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조직원 지식의 정보 시스템 이전 : 전자 구매 서비스 기업 사례를 통한 관리적 함의

Migration of Workers' Knowledge into Information Systems : Managerial Issues from the Case of e-Procurement Service Company

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초 록

오늘날 많은 기업들은 MRO 구매를 아웃소싱하고 있다. 따라서 MRO 제품의 효율적 공급을 위하여 MRO 제품 공급자에 대한 평가는 매우 중요한 사안이 되고 있으나, 제품과 공급자의 수가 급격하게 증가함에 따라 매우 복잡한 작업이 되었다. 경쟁력있는 가격에 좋은 제품을 공급하는 공급자를 선별해 내기 위해서는 공급자의 이력 등에 대한 매우 체계적인 분석과 평가를 필요로 한다. 이 논문에서는 우리나라의 대표적 MRO 전자 구매 대행 기업의 공급자 평가 시스템에 대한 사례분석을 하고자 한다. 공급자 평가를 통해 소싱 업무의 의사결정을 지원하는 이 시스템은 3차례의 성능개선 프로젝트를 거치게 되었다. 이 과정에서 도출한 주요 관리적 함의를 TOE 관점에서 정리함으로써 조직 내 의사결정지원시스템의 성공적 도입을 위한 전략을 제언을 정리한다.

ABSTRACT

With the emergence of indirect procurement, it has become a global trend for companies to outsource their maintenance, repair, and operating (MRO) supplies to procurement service providers (PSPs). Due to the variety of MRO items, evaluation of numerous suppliers in various industries is a particularly complex task for PSPs. Due to this complexity, many PSPs still evaluate and select suppliers based on the sourcing managers' subjective knowledge. Through the case of adopting a supplier evaluation system, this research is to find the managerial issues organizations should consider when they transform sourcing managers' knowledge into the system. We interpret the issues based on the Technology-Organization-Environment (TOE) framework. This case conclusively shows the importance of positive feedback loop between the users and the information system for the performance improvement of the system.

키워드 : 의사결정지원시스템, B2B 전자상거래, MRO 구매, 지식관리시스템, 공급자 평가
Decision Support Systems, B2B e-Commerce, MRO Procurement, Knowledge Management Systems, Supplier Evaluation

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1. Introduction

1.1 Background

Procurement of indirect materials has become increasingly important in the B2B e-commerce area. Indirect materials are not directly consumed as a part of production, but very important for the maintenance, repair, and operation (MRO) of the company. Although MRO items are usually considered as low-value, high-variety ones [8], their transaction volume accounts for about 80% of the workload in procurement. It was estimated that the market for MRO supplies would reach $400 billion in the U.S. [11]. Due to the characteristics of MRO supplies, which is strategically peripheral but financially significant [12], outsourcing of MRO supplies has become a global trend for cost saving.

Following this trend, the evaluation of numerous suppliers in various industries has become the most important strategy in e-procurement services [2]. The primary goal of supplier evaluation is not only to find suppliers who can deliver low price items on time but also quality ones. Ultimately, keeping up long-term relationships with this quality suppliers is the main purpose of e-procurement service. However, finding quality suppliers is a very complex and difficult task, which needs systematic and transparent evaluation with various factors of supplier and even market environments. Hence, this evaluation usually relied on the subjective experience and tacit knowledge of sourcing managers and was not systemized well. Even with the systematic evaluation model, it is not easy to let the system adjust to the dynamic changes of the MRO markets and the suppliers.

iMarket Korea (IMK) is the leading B2B procurement service provider in Korea. This company was founded as an affiliate of the Samsung group in 2000, a year in which Korean B2B procurement market started to grow rapidly with annual rate of 30% [19]. After a year of experience (in 2001), IMK did not just rely on its captive market-Samsung Group-and expanded its business by offering a B2B MRO e-marketplace to the open market. IMK mainly focused on providing outsourcing services for MRO goods. As one of the market leaders, IMK manages over a million MRO items and hundreds of clients.[2] This large customer base enabled IMK to achieve economies of scale in MRO procurement.

With the expansion of business, IMK faced serious difficulties and complexities in supplier evaluation processes. Thus, after four years its foundation, IMK decided to develope its own decision support system (DSS) for supplier evaluation and selection, called "W-system."[3] As the name represents, this system provided "wise" selections of quality suppliers for sourcing managers. IMK eventually

2) http://en.wikipedia.org/wiki/Samsung_iMarketKorea.
3) It is not the real name of the system. For the security purpose, we use this name for the system.

intended to achieve cost saving in MRO sourcing through systemized supplier evaluation and selection. Of course this reputation system, W-system, significantly increased the business efficiency of IMK and IMK acquired a patent for this system in September 2004.[4)]

1.2 Research Objective

W-system has a basic structure of "model and data" driven DSS, which is based on the large volume of database on suppliers and evaluation models for recommending quality suppliers [21]. The evaluation models in this system had been created and managed by sourcing managers in IMK. Based on their experience and knowledge, sourcing managers developed the evaluation models, hence the performance of W-system is greatly determined by the collective intelligence of sourcing managers. From this point, W-system can be defined as a sort of knowledge based decision supporting system for MRO e-Procurement. Encouraging the sourcing managers to feedback their tacit knowledge on supplier selection model, IMK constantly tried to improve the performance of W-system as well as respond to the dynamic changes of MRO market. Although IMK expected W-system to be a continuously evolving system by the active contribution of sourcing managers, the managers' participation did not meet the expectation of the company so that the performance of W-system was disappointing in the early stage. Hence, IMK carried out three times of innovation project to identify and resolve the latent problems in the utilization of W-system, from 2004 to 2008.

Our research objective is to derive and organize managerial implications based on the theoretical framework for the management of knowledge based supplier selection systems. Then our result can be referenced or applied to the various decision supporting models in other organizations. For this purpose, we first traced the records of IMK's innovation projects. Then, from the investigatio n of the projects and additional interviews with W-system developers and sourcing managers, we derived some issues which seemed to be closely related to the operation and management of knowledge based DSS. Finally, we interpreted the issues in a comprehensive framework to deliver managerial implications for the successful utilization of the system.

In this vein, we adopted a Technology-Organization-Environment (TOE) framework to explain several managerial issues which arose from our investigation on the projects. Based on this framework, the main issues were categorized into three perspectives, technological, organizational, and environmental issues [23]. First, in the technological perspective, we addressed some of technological prohibiters

4) http://company.imarketkorea.com/company_v6/en/company/history.jsp?pageNum=1&subNum1=2&subNum2=3.

that obstructed the adoption of the information systems. Second, in the organizational perspective, we focused on the relationship between organizational support and W-system usage and the role of top management in promoting employees' knowledge contribution. Third, in the environmental perspective, we mainly investigated the industry environment related to the performance of W-system. We believe such approach will benefit for better understanding and more efficient utilization of DSS in organizations, and beyond DSS, deliver general understanding on the management of organizational information systems.

2. Theoretical Background

2.1 Supplier Evaluation System and W-system

MRO suppliers cover from low-value, non-critical, high volume items to highly expensive, specialized equipments. Third party MRO marketplaces like IMK offer, for buyers, the below market bulk prices with minimal searching cost and for sellers, the opportunity to find potential buyers with minimal marketing cost. The key process for such benefit is to identify the suppliers and match them with the buyers properly. In this context, selection of proper supplier is the critical challenge in e-Procurement services, hence requires the systematic and analytical decision model for supporting its processes.

With the radical increase of its business, IMK had to manage enormous number of different MRO items supplied by various suppliers. In 2004, a year when the company just reached a total of KRW 2.1 trillion trading volume [14], IMK was managing nearly 500,000 MRO items and 15,000 suppliers. With the massive number of items and suppliers, the CEO realized that the 60 sourcing managers in the company were facing impossible odds by examining an average of 18,000 new MRO items and handling over 100,000 purchasing requests per month-in short: they need a powerful solution to deal with their tremendous supplier selections efficiently.

Supplier selection models are traditionally based on the linear weighting models, total cost of ownership (TCO) models, mathematical programming models, statistical models, and artificial intelligence (AI) based models. Linear weighting model, the representative one, gives weights to each criterion according to the importance and multiply each ratings on the criteria by the weights to get a total score. Then the supplier with the highest score is selected [9]. In this model, the main issue is that it is so difficult to score each criterion precisely that, in order to refine this imprecision problem, analytic hierarchy process (AHP) model is adopted. In AHP model, pairwise comparison is given to the suppliers to solve multi-criteria decision problems [12]. Another studies combine fuzzy model [7, 13]

or total cost of ownership [4] with AHP to handle the uncertainties and imprecision problems in linear weighting models and AI approach usually adopts neural networks [6].

W-system also adopted AHP model for its supplier evaluation. Its evaluation model, called "Policy", have 13 main factors such as price and lead time originally (increased to 23 factors in 2006) and assigned respective weight to each factor. Selection of factors and weights were decided by sourcing managers. Based on their experience or knowledge, and considering the characteristics of the markets, sourcing managers created 75 Policies to evaluate the suppliers which handle around 500,000 MRO items in total.

2.2 TOE Framework

Yusoff et al. [24] insist that it is misunderstanding to presume that the difficulties involved in e-procurement adoption are mainly caused by technology rather than management, culture or environment. Hence, in order to properly understand the complexities, key issues and risks existing in the adoption of information systems, we need to adopt comprehensive framework. The Technology-Organization-Environment (TOE) Framework describes the process of a firm which adopts and implements technological innovations, based on the three contexts [24]. Since Tornatzky and Fleischer [23] introduced TOE framework, it has been widely applied in IS research whenever examination of technology adoption was required: e-business system [25], EDI systems [18], Enterprise Systems of Small Medium Enterprises [22], IT project [5], RFID implementation [1], knowledge management systems [16]. While investigating the development and innovation processes of W-system, we also realized that the points we should handle are closely related not only to the technological issues but also to the organizational and environmental issues.

First, technological perspective considers both the internal and external technologies relevant to the organization. Technologies inside the organization or available in the external market belong to this dimension. In this context, Kotzab et al.'s study [17] examines system maturity and Park and Jang's study [18] considers technological fitness or competence. Park and Song's study [20] investigates IT infrastructure and technology readiness. Our study investigates system error control and related tradeoffs in terms of the system maturity.

Second, organizational perspective is characterized by some features such as firm size, scope, complexity of managerial structure, top management's support and perceived barriers [18, 20, 25]. Among the factors, top management support is mainly considered as the influential organizational factor and we also examines how the CEO leadership affects the adoption and utilization of W-system.

Third, environmental perspective means the place where a firm conducts its business. Hence most study examines the factors such as industry characteristic, competition in tensity, market uncertainty, market turbulence, regulatory environment [18, 20]. Our study investigates the effect of industrial environment.

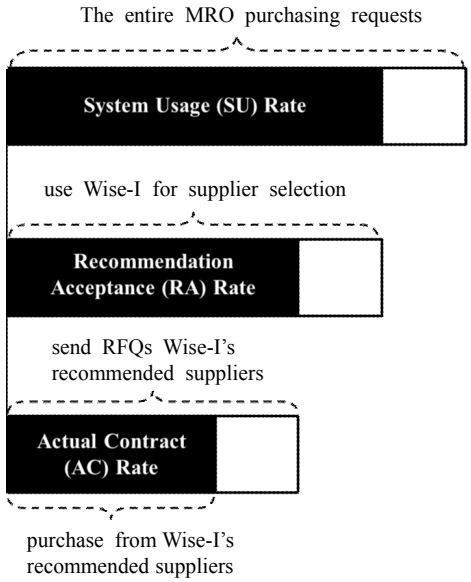
In this paper, we adopt the TOE framework as a lens for investigating the efficiency and performance of the supplier evaluation system and the overall summarization is given in <Figure 2>.

3. The Performance of W-system and Innovation Projects

3.1 Key Performance Indicators of W-system

IMK tried to introduce a transparent supplier evaluation model that excludes any sourcing managers' subjective evaluation. Along with transparency, the systemization relieved sourcing managers of their trivial burdens such as repeating MRO purchasing requests, and allowed them to focus on more strategic operations.

For the management of the system performances, W-system took three measurements as key performance indicators (KPIs).



〈Figure 1〉 Key Performance Indicators (KPIs)

The first one is "System Usage (SU) rate." This rate measures the portion of MRO purchasing requests from which supplier evaluation is done by W-system. This rate also implies how many transactions are systemized in business of IMK. The second one is "Recommendation Acceptance (RA) rate." If sourcing managers use W-system for supplier selection, W-system recommends the best suppliers by its evaluation method composed of policies and factors. If the recommendation seems reasonable based on the sourcing manager's judgment, she(he) would accept the W-system's recommendation, or she (he) might select the other suppliers which are not recommended by W-system. The RA rate captures the portion of recommendations that are

accepted by sourcing managers. In short, it reflects the consistency between W-system's recommendation and the sourcing managers' knowledge and judgment. The last indicator is the "Actual Contract (AC) rate." After suppliers are selected, sourcing managers send a quotation requests (RFQ) to each selected supplier. AC rate stands for how many recommended suppliers of W-system actually make MRO item supply contracts with IMK. From the development to the maintenance stages of W-system, all attempts and improvements that were implemented regarding W-system had the goal of increasing these three KPIs. Especially, more focuses are given to SU and RA rate, which are more system based performance while AC rate is rather complicated with political issues and market environment.

3.2 Performance of W-system in Early Stage

After the design and development of W-system, IMK implemented it and ran a pilot test from August to October in 2004. Out of 11 sourcing divisions, "Petrochemicals" and "General machineries" divisions were selected for pilot test. At the end of the pilot test, 95% and 87% (RA rates) of W-system's recommended suppliers in respective divisions were selected by sourcing managers and sent to RFQs. AC rates recorded 98% and 99% respectively during this period, which implies that W-system properly recommended quality suppliers to sourcing managers. The implementation of W-system was propelled by the successful pilot test results. In November 2004 W-system was applied to 5 more divisions, and all the entire sourcing divisions started using W-system in January 2005.

In spite of the impressive results of the pilot test, several unexpected problems have gradually arisen as the expansion of W-system adoption. Just after the successful first results, it seemed that W-system mitigated the workload of the sourcing managers and increased the efficiency in sourcing processes. However, after one year of the company-wide implementation of W-system, System Usage (SU) and Recommendation Acceptance (RA) rates significantly dropped to averages of 58% and 52% respectively (measured in October 2005). It seemed that W-system was not so helpful for sourcing managers as it was expected.

3.3 Three Innovation Projects: Endeavors to Improve W-system's Performance

To identify what kinds of barriers prohibited the sourcing managers' usage of W-system and in order to improve W-system's performances, IMK carried out three innovation projects from October 2005 until December 2008. The common purpose of the three projects aimed at improving the per-

formances of W-system-SU, RA, and AC rates. During this period, IMK organized a special task force and analyzed the causes of the low performances. This task force had the following personnel on board: one developer of W-system, a director who had managed the initial implementation, a head of sourcing manager who represented every sourcing manager in all divisions, and several outside consultants.

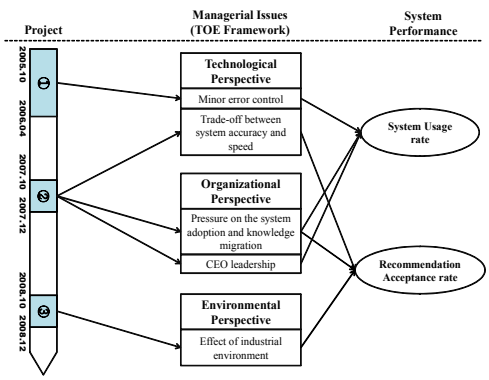
The first project, especially named "6 Sigma Project", mainly aimed to retrieve the declined SU rate of W-system. Because the evaluation mechanisms of W-system were strategically important and confidential, IMK self-developed W-system without any support from professional software vendors outside. Due to lack of experience in system development, IMK failed to notice the practical and detail problems which could happen in the maintenance processes of W-system. The task force concluded that the principal reason of the low SU rate was technological defects which hindered system use of sourcing managers. To fix these defects, the task force mainly concentrated on the correction of minor errors and on implementing a convenient user interface (UI). During the 5-month period, IMK collected various feedback opinions from sourcing managers and accordingly made 40 small modifications to the system.

The second project, which was executed from October to December 2007, mainly focused on improving the accuracy of W-system's recommendation-the issue of RA rate. After the first 6 Sigma project, sourcing managers used W-system more frequently but the CEO was still not content with the results. While the first project mainly focused on the correction of minor errors in W-system, the second one touched the algorithm of evaluation mechanism. The task force reviewed the MRO purchase database; data which was recorded during the supplier evaluation and selection processes. This database included MRO item categories, recommended supplier list, sourcing managers' decisions, and reasons why recommendations of W-system were not adopted. Based on this data, the task force tried to identify which factors caused inaccurate recommendations.

The third project was an in-depth analysis to improve W-system's overall performances. In spite of IMK's efforts to improve W-system's performances, several sourcing divisions disclosed extremely unsatisfied results regarding both SU and RA rates. Especially, the Petrochemicals and General Machineries divisions showed the lowest performances of all sourcing divisions. The task force performed an in-depth analysis to find out why sourcing managers in these divisions did not well-utilize W-system. Through the results and implication of the detailed analysis in the third project, IMK wanted to construct a guide manual for the performance management of W-system.

4. Specific Issues and Managerial Interpretation

Reviewing all three projects, we discovered that there exist 5 different issues which prohibits the adoption and utilization of W-system. We organized these issues based on TCO framework and derived managerial implications. as shown in <Figure 2>. In perspective of system performance, we also linked the five issues into the two main KPIs of W-system. The AC rate usually had shown over 95% during the entire projects, hence AC rate was excluded here.



〈Figure 2〉 Managerial Issues and Performance

4.1 Technical Perspective

Q: How do minor errors in the system change the attitude of workers toward the system?

A: It is not the critical errors but the many of minor errors which lower the usage rate of W-system.

The first step in improving W-system's usage rate was to patch any technical defects. In the first project, the task force collected error reports from sourcing managers. As a result, during the duration for one month, in November 2005, 58 errors were reported. The reported errors were mostly related to the missing database or user interfaces. For example, sometimes a few suppliers accidentally missed their supplier code, and afterwards sourcing managers couldn't find them in W-system (13 cases were reported). One interesting fact was that only 8.6% of reported errors were related to the evaluation mechanism - which is the backbone of W-system. This shows that most of the reported errors were not that critical to the accuracy of recommendations.

These technical errors would sometimes seriously bother sourcing managers in their use of W-system, especially when they were dealing with huge amounts of daily operations. Even with a few minor errors, sourcing managers' attitude could be hostilely swayed against the use of W-system. In fact, although the implementation of W-system reduced the time for supplier evaluation selection processes by 50%, several sourcing managers complained that W-system took more time to evaluate suppliers than they would without it. This implies that the system performance perceived by workers can be underrated due to the minor,

technical errors, which could be fixed but not handled yet.

During the 6-sigma project, which took place from October 2005 to April 2006, the task force made 40 small updates based on the aggregated opinions by sourcing managers. Theses updates mainly focused on the improvement of database management and user interfaces; features that are not directly linked to the mechanism or knowledge of supplier evaluation. However, these attempts of fixing minor errors in W-system really contributed to an increase in the SU and RA rate. After one and a half year from the "6 Sigma" project, both the SU and RA rate increased by about 20% respectively compared to the first project. This case shows that the reason of Wise disuse is not limited to its fundamental performance problems. A considerable portion might come from just simple technical errors.

Q: What are the benefits and costs of high RA (Recommendation Acceptance) rate? : Tradeoff between the recommendation accuracy and process speed.

A: RA rate can be optimized at the level where the recommendation accuracy and processing speed are balanced together.

The mechanism of W-system's supplier evaluation consists of two major parts. The first part is the supplier database recorded by MRO purchasing transactions, and the second one is the evaluation model created by knowledge contribution of the sourcing managers. The point is that both two parts require continuous participation of the sourcing managers for the update of data and model.

Each supplier in the database has 23 factors which are considered to be important for supplier evaluation. These factors can be categorized into three types-a supplier's basic information such as revenue and profit, a supplier's capability of providing the MRO items such as price and lead time, and information about the relationship between IMK and the supplier. Each supplier usually has a multiple set of factor databases because it provides more than two items. Therefore the size of database that each supplier holds is proportional to the number of MRO items it can provide. During the third maintenance project, it was found that each sourcing division had a database containing about 3,000 suppliers in average, and each supplier had 27 sets of factors in average.

Due to the structure of the database and of the evaluation models, W-system should contain information of all suppliers to provide reliable recommendations in any MRO purchasing request. As the CEO mentioned, a 100% RA rate implies that W-system should provide completely reliable recommendation even when clients request new MRO items the database or evaluation models of W-sys-

tem do not cover. However, this might be impossible in perspective of the system structure, because W-system may not have database of new items or corresponding suppliers. Then, in order to increase the RA rate, taking as much supplier information as possible to cover all the various cases can be a simple solution. Based on the structure of W-system, the size of the supplier database is obviously proportional to the RA rate of W-system. This implies that the database should include suppliers even if they are rarely recommended by W-system. However, as the size of database increases, the time which it takes for supplier evaluation may also increase. In October 2008, there were 87073 sets of factors in the database, but 24437 (28.1%) out of them did not have any transaction record at all. Only 1248 sets (1.4%) had made more than 100 transactions. However, while evaluating suppliers, W-system had to consider all sets in the database, even including ignorable sets. Hence, many sourcing managers complained about the speed of supplier evaluation in W-system. For sourcing managers, who faced hundreds of transaction in one month, not only is it important to increase the accuracy of recommendation, but also it is critical to maintain the speed of the evaluation process.

After the implementation of W-system, the RA rate maintained a range from 60% to 80%. Considering the learning effects and the speed of supplier evaluation, this score might be the rate that optimizes W-system's reliability of the recommendations. 100% RA rate might be possible only for the static and never-changing routine sourcing. Looking back to the previous studies on IS research, accuracy and acceptance are the most important factors for evaluating systems. However, on the other hand, this kind of system also should be well adapted to the dynamic changes of environments [22]. Our finding shows companies have to balance these two parts properly. Though W-system cannot evaluate suppliers when clients request a new type of MRO items, the sourcing managers' feedback may enhance W-system's supplier evaluation feature for the next time. This shows that W-system needs the time to learn the characteristics of new items and semi-structured industries by interacting with the managers. Eventually, information systems can be improved through repeated knowledge refinement cycles [14] between the users and information systems.

4.2 Organizational Perspective

Q: Why is it difficult to encourage the managers to migrate their knowledge into W-system?

A: Knowledge migration cannot be forced by top management. It can be accomplished voluntarily through the interaction between the managers and the system.

As an important asset of IMK., W-system is a knowledge storage for supplier evaluation, and the value of W-system is significantly dependent on the feedback of sourcing managers. That's why IMK strongly encouraged sourcing managers to use W-system. Moreover the users' understanding of the system critically affects the system usage rate [3]. Hence, we surveyed 32 sourcing managers to check their understanding of W-system and attitude toward W-system. The survey mainly consisted of three main categories-test of sourcing managers' understanding, perceptions on W-system, organizational culture on W-system adoption. Factors in each were measured by a seven point Likert scale. There were a total of 92 sourcing managers in the company at that time, but most of them were affiliated to local offices. Moreover, those who participated in the survey belonged to the head office in Seoul and managed 60.3% of the total MRO purchasing requests. 32 sourcing managers had been working at IMK for 3.12 years in average. At that time, it was the 6th year since IMK's foundation. Therefore, these statistics shows that the surveyed managers were experienced workers in terms of MRO sourcing with W-system.

First, in order to check the managers' understanding of W-system, the task force took a surprise quiz to the 32 managers. The quiz consisted of five questions. First of all, sourcing managers were asked to self-evaluate their understanding of W-system's functions (Question 0). The remaining four questions were about actual evaluation of their understanding. The questions are stated in <Table 1>.

Ironically, the majority of sourcing managers (67%) answered that they fully understood the functions in W-system (Question 0), but on the other hand, the percentage of correct answers for the remaining questions were only 11.7% in average. What was worse, out of 32 sourcing managers, no one was aware of W-system's feedback analysis (Question 3) which was for the examination of evaluation functions created by sourcing managers.

This contrary result implies that sourcing managers usually over-evaluated their own understandability of the system, and they rarely

〈Table 1〉 Survey Part I: Test of Sourcing Managers' Understanding

Self-evaluation about the Understanding of W-system	
Question 0	Do you think that you fully understand functions built in W-system?
Questions about W-system	
Question 1	How many factors can W-system use when making evaluation functions?
Question 2	How many types of functional form can W-system use when making evaluation functions?
Question 3	How many types of feedback analysis tools exist in W-system?
Question 4	What is "Sensitivity Analysis" in the menu of W-system used for?

〈Table 2〉 Survey Part II: Perception on W-system[5)]

Reliability	Objectivity	Usefulness	Satisfaction	Attitude	Intention to Use
3.16	4.30	4.44	4.39	4.22	4.62

have the opportunity to learn the specific functions of W-system. It means lack of education system for new information systems in the organization. Although just four questions were asked in this quiz, all these questions were checking whether the managers knew about the functions related to knowledge transferring into the system. For example, the number of factors and functional forms of evaluation models are basic information when sourcing managers design the evaluation models by transferring their knowledge. Tools for feedback and sensitivity analysis are used for reviewing the evaluation models which were made by other managers. The low percentages of correct answers in this surprise quiz indirectly showed that the usage of W-system was limited to simple operations.

In fact, many sourcing managers constantly complained about too many MRO purchasing requests assigned to them. Due to the lack of opportunities for learning W-system, functions like feedback analysis or sensitivity analysis were out of the managers' concern. As a result, designing the evaluation models in W-system unavoidably became a responsibility of senior sourcing managers, who conducted relatively less MRO purchasing request than juniors. After creating 75 "Policy" functions (evaluation functions) in the W-system's development, there were only 39 modifications or creations in W-system's Policy functions until the first project. Nine sourcing managers were involved in these modifications, but only two sourcing managers contributed 15 out of 39 modifications. Between the first and second project, the number of modifications increased to 90. However, in the same way, only two sourcing managers (out of 19 contributors) were involved in 44 modifications. It shows that most sourcing managers were not involved in the modification of W-system nor had the chance of learning, hence they could not fully utilize the functions of W-system and used very basic functions just for supplier selection.

<Table 2> shows sourcing managers' evaluations and perceptions on W-system: from reliability to the intention of use. Considering the survey items have seven point scale, the result shows just neutral and somewhat low evaluations. While interviewing and surveying sourcing managers, the task force found two main factors that lower the use of W-system. The first one was the heavy workload of sourcing managers. The second one was sourcing managers' lack of confidence in W-system's

5) The survey used seven point Likert scale. We assign the 1 to 'strongly disagree' and the 7 to 'strongly agree,' which implies higher points means a more positive attitude.

recommendations. Evidencing it, here the score of 'Reliability' was very low as well as the other scores were just slightly above 4. Sourcing managers didn't showed strong intention to use W-system. Their heavy workload and little confidence on W-system recommendation were obstructing it. In conclusion, <Table 1> and <Table 2> implied following two things. First, sourcing managers did not fully understand nor utilize W-system because they didn't have the opportunity to learn W-system sufficiently with no organizational education system. Moreover their heavy workload didn't provide even the personal learning opportunity. Second, in addition to the imperfect understanding on W-system, they did not have much confidence on the results of W-system. Hence, they have been using W-system almost everyday under the pressure of Top management, but not actively. Therefore, there has been few mutual interaction between the sourcing managers and W-system for knowledge sharing or migration.

Q: How does the CEO leadership affect employees' attitude toward the system?

A: CEO leadership is necessary condition but not sufficient condition for information system utilization.

Since its development, the CEO had been highly interested in W-system. He was the one who initiated the three maintenance projects, and constantly checked the progresses of these projects. It is common sense that the CEO-driven culture gives a positive effect to the system implementation. This argument seems to make sense in the case of W-system at least during the pilot test. Although W-system showed high RA and SU rate at that time, the effect of the CEO's promotion did not continue less than a year. The task force also addressed this issue in the survey to measure the sourcing managers' response to the CEO's encouragement.

〈Table 3〉 Survey Part III: Organizational Culture on W-system Adoption

Normative obligation	CEO leadership	Spontaneous utilization
5.51	6.27	3.45

Summarizing <Table 3>, sourcing managers strongly felt the obligation to use W-system by CEO leadership but their insufficient understanding turned the obligation into a burden. Because of the CEO's strong interest, sourcing managers felt that they had to use W-system for supplier evaluation. However, as shown in <Table 1>, few chances of learning made them normatively use W-system - just for supplier evaluation without full understanding on the system. This implies that CEO leadership is necessary condition but not sufficient condition for information system utilization. Even worse, CEO leadership sometimes gives

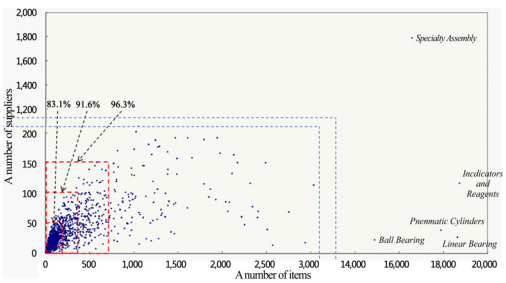
negative effects to the system unless there is sufficient understanding of the system and communication among workers.

4.3 Environmental Perspective

Q: How are the industrial environments related to the performance of W-system?

A: The performance of W-system is various according to the characteristic of industry.

To evaluate numerous MRO items and their suppliers efficiently, W-system created the unique classifications - "Leaf Class (LC)." LC is the classifications for MRO items and their suppliers based on United Nations Standard Product and Service Classification (UNSPC[6]). During the third project, 3140 LCs were registered for classification of MRO items. Each LC included 340.2 MRO items and 28.6 suppliers in average.



〈Figure 3〉 Number of Suppliers and MRO items in each LC

6) http://www.unspc.org.

In terms of efficiency and economies of scale, sourcing managers usually identified three or four major suppliers in each LC. These major suppliers had large market shares and provided most of MRO items in their affiliated LCs. Identifying the major suppliers in each LC, sourcing managers made most MRO purchasing transactions with them. This "selection and concentration" was for both improving the speed of supplier evaluation (reducing the number of suppliers that W-system had to consider for evaluation) and achieving economies of scale (decrease prices of MRO items). IMK named these major suppliers as "strategic suppliers."

〈Table 4〉 The Results of Supplier Evaluation

	Specialty Assembly	Building Materials
Max. Score	0.06	0.76
Min. Score	0.00	0.64
Avg. Score	0.02	0.68
# of Recommendations	Less than 10 suppliers	Over 60 suppliers

In most LCs, sourcing managers could easily identify strategic suppliers because about 90% of LCs had less than 100 suppliers and 500 MRO items <Figure 3>. However, several LCs were extremely hard to identify strategic suppliers due to their industrial environment. For example, the LC named "Specialty Assembly" which had 16569 MRO items and 1789 suppliers (the top-right in

<Figure 3>) during the third project. “Linear Bearing (the bottom-right in <Figure 3>)” had only 136 suppliers, but 18628 MRO items. These exceptional LCs had several common characteristics. First of all, items in these LCs had too many features-such as length, radius, or material-to specify them. However, the classification in W-system (LC) cannot distinguish these detailed specifications of MRO items. As a result, W-system could not provide proper and credible evaluations when evaluating suppliers in these LCs. <Table 4> shows the results of evaluation in case of “Specialty Assembly.” In this case, the highest evaluation scored only 0.06 out of 1. On the other hand, in cases of regular LCs, the highest evaluation usually scored more than 0.5. The characteristic of LC reflects the attribute of industry. Therefore LC is one of the representative example which shows how various are the characteristics of industries and how is it difficult to abstract real world in a standardized system. Such problems leads to the defects of W-system and lowers usage rate.

5. Conclusion

Experiencing lots of troubles from its development and innovation, W-system gradually aligned with IMK’s business, and its KPIs had risen again after the maintenance projects. Even though SU and RA rate is lower than 100%, these rate have been significantly increased since the start of the projects. Right after the end of third project, IMK recovered SU and RA rate to almost 80%. Nowadays, the number of purchasing requests increased to more than 200000, and over 20000 new items are registered in every month. However, as a consequence of using W-system, the entire lead time of sourcing process is reduced by 70%. After four years of W-system innovation project, the revenue of IMK exceeded KRW 10,000,000 (2008) which was around two times the one before the innovation project (2003). IMK recently tried to expand its business and applied its valuable asset (W-system) to the global market.

The ultimate aim of this study is to derive the critical issues we should understand in order to improve the performance of knowledge based decision support systems. Regarding the SU rate, the main question was how to migrate individual tacit knowledge on supplier evaluation into the organizational asset (W-system), in order to improve the evaluation performance of W-system. First, in an organizational perspective, our study shows that the migration of knowledge should be accompanied not only by the top manager’s leadership and encouragement, but also by the organizational and systematic support for the employees to have the time to study, interact with and contribute to the information systems. When the latter condition is not satisfied, as W-system case shows, the information system can be consid-

ered as a sort of burden forced to use rather than a decision supporting tool. In a technical perspective, the system should be designed to be user-friendly and to make sourcing managers conveniently use the system. More significant point is the large portion of technical problems of W-system was not fatal errors which should be fixed through the renewal of main algorithm of the system. Most of the errors were caused by just data input errors and such minor problems has lowered SU rate of W-system when it was not handled properly. These two things-the organizational and technical issues involved in W-system usage-deliver us the basic principle we should consider during new information systems adoption in organization. First, remove all the technical errors prevalent in the early stage of new system adoption. Then give the users the chance to explore and learn the system sufficiently. The users will adopt the system not because they are forced to use it, but because they understand the value of the system.

Additionally, this case investigates how to manage the system accuracy (RA rate) to support sourcing managers' decision making process. Under the condition that new suppliers and items are registered continuously, the system cannot suggest the perfect solution for every request. W-system is a decision support system for supplier selection, not a decision making system. The CEO initially tried to substitute sourcing managers for W-system, but the system just makes sourcing managers' supplier selection process more efficient. Therefore the system accuracy should be managed not in perspective of not the perfectness of the system but the proper degree of supplier selection. In part, the trade-off between system accuracy and system speed evidences the negative side of full automation of evaluation and raises us the question "what is the optimal level of systemization in supplier evaluation?."

Hence, the case of W-system implies that there might be difference between theoretical definition and practical understanding of DSS. The ultimate question is how to develop, operate valuable decision support system. In our conclusion, the key point is not to make system perfectly support managers' decision making, but to make system harmonize with managers and support their work efficiently. Thereby when the system and managers can share their knowledge and learn each other, finally the decision support system might have sustainability.

In theoretical view point, this study introduced a holistic view on the adoption and utilization of decision support systems for the key process of eProcurement-supplier evaluation and selection. So far the studies of supplier evaluation have mainly focused on the improvement of evaluation algorithm itself [15]. However, the TOE framework argues such technological approach does not resolve the problems of organizational system adoption comprehensively. Our study, beyond the tech-

nical issue, more touches the issues of interaction between users and information system in order to help the evolution of the information system. Thereby this study could be a reference for the studies investigating the development and management of the organizational information systems. The limitation of this study is that we did not examine the performance of W-system for the longer period of time. Although we identified the practice of KPI values of the initial stage of the projects, we could not follow up the changes of KPI after projects. If such data is added to our study, comparing the KPI results with the IMK's T.O.E strategies, our study could be able to deliver the deeper understanding on the relation of T.O.E issues and organizational performances regarding information systems adoption. This is the area of our next study.

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