Performance Evaluation for Public u-IT Services using a Proposed Three-dimensional Model

Jae-Won Kim † • Se-Jin Kim † † • Jong-Bong Byun † † †

ABSTRACT

In this paper, we introduce an integrated performance evaluation model defined by the three indices (evaluation index for each evaluation stage, performance viewpoint, and performance type) and analyze the utilization and satisfaction of the seven public u-IT services implemented from 2008 to 2009 using the proposed model. From the performance results of the public u-IT services, it was found out that most of the research goals initially set by the public u-IT service support projects were satisfied. Furthermore, we suggest improvement directions and promotion strategies of future projects.

Key Words : Public U-IT Service, Performance Evaluation Model, Three-Dimensional Performance Evaluation Model, New Project Evaluation Method

3차원 평가모델을 이용한
공공 u-IT 서비스 성능분석

김재원 † • 김세진 † † • 변중봉 † † †

요 약

본 논문에서는 3차원 평가모델을 기반한 성과측정모델을 제안하며, 제안하는 평가모델을 이용하여 2008년과 2009년에 수행한 7개의 공공 u-IT 서비스의 사용자 만족도와 활용도를 분석한다. 본 연구를 통해, 당초 공공 u-IT 서비스 지원사업이 목표하였던 대부분의 연구목적을 달성하였음을 알 수 있었으며, 성과측정 및 분석결과는 향후 추진할 신규과제의 추진방향 제시한다.

주제어 : 공공 u-IT 서비스, 성과측정모델, 3차원 성과측정모델, 신규사업 추진방안

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1. Introduction

Since 2004, the Korean government has been pushing forward a variety of pilot projects and policies aimed at industrial revitalization the public the private sectors, in order to develop Radio Frequency Identification (RFID) / Ubiquitous Sensor Network (USN) industry as the new growth engine. In 2008, Korea’s new government adopted slogans such as “safe country” and “customized welfare” as some of the 100 major national tasks, and by utilizing ubiquitous technology in public sectors, the Korean government strived to solve social issues such as preventing natural disasters and accidents and improving welfare services. As the recent information technology environment is aimed at creating new services and values through fusion, a new strategy of national informationization is needed. Based on the necessity and demand of such technology, the Korean government pushed forward u-service support projects called public ubiquitous Information Technology (u-IT) services for various project goals from 2008 to 2009 [1][4][5][6][7].

However, performance evaluation of each project goal is just as important as the implementation of such u-IT services. That is, the performance evaluation model of each project and the development of reflux system should be studied, and based on these results, the development of an integrated model measuring the performance of u-IT projects, and the actual performance evaluation using such model is required.

Therefore, in this paper, we introduce an integrated performance evaluation model defined by the three indices (evaluation index for each evaluation stage, performance viewpoint, and performance type) and analyze the utilization and satisfaction of the seven public u-IT services implemented from 2008 to 2009 using the proposed model. From the performance results of the public u-IT services, it was found out that most of the research goals initially set by the public u-IT service support projects of the research goals initially set by the public u-IT service support projects were satisfied. Furthermore, we suggest improvement directions and promotion strategies of future projects.

The remainder of this paper is organized as follows. Section 2 introduces the related work and section 3 proposes an integrated performance evaluation model defined by the three indices. Section 4 analyzes the performance results of public u-IT projects and section 5 concludes this paper with future research issues.

2. Related work

2.1 IT Balanced ScoreCard (BSC) performance evaluation methodology

<table>
<thead>
<tr>
<th>Year</th>
<th>Name of projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Installation of a school zone safety system in a ubiquitous environment</td>
</tr>
<tr>
<td></td>
<td>Installation of an unmanned security system in the government complexes</td>
</tr>
<tr>
<td>2008-2009</td>
<td>Installation of a USN-based integrated weather/ocean observation environment</td>
</tr>
<tr>
<td></td>
<td>Installation of a u-Care system for seniors living alone</td>
</tr>
<tr>
<td></td>
<td>Installation of a RFID-based air cargo customs clearance system</td>
</tr>
<tr>
<td></td>
<td>Proliferation of a RFID-based national stock management environment</td>
</tr>
<tr>
<td>2009</td>
<td>u-Waterfront safety pilot project</td>
</tr>
</tbody>
</table>
BSC, which is designed by Kaplan and Norton (1992), is a tool that strategically operates a system through the Strategy Map and the Key Performance Indicator (KPI), and it is also a methodology that can evaluate and manage the performance of a firm’s financial performance, customer viewpoint, improvement viewpoint of the internal process, education of the organization, and growth viewpoint in a balanced way [9][11].

However, IT BSC analysis methodology solves several problems possessed by the performance analysis methodology of the current information technology and system. First, IT BSC methodology analyzes and manages performance through the introduction and institutionalization of performance index for analysis, it ultimately improves the value creation level of the organization. Second, IT BSC analyzes performance through various indices from the investment effect index from a financial viewpoint to the customer satisfaction rate, and thus based on this capability, it helps acquire information related to decision making, such as future investment validity and readjustment plans for resource distribution. Third, IT BSC has the advantage of having the capacity to continuously improve the performance by requiring participation for the people in charge at the work-site department, and moreover, endowing responsibility for the result to the pertinent department to, by monitoring IT investment performance.

In conclusion, IT BSC analysis methodology grows out from the fragmentary analysis of the studies of the previous information technology and system, which analyzes the verification of factors of success consequences of the system itself or the economic effects.

2.2 Delone & Mclean’s information system evaluation model

In this model, the six performance factors that influence the success of an information system are composed of system quality, information quality, system usage, user satisfaction, individual performance, and organization performance. In evaluating the outcome of an information system, one can use performance measurement indices of various properties such as the property of the system itself, property of the information coming out of the system, user property, and organization property [2][3][8][10].

Since Delone and Mclean’s (1992) initial model only considers the impact factors of the information system itself [2], it has limitations: first, variables for the situation of the organizations using the information system are missing. Second, “use” of the information system can be replaced with “usefulness,” not simply usage. In other words, if this usage is not compulsory, “system use” can be a sound alternative for evaluating “system usefulness” and be an objective evaluation index, but if the information system is not used or the usage is compulsory, such approach is inappropriate and thus “system utility” should replace “system use”. Third, although the system function of the information system itself contains service factors that satisfy the IT needs of an organization, most models do not consider such factors in performance evaluation.

After 1992, Delone and Mclean (2002) partially revised their model based on the criticism from other studies by adding “service quality” to the “system quality” and “information quality,” introducing “usage purpose” to the “system usage” domain, and by realizing that the benefit of distinguishing “individual effect” from “organizational effect” is not large, these two were combined as the “net effect.” The characteristic of the “net effect” is that the reflux properties that influence the “system usage” and “user satisfaction” again are contained in the mode [3].
3. Proposed three-dimensional performance evaluation mode

3.1 Three-dimensional evaluation reflux system

The three-dimensional reflux system overcomes the disadvantages of the two-dimensional reflux system and it is aimed at correctly reflecting the characteristics of the three-dimensional cube performance evaluation model of u-public services.

Although the two-dimensional reflux system has the advantage of being able to make clear decisions by expressing the continuity of a project in the form of a portfolio through evaluation results, two characteristics of the evaluations results are not reflected as both the evaluation results for each performance viewpoint and those for each performance type are interpreted simultaneously.

As explained previously, the evaluation results

![Diagram](image)

<table>
<thead>
<tr>
<th>Formula for deciding whether to invest/drop a new project 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ f(\alpha, \beta, \gamma) = \frac{1}{3} \times \left( \frac{1}{2} \times \alpha \times \beta \right) \times \gamma \geq 36 ]</td>
</tr>
</tbody>
</table>
| Invest
| \[ f(\alpha, \beta, \gamma) = \frac{1}{3} \times \left( \frac{1}{2} \times \alpha \times \beta \right) \times \gamma < 36 \] |
| Drop
|

<table>
<thead>
<tr>
<th>Formula for deciding whether to invest/drop a pilot project 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ f(\alpha, \beta, \gamma) = \frac{1}{3} \times \left( \frac{1}{2} \times \alpha \times \beta \right) \times \gamma \geq 36 ]</td>
</tr>
</tbody>
</table>
| Invest
| \[ f(\alpha, \beta, \gamma) = \frac{1}{3} \times \left( \frac{1}{2} \times \alpha \times \beta \right) \times \gamma < 85.3 \] |
| Drop
|

<table>
<thead>
<tr>
<th>Formula for deciding whether to self-expand/drop an expanding project 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ f(\alpha, \beta, \gamma) = \frac{1}{3} \times \left( \frac{1}{2} \times \alpha \times \beta \right) \times \gamma \geq 36 ]</td>
</tr>
</tbody>
</table>
| Self-expand
| \[ f(\alpha, \beta, \gamma) = \frac{1}{3} \times \left( \frac{1}{2} \times \alpha \times \beta \right) \times \gamma < 36 \] |
| Drop
|

1) Standard basis of choosing a new project
   - If the score of X, Y, and Z axis is 50% (6 points), respectively: \[ f(\alpha, \beta, \gamma) = 36 \] ← Threshold score for choosing the project
2) Standard basis of choosing a pilot project
   - If the score of X, Y, and Z axis is 80% (8 points), respectively: \[ f(\alpha, \beta, \gamma) = 85.3 \] ← Threshold score for choosing the project
3) Standard basis of choosing an expansion project
   - If the score of X, Y, and Z axis is 50% (6 points), respectively: \[ f(\alpha, \beta, \gamma) \geq 36 \] ← Threshold score for choosing the project

Increase the rate of success of expansion projects by setting the threshold score for pilot projects relatively higher than that for the new and expansion projects.

[Fig. 1] Basic three-dimensional performance evaluation model.
for each performance viewpoint, which corresponds to the y axis of the three-dimensional cube model, possess time-series properties, and the performances of each IT BSC viewpoint expressible by each project are evaluated in the form of common indices. However, evaluation for each performance type, which corresponds to the z axis of the cube model, is a specialized index that should be separately classified and evaluated as it expresses a more fundamental and representative performance of the project. Therefore, the evaluation reflux system should also be expressed in three dimensions in order to correctly evaluate such characteristics.

Fig.1 shows a basic model of a three-dimensional reflux system which can be compared to a three-dimensional cube model for performance evaluation of u-public services. The combined evaluation results for each aspect are converted into a 10-point scale, and if the evaluation result value in terms of evaluation stage (x axis) is α, the evaluation result value in terms of performance viewpoint is β, and the evaluation result in terms of performance type is γ, the volume of the solid expressed as a triangular pyramid obtained by connecting each value is the final evaluation score. That is, if the volume of the triangular pyramid is expressed as \( f(\alpha, \beta, \gamma) \),

\[
f(\alpha, \beta, \gamma) = \frac{1}{3} \left( \frac{1}{2} \times \alpha \times \beta \right) \times \gamma.
\]

(\( \alpha \): evaluation result value in terms of evaluation stage, \( \beta \): evaluation result value in terms of performance viewpoint, \( \gamma \): evaluation result in terms of performance type)

When using the three-dimensional reflux system, if the standard value of the x, y, and z axis, or the threshold value of the volume is determined, one can determine the continuity of each project. Just as an evaluation of the corresponding index is possible when the average value of each evaluation index exceeds a threshold value – although if any of these indices affects dropping the project, it may not be invested because of such an index, even if the combined average is high - if there exists a specific drop criteria, a project may be dropped even if the volume is above the threshold value.

4. Performance Analysis of Public u–IT Services

4.1 Measurement of Performance and Analysis of Public u–IT Services

In this sub-chapter, performance measurement results about the utilization and satisfaction of public u–IT service projects carried out are analyzed in Table 2 and 3.

4.2 Suggestion for Improvement Measures for the Future Implementation of u–IT Service Business

4.2.1 Building up Business Alliances with Related Organizations and Improving Legal System

As public u–IT services are carried out by the central government, it often requires close cooperation with related organizations compared to businesses carried out by local governments. Especially, for u-Safety field, cooperation with police authorities and for u-Life field with medical institutions and fire department are very important factors for services’ completeness and increasing efficiency. Also, the actual effect of remote health monitoring service would only be feasible only if related regulations are amended. In case of emergency of a senior citizen living alone, close cooperation system with the fire department is crucial.
<Table 2> Satisfaction rate of users (%).

<table>
<thead>
<tr>
<th>Name of projects</th>
<th>User distribution</th>
<th>Average</th>
<th>Total rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Civilians</td>
<td>Officers</td>
</tr>
<tr>
<td>Installation of a school zone safety system in a ubiquitous environment</td>
<td>93.3</td>
<td>6.7</td>
<td>37.9</td>
</tr>
<tr>
<td>Installation of an unmanned security system in the government complexes</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Installation of a USN-based integrated weather/ocean observation environment</td>
<td>66.7</td>
<td>33.3</td>
<td>76</td>
</tr>
<tr>
<td>Installation of a u-Care system for seniors living alone</td>
<td>70</td>
<td>30</td>
<td>92.2</td>
</tr>
<tr>
<td>Installation of a RFID-based air cargo customs clearance system</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Proliferation of a RFID-based national stock management environment</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>u-Waterfront safety pilot project</td>
<td>50</td>
<td>50</td>
<td>65.2</td>
</tr>
</tbody>
</table>

4.2.2 Expansion of Project Scope and Budget Input

Two of the most remarkable characteristics of ubiquitous technology are real-time information collection (Sense) and proper response through shared use. It is very meaningful to collect real-time information through remote data collection technology in previously difficult environment - for instance, island areas or the coast where it is extremely hard to approach. However, such information must have high credibility. Also, as the information is collected with great difficulty, more related organizations should share it and enable multilateral responses.

Even though some achievements were revealed in a few researched assignments, the projects’ scope was limited to certain regions (Northern Jeju, around Halla Mountain, waters around Seongsan, etc.) and it was hard to maximize the projects’ effects. Especially for projects whose prediction performance is enhanced only when data collection from vast range of regions such as weather and ocean forecasting, enlarging the scope of the projects and expansion of budget that follows are essential.

4.2.3 Clarification of the Projects’ Policy Direction

For projects with insufficient economic achievements or difficulties in measuring economic achievements, their characteristics themselves may have nothing to do with economics. However, in fact, they may have uncertain policy directions.

Of course it is possible for a service to have various achievements. However, no matter how satisfactory collateral achievements are, if initial policy directions are ambiguous or unclear, it is hard to get good evaluations for the overall project.

This problem must be solved by a thorough review of the policy directions and design of a service model that suits the purpose of the project before the carrying out the specific projects. Even when the project is being pushed forward, the projects’ policy direction must be clearly defined to enhance final achievements.

5. Conclusion

In this paper, we introduce an integrated performance evaluation model defined by the three indices (evaluation index for each evaluation stage, performance viewpoint, and performance type) and analyze the utilization and satisfaction of the seven
public u-IT services implemented from 2008 to 2009 using the proposed model. From the performance results of the public u-IT services, it was found out that most of the research goals initially set by the public u-IT service support projects were satisfied.

Therefore, we point out that various u-IT projects that would be implemented by the Korean government must consider the following:

Firstly, project must not have any legal problem. Installation of a school zone safety system in a ubiquitous environment project implemented in 2008 and 2009 cannot be operated anymore because of legal constraints that limited the speed measurement to specific technology. This is an example of a problem that was caused by lack of legal reviews of the project before implementation.

Secondly, technological development must have been completed before implementing the projects. Due to the unique characteristics of u-IT projects, leading performance of new technology is needed but projects using immature technology could cause a waste of business costs.

Also, projects must have economic values. In many cases the government’s information projects are carried out for investment purposes, but it is an inevitable fact that there is less and less resources for projects with no ROI (Return of Investment).

The installation of a RFID-based air cargo customs clearance system project has saved 140.4 billion won from improvements in customs process and reduction in cost of resources and the Proliferation of a RFID-based national stock management system project saved 168 billion won from enhancing national stock management process, and both projects contributed greatly to boosting competitiveness of related industry. Similar projects such as building export customs systems or ocean trade customs systems would be the model of economic information projects.

Finally, projects must contribute to job creation. This means that information business also must consider the domestic economic situation and it could be the logic shielding the projects from criticisms that state that information reduces jobs. Proliferation of a RFID-based national stock management system project is a good example as it created 95,900MM jobs. Similarly, information business that attaches, operates and manages the QR (Quick Response) codes is a good example as well.

While keeping the basic frame of public u-IT service performance measurement model developed in this research, partial modification and supplementation are needed every year to suit projects’ strategic direction. The performance evaluator should modify the model considering the trend of performance measurement and change in project details but higher evaluation plan and higher project strategy must also be reflected. In the future, there is a need to analyze time-series change in performance according to project strategies.

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