactions safely [11]. In Korea many different types of e-Business models are emerging, and particularly we have observed a rapid growth of MRO e-marketplaces evidenced by iMarketKorea (IMK), LGMRO, KeP, MRO Korea. As these marketplaces are handling with tens of thousands products and supplier selection everyday, a sophisticated supplier selection decision system is required for both efficient daily transactions and providing trust to participating customers.

Despite the importance of systematic supplier selection, many MRO purchasing service companies have evaluated and selected suppliers based only on price and on-time delivery rate [7]. At the same time, the evaluation methods and systems are on the realms of the subjective estimation of sourcing managers, deviating from company policies and rules in many cases [2].

In addressing these problems, we developed a decision support system, which is called Wise-I, and incorporated the knowledge-based "Policy" with which sourcing managers are able to select necessary factors and relative importance of those factors for their supplier selection. The system reflects managers' previous know-how and company's strategies, enabling consistent supplier selection processes and decisions. Moreover Wise-I enabled sourcing managers to apply scientific methods such as AHP [16] to evaluate suppliers based on multi-factors and company policy.

This research paper aims to report the development and the effectiveness of Wise-I system. The effectiveness of the system was measured by the saving on delivery time, the simplification on purchasing section, the reduction in the cost, and the transparency of buying process by using the method of an interview, the questionnaire survey, and the business administration index.

The remainder of this paper is organized as follows. In Section 2, we discuss existing sourcing problems and a summery of Wise-I project. In Section 3, we present the role and character of Wise-I. And in Section 4, we report the result and the effectiveness of Wise-I. Finally, in Section 5, we present a conclusion and a line for future research.

2. EXISTING SOURCING PROBLEMS AND A SUMMARY OF WISE-I PROJECT

Sourcing, an important role in e-Marketplace services for purchase/supply has multiple stages of decision making processes. Generally, after receiving a request of new items, purchasing managers search for suppliers and send RFQ (Request For Quotations) to candidate suppliers. The managers evaluate coming quotations and contract a selected supplier.

As the sourcing process is very complex and changing rapidly, the sourcing processes usually have embraced following four problems.

First, industrial buying behavior is generally believed to be affected by rational factors as well as subjective variables [17]. However purchasing managers have considered only a limited number of factors such as price or on-time delivery rates, and evaluated and selected suppliers based on those factors only [7].

Second, tools with which sourcing managers analyze suppliers for a more effective sourcing are not available much in the market [2]. The absence of technical tools leads the sourcing selection process to depend heavily on managers' subjective choice during selecting process. The problem further aggregates the transparency in supplier selection process.

Third, there are two different types of sourcing; one is a general simple purchasing process, and the other is a strategic sourcing that considers a total cost ownership. In recent years, considerable attention has been focused on strategic sourcing, as more managers have come to realize its potential for contributing to the firm's overall strategic success [5]. However, the application of strategic sourcing is very difficult to be realized in the firm as most of purchasing managers' time and energy is spend on general purchasing as the process is executed very inefficiently.

Forth, the sourcing policy and know-how of is not diffused in an enterprise level although it is an important source of capability for the organization.

To remedy those problems mentioned above, we designed Wise-I that complements the previous decision making system. The general design guideline for the system was that anyone can use the system conveniently and analyze information/data easily, and the data generated in the system is objective and reliable. The expected result from Wise-I was that the selection process becomes more transparent and efficient. We also tried to integrate the legacy system as it provides a foundation to automate overall sourcing processes.

Wise-I development project started in December 2003 and opened in July 2004. The system currently is put to practical use in a purchasing service com-

pany of B2B e-Marketplace in Korea.

3. THE ROLE AND CHARACTER OF WISE-I

Wise-I enables sourcing managers to consider more suppliers by extracting data from a database of suppliers than the previous system. The system provides many analytical tools such as Sensitivity Analysis and Similarity Analysis that can evaluate selected suppliers. Together with the functions of considering many different factors, the system provides the automatic function in evaluating options and sending quotation. Additionally, the visual interface of Wise-I enables its users to analyze suppliers easily. The utilizing of Wise-I means that selecting process is optimized and the company's know-how and strategy is reflected in the sourcing process. We will give a full detail of functions of Wise-I in the next section.

3.1 The concept of Policy and evaluation model [12]

Purchasing service is processed based on product unit. Products are classified by a Standard classified system such as UNSPSC [18] or prescribed rules in marketplace. Policy [3] is a concept which makes users assign a similar evaluation method for the same classification. Policy is composed by the evaluation range, the evaluation factor, the evaluation function, the evaluation weight and the constraint conditions.

- (1) Evaluation range is the range of appliance for Policy. It applies for the same policy to the product that is evaluated similarly.
- (2) Policy could be selected from an evaluation factor pool that has information for evaluation factors. The information for evaluation factors is constructed by each supplier about the range of data warehouse.
- (3) Evaluation function transforms evaluation factors into numbers. In this process Policy makes it possible evaluate the factors through a different range of weighted scores. Wise-I uses the different evaluation functions such as linear functions, exponential functions, logarithmic functions and stepped functions.
- (4) Evaluation weight is the degree of importance for each factor. It is designated by using AHP [3].
- (5) Constraint functions enables users pre-select suppliers based on specified

conditions. The functions make it possible to sensibly evaluate candidate suppliers by reducing number of suppliers to evaluate.

Policy is divided into policy management and policy appliance. Evaluation policy is produced by using selected functions and factors in the pool of factors and functions. Policy managers are responsible for managing the database.

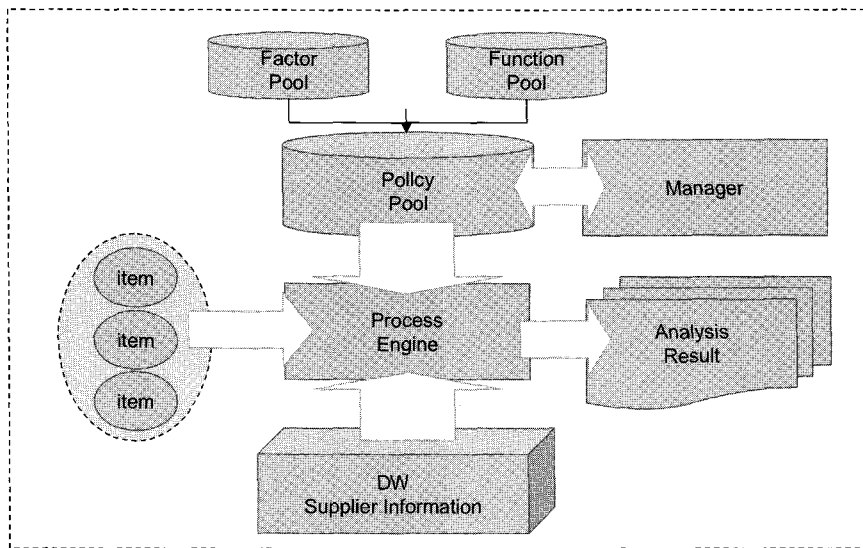


Figure 1. Policy based model

Purchasing service products are selected by using the policy that is produced by a policy manager. The system selects the policy that can apply to the certain products and suppliers. Once an item is selected for evaluation, the policy that has same evaluation range is automatically selected. With this automatically selected policy, selecting and evaluating for candidate suppliers is done very efficiently. In this policy based model, the accurate management for policy becomes very important. Policy has to maintain proper constructs to extract and evaluate suitable suppliers.

3.2 AHP method

AHP is a technique that suggested by Satty [16]. The technique is designated for decomposing the problem into several levels to support the effective decision making.

In generally the decision making process is done by the standard rules imposed by decision makers, or by pair-wise comparison when such a standard rule does not exist. AHP is a technique that enables the optimal decision through organizational analysis and effective feedback using the judgment and comparison. With the AHP technique, both quantitative and qualitative aspects of factors can be evaluated. Moreover a total guideline for decision making is provided by interactive comparison [15].

The AHP technique is used to select suppliers as the technique allows us to evaluate many different factors simultaneously.

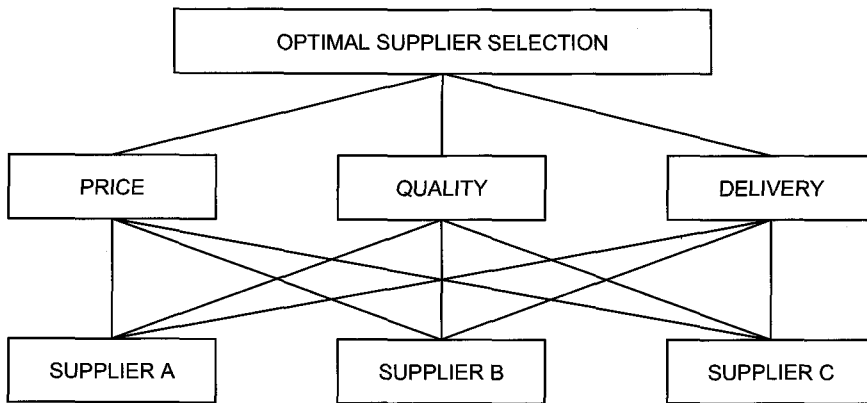


Figure 2. AHP Conceptual Map [8]

Figure 2 shows typical factors [8] such as price, quality, and delivery in the system. Typically along with those factors many more other factors need to be evaluated in practice. We incorporate all other factors into a database called 'Factor Pool'. Those factors include on-time delivery rate, performance rate to promise dates, lead time to new items RFQ, response rates to new items RFQ, response lead time to urgent request items, performance rate to urgent request dates, response rate to urgent request time, direct delivery rate/region Coverage, delivery rate, order creation lead time, delivery completion lead time, image registration rate.

Every product in the process of MRO procurement has different characteristics. Some are more important in the time of delivery. In some other cases, prices are the most critical factor. Therefore depending on the characteristics of products some factors are more important than the others. In the past, the purchasing managers selected the factors by their own experience and knowledge, and weighted the importance of factors by rule of thumb. This selection process is

automated in Wise-I.

Policy is defined as a rule which includes a list and importance of each factors that suppliers must have. Sourcing managers for certain products create and control the policy, and sourcing staffs apply the policy to sourcing process.

AHP technique is used to create policy. A sourcing manager selects factors which have a close relationship with certain products. Then, they define the importance of each factor by using AHP, derive weighted scores for factors and store the weighted scores and selected factors into the system by linking the numbers to each product category.

3.3 The detail description of Wise-I system

Turned to the developed Wise-I system in detail, the full screen is as shown in the Figure 3.

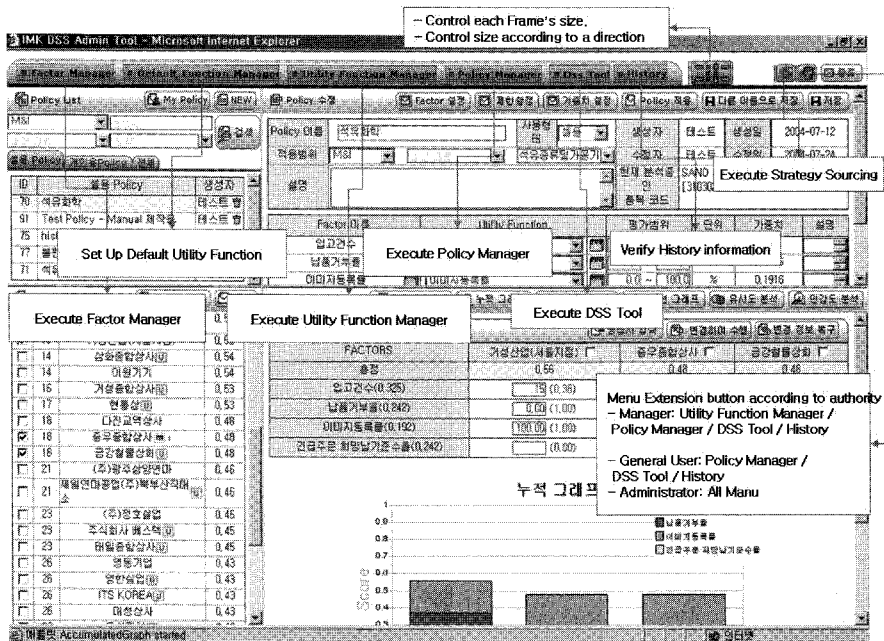


Figure 3. Full Screen

The first step of Wise-I system offer Policy which is appropriate for searching condition. At this step, managers can make Policy which is suitable for their department. After selecting sourcing group, they search target suppliers. Figure 4 shows above-mentioned processes.

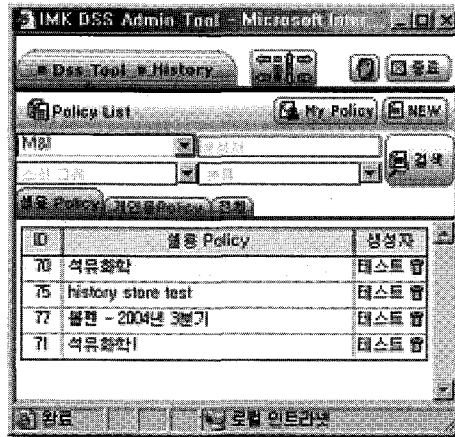


Figure 4. Policy list – Selecting Detail Searching Conditions

If managers do not use previously created Policy or factors, they can create new Policy by taking into consideration of other factors. The next step is creating final policies by adopting the AHP method after using selected factors. At this step, by saving factors such as returned good rate, lead time, financial strength rating and number of warehousing other than the two factors in ‘factor pool’, the system allows the managers to store other factors and use them in the later purpose.

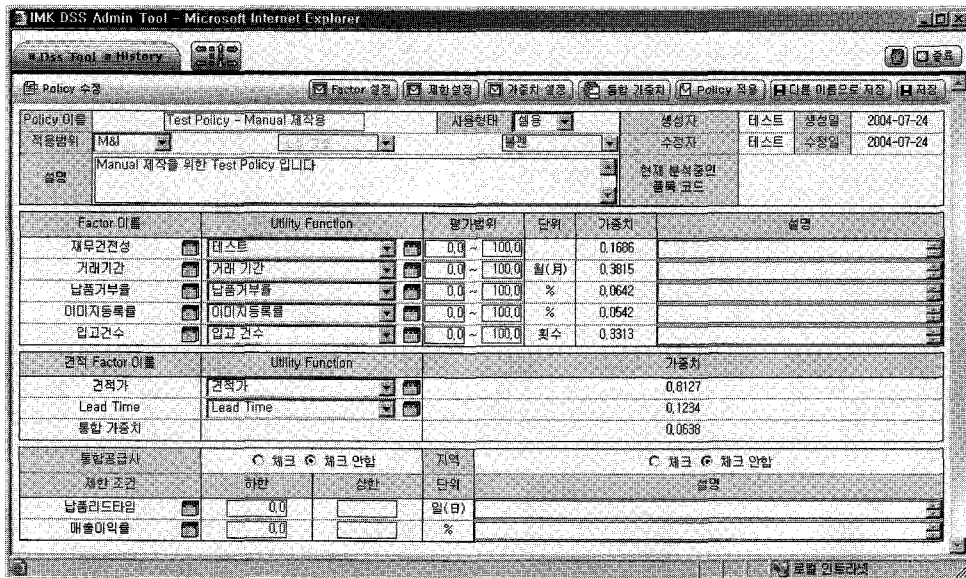


Figure 5. Completed Policy

After selecting Policy, the system shows supplier's list. The managers select higher ranked suppliers among list and sends RFQ to selected suppliers. They can also have the information of sensitivity analysis and similarity analysis among selected suppliers.

The system provides information about ranking of suppliers according to supplier's quotation. Once RFQs are received, supplier's background color changes to green, and it is possible to choose the best supplier.

4. THE RESULT AND EFFECTIVENESS OF WISE-I

Wise-I was introduced to an MRO marketplace company. We report the effectiveness of the system after the systems was implemented in July 2004.

4.1 The result of Wise-I

First, we found that the current system address many previously mentioned sourcing problems.

The first problem was that a purchasing manager selected suppliers considering only a limited number of factors such as price or on-time delivery. Traditionally, companies have focused on purchase price alone instead of taking a total cost view [1]. Under the new concept of TCO (Total Cost Ownership), it is important to consider a total cost over a period of product or service's complete lifecycle. To apply the concept successfully, companies need to understand a wide range of cost and value when they purchase a product or service. Wise-I allow sourcing managers to consider various factors such as quality and performance rate to promise dates that match specific product, enabling the companies to apply the total cost view.

The second problem was that there was not an appropriate tool for analyzing suppliers in sourcing process. With recent moves towards outsourcing, supply chain management is increasingly recognized as an important determinant of company's competitiveness [4]. In purchasing service, if a company has no objective data for selecting suppliers, it sacrifices transparency and trust as a service provider. Wise-I helps the company select and manage suppliers effectively and secure transparency and buyers trust.

The third problem was that the company could not enforce strategic outsourcing [1]. Wise-I offered the opportunity to be able to concentrate on strategic sourcing

ing by promoting efficiency through the whole purchasing process.

Finally, the company could not diffuse their sourcing policy, know-how and strategy throughout enterprise. Knowledge embedded in the interactions of people, tools, and tasks provides a basis for competitive advantage in firms [13]. By adopting Wise-I's Policy concept, previous manager's knowledge can be maintained in the organizational knowledge base.

4.2 The effectiveness analysis of Wise-I

This research used interviews, surveys, and log data, a method that provides more correct data than using only one method [6, 9, 14]. This method has three advantages. First, the data from interviews are used to classify survey questionnaires to organize an implemental measure. Second, surveys can overcome errors from interviews. Finally, log data can verify the information from surveys.

4.2.1 Survey Analysis

The questionnaire is based on the Wise-I's effectiveness. The use of the system is detailed as a phase that causes system effects, proving efficiency of the system function and supplier selection that made the use of the system. The questionnaire is measured based on 5 Likert scales, and the subjects were 10 staff members and a department manager. Since the number of data collected was less than 10, we have analyzed the mean value of each questionnaire.

Table 1. Survey questionnaire and answer

Questionnaires	Mean Value
When selecting supplier, system let information be compared easily.	3.5
When selecting supplier, system let information be compared easier than previous system.	3.6
The necessity of communication with manager decreased during supplier selection process.	3.5
The result with Wise-I system is more reasonable than before.	3.2
There are many manual process cases ignoring Wise-I.	2.8
The result with Wise-I system is more accurate than before.	3.1
The time length of sourcing process is decreased.	2.2
When selecting supplier, the system helps to consider more supplier.	3.8
When selecting supplier, the system provides more objective reason than before.	4.0
When selecting supplier, the system can apply more analysis than before.	3.8
When selecting supplier, the system can analyze more factors than before.	3.9

According to analysis, the value of the sourcing process time reduction was 2.2, nonuse of Wise-I was 2.8, rests of all were more than 3.0. The value 2.8 in nonuse of Wise-I asked manual processing with ignoring Wise-I. This implies that the use of Wise-I is highly encouraged.

About overall sourcing process time length was 2.2, we need to have more time to research since the use of system was more focused on effectiveness than time length, or this survey processed right after system had installed, so the users were not used to use the system. However, we have testified that the system users have satisfied with Wise-I, and selecting supplier with the system is more efficient than before installing the system.

4.2.2 Interview Analysis

Through the interview, we analyzed that purchase processes were efficient and purchase procedures were transparent by utilizing Wise-I. The interview took each one hour with two managers of departments that introduced Wise-I in which about five employees worked. Through the interview, we found that purchase procedures come to be more efficient by utilizing the system. Using Wise-I makes it ready for consistent sourcing strategy, and the process efficiency was still maintained although the manager changed. One manager said that the **“company’s strategy can be owned jointly because the sourcing strategy can be delivered in a top-down procedure...”**

Likewise, regarding the changing department manager, **“when the manager changed, the department employees had difficulty adapting to the environment. Although the previous manger changed, Wise-I enabled the employees to process work consistently because the manager’s know-how could be kept up...”**

In other words, because the system reflected the company’s strategy, the efficient supplier selection enabled the whole purchase process to be efficient too. Moreover, **“our works are classified into a simple process work and a strategy sourcing. The strategy sourcing provides customers with different services....The ratio of the works is 70:30, but the ratio of interest is 20:80....So, we plan to adopt step-by-step Wise-I into strategy sourcing, after adopting the system into simple process works perfectly....Our short-term object is to concentrate on strategy sourcing by adopting the system.”** This shows that the use of the system has not only caused efficient purchase process but also influenced the company’s profit by concentrating on strategy sourcing.

The interview verified the transparency of the purchase procedure. **“...By utilizing Wise-I, the function sourcing audit could be strengthened,”** and **“In the past, we subjectively selected suppliers...sent a quotation...we could contract only suppliers who had frequently contracted with us.”** In addition, **“...perfectly adopted Wise-I for simple process works....”** This also shows that the purchase procedure was transparent by leaving a result of sourcing process behind the system and using information based on the database.

In addition, he said that **“our purchasing department is divided by MRO materials characters, there are 5-6 employees for each department and each one handles 20-30 matters a day. And we will adopt the system 100 percent into simple purchase process in the short term, gradually reducing several mistakes that induced the initial stage.”**

Through the interview, we verified that the supplier selection efficiency by effectiveness of Wise-I allowed the purchase process to be more efficient and the purchase procedure to be more transparent.

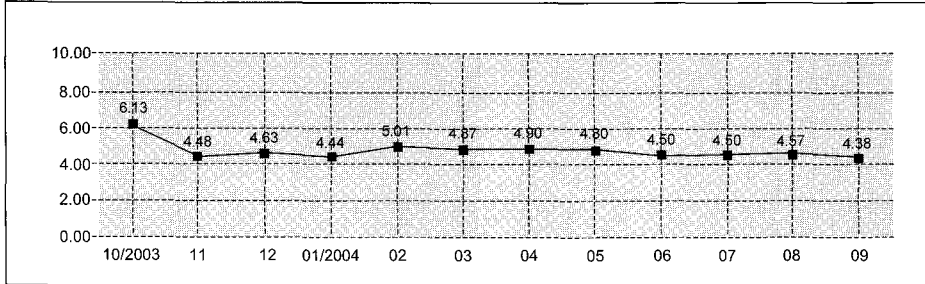
4.2.3 Log Data Analysis

As a final phase of the study, we found how the system usage can be connected to managerial indicators exploiting log analysis on standard on-time delivery rate and delivery lead time. It is said that the standard on-time delivery rate and delivery lead time are the most critical factors in association with Policy. Those indicators are regarded to be core components for evaluation e-marketplaces should provide to clients. These are used to identify the actual improvement in delivery due to the result of lead time reduction. It shows that cost reduction is achieved by keeping the due date of delivery through the standard on-time delivery rate.

As is depicted in log data pertaining to delivery lead time Figure 6 below, it shows the both departments have achieved improvements in lead time reduction after adopting Wise-I in September. It is a significant improvement in lead time reduction that one of departments indicates 4.38 in September compared to 4.57 in the previous month. The performance the other department shows in lead time reduction also made some advance. Although it may be affected by uncontrollable exogenous variables, it seems that the Wise-I played a major role in reducing delivery lead time.

As you see in the below, Figure 7, both departments outperform in the standard on-time delivery rate. One department got better by 87.82% in September compared to 82.69 in August. The other shows a similar result. We can conclude that the observance of the standard due date has an influence on cost reduction.

Delivery Lead Time



Delivery Lead Time

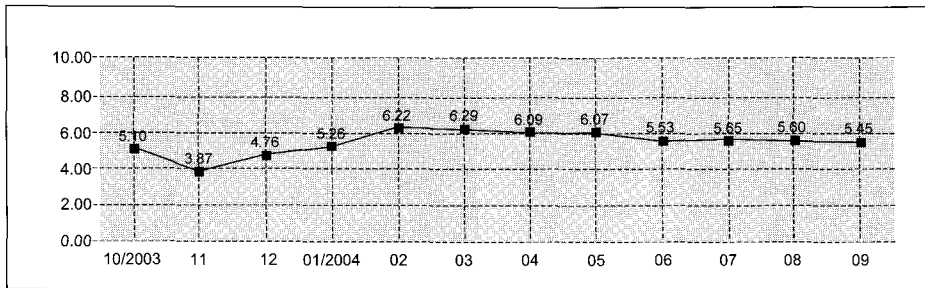
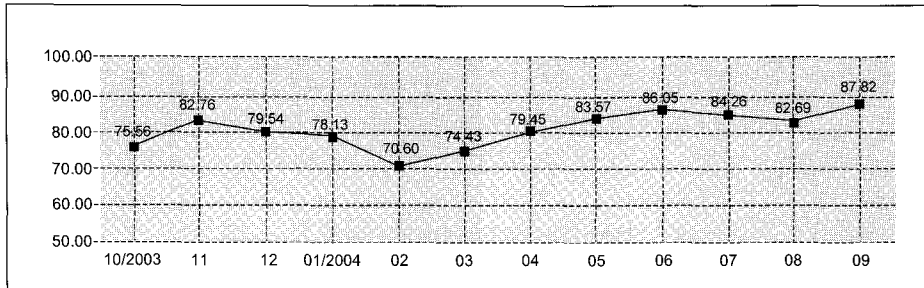


Figure 6. Two Department's Lead Time Log Analysis

On-Time-Delivery Rate



On-Time-Delivery Rate

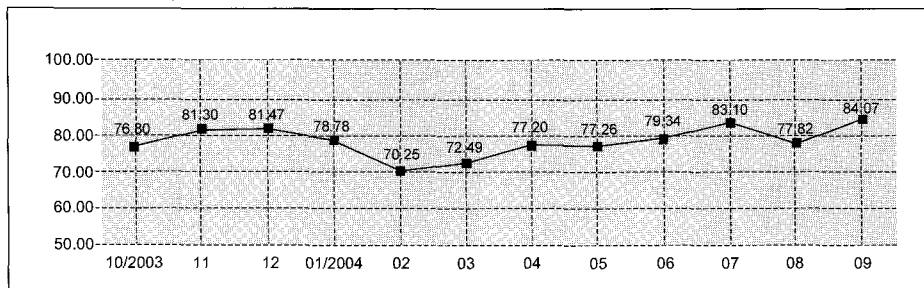


Figure 7. Two Department's On-time Delivery Rate Log Analysis

5. CONCLUSION AND FUTURE RESEARCH

We can see that the introduction of the decision support system Wise-I in an e-Marketplace reinforces an existing system. One effect of using the system is results in the ability to have influence on the business administration index. With the system's efficient function, the system's user was satisfied with results and the efficiency of supplier selection was improved, indicating that the system leads to transparency and efficiency of purchase process and reduces delivery time and cost in the company's business.

The result analysis shows that Wise-I could not definitely reduce the time of sourcing process, but it could realize the efficiency of the sourcing process by reducing the time of the strategy sourcing due to the computerization of the simple sourcing process and a continuation of the sourcing process. This system is able to be adapted to diversified fields that suffer similar problems of the e-Marketplace. However, if the definition of the evaluation method is incorrect, this weakness was generated by the wrong evaluation method.

Finally, we considered future research directions that need to have periodical effectiveness analyses and prepare for an automatic system of strategy sourcing.

REFERENCES

- [1] Anderson, M., "Strategic sourcing," *International Journal of Logistics*, (Jan 1998), 1-13.
- [2] Bevilacqua, M. and A. Petroni, "From Traditional Purchasing to Supplier Management: A Fuzzy Logic-based Approach to Supplier Selection," *International Journal of Logistics: Research and Applications* 5, 3 (2002), 235-255.
- [3] De Boer, L., L.V. Wegen, and L. Telgen, "Outranking Methods in Support of Supplier Selection," *European Journal of Purchasing and Supply Management* 4 (1998), 109-118.
- [4] Dyer, J., D. Cho, and W. Chu., "Strategic supplier segmentation: The next 'best practice' in supply chain management," *California Management Review*, (1998), 57-77.
- [5] Ellram, L. and A. Carr, "Strategic purchasing: a history and review of the literature," *International Journal of Purchasing and Materials Manage-*

- ment 30 (1994), 2.
- [6] Gable, G., "Integrating Case Study and Survey Research Methods: An Example in Information Systems," *European Journal of Information Systems* 3, 2 (1994), 112-126.
 - [7] Garfamy, R. M., "Supplier Selection and Business Process Improvement: An exploratory multiple-case study" Research Paper, Dept. of Business Economics, Autonomia Univ., Barcelona., 2003.
 - [8] Ha, S. H. and M. S Nam, "A Supplier Selection Support System Development for E-Procurement," *Management Science* 21, 1 (2004), 113-129.
 - [9] Kaplan, B. and D. Duchon, "Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study," *MIS Quarterly* 12, 4 (1988), 571-587.
 - [10] Kaplan, S. and M. Sawhney, "E-Hubs: The New B2B Marketplaces," *Harvard Business Review*, 78, 3 (May/June 2000), 97-103.
 - [11] KT, "MRO B2B Marketplace Business Drive State," *MRO B2B Marketplace T/F*, 2000.
 - [12] Lee, D. J., S. H. Lee, S. K. Lee, T. H. Lee, M. S. Kim, M. H. Song, S. G. Lee, "E A Decision Support System for Supplier Selection In e-marketplace," *Korea Information Science Society*, 2004.
 - [13] Linda Argote and Paul Ingram, "Knowledge Transfer: A Basis for Competitive Advantage in Firms," *Organizational Behavior and Human Decision Processes* 82, 1 (May 2000), 150-169.
 - [14] Mingers, J., "Combining IS Research Methods: Towards a Pluralist Methodology," *Information Systems Research* 12, 3 (2001), 240-259.
 - [15] Nam, M. S., C. K. Seo, and S. H. Ha., "A Supplier Selection Support System Using AHP in B2B e-procurement," *The Korea Society of Management Information Systems* (2002), 654-664.
 - [16] Satty, T. L., "Models, Methods, Concept & Application of The Analytic Hierarchy Process," *Kluwer's International Series* (2000), 93-94.
 - [17] Sheth, J. N., "A model of industrial buyer behavior," *Journal of Marketing* 37, 4 (1973), 50-56.
 - [18] UNSPSC, UNSPSC Home, <http://www.unspsc.org.>, 2003.