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AN INTEGRATED METHOD FOR BUSINESS PROCESS IMPROVEMENT

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Abstract. *In recent years, business process management (BPM) has emerged as a major process management approach to acquire the agility and flexibility of the business processes. As being failed to effectively evaluate, monitor, and control the business processes, paradigms of BPM have evolved continuously with changes in information technology (IT), and vice versa. BPM should be implemented based on a synthesis of suitable technology and techniques, which support the integration of business processes. Accordingly, a method is required to carefully select the business processes that will be tackled first in a BPM project. However, an in-depth analysis of criteria for selecting processes to improve has not been done before. In this study, an integrated method for business process improvement, which includes the evaluation criteria of business processes to improve, the decision framework for business process selection, and the four types of business process improvement strategies, is developed. Finally, we apply a method to a BPMS planning project in a Korean government agency in South Korea, to show this method's practical utility.*

Keywords: Business process management, Business process evaluation, Business process selection, Business process improvement strategies

1. **Introduction.** Paradigms of business process management (BPM) have changed continuously with changes in information technology (IT), and vice versa. In recent years, BPM has emerged as a major development to ease the understanding and evolution of, and communication about, process-oriented information systems (IS) in a variety of application domains [1].

During the early development of BPM, enterprise managers believed that processes could be re-engineered through one-time activity with software such as enterprise resource planning (ERP) applications. However, these applications are essentially fixed in software [2]. Many enterprises failed to manifest the agility and flexibility of business processes, and a new wave of BPM appeared, i.e., the business process management system (BPMS). BPMS is a revolutionary IS that supports designing, administrating, and improving the business processes systematically [3]. Since BPMSs are designed to improve agility in business processes, value chains can be continuously monitored and improved. A BPMS is not just a middleware technology or a packaged application; rather, it is a synthesis of all methods and systems into a unified whole [2]. Accordingly, high risks are present, and considerable resources are required, when a BPMS is implemented.

For several decades, many researchers have considered IS planning methodology as a significant topic related to selecting the business process to improve [4]. Value Chain Analysis [5], Critical Success Factors Analysis [6], Business Systems Planning (IBM), Information Engineering [7], and Method/1 (Accenture) are broadly used and discussed in academia and business. However, Palanisamy (2005) pointed out that some of these classical methodologies are too abstract to address systems implementation issues, and others are too detailed, time consuming, costly, and require high degrees of IT experience [8]. In other words, classical methodologies may be too conceptual or too burdensome for process selection in BPM/BPMS projects.

Enterprises derive business value from IT through its impacts on intermediate business processes [9]. Continuous evaluation activities are also helpful to identify the improvement directions of business processes [10]. Thus when improving the business processes like BPM projects, the most important starting point is evaluating the enterprise-wide business process and selecting the candidate target process that needs to be controlled and managed. In this context, it should be recognized that the process selection step can be key to the success of the BPM projects, and can be a difficult decision making process in itself [11]. Therefore, a method is required to select the business processes that will be tackled first in a business process improvement project.

In this study, we suggest an integrated method for evaluating, prioritizing business processes, which contains a multi-item instrument for evaluating the processes, the decision framework for business process selection, and the four types of business process improvement strategies. First, by reviewing the previous research on the success factor of the business process, the primary evaluation items are drawn. Based on these items, we manifest the business process evaluation criteria through the exploratory factor analysis. Using the three evaluation criteria, a three-dimensional decision framework is developed. Also, to adapt a decision framework flexibly, four types of improvement strategies will be proposed so that the priorities to improve the processes can be mediated in accordance to enterprises' goals of process improvement. We finally describe a case study application, regarding BPMS planning project in a Korea government agency, to show this method's practical utilities. A major contribution of the proposed method is its independence from the planning team's expertise and the reduction of complexity in the analysis process.

2. Business Process Evaluation Criteria.

2.1. **Primary evaluation items in previous research.** Several studies have investigated guidelines to select the business processes process selection for benchmarking (improvement) [12-14]. Such guidelines, however, are qualitative and do not help a decision maker in choosing among alternatives on a quantitative basis [15]. As a possible quantitative alternative, the analytic hierarchy process (AHP) has occasionally been applied to determine the values of processes and to allow the selection of improvement opportunities [15-17]. However, there is a significant limitation of the AHP approach when business processes are divided into sub-processes. If a relatively detailed lower level in the process hierarchy is selected for decision making, then the number of candidates may increase markedly, and the AHP may become too complex to be easily solved by human judgment. a multi-item analysis that strategically evaluates and prioritizes business processes early in a Maganelli and Klein (1994) recommend project. Accordingly, a more practical evaluation tool, which accompanies the prioritizing scheme, is required.

To identify a comprehensive list of relevant items, we conducted a literature search of articles published in academic journals, reasoning that limiting our search in this way would ensure a high level of quality due to the rigorous peer review process. We searched for articles from a set of journals using major databases such as ACM digital library and ScienceDirect. Evaluation items were collected by considering various keywords related to success factors of business processes: IS planning [19-22], IS evaluation [9,23], project management [24-26], business process redesign [27-34], task-technology fit [35], and business process management [27-32].

Consequently, in previous researches, we could find that there were ten common critical factors of business process success. Table 1 shows major items discussed frequently and their most suitable definitions.

Table 1. Primary items to evaluate the business processes

Item	Definition
Flexibility	Degree to which its resources are sharable and reusable [19]
Effectiveness	Quality of the service delivered [32]
Efficiency	Cost and benefit [27]
Strategic importance	Culture and financial position of the business [22]
Complexity	Number of conflicts, and excessiveness of non-structured communication [34]
Frequency	Frequency of running the process [34]
Ownership	Clearness about who is responsible for process performance and improvement [36]
Level of documentation	Use of process language, and utilization of process documentation [37,38]
Level of measurement	Level of process performance measurement [37,38]
Feasibility of automation	Whether the business process can be naturally supported by IS or not [39]

2.2. **An assessment of evaluation items.** Through combining these items derived from this previous research, a ten item-instrument and a structured questionnaire using a three-point Likert scale were developed (see Table 2). To investigate the appropriateness of the selected items, the instrument was applied to a BPMS project of the Korea Employment Information Service (KEIS), which was established as a subordinate agency of the Korean Ministry of Labor in 1979. The KEIS was deemed suitable for this pilot study since it performs various types of functions including research, consulting, education, and insurance, amongst others (see Table 3). Within the seven functions of the organization, 146 business processes were selected for the survey.

Table 4 provides the profile of the 201 respondents to the sample. The responses were from staff members who are responsible for each business process. A primary objective in the data collection process was to obtain responses from representatives of all business processes. We reasoned that the obtained respondents' job expertise levels were sufficient because 80.2% of the respondents had more than 7 years of work experience, and 98.0% were management, supervisor, and professional employees.

We conducted an exploratory factor analysis of the data from 201 respondents for 146 business processes and modified the instrument, assessed its reliability, and examined the validity of the modified instrument by using Doll and Torkzadeh (1988)'s approach with

SPSS 12. The data were analyzed using principal components analysis as an extraction technique and varimax as a method of rotation.

Table 2. The ten items used in pilot study and their Likert scale measures

Items	**Measures**	**Items**	**Measures**
Flexibility (iFX)	1 = Poor 2 = Fair 3 = Excellent	Frequency (iFR)	1 = Seldom 2 = Occasionally 3 = Consistently
Effectiveness (iET)	1 = Poor 2 = Fair 3 = Excellent	Ownership (iON)	1 = Ambiguous 2 = Changeable 3 = Definite
Efficiency (iEC)	1 = Poor 2 = Fair 3 = Excellent	Level of documentation (iLD)	1 = Low 2 = Middle 3 = High
Strategic importance (iSI)	1 = Low 2 = Middle 3 = High	Level of measurement (iLM)	1 = Low 2 = Middle 3 = High
Complexity (iCP)	1 = Low 2 = Middle 3 = High	Feasibility of automation (iFA)	1 = Impossible 2 = Partially possible 3 = Possible

Table 3. Business process profile of the Korea employment information service

Functions	**# Sub-functions**	**# Business processes (Survey subjects)**
Employment Insurance (EI)	4	22
Unemployment Compensation (UC)	5	23
Employment Support (ES)	5	35
Job Training (JT)	4	22
Policy Decision (PD)	4	21
Foreign Worker Management (FM)	4	15
Irregularities Management (IM)	2	8
	Sum	146

Table 4. KEIS's respondents' demographics

Variables	**Sample composition**	**Percentage (%)**
Position	Management	3.0
	First level supervisor	35.8
	Professional employees without supervisory responsibilities	59.2
	Other operating personnel	2.0
Experience	1-3 years	2.0
	4-6 years	17.9
	7-9 years	39.8
	10-12 years	36.8
	13 and more years	3.5

2.3. **Evaluation factors for selecting business processes.** Table 5 presents the Kaiser-Meyer-Olkin measure of sampling adequacy (> 0.5) and the result of the Bartlett sphericity test (Sig. $= 0$). Without specifying the number of factors, three factors with principal component eigenvalues greater than 1 emerged. To explore which of those were the more interpretable factors, the analysis was repeated specifying two, four, and five factors. Based on those results, we concluded that three factors produced the most interpretable structure. The three factors explained 57.3% of the total variance. The loadings (> 0.30) of the ten items in the instrument on each of those factors are shown in a rotated factor matrix in Table 6.

The three factors were named 'Improvement Needs, Process Performance, and Improvement Readiness', based on the combination of each factor's items definition and their effects on the business processes. Improvement Needs is a degree of employees' perceived requirement to improve the business process, which has to be frequently executed to achieve its strategic goal. But its procedures and methods to execute is too complex to efficiently conduct. Process Performance indicates the degree, which utilizes a reusable method, also sharable, to achieve the targeted results effectively. Lastly, Improvement Readiness is the quantity of information, which can be acquired before the execution in case of a process improvement project, or the prepared standard level in a process improvement project, since its process is formalized and standardized and it has a concrete performance measure as target.

Table 5. Summary of measures of data adequacy and sphericity

Kaiser-Meyer-Olkin measure of sampling adequacy	**Bartlett's test of sphericity**		
	Approx.chi-square	df	Sig.
0.614	296.398	45	0.000

Table 6. Rotated factor matrix of loadings of the ten items

Item code	**Factors**		
	Improvement Needs	**Process Performance**	**Improvement Readiness**
iFR	0.842		
iFA	0.809		
iCP	0.671		
iSI	0.629		
iET		0.830	
iEC		0.820	
iFX		0.674	
iLD			0.803
iON	0.370	0.670	0.734
iLM			0.533

The items are categorized in Table 6 by their highest factor loading. However, the iON had factor loadings above 0.3 on the both of two non-primary factors. To improve analytical distinctions between factors, iON was deleted from the scale. Figure 1 illustrates this modified evaluation construct for business process selection.

The resulting three factors and nine items instrument had an overall Cronbach α reliability of 0.625, and the Cronbach α value for each of the factors were > 0.60 (see Table 7), which indicates that the factors are composed of reliable items.

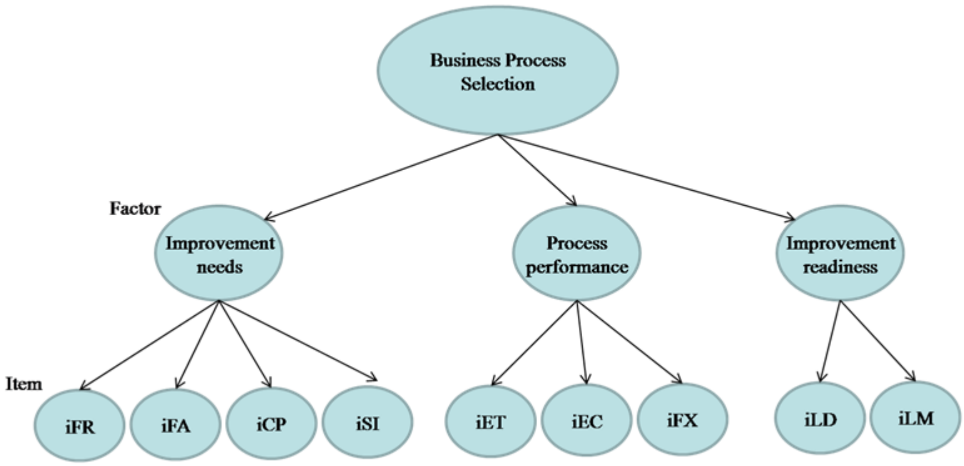

Figure 1. Evaluation criteria for business process selection

Table 7. Reliability of each factor

Factors	Number of items	Cronbach α
Improvement Needs	4	0.734
Process Performance	3	0.668
Improvement Readiness	2	0.605

Table 8. Correlation matrix of items

Improvement Needs	iFR	0.59								
	iCP	0.42	0.60							
	iFA	0.54	0.86	0.61						
Process Performance	iFX	0.38	0.36	0.40	0.24					
	iEC	0.11	0.21	0.28	0.29	0.52				
	iET	0.25	0.29	0.31	0.39	0.60	0.72			
Improvement Readiness	iLM	0.19	0.25	0.11	0.27	0.29	0.04	0.22		
	iLD	0.35	0.31	0.11	0.37	0.12	0.20	0.23	0.45	
		iSI	iFR	iCP	iFA	iFX	iEC	iET	iLM	iLD

Table 8 provides the correlation matrix for each of the items. Using the multi-trait-multi-method (MTMM) approach [41], discriminant validity is tested [40]. The smallest within-factor correlations were for the Improvement Needs, 0.42 (iCP vs. iSI); in the Process Performance, 0.52 (iEC vs. iFX); and in the Improvement Readiness, 0.45 (iLD vs. iLM). Table 8 does not show any violations of the conditions needed for discriminant validity. For example, the lowest correlation between iSI and the other items within Improvement Needs is 0.42 with iCP. This correlation is higher than iSI's correlation with the other five items in the Process Performance and Improvement Readiness. Thus, each of the nine items is more highly correlated with other item(s) within its factor group than with any of the items in the other factors.

3. **Business Process Selection Framework.** Using the aforementioned three factors; Improvement Needs, Process Performance, and Improvement Readiness, a three-dimensional decision framework was created as shown in Figure 2. The level of each factor in the decision framework is determined by the average of the contained sub-items. For example, a business process is strategically important, frequently conducted, complex

in cross-functional transactions, and has a high feasibility of automation, then the level of Improvement Needs is high. If a business process has high flexibility, efficiency, and effectiveness, then level of Process Performance is also high. Lastly, if a business process is well documented and monitored systematically, then the level of Improvement Readiness is high.

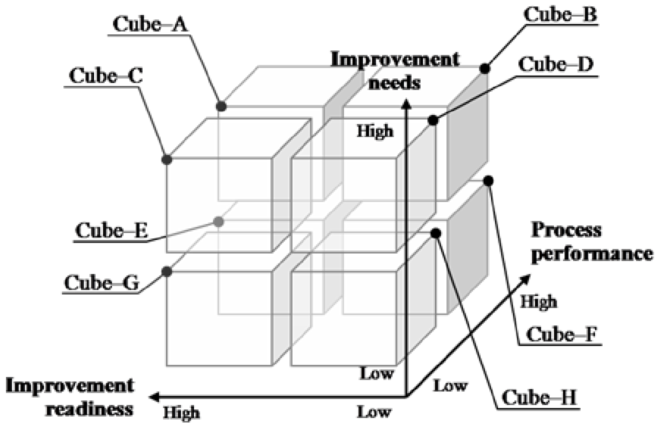

Figure 2. Three dimensional decision framework for business process selection

Based on each factor's average level, we divided the business process into a pair of modalities that are opposite to each other; i.e., high or low. Consequently, the three-dimensional framework is composed of eight sub-cubes. The sub-cube into which the business process is mapped determines the priority of, and the objective for, business process innovation. In other words, the strategic initiatives for business process improvement are different based on where, within the decision framework, the business processes are positioned.

Table 9 summarizes the relative priorities for each of the eight sub-cubes. Without the addition of further theoretical foundations, these priorities are inherently acceptable since it is intuitively reasonable that business processes with high Improvement Needs (+1), low Process Performance (+1), and high Improvement Readiness (+1) are the most in need of innovation (the aggregated score: +3). Thus, in this pilot study, we have defined four main priority stages by classified evaluation scores into four categories: +3 (top priority), +1 (second priority), −1 (third priority), and −3 (last priority).

Table 9. Priority of business process improvement for each sub-cube within the decision framework

Sub-cubes	Improvement needs	Process performance	Improvement readiness	Evaluation scores	Relative priority
Cube-A	High (+1)	High (−1)	High (+1)	+1	Second priority
Cube-B	High (+1)	High (−1)	Low (−1)	−1	Third priority
Cube-C	High (+1)	Low (+1)	High (+1)	+3	Top priority
Cube-D	High (+1)	Low (+1)	Low (−1)	+1	Second priority
Cube-E	Low (−1)	High (−1)	High (+1)	−1	Third priority
Cube-F	Low (−1)	High (−1)	Low (−1)	−3	Last priority
Cube-G	Low (−1)	Low (+1)	High (+1)	+1	Second priority
Cube-H	Low (−1)	Low (+1)	Low (−1)	−1	Third priority

4. **Business Process Improvement Strategies.** Decision framework for business process selection has four stages of prioritization (Top, Second, Third, and Last Priority) to aid the decision making on which process to improve. If all the enterprises have sufficient amount of time and budget, business process will be improved in order of priority as defined. But in reality, enterprises have limited resource of investments and have strategies focused and so the improvement boundaries, goal and direction of the process should be redefined depending on what situation the enterprise is in. In similar context, Okrent and Vokurka (2004) defined three basic strategies to the implementation of IS: big-bang, pilot, and parallel. In the big-bang implementation strategy, IS implementation occurs over the whole scope of the feasible functional area. In the pilot implementation strategy, a specific functional area, which provides the most benefit first, has the highest priority. These successful experiences will be applied and spread to different domains. In the parallel implementation strategy, newly defined business processes and IS are run parallel with the old ones over a certain period of time. Accordingly, interpreting from a business process improvement perspective the parallel strategy to minimize extraordinary efforts from employees, well-ready business processes must be preferentially selected. Pilot implementation may be further divided into two different types by establishing the primary criterion of the benefit; i.e., visible value or invisible value; thus, creating four strategies to innovate the business processes.

In this study, we adopt the classification of Okrent and Vokurka (2004) and define the four types of business process improvement strategies. The enterprise is willing to invest sufficient money for enterprise-wide innovation, and then selects the big-bang improvement strategy. However, if there is not enough investment, the pilot improvement strategy is selected. In other words, the core parts are improved first, after that, the additional improvement project will be progressed, when the demand for process improvement increases. At this point, the goal of the process improvement has to be considered and clarified, whether it is for strategic performance improvement, such as improving financial performance in short-term, or satisfaction of job functions, through improvements of the process. Depending on the goal of the process improvement, the pilot improvement strategy is divided into performance-driven pilot improvement and needs-driven pilot improvement. Also, even if the present processes and the newly improved processes coexist alongside for a specific period of time, but not affect the work execution severely, then the parallel improvement strategy is selected. In this case, as mentioned earlier, a process with high Improvement Readiness, in other words, the business process is standardized and provides most effectively process information for the improvement project, will be selected with top priority, to efficiently execute the improvement process, while minimizing the efforts of the organization. The strategies of the business process improvement can be summarized into four types such as big-bang, performance-driven pilot, needs-driven pilot, parallel.

Figure 3 visualizes these various improvement strategies including the prioritization paths in which the candidate processes can be aligned with the top, second, and third priorities in a row. The improvement priorities of the business processes are determined by the evaluation scores of the three factors as shown in Table 2. In a big-bang improvement strategy, all business processes should be selected to improve. A second strategy is a performance-driven pilot improvement strategy. In this strategy, enhancement of business process performance, which is composed of flexibility, efficiency, and effectiveness, is the key objective of the process improvement project. Thus, enterprise managers would only to consider the business processes mapped in the forward area of the decision framework: sub-cubes C, D, G, and H in which Process Performance is low. The third strategy would be a needs-driven pilot improvement. In this strategy, the business processes the strategically important, however, the difficulties of conducting processes are frequently exposed, are primarily selected since enterprise managers and end-users' satisfaction has to be obtained rapidly. As in the performance-driven pilot case, only four sub-cubes, those positioned in the upper area of the decision framework are considered: sub-cubes A, B, C, and D in which Improvement Needs are high. The last of the four improvement strategies is the parallel one. In this strategy, the business processes mapped in the left area of the decision framework are selected: sub-cubes A, C, E, and G in which Improvement Readiness is high. Figure 3 shows how each four types of strategy shape the boundaries of business processes to improve and their priorities according to the strategic intention which the enterprise has.

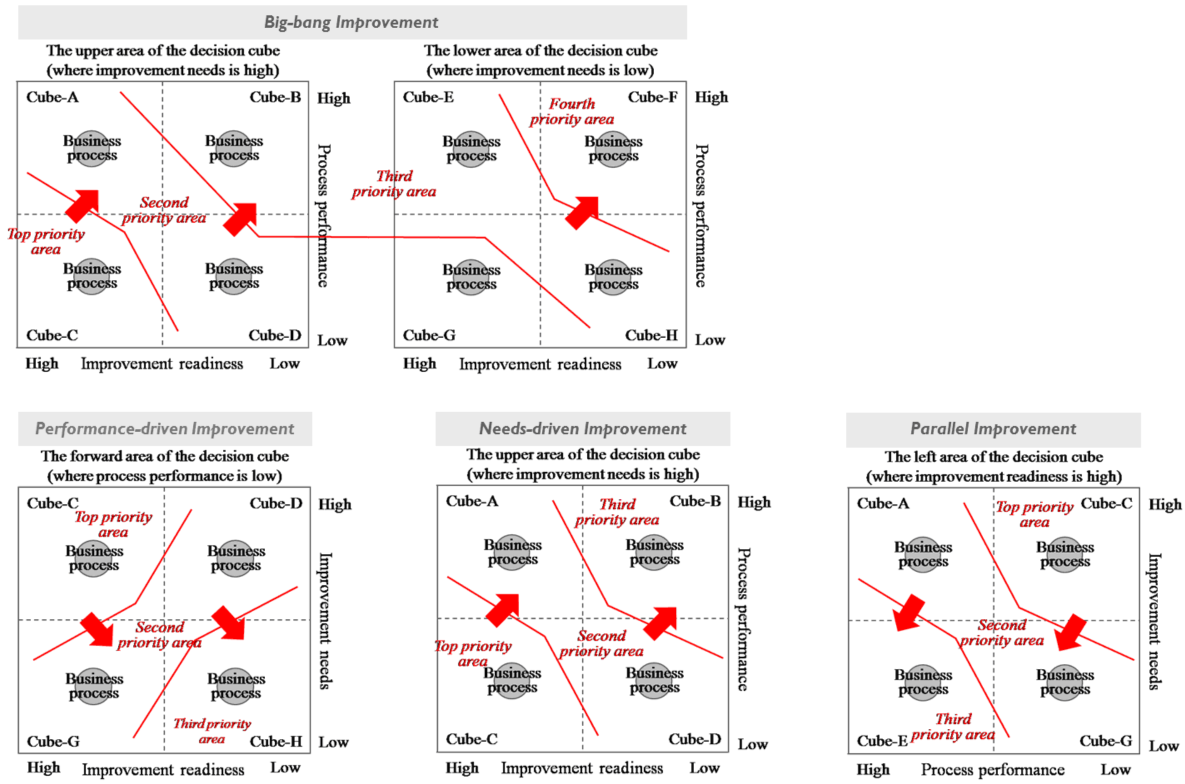

FIGURE 3. The four types of business process improvement strategies

5. **Practical Application.** In this section, we briefly describe a case study application of the evaluation criteria, the decision framework, and the four types of improvement strategy developed in the above sections to show this method's practical utility. The data collected from KEIS, which has a wide variety of functional areas as a government agency in Korea, was used. KEIS launched a BPMS planning project and initially needed to choose candidate target business processes. The general approach to BPMS implementation included a series of steps: visualizing, standardizing, digitalizing, and automating. In the case study, however, the process classification of KEIS was based on its organizational structure, without using a set of business process maps and a holistic view based on a value chain. Thus, additional efforts were required to structure a business reference model (BRM) with referring to job descriptions and office task delegation principles. Following these analyzing and structuring courses, we decomposed the business functions, and identified the business processes. Table 10 shows the five phases of BPMS planning project used in the case study.

Table 10. Phases of the case study of Korea employment information service

Phases	Activities
Phase 1. Define BRM	Analyze the pre-defined process classification (BRM) Define a business reference model
Phase 2. Identify business processes	Derive business functions from the BRM Identity major business processes and their subsequent processes
Phase 3. Collect data	Interview users with the instrument Map the data into the decision cube
Phase 4. Set priorities	Analyze the priority of business processes Determine the improvement strategy based on strategic goals of project
Phase 5. Review the results	Analyze redundancy between any of two processes Finally select the target business processes

Table 11. Mapping results of business processes in the KEIS

Functions	Number of business processes								
	Cube A	**Cube B**	**Cube C**	**Cube D**	**Cube E**	**Cube F**	**Cube G**	**Cube H**	**Sum**
EI	6	0	6	1	8	0	1	0	22
UC	3	0	4	0	13	1	2	0	23
ES	9	4	6	5	2	3	1	5	35
JT	3	6	1	3	2	5	0	2	22
PD	0	0	3	0	0	0	14	4	21
FM	3	0	1	1	7	0	3	0	15
IM	2	1	3	1	0	0	0	1	8
Sum	26	11	24	11	32	9	21	12	146
Priority	Second	Excluded	First	Excluded	Third	Excluded	Second	Excluded	

Figure 4 depicts the result of evaluating the 146 identified business processes and assigning them to the business function categories. The business processes included in each of the seven business functions (See Table 3 for function abbreviation definitions) were mapped into one of the eight sub-cubes (cube A to H) as shown in Table 11. As a result, 26 business processes were mapped into cube A, 11 into cube B, 24 into cube C, 11 into cube D, 32 into cube E, 9 into cube F, 21 into cube G, and 12 into cube H. After considering the strategic goals to conduct BPMS planning, which aim at firstly establishing the BPMS in processes, which can be efficiently controlled and managed and then afterwards, which will be applied on more difficult areas, the parallel improvement strategy was chosen. Consequently, 103 business processes were selected and their priority determined as follows: the 24 business processes in cube C were given the top priority, while 26 business processes in cube A and 21 in cube G were assigned second priority, and 32 in cube E the third priority level. Because of limited resources, however, only the 71 business processes in the first and second priority sub-cubes (cubes C, A, and G) were selected for BPMS design process.

Although BPMS should be streamlined throughout the end-to end process [28,36,43,44], the business processes selected in this case study could result in significant discontinuities with other preceding or following unit processes. To eliminate this possibility, the connections among each of the 71 selected business processes with the entire 75 remnant processes were taken into consideration. Finally, researchers concluded that 5 out of the 75 remnants were consecutively related with some of the 71 selected business processes. Those 5 processes were added to the previously selected business processes; thus, 76 business processes were selected for BPMS implementation.

Several additional activities may be undertaken after the initial selection of business processes in order to improve the results of the initial selection. For example, based on

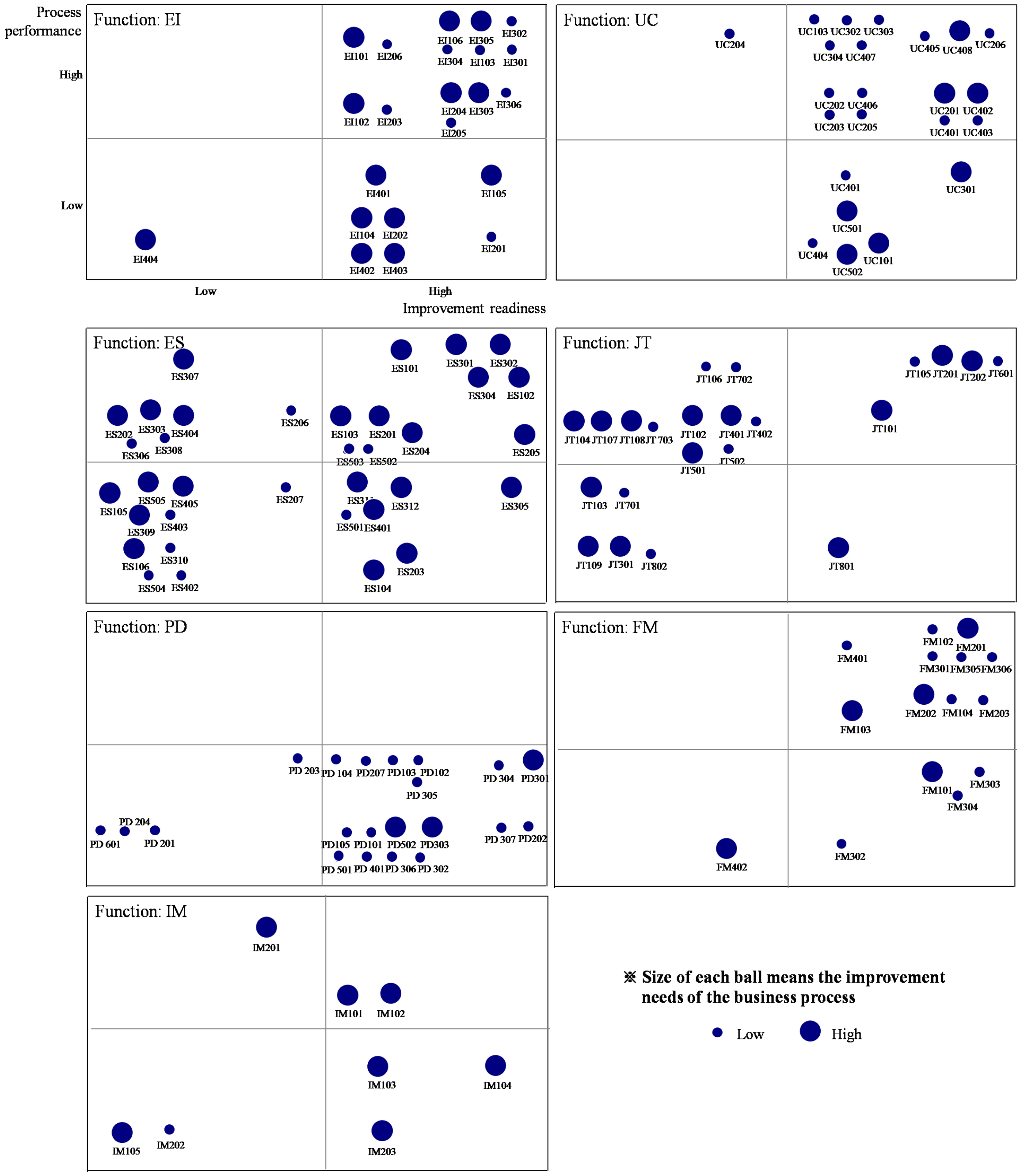

FIGURE 4. Evaluation results of the business processes in the KEIS

contingency theory, dynamic capability theory, or task-technology fit theory, the level of employee's specialization may be included as a critical success factor for BPM [45]. Thus, additional processes involving investments into training and empowerment of employees should be included in BPMS studies. Based on the results of this case study, we suggest that our method provides a flexible and relatively simple way to select and prioritize business processes.

6. **Summary and Conclusion.** We used exploratory factor analysis and presented a practical application case to illustrate a business process selection method useful for planning BPMS implementation. Three factors (Improvement Needs, Process Performance,

and Improvement Readiness) and nine items within those factors were defined. Based on our factor-item construct, a three-dimensional decision framework was developed. The method contains the logic required for prioritizing business processes, and permits the use of four types of business process improvement strategies. Through this method, we can evaluate and select the business processes that provide improvement opportunities. The proposed method could become an important tool in business process innovation (or reengineering), and a key to its success. Furthermore, by monitoring business effects subsequent to the use of our method, the amount of business value from BPMS could be increased.

There are some limitations in our method that need to be resolved. Since cross-functional collaboration or inter-functional integration is an essential factor for process innovation and performance achievement, not only unit processes, but also pre- and post-processes, which are connected to this, have to be comprehensively improved, managed and controlled. As noted in Section 6, however, there is no structured form or method for reviewing the discontinuation of selected business processes, though such review is indispensable when considering whether each of the selected business processes is connected with non-selected or discontinued processes. Without such further research, our method may be useful, but the review process will remain costly and time-consuming, and dependent on analyzers' expertise.

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