Pre and Post Evaluations on IT Platform Migration to Open Systems

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Abstract

IT platform migration to open systems (IPMO) bears a great deal of risk over all the associated processes, in terms of a major IT investment. Hence it requires empirical data and references for decision making. Although there have been a number of published papers encouraging or discouraging IPMO, the studies that deliver useful empirical evidence for IPMO decisions are rare. The obvious first step to resolve this problem would be to gain lessons from the organizations who experienced IPMO. Based on the Delphi study, we examine both the pre and post evaluations on IPMO benefits and risks and analyze the underlying reasons of different evaluations from different stages. Our results identify the most important factor the organizations should seriously consider, and which factor is easy to neglect at the ex-ante appraisal stage.

Keywords : IT Platform Migration, Delphi Study, IT Project Management

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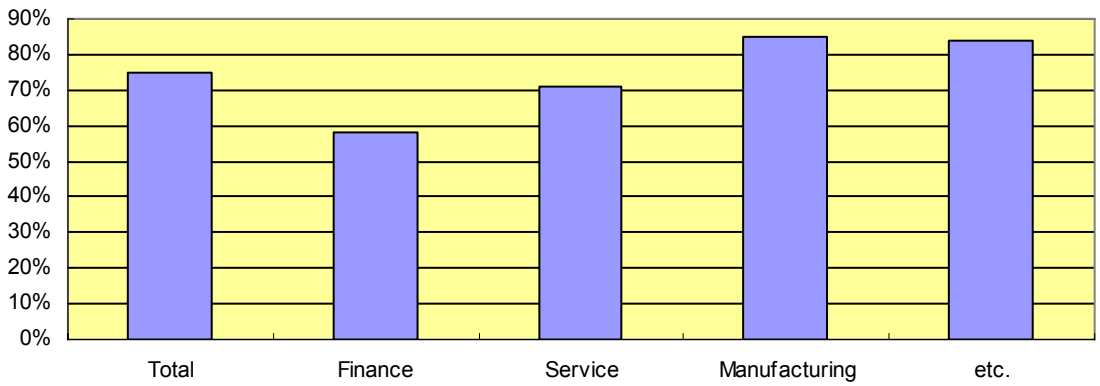
1. Introduction

Dramatic changes and improvement of business processes are demanding continuous investment in the organizational IT infrastructure [17]. Overcoming the slow down in IT growth of the year 2000, contemporary IT investment is increasing globally and there is a deep awareness of the business value of IT. Among the many of IT-developed countries in the world, Korea is the most aggressively investing nation in IT. The average IT budget of Korean organizations was 2.53% of their total budgets in 2005, which was comparable to the average level of major foreign companies in 2004, 2.78% [38]. With an increase of 8.27% since 2006, the average IT budget of Korean organizations has reached $8.8M in 2007 and 80% of this budget is surveyed to be actually executed [30].

One important enabler of these large-scale IT investments is the aggressive trend of system downsizing. System downsizing means migrating applications traditionally deployed on mainframes to high-end Unix servers [1]. Through system downsizing, the organizations can get the benefit of open systems[1)] which is a main characteristic of Unix servers. Hence, in other words, system down sizing is defined as ***'IT Platform Migration to Open Systems' (IPMO).*** Of course, IPMO itself is not a new issue. However, recently, even financial firms, which have been reluctant to migrate open system due to IS stability and security problems, are aggressively joining IPMO with the name of 'Next Generation System Projects' [1] and nearly 60% of financial firms are surveyed to fully moved their IT platform to open systems. According to our survey in 2006, the average rate of IPMO is about 75%, which includes the companies of partial or full migration of IT platforms to open systems. It is greatly high adoption rate of open systems, compared to 54% of mainframe installation rate in US at the same year [11], which makes us pay re-attention to the IPMO adoptions and outcomes in Korea. The classified records for IPMO adoption in 2006 are given in <Figure 1>.

IT platform migration is one of the most serious IT decisions that determines the fundamental structure of enterprise IT, thereby shapes the basic way of businesses. During new system development, legacy applications can be frozen for months or the cost of migration projects can be higher than expected [34]. The technical performance of a new system also can be significantly below the estimated level [51]. Moreover, adoption of open systems brings up various concerns on the new system performance or security problems [48]. The multi-tier of distributed open systems also can reduce system manageability. With the large variation of outcomes, migration decisions to open systems bear a great deal of risk which should be considered in a very careful manner because general failure rate of large-scale IT projects has even been reported to be up to 85% [4]. In this vein and for the next

1) Open system means inter-operable system with any other open systems using globally approved OSI (Open System Interface) standards.



〈Figure 1〉 Ratio of IPMO over Industries

successful IT investment, we need to make a sufficient analysis and evaluation on the outcome of IPMO, which is a representative major IT project. With the aggressive IPMO trend, Korean organizations provide really good conditions for investigating this issue.

When faced with such serious platform migration decisions, many organizations fail to make wise choices because there is no available data for references [20]. In spite of its large-scale investment, we cannot easily find any valuable analysis on the outcome of IPMO : although many studies pointed out various risks and benefits of platform migration, there are few evaluations by the organizations that have actually experienced IPMO. In an exploratory manner, Chau and Tam [8] show that more weight is given to the risk side than the benefit side with IPMO decisions. Pointing out the absence of theoretical or empirical based studies on this issue, Udo and Kick's studies [48-49] investigate the ex-post evaluation on IPMO. However, except their studies, we cannot easily find the empirical research evaluating IPMO outcomes. Large-scale IT investment such as IPMO needs to be evaluated, controlled and managed in a more comprehensive and practical manner, if businesses are to derive value from IT investment [32].

The obvious first step for the management of IPMO would be to identify the factors the organizations should seriously consider at the ex-ante appraisal stage. In this vein, we examine both the pre and post evaluations on IPMO benefits and risks to analyze the different viewpoints from different stages : what are the benefits and risks the organizations expect and experience from IPMO? Through the comparison of pre and post evaluations, we can deliver more useful lessons to the organizations contemplating IT platform migration decisions. Hence, our research includes the followings :

First, we identify the priority of IT platform migration benefits and risks at the both ex-ante and ex-post stages. Through the Delphi analysis of each period, we examine whether

the different results are derived from the pre and post evaluations.

Second, if there are differences between the expectations and ex-post evaluations, we investigate the underlying reasons of this gap.

Finally, through the findings of our Delphi analysis, we conjecture the risk appraisal capability of organizations on IT projects which bear an inherently high-level of risks. Moreover, identifying which factors should be seriously contemplated for platform migration, our research would contribute to the improvement of ex-ante assessment skill and decision ability for large-scale IT investment.

2. Related Studies on IPMO Benefits and Risks

IPMO determines fundamental structure of enterprise IT thereby shapes the basic way of businesses. Simply, it is understood as a replacement of hardware systems, from mainframe to unix servers. However, it requires massive rewriting of legacy systems while a wide range of new technology sets are employed [6]. According to the change of hardware and OS platforms, new implementation and development of DBMS (Data Base Management Systems) and middleware solutions, and business applications for new hardware platform are also required. Hence, IPMO bears great deal of risk over all the processes of migration and the failure of which can seriously harm the business.

Nevertheless, organizations adopt IPMO because they expect to get various benefits from small and open systems. We can find many studies on the benefits and risks of IPMO. However, few studies on the empirical evaluations of these factors are available. Therefore, the previous research not only provides us with a good starting point for our study but it also highlights the value of our research.

We find out that 'cost' is the most frequently mentioned factor from both the benefit and risk sides of IPMO [9, 13, 20, 31, 43, 48]. The high costs of maintaining old programming languages and application systems stimulated organizations to consider upgrading their system architecture. As a result, many of organizations concluded that the only way was to replace legacy systems with new, open platform architecture. Organizations expected the reduction of ex-post maintenance cost with IPMO [9, 31, 48]. On the other hand, they worried about direct and indirect costs of platform migration : migration incurs large-scale investment for the project period and it bears various hidden costs during maintenance period [13, 20, 43].

Hence, the cost factor has been reported to be a major facilitator as well as a significant barrier of the IPMO decision. However, the empirical evidence of cost reduction does not exist except for a few studies and the results, which are seemingly contradictory : A decrease of monthly operating cost by 50% was reported by Rhodes [39] while Udo and Kick [48] identified that the success in terms of cost reduction was achieved by less than half percent of the IPMO organizations. Hadley [20]

also argued that a doubling of anticipated cost after migration is not unusual due to unexpected problems.

Besides the cost factor, various benefits and risks of IPMO are pointed out in previous studies. There was often positive or negative bias in promoting IPMO depending on the interests and incentives of reporting groups. Hadley [20] pointed out that depending too much on these published papers causes mismanagement of IT platforms, which stimulates us to investigate the IPMO outcomes with empirical evidence.

The listing of benefit and risk factors identified from previous studies are illustrated in <Table 2> (see <Appendix>).

3. Research Methodology and Data Collection

3.1 Design of the Delphi Study and Data Collection

For the analysis of our research questions we adopted the Delphi study. The Delphi technique is a method of generating ideas and facilitating consensus among individuals who have special knowledge to share on the focused topic. It is an appropriate approach for various debated factors with no rigid answer. By aggregating the ranks from field experts, we can develop an integrated view on the research questions and draw out a consensus on the research problems [47]. Hence, the importance ratings (ranking-type Delphi study) have been used in various fields of research : social work education [40], operation management studies [33] and IS studies [27, 42], which show that the Delphi study is very appropriate to handle the controversial IT management issues.

For the validity of the outcomes of Delphi analysis, a panel of domain experts is selected and then multi-step of group decision processes is adopted. However, according to the research problems and situations, a number of variations have been applied to the studies in social science. For example, Keil et al.'s Delphi study [27] focuses on the comparison of the different perception on IT project risks between project managers and users. In order to eliminate the variations in definitions of 'risk' factors, they proposed a list of factors identified by a prior study [42] at the beginning of their Delphi study.

Here, we need to pay attention to the major purpose of our Delphi study. By comparing the pre and post evaluations, we focus on the identification of different results from different appraisal points. To be a panel of our study, it is required to have comprehensive awareness on the overall history of IPMO via serious involvement in IPMO project. Hence, the only possible panelists for this study are the CIOs in organizations. CIOs make major IT decisions responsible for the enterprise IT platform hence they must be the most knowledgeable person from the before to the after of IPMO. Nonetheless the appropriateness of CIOs as our subjects, the dual evaluations on both pre and post periods of IPOM over multi-phases requires serious resource investment for

them physiologically and physically. The best alternative for reducing the burden of multi-stages of rating and deriving out more credible evaluations would be decomposing the factor finding process from the evaluation process. Hence, in this study, we adopted a modified Delphi study, which is similar to Keil et al.'s study [27].

At the beginning of this study, based on the prior studies, we prepared 25 most frequently considered factors as a seeded list for benefits and risks of IPMO respectively (see <Table 2> in <Appendix>). Through the interview with an experts group, we narrowed down the seeded list to thirteen representative benefit and risk factors. The experts group is composed of two MIS professors and six field experts - four who are working for the sales department and two for marketing department in IT vendor companies (e.g. IBM and HP).

In the first phase, we adopted CIOs as our panelist for the rating of the thirteen risk and benefit factors from the pre and post perspectives of IPMO. We compared both results for benefit and risk factors respectively and identified six factors which have significant difference from each evaluation.

In the second phase, we surveyed the CIOs again with the questionnaires requiring quantitative evaluation on the six factors identified in the first phase to investigate the underlying reason of phase 1 results.

To be an appropriate sample in phases 1 and 2, the organization should experience platform migration practice to open systems. If the organizations stick to mainframes only, they cannot be the sample of our survey. Hence, we first contacted CIOs of 127 organizations which were once registered as IBM system Z mainframe clients because they were the most likely organizations to have migration experience and investigated the possibility of data collection. Next, when the organization is identified to have IPMO experience(s), we delivered our survey questionnaires to the CIO via mail or email. Finally we collected the respon-

〈Table 1〉 Profiles of Organizations and CIOs

Organization							
Industry	# of Corp.	Staff	# of Corp.	IT Staff	# of Corp.	IT budget	# of Corp.
Manufacturing	26	0~500	23	0~20	21	0~20($ mil)	21
Service	22	501~1000	11	21~100	25	21~100	18
Finance	17	1001~5000	21	101~200	17	101~1000	19
Logistics&etc.	15	> 5000	25	> 200	17	> 1000	22
CIO				IPMO			
CIO's IT Experience (Y)	# of Res.	Non-IT Experience (Y)	# of Res.	Time of IPMO	# of Corp.	IPMO Approach	# of Corp.
0~5	6	0~5	68	~1996	12	Big-Bang	38
6~10	23	6~10	10	1997~2000	20		
11~15	23	11~15	2	2001~2003	32	Phased-Out	42
> 15	28	> 15		2004~	6		

ses through mail or email. We gathered responses from 80 organizations during May and Jun of 2006. The profiles of the 80 respondents and their organizations are given in <Table 1>.

In our survey, 48 percents of organizations reported to have adopted the Big-Bang approach and 52 percents adopted phased-out migration. In the latter case, we limited the respondents by requiring them to answer in terms of their first migration experience. The time of IPMO shows that IPMO has been continuously practiced since 1994 and were more prevalent around the millennium dealing with Y2K problems. It is announced that 'the law of capital market integration', which allows one financial investment company to service most of the financial products, will be executed from February 2009 in Korea.[2] In order to survive in this situation, it is expected that the more financial organizations will aggressively adopt IPMO with the title of 'next generation systems project' for the provision of more inter-operable and flexible systems to the market demand. Since 2006, most finance organizations have been announcing IPMO plans, which continuously increases IPMO rate in Korea.

4. Survey Items and Results

4.1 Phase 1

<Table 3> (see <Appendix>) shows the survey questionnaire for CIOs in phase 1. We asked the respondent to rank the priorities of the benefit and cost factors from both ex-ante and ex-post perspectives respectively. Ex-ante evaluation shows which factors were most seriously considered before IPMO decision while ex-post appraisal implies what are the realized benefit and risk priorities through the IPMO experience. The raters assigned '13' to the factor with the highest priority, namely the most important factor, and '1' to the lowest one for the thirteen risk and benefit factors, respectively.

(1) Statistical Techniques for Delphi Study

To make the ranking-type Delphi study a sound method for the collection and analysis of data, we need to make use of available statistical techniques. The most popular method for this purpose is Kendall's method [29]. Based on the least squares solution, Kendall's method measures the ordered list by mean ranks. The details of this method are as follows.

First, the Delphi results should reach an acceptable level of consensus among panelist. Hence, Kendall's coefficient of concordance (W) measures to what extent the panels agreed on the relative importance of various factors [29, 41]. Our results in <Table 4> (see <Appendix>) show that fair level of agreement on the ranking by the raters has been established, higher than cutoff value ($W > 0.5$) for each evaluation.

Next, Kendall's rank-order correlation coefficient (T) is used to make pair-wise comparisons between two different rating results [29, 41]. Kendall's T is adopted rather than

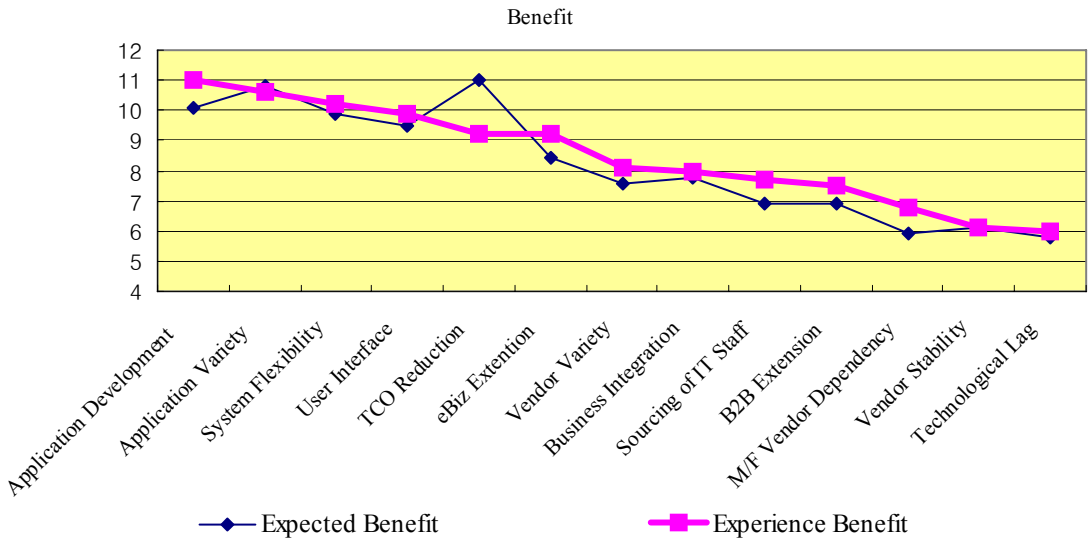
2) 자금 시장 통합법

Spearman rank-order correlation coefficient because it emphasizes the relative ordering of the issues rather than the magnitude of difference between ranks [41]. Our results show that there is a significant difference in the pre and post evaluations (both for benefit and risk factors), which means that different views on the IPMO have been established from the two time-different evaluations [50]. For benefit factors, the mean priority comparison between pre and post evaluation derives $T = 2.7$ ($P = 0.25$). The result for risk factors is $T = 1.437$ ($P = 0.14$). The peculiarity of our study is that we not only examine the independent ranking of each evaluation, but also compares the pre and post evaluations. Hence, Kendall's rank order correlation coefficient (T) really supports the significance of our pair-wise comparisons, by showing that the pre and post evaluations have significant differences at 95% or 99% significance level ($p > 0.05$).

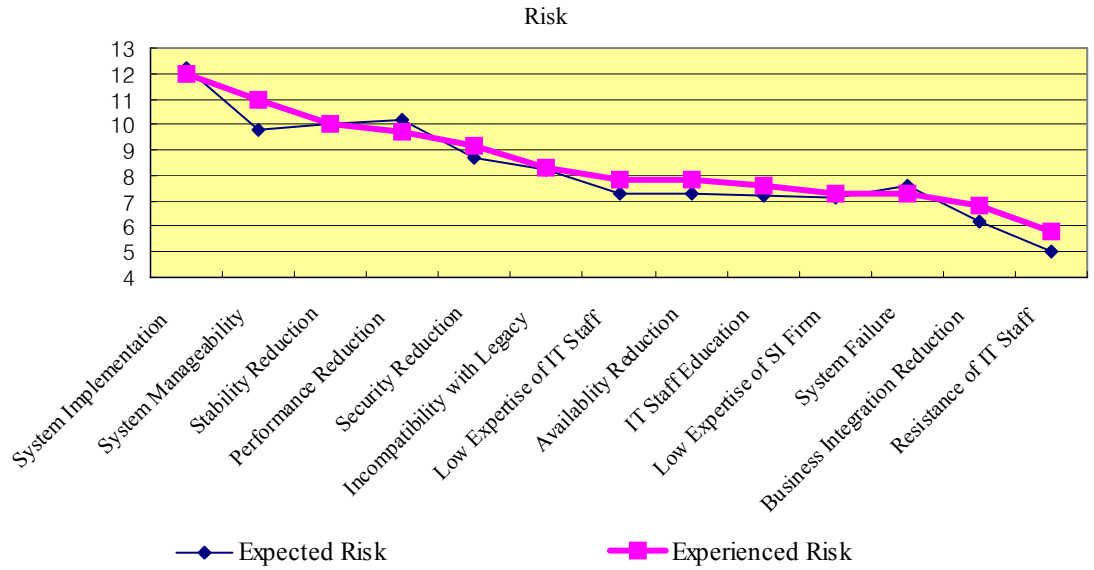
Additionally, we adopt ANOVA test on each ranking result to make sure that each rank in one evaluation has statistically significant difference. The purpose of analysis of variance (ANOVA) is to test for significant differences between means, hence we adopted ANOVA test for all the four ranking results (pre and post ranks on the benefit and cost factors respectively) and the F-values show that the mean ranks in each ranking-list have a significant difference each other. For details of test results, see <Table 6> in <Appendix>.

(2) Interpretation of the results (phase1)

In <Figure 2> and <Figure 3>, benefit and risk factors are sorted through the priority of ex-post evaluation (the bold line). The results show that the ex-post evaluation on IPMO is different from the organizations' preconception, which might be affected by the previous studies mostly concentrated on cost saving is-



<Figure 2> Ranking of IPMO Benefit Factors



〈Figure 3〉 Ranking of IPMO Risk Factors

sues and performance warnings. We capture some practical implications through the comparison of these two evaluations. First, in <Figure 2> and <Figure 3>, 'Application Development' and 'System Implementation Cost' are rated as the number one benefit and cost of IPMO via the ex-post evaluations on IPMO.

Moreover, we can find a few over-evaluated factors at the ex-ante point.

In the benefit side, although 'TCO (Total Cost of Ownership)' has top priority among IPMO benefits at ex-ante stage, organizations reply that they gain the largest benefits from 'Application Development Convenience' and 'Application Variety.' The results show that the actual benefits of IPMO are in the easier exploitation of various applications, rather than TCO reduction which is the fifth ranked experienced benefit. In the risk side, the direct cost of project, in other words, 'Implementation Cost', has the highest priority at the ex-ante period, and it is evaluated as the real number one risk of IPMO at the ex-post period again. It is observed that 'Performance Reduction' and 'System Failure' have higher mean priorities at ex-ante appraisal time than at the ex-post evaluation.

4.2 Phase 2

The results in previous phase give us the incentive of investigating why the risk and benefit factors are differently evaluated at the ex-ante and ex-point stages. The purpose of this phase is to examine the underlying reasons of some significant differences between two evaluations in the previous phase. Mainly, we focus on the number one factors from both evaluation for both benefit and risk side - although the number one risk factor, 'system

implementation cost', is identically identified from ex-ante and ex-post evaluations, we still focus on this factor to notify the significance of the risk involved in system implementation. The first four items in <Table 5> (see <Appendix>) are adopted for this purpose - first two are for benefit side and the other two are for risk side. Moreover, we pay more attention to the over or under measured risk factors at the ex-ante point because organizations conservatively behave weighing more on the 'risk' side than on the 'benefit' side regarding their IT platform decisions [8]. Hence, we additionally adopt the last two items in table 5 to investigate why the risk of 'system manageability' is under-evaluated and how the CIOs are over-worried on the performance reduction issue. Presumably, the best way for identifying the reason of different evaluations is to assess the actual changes in each factor between two appraisal points so that we asked the CIOs to do quantitative evaluation of the IPMO factors using the items in <Table 5>.

The implications from the results are as follows. The first two subsections are the analyses from benefit side and the other ensuing sections for analyzing risk side.

(1) Blind Myth in TCO

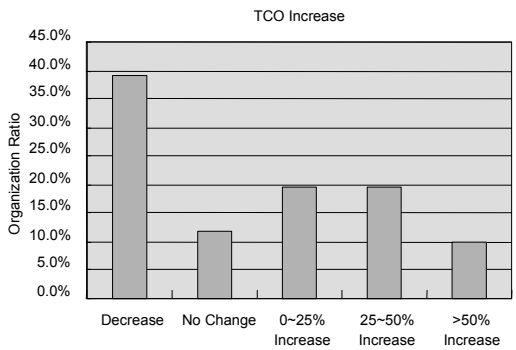
As shown in the ex-ante evaluation result and as predicted in the literature, every organization wanted to reduce TCO through IPMO, but TCO reduction was positioned far behind of the largest IPMO benefits. About half of the CIOs replied that they experienced a TCO increase after IPMO.

Because TCO reduction was the number one expected benefit of IPMO, organizations might most seriously consider this factor before their IPMO decision. Hence, it is surprising that only half of the organizations replied that they succeeded in TCO reduction. We think that there are two main reasons for this result. First, they have difficulty in comparing the pre and post TCOs, hence can be not certain about the reduction of TCO.

Second, they really do experience an increase of TCO through IPMO. Generally, open systems are believed to deliver lower 'TCO' than mainframes because of the high license fee and the low number of operating experts for mainframe applications. Many organizations struggled to reduce the high maintenance cost of mainframes and decided to implement IPMO. Hence, the TCO framework has been widely adopted to appraise the economic value of new adopted or migrated IT platforms. However, there are various factors composing the true cost of computing : the cost of operating hardware and software over a reasonable period, the cost of application software, the personnel costs associated with operating the hardware and software and sorting out any problems that may occur [5]. In some cases, studies insist that the incidental costs like office space, electronic power, special cooling requirements also should be added for the measure of true TCO [35]. The measure of TCO is so situation-specific that the costs that are relevant and significant to decision-makers vary by company and even within companies [16]. Because there are so many

hidden costs we should consider for the measure of total cost, comparing different platforms or applications seems to be down-right impossible [18]. This intrinsic limitation of TCO evaluation might be a major reason that makes it difficult for the people to make a precise measure of TCO after IPMO.

Of course, TCO could actually be increased after IPMO. Besides the direct cost of the IPMO project, the system manageability could be increased with the migration to the open, distributed systems. The horizontally distributed systems require more IT controllability compared to the legacy under vertical control. Additionally, there can be additional costs for the change management of IPMO (e.g. education of IT staff and end-users). Although there have been some contradictory predictions on the TCO issue [20, 39-48], the important thing is that over half of our sample organizations replied that TCO increased from 15% up to 70% after IPMO (See <Figure 4>).



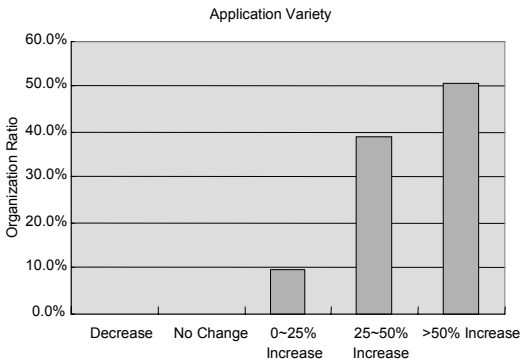
〈Figure 4〉 Changes in TCO after IPMO

Observing the serious gap in the pre and post evaluations on the TCO reduction, we consider another possibility in the IT tradition that IPMO decisions can be made not from serious economic and managerial analysis but from the other factors such as the IT decision maker's preconception from a technical perspective [25] or external pressure to follow trends [3]. If TCO is used simply for the manipulated justification of the IT investment decisions at the ex-ante period, the actual outcome would certainly be worse than the expected level.

(2) 'Application Variety', Real Value of IPMO

Application Development Convenience' and 'Application Variety with Open Systems' are evaluated as the largest true benefits of IPMO. With the proliferation of e-Business and process re-engineering in response to the rapid change of business environments, organizations need to adopt or develop various business applications : large volume of batch transactions turned into distributed, real time transactions with the introduction of ERP and SCM applications [23]. However, the high level of vendor dependency of mainframes for the modification or new implementation of systems has been a great hurdle in business extension for the organizations operating mainframes. The increasing needs for these more flexible and inter-operable systems encourage organizations to consider innovation of fundamental IS platforms despite immense investment at the initial stage. It is easier for open systems to load various free and open applications with no additional adoption cost compared to main-

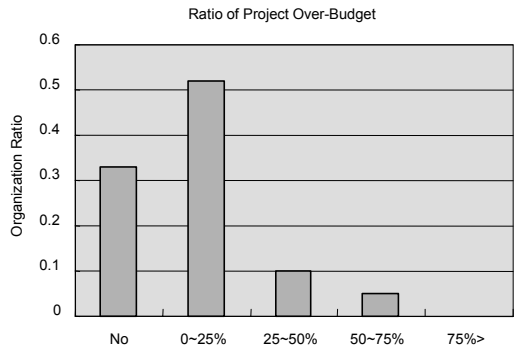
frames. Moreover, the various standardized and open source applications are supported for the easier development of new applications. Organizations get great satisfaction from this factor and reply that it is the number one, real value of IPMO, rather than cost savings. Regarding this factor, all the organizations replied that they experienced increased application variety after IPMO.



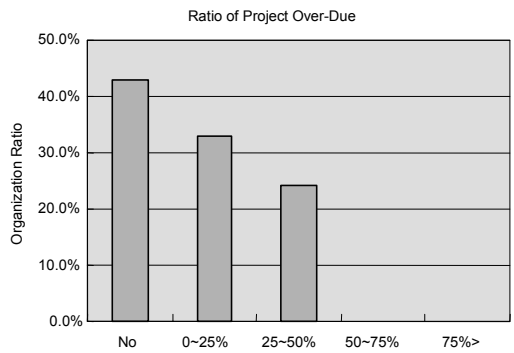
〈Figure 5〉 Changes in Application Variety after IPMO

(3) Under-Estimated System Implementation Cost of IPMO

From the risk side, 'System Implementation Cost' is appraised as the number one risk of IPMO both at the ex-ante and ex-post stages. It again reinforces many arguments over the burden of direct project cost of IPMO. However, through the in-depth investigation on project cost consumption, we also find a loophole in the risk appraisal level with this factor. When we surveyed the direct cost and time of the IPMO project, 67% of the organizations replied that the projects were 5%~60% over-budget, and 57% of respondents answered that they experienced 5%~40% of project time over-run. More than half of the organizations failed to assess the cost and time consumption of the IPMO project at the ex-nte point.



〈Figure 6〉 Over-Budget of IPMO Project



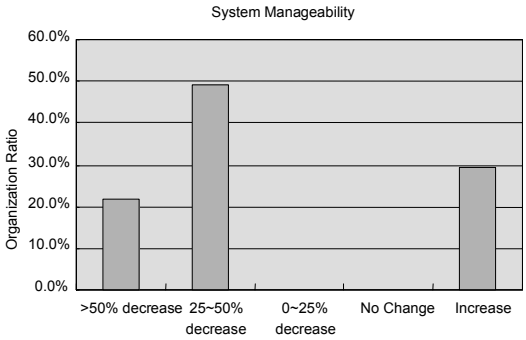
〈Figure 7〉 Over-Due of IPMO Project

Under-analysis of risk is not atypical in large-scale IT investment decisions [51]. The OTR Group [37] reported that 200 large-scale IT projects were 90% over budget, 60% were late, and 98% had specification changes. The Standish Group [45] also reported that the average IT project exceeds its budget by 90% and slips off its schedule by 120%. Although the respondents predicted that the largest bur-

den of migration would be the migration project itself and it actually was, they did not measure how large it would be. It confirms again the tradition of risk under-estimation in handling IT projects.

(4) Hidden Cost of System Manageability

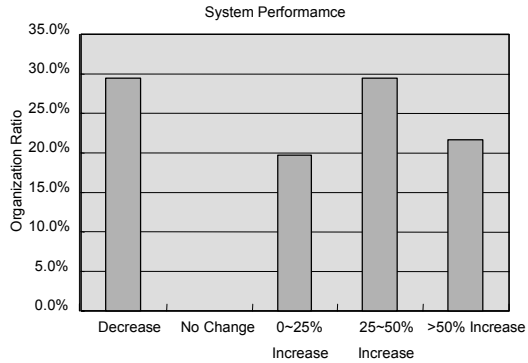
An additional important point on the risk side is the under-estimation of 'System Manageability Reduction'. At the ex-ante stage, 'System Manageability' was ranked as the fourth ex-ante measured risk of IPMO, however, it was rated to be the second largest risk after IPMO. With the adoption of mini and distributed computers, organizations took the horizontal expansion of systems by increasing the number of system units, rather than the vertical scale-up of the computing power with the increase of the number of CPUs in a system [7, 15]. This scale-out expansion of the system extremely increased the complexity of system control, hence manageability reduction was observed as the hidden, but significant risk factor of IPMO. In our survey, 70% of organizations replied that the 'System Manageability' decreased after IPMO from 30% up to 100%.



〈Figure 8〉 Changes in 'System Manageability' after IPMO

(5) Over-Measured Risk of System Performance

Finally, from <Figure 3>, we can find that the risk of 'System Performance' is over-estimated at the ex-ante appraisal time. The reduction of 'System Performance' is the second highest predicted risk of IPMO but it is identified as the forth risk factor by ex-post evaluation. Although the scale-out extension of the system units decreased system manageability, it seems to deliver high system performance and low system failure even after migration to mini and open systems. For this reason, about 70% of organizations replied that they experienced improvement in system performance after IPMO.



〈Figure 9〉 Changes in System Performance after IPMO

5. Subgroup Analysis

Although many of financial firms have started to join IPMO or announced their IPMO plans since 2006 it is a recently observed trend, which was not prevalent even a few years

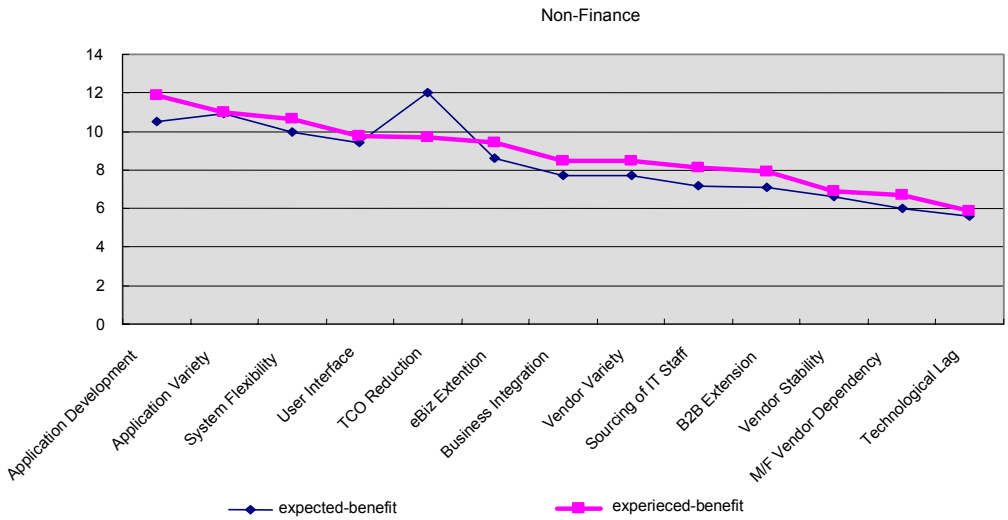
ago. Hence, <Figure 1> shows that the finance sector is the laggard in IPMO by the end of 2006. Prominently, about half of the finance organizations still operate mainframes while the organizations in other industries have mostly done IPMO. Finance organizations' main business is providing the financial services for the public so that the business continuity with no system failure is really critical for them [46]. With this high mission criticalness of IT, the companies in finance sector have made more conservative decisions in terms of radical IT innovation or changes. Observing this trend, we expect that their pre and post interests regarding IPMO will be different from those of other organizations. For this reason, we've done a sub analysis on our Delphi study classifying the samples into a financial group and a non-financial group.

The subgroup analysis of the IPMO includes 17 finance organizations and 63 non- finance organizations. The factors are sorted from the top priority factor at ex-post to the last factor (bold line).

The Kendall's Ws are 0.63 (expected benefit) and 0.73 (experienced benefit) for the financial group. In case of non-financial group, they are 0.58 (expected benefit) and 0.67 (experienced benefit), respectively. Of course, the Kendall's T evidences significantly different views on the IPMO benefits between financial and non-financial groups : T = 2.3 (P = 0.21) for expected benefits and T = 2.8 (P = 0.19) for experienced benefits.

As we expected, some different evaluations on IPMO benefits are observed between the two groups.

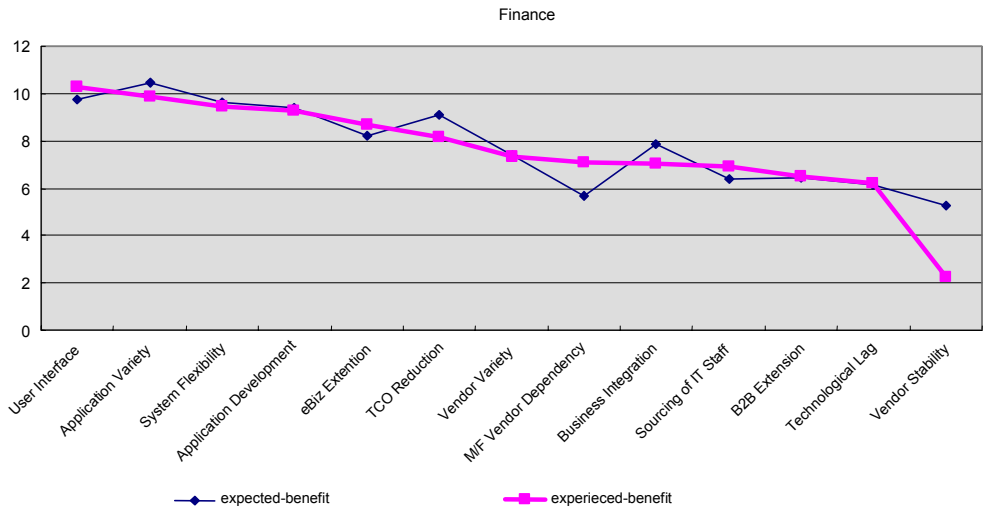
While the non-finance group shows very similar results to the general evaluations given in <Figure 2>, the finance group shows different priority on the benefit factors. First, at the ex-ante point, the finance group's main



〈Figure 10〉 Ranking of IPMO Benefits (Non-Finance)

purpose of IPMO is not TCO reduction while the non-finance group marks it as the number one expectation. The improvement of 'User Interface' and 'Application Variety' are ranked as the financial group's top two main factors of IPMO. Generally, compared to the other industries, IT systems in finance sectors have more rigid structure based on Cobol programs hence, there have been high constraints on the adoption and operation of various applications, which have worked as a significant hurdle of business extensions. This may be the main reason why finance organizations expect the greater benefits from 'User Interface' or 'Application Variety' through IPMO. It is usually said that in case of the finance sector, the main focus of IPMO was on the successful migration of core trading systems instead of ROI improvement due to the high burden of IT mission criticalness [46]. Therefore, sometimes, IPMO is evaluated to be successful only if the new systems operate the conventional trading processes with no problem, regardless of the real improvement of system performance and the integration with business [10].

Moreover, while the non-finance group reported the higher ex-post evaluations on all the factors except TCO, the finance group pointed out two more over-anticipated benefits : 'System Integration' and 'Vendor Stability'. IT systems of the finance sector are mainly composed of two parts-trading system and information system. Trading system is for supporting the main business of the organizations -transactions of all the financial services-hence it requires higher system availability to deal with large transaction volumes with rigid fault tolerance in terms of performance. On the other hand, information operating system has relatively lower mission criticalness compared to the trading systems, and it is for providing various information about the transactions and



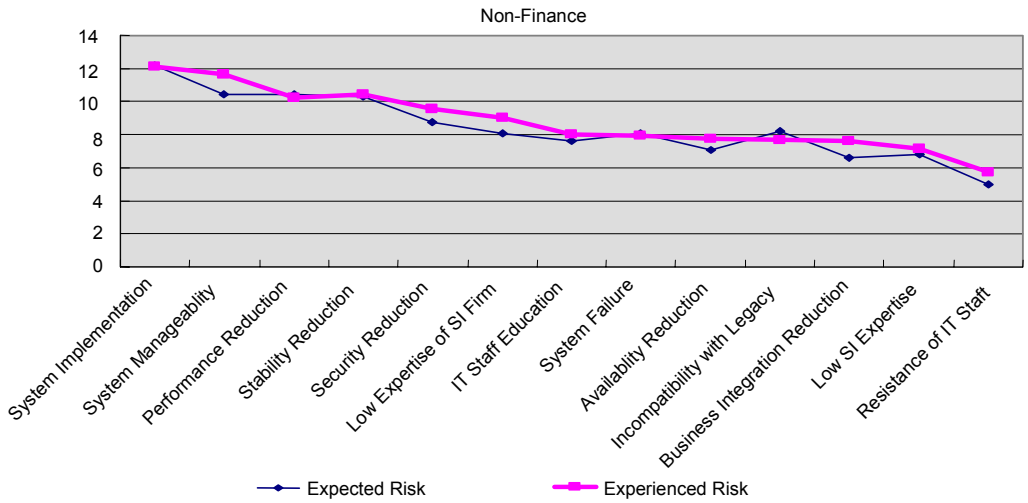
〈Figure 11〉 Ranking of IPMO Benefits (Finance)

account, the notices, news, analyzed report for investment [26]. Because of the prominently different mission criticalness, the finance organizations generally adopted IPMO for the information system only. These traditions in the finance sector presumably result in placing less priority on 'system integration' than other sectors.

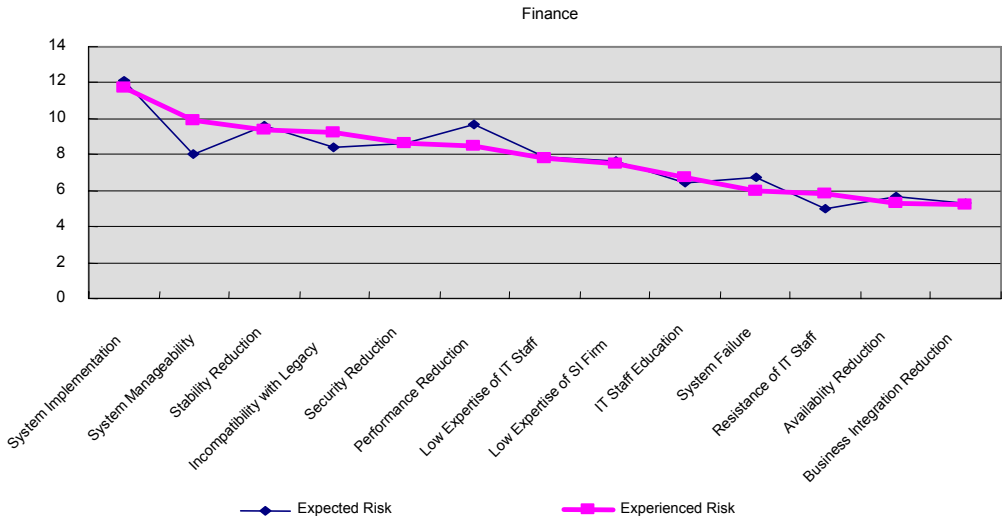
Moreover, with the high level of mission criticalness, the finance organizations' vendor dependency is very high so they expect highly guaranteed viability of vendor service. With IPMO, the system vendor market became more competitive and with these various vendors and easier switching to other vendors, vendor stability is lower than the expected level. The result shows that the finance group is more sensitive to this factor with higher IT mission criticalness. The analyses on the risk factors is given in <Figure 12> and <Figure 13>.

Regarding the first two risk factors, 'Implementation Cost' and 'System Manageability', the two groups showed the same ex-post priority. The interesting point is that the finance group greatly over-measured the risk of 'Performance Reduction' and 'System Failure' before IPMO while the non-finance group did not. The result of risk side in <Figure 3> coincided with this results in that the risk of 'Performance Reduction' is generally over-measured. Probably, the general evaluation on 'Performance Reduction' is dominantly affected by the evaluation of financial firms. Moreover, the ex-post ranking of these factors was slightly lower by the finance group than by the other group, which shows that the finance group more strongly considers the risk of 'System Performance' and 'System Failure' at the ex-ante appraisal time.

Due to the extremely mission critical importance of IT, finance organizations have somewhat different and conservative criteria on



<Figure 12> Ranking of IPMO Risks (Non-Finance)



〈Figure 13〉 Ranking of IPMO Risks (Finance)

the ex-ante appraisal of IPMO risk. They, initially, would not take the risk of IPMO for the reduction of TCO and they more seriously considered the 'System Performance' issues than others. These different views on the new IS adoption made the finance sector the laggard of IPMO.

Here, the Kendall's T is insignificant only for the financial groups' pre and post evaluations on the IPMO risks ($T = 1.8$, $P = 0.13$) while it shows the significant agreement (insignificant difference) between the two evaluations for the non-financial group ($T = 1.1$, $P = 0.15$). It implies that the overall results in Figure 3 are mainly led by financial group - by their conservative over-evaluations on the risks. The Kendall's W is measured as 0.58 (expected cost) and 0.67 (experienced cost) for the financial group. In case of the non-financial group, they are 0.68 (expected cost) and 0.76 (experienced cost), respectively.

6. Conclusion and Implication

In this paper, we empirically investigate the ex-ante and ex-post evaluations on the IPMO and we find out that there are some different practices in the real world from the predictions based on the theoretical perception.

After IPMO, organizations usually operate distributed Unix-serves instead of large-scale mainframes. Hence, the decrease of TCO and the performance drawbacks are expected. However, because of these preconceptions, real practices in the field have embraced excess investments in the scale-out expansion of open systems. Hence, organizations replied that they experienced the uncertain or failed TCO reduction but adequate system performance even after IPMO.

Therefore, our results imply that more attention should be paid to the overall structure of open systems rather than each individual

factor. Of course, the scale-out expansion of systems incurs a system manageability problem, but open systems (e.g. Unix/NT servers) can sufficiently substitute mainframes in terms of capacity or scalability through the scale-out investment strategy : clustering and load balancing technologies provide a strategy for adding smaller, standard systems incrementally on an as-needed basis to meet overall processing requirements. This approach is provided for the growth of services with increasing performance and capacity requirements [12]. On the other hand, this kind of expansion strategy can result in the increase of TCO.

Therefore, when considering the adoption or migration to open systems, presumably the issue of interest would be not that the open systems are sufficiently capable for replacing mainframe but that how to optimize the system expansion with open systems - how many mini servers should be adopted for guaranteeing system performance and managerial controllability. The subsequent problems (e.g. system performance, operational cost, system failure) ultimately depend on this decision. This is our lesson on IPMO in this study. Hence the organizations need to strategically balance the expansion of systems scale and the manageability of enterprise systems. While the IPMO delivers wider selections for business applications and various opportunities for the collaboration with new business partners, the tradeoff between scale and manageability remains as a critical decision problem, which finally affects the TCO of the organizations.

The platform migration is, of course, not a new issue in the IS world. Instead, IPMO has gotten continuous attention from both the academia and industry for at least ten years, and there have been a number of papers dealing with this issue. However, with this conventional topic, our research has unique value with those following reasons.

First, even though there are numerous studies on the IPMO pros and cons, few of them empirically proved these factors. In this paper, we examined the evaluations on the benefit and risk factors through the ranking-type Delphi study and surveying the organizations that actually experienced IPMO. To develop meaningful IT management strategy, it is very important to identify the relative importance of the risks and benefits, along with some understanding as to why certain factors are perceived to be more important than others [27]. Moreover, based on the non-parametric statistical analysis, we evidenced how ranking-type Delphi study can be a sound method for the collection and analysis of data. We believe that it is one of our contributions for academia.

Second, we compared the ex-ante and ex-post evaluations and identified the underlying reasons for different evaluations. Our results, the significantly different views from the evaluations of different stages, not only deliver practical directions for IPMO decisions, but also give further implications on the large-scale IT investment tradition. A lack of systematic benefit or risk analysis tools for IT investment has been generally observed. Hence, inaccurate analysis of IT investment outcome

(e.g. under-analysis of risk or over-analysis of benefit) has been perceived as not atypical in large-scale IT investment decisions [51]. However, if we consider the significant gap between the ex-ante and ex-post evaluations, more prudent organizational measures to control IT investment need to be implemented so that managerial attention should be more focused on the further accuracy of ex-ante analysis for IT investments.

Additionally, we did a subgroup analysis and identified different attitudes in IPMO decisions between finance and non-finance groups. Although IPMO is a mainstream in the tradition of organizational IT investments and managements, it is saliently observed that financial firms evaluate the risk of IPMO in a more conservative manner than other groups due to the mission criticalness of financial systems. It is notable that financial firms mainly cause the distortions between ex-ante and ex-post evaluations on IPMO risks.

Given the rapidly growing share of IPMO organizations and speedy changes of business environments, we believe that our study delivers very pressing managerial implications for the organizations contemplating IPMO decision or other fundamental IT architecture problems.

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<Appendix>

〈Table 2〉 Related Studies

IPMO Benefits	Authors	IPMO Risks	Authors
1. Cost saving	Chivvis (1991)	1. Deceptive Cost Savings	Dearden
2. Operating Cost Reduction	NW Mgmt.	2. Loss of Control	(1987)
3. Application Variety Increase	(1992)	3. Poor Product Quality and	Doll and Doll
4. Reduction of Technological Lag		Productivity	(1992)
5. Business Productivity Increase		4. System Failure	Heenan
6. Mainframe Vendor Dependency	Udo and Kick	5. Inferior Staff Service	(1989)
Reduction	(1994)	6. Cost Inefficiency	
7. Effective IT Utilization		7. System Performance Reduction	NW Mgmt.
8. eBiz Extension Enhancement		8. Low Shortage of IS Firms	(1992)
9. Business Integration Increase		9. System Security Reduction	Sebrell
10. System Flexibility Increase		10. Cost of Alternative Systems	(1990)
11. User Interface Improvement		During Migration	Kiely (1992)
12. Vendor Variety Increase		11. Resistance of IT Staff	
13. Easier Sourcing of IT Staffs in Labor		12. Administrative Cost after	
Market		Downsizing	
14. Resource Reallocation and Focusing		13. IT Staff Education Cost	Udo and Kick
on the Core Business		14. Business Integration Reduction	(1994)
15. Streamlined Responsibilities to		15. System Manageability Reduction	
Business		16. Administration Cost Increase	Hadley (1994)
16. Simplifying Management Process		17. TCO Increase with Hidden Cost	Greenemeier
17. Maintaining Consistency with the		18. System Stability Reduction	(2002)
Firm's Strategy		19. Low Expertise of IT Staff	IT Centrix
18. TCO Reduction		20. System Implementation Cost	(2004)
19. Vendor Stability Increase		21. Indirect Cost of IPMO (e.g.	
20. Ender-User Satisfaction	Lee et al.	education, change management)	
Improvement	(1996)	22. Freezing Legacy Systems During	
21. High Degree of Information Usability		Migration	
22. Easier Use of Applications		23. Incompatibility with Legacy	
23. Improved Batch Performance	IT Centrix	System	
24. Easier Application Development	(2004)	24. System Availability Reduction	
25. B2B Extension Enhancement		25. Consulting Cost	

Note) NW Mgmt. : Network Management.

〈Table 3〉 Phase I Survey Items

	Benefit Factors	Risk Factors
1	TCO (Total Cost of Ownership) Reduction	System Implementation Cost
2	Application Variety Increase	IT Staff Education Cost
3	Easier Application Development	System Manageability Reduction
4	Easier Sourcing of IT Staffs in Labor Market	System Performance Reduction
5	System Flexibility Increase	System Stability Reduction
6	Business Integration Increase	System Security Reduction
7	Vendor Variety Increase	System Availability Reduction
8	Vendor Stability Increase	System Failure
9	B2B Extension Enhancement	Incompatibility with Legacy System
10	eBiz Extension Enhancement	Resistance of IT Staff
11	User Interface Improvement	Low Expertise of IT Staff
12	Mainframe Vendor Dependency Reduction	Low Expertise of SI Firm
13	Reduction of Technological Lag	Business Integration Reduction

〈Table 4〉 Ranking of Items and Kendall's W

Factors	Mean Rank				
	Expected Benefit	Experienced Benefit	Factors	Expected Risk	Experienced Risk
Application Development	10.1	11	System Implementation	12.2	12
Application Variety	10.8	10.6	System Manageability	9.8	11
System Flexibility	9.9	10.2	Stability Reduction	10	10
User Interface	9.5	9.9	Performance Reduction	10.2	9.7
TCO Reduction	11	9.2	Security Reduction	8.7	9.2
eBiz Extension	8.4	9.2	Incompatibility with Legacy	8.2	8.3
Vendor Variety	7.6	8.1	Low Expertise of IT Staff	7.3	7.8
Business Integration	7.8	8	Availability eduction	7.3	7.8
Sourcing of IT Staff	6.9	7.7	IT Staff Education	7.2	7.6
B2B Extension	6.9	7.5	Low Expertise of SI Firm	7.1	7.3
M/F Vendor Dependency	5.9	6.8	System Failure	7.6	7.3
Vendor Stability	6.1	6.1	Business Integration Reduction	6.2	6.8
Technological Lag	5.8	6	Resistance of IT Staff	5	5.8
N	80	80	N	80	80
Grand Means	8.21	8.48	Grand Means	8.22	8.50769
Kendall's W	**0.62**	**0.7**	**Kendall's W**	**0.75**	**0.6425**
Chi-Square	155	142	Chi-Square	168	164.398
df	12	12	df	12	12
Asymp. Sig.	0	0	Asymp. Sig.	0	0

〈Table 5〉 Phase II Survey Items

In-depth Evaluations on the IPMO (in percentage)	
1	How much did 'TCO' increase after IPMO?
2	How much did 'Application Variety' increase after IPMO?
3	How much 'Cost Over-Run' did you experience with the IPMO project than you expected?
4	How much 'Time Over-Run' did you experience with the IPMO project than you expected?
5	How much did 'System Manageability' decrease after IPMO?
6	How much did 'System Performance' increase after IPMO?

〈Table 6〉 The Results of ANOVA Test

	Expected Benefit					Experienced Benefit				
	SOS	DF	MS	F	Sig.	SOS	DF	MS	F	Sig.
BG	2369.16	12	197.43	20.3	0.00	2200.17	12	183.35	18.11	0.00
WG	4919.83	1027	9.70			5133.8	1027	10.13		
Total	7288.98	1039				7333.97	1039			
	Expected Cost					Experienced Cost				
	SOS	DF	MS	F	Sig.	SOS	DF	MS	F	Sig.
BG	2552.18	12	212.68	22.9	0.00	2501.42	12	208.45	22.11	0.00
WG	4712.77	1027	9.3			4780.55	1027	9.43		
Total	7265.95	1039				7281.97	1039			

Note) SOS : Sum of Squares, DF : Degree of Freedom.
BG : Between Group, WG : Within Group.

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