

Evaluation System for Defense IT Project in Korea: Post-Implementation Stage

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Abstract

Performance measurement is not an easy task. However, it is necessary to measure the expected value of the informatization project to be invested, to help the successful progress of the informatization project, and to confirm the result of the informatization project. This study describes the evaluation systems of the defense informatization project in Korea used after the end of the informatization project (post-implementation evaluation stage). In the post-implementation evaluation stage of proposed system, the informatization project is evaluated in terms of performance achievement, project plan compliance, project management, and economic validity. For each element, this study suggests metrics and practical measurement method. With metrics and their method, it can be evaluated which project is better than others. Moreover, the lessons learned can be developed. Under scarce budget condition, defense organizations can make better performance from IT project with the evaluation system suggested in this study.

Key Words: IT Project Evaluation, Metrics, Measurement Method, Economic Validity.

I. INTRODUCTION

The Korea Ministry of National Defense (MND) distinguishes the evaluation of the defense informatization by the evaluation of the information policy, the evaluation of the IT project, and the evaluation of the level of informatization in the organizations [1]. The evaluation of informatization policy is related to various policies in the field of defense informatization. The evaluation of IT project evaluates various projects such as information systems development project, IT procurement project, information systems operation project which are going on in the defense sector. The evaluation of the level of informatization assesses the level of informatization of the defense organizations or institutes such as army, navy, air force [2].

In the evaluation systems of defense informatization projects, there are a pre-project evaluation for selection of IT project to invest, an in-project evaluation for effective management of IT project, and a post-implementation evaluation for measuring whether IT project achieved planned performance objectives or not [1].

The MND has the directive that is related to defense informatization [3]. However, the directive does not

describe a specific method of evaluation for informatization project. The evaluation is being conducted by experts without a firmly consistent method to execute the directive. Though many studies (e.g., [1]) developed evaluation systems and measurement methods in the defense environment, the agreement to a formalized method is incomplete. To overcome such a limitation, it is needed an evaluation system that users can understand and use easily.

This study describes existing works to related the evaluation system. In addition, it suggests the evaluation system for defense environments, evaluation metrics, and their measuring method used in the post-implementation evaluation stage of the informatization project. Last section depicts conclusion and future works.

II. RELATED WORKS

1. Information Systems Success Model

DeLone and McLean [4] developed an information systems (IS) success model (Fig. 1) using existing studies related to IS performance. The model describes that the quality of information systems and the quality of information affect the use of information systems and the

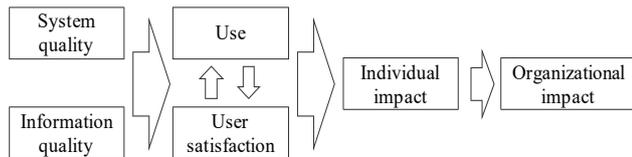
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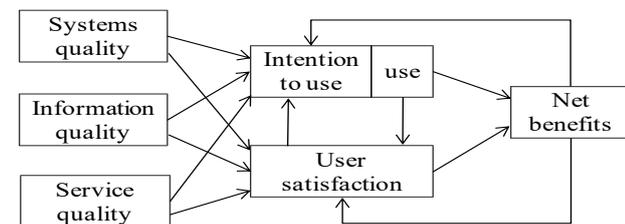
user satisfaction, that the use of information systems and the user satisfaction affect the individual performance of information systems, and that the individual performance lastly has an effect on organizational performance. In the view of information systems success model, the evaluation of information systems needs to be done in terms of information systems quality, information quality, information systems use, user satisfaction, and individual and organizational performance of information systems.



Sources: DeLone and McLean [4, p. 87], Fig. 2.

Figure. 1. DeLone and McLean's information systems success model

DeLone and McLean's IS success model [4] gained much interest from IS researchers. The model was widely used in various domains. Empirical studies using the IS success model were accumulated over time. The researchers also presented the limitations of the model. DeLone and McLean [5] reviewed the cumulative empirical studies with their model and presented updated IS success model (Fig. 2). They added service quality and intention to use to the existing model and added the feedback from net benefit (performance) to intention to use and user satisfaction. In the view of updated IS success model, information systems should be evaluated by measuring information systems quality, information quality, service quality, intention to use, use, user satisfaction, and net benefits (performance).



Sources: DeLone and McLean [5, p. 24], Fig. 3.

Figure. 2. DeLone and McLean's updated information systems success model

2. Measuring Method of IT Performance of US GAO

For measuring the performance of IT investment and showing results, United States General Accounting Office (GAO) suggested the guide that (1) use IT results chain, (2) use balanced score card (BSC), (3) develop performance indicators and results in each level of organization, (4) develop easy and understandable performance indicators,

data gathering and analysis capability, (5) strengthen IT process to improve the achievement of organizational mission performance [6]. In the guideline, performance of informatization project is measured by BSC.

In addition, GAO suggested the select-control-evaluate model as a central tenet of the federal approach to IT investment management [7]. During the select phase, there are activities such as screen, rank, and choose IT projects. In control phase, one has to monitor progress and take corrective actions. Lastly, one should conduct interviews, make adjustments, and apply lessons learned during the evaluate phase. One will check that the information systems are delivering what you expected.

3. Evaluation Method of Korean Government

In Korea, the government evaluation is conducted based on the Framework Act on the Evaluation of Government Activities [8]. The evaluation of the government work is divided into the self-evaluation which evaluates the main policy of the central administrative agency itself and the specific evaluation which evaluates the policy that the Prime Minister needs to integrally manage the central government.

Another axis of the national level evaluation for government is the financial business performance management systems implemented by the Ministry of Strategy and Finance based on Article 8 of the National Finance Act [9]. As a performance monitoring system, an organization derives its strategic goals / performance targets and develops performance indicators that can be used to measure actual achievement in performance plans, and verifies them through performance reports. It is an autonomous evaluation method in which the project executing department autonomously evaluates the financial business and uses the evaluation results confirmed and checked by the Ministry of Strategy and Finance for financial management. As another evaluation method, in addition, there is the program evaluation that suggests alternatives by deeply analyzing the effectiveness of the project using external experts and statistical techniques.

The MND evaluates IT projects according to the Defense Informatization Task Directive [3]. It includes the evaluation subject, principle, type, time, and items to be evaluated. The evaluation items are four questions (Has the planned performance met the target? As a result of the project evaluation, is the project performing effectively? Have you improved efficiency in achieving performance goals? Have you improved

efficiency in achieving performance goals?). However, though the directive suggests the evaluation items, it does not present a specific evaluation method.

III. EVALUATION SYSTEMS FOR DEFENSE IT PROJECT

As shown in Table 1, the evaluation system (post-implementation evaluation stage) of the informatization project is evaluated from the viewpoint of achievement of performance, project plan compliance, project management, and economic validity. Achievement of performance measures the degree of achievement of performance objectives (indicators) proposed in the informatization project plan. Compliance with the project plan measures whether the project cost was used according to the budget of the project plan and whether the planned period of the project plan has been complied with. The project management confirms that a project manager has fulfilled the regulations / guidelines / procedures related to the project management in the defense environment, has completed all the points in the audits, in-project evaluation, review meetings, and tests within the project period, and that there is reasonable and reliable evidence of these. Moreover, economic validity uses the benefit cost ratio. It measures the economic validation of the informatization project by comparing actually executed cost with accomplished performance (actual benefit), not planned budget or performance targets in the project plan.

Table 1. Post-implementation metric for evaluation of defense informatization projects

Metric	Description
<Post metric #1> Accomplishment of performance objective	This metric measures the degree of accomplishment of planned performance objectives in the project plan.
<Post metric #2-1> Observance of project budget	This metric measures the degree of observance of actual cost against planned budget in the project plan.
<Post metric #2-2> Observance of project period	This metric measures the degree of observance of actual project period against planned period in the project plan.
<Post metric #3> Appropriateness of project management	This metric checks the degree of reasonable progress of project management.
<Post metric #4> Benefit cost ratio	This metric calculates the ratio of achieved benefit to actual cost.

In the evaluation system, the evaluation items are measured as evaluation metrics. Table 2 shows the measurement method for measuring the degree of

accomplishment of performance objective in the project. There are two options of the measurement method for this metric. The first option is calculating the degree of accomplishment of performance objectives as a percentage. Another option is the method of using four-point scale ("No" - "Some" - "Considerably" - "Yes"). If there are multiple performance indicators of a specific IT project, weights are applied to each performance indicator to obtain a weighted average.

Table 2. <Post-implementation metric #1> Accomplishment of performance objective

Item	Description
Evaluation item	Accomplishment of performance
Metric	<Post metric #1> Accomplishment of performance objective
Explanation	Have the planned performance indicators met the targets?
Measurement method	<p><input type="checkbox"/> (Option #1) Score according to degree of accomplishment of performance objectives.</p> <p>※ Calculate the degree of accomplishment of performance objectives as a percentage.</p> <p>※ If there are many performance objectives in the project, after calculating the weight between the performance indicators developed according to the performance objectives, the degree of accomplishment of performance objectives is measured by weighted addition.</p> <p><input type="checkbox"/> (Option #2) The degree of accomplishment of reasonably presented performance targets is confirmed and graded in four-point scale.</p> <p style="text-align: center;"> ----- ----- ----- No Some Considerably Yes</p> <p>▶ Mark at "Yes" when below all criteria are satisfied</p> <p>a. "Yes" in <Ex metric #2-3> (Table A1 in Appendix)</p> <p>b. Achieved at least 100% of the target of the performance indicator</p> <p>▶ Mark at "Considerably" when it is applicable to any case below</p> <p>a. "Yes" in <Ex metric #2-3> and when the target of the performance indicator is achieved to a considerable degree (90-99%)</p> <p>b. "Yes" in <Ex metric #2-3> and even if the target value of the performance indicator is achieved at least 100%, when it corresponds to any one of the following cases: 1) if the execution is not successful due to a problem during the project, 2) if the target value of the performance indicator was exceeded by the external factors</p>

Table 2. <Post-implementation metric #1> Accomplishment of performance objective (Continued).

Measurement method (Continued)	<p>c. "Yes" in <Ex metric #2-3> and even if the target value of the performance indicator is not achieved (below 80%), when the project manager manages the project appropriately according to the project plan and has active efforts to respond to external changes</p> <p>▶ Mark at "Some" when it is applicable to any case below</p> <p>a. "Yes" in <Ex metric #2-3> and when one achieves the target value of the performance indicator to some extent (80-89%)</p> <p>b. "Yes" in <Ex metric #2-3> and even if the target value of the performance indicator is achieved at least 100%, when the data are not trustful</p> <p>c. "No" in <Ex metric #2-3>, but the target value is achieved at least 90%</p> <p>▶ Mark at "No" when it is applicable to any case below</p> <p>a. "No" in <Ex metric #2-3> and when the target value of the performance indicator is achieved below 90%</p> <p>b. "Yes" in <Ex metric #2-3> and when the target value of the performance indicator is achieved below 80%</p> <p>c. When there are the false reports about the achieved target value of the performance indicator or the manipulation of data</p> <p>※ If there are many performance objectives, one judges "Yes", "Considerably" degree, "Some" degree, and "No" in each indicator and calculates the degree of accomplishment of all performance objectives by weighted addition.</p>
Data gathering method	<input type="checkbox"/> System <input checked="" type="checkbox"/> Data <input checked="" type="checkbox"/> Questionnaires <input type="checkbox"/> Interview
Data sources	Relevant document or data to demonstrate the achievement of the performance indicators and the reliability of the data, e.g., Project Plan, Project Closure Report, Performance Report

Tables 3 and 4 show the measurement method for the observance of the project budget metric and project period metric, respectively, presenting compliance with the project plan.

Table 3. <Post-implementation metric #2-1> Observance of project budget.

Item	Description
Evaluation item	Observance of the project plan
Metric	<Post metric #2-1> Observance of project budget

Table 3. <Post-implementation metric #2-1> Observance of project budget (Continued).

Explanation	Whether or not the actual cost against planned budget of the project plan approved in the ex-project (budget) evaluation stage was used?
Measurement method	<input type="checkbox"/> Did one use the planned budget outlined in the project plan? ----- ----- No Partial Yes
	<p>▶ "Yes" criterion</p> <p>a. When one has used the budget according to the project plan</p> <p>b. Even if the budget was reduced, it is judged as "Yes"</p> <p>▶ "Partial" criterion</p> <p>When actual cost increased by less than 5% against the planned budget of the project plan (less than 5% increase)</p> <p>▶ "No" criterion</p> <p>When actual cost increased by more than 5% against the planned budget of the project plan (more than 5% increase)</p>
Data gathering method	<input type="checkbox"/> System <input checked="" type="checkbox"/> Data <input type="checkbox"/> Questionnaires <input type="checkbox"/> Interview
Data sources	Project Plan, Project Closure Report

Table 4. <Post-implementation metric #2-2> Observance of project period

Item	Description
Evaluation item	Observance of the project plan
Metric	<Post metric #2-2> Observance of project period
Explanation	Verify compliance with the duration of the project plan in the ex-project (budget) evaluation stage.
Measurement method	<input type="checkbox"/> Did one finish the project according to the project period in the project plan? ----- ----- No Partial Yes
	<p>▶ "Yes" criterion</p> <p>a. When one followed the period of the project plan</p> <p>b. Even if the project is completed early, it is judged as "Yes"</p> <p>▶ "Partial" criterion</p> <p>When the project period is delayed by less than 5% (less than 5% delay)</p> <p>▶ "No" criterion</p> <p>When the project period is delayed by more than 5% (more than 5% delay)</p>
Data gathering method	<input type="checkbox"/> System <input checked="" type="checkbox"/> Data <input type="checkbox"/> Questionnaires <input type="checkbox"/> Interview
Data sources	Project Plan, Project Closure Report

Table 5 shows the explanation of the appropriateness of project management metric. The project manager has to follow the regulations, guidelines, and procedures that is related the national and defense project management. Furthermore, there is evidence can reveal their observance.

Table 5. <Post-implementation metric #3> Appropriateness of project management.

Item	Description
Evaluation item	Project management
Metric	<Post metric #3> Appropriateness of project management
Explanation	Verify that the project management has proceeded rationally.
Measurement method	<input type="checkbox"/> Have you followed the regulations, guidelines, and procedures related to project management and rationally proceeded? ----- ----- ----- No Some Considerably Yes ▶ Mark at "Yes" when below all criteria are satisfied a. When all the regulations, guidelines, and procedures related to project management are faithfully implemented b. When all the points in the audits, review meeting, and examinations are resolved within the project period c. When you have all of the evidence ▶ Mark at "Considerably" When most of the regulations, guidelines, and procedures related to project management are faithfully implemented ▶ Mark at "Some" When some of the regulations, guidelines, and procedures related to project management are faithfully implemented ▶ Mark at "No" when it is applicable to any case below a. Failure to comply with the regulations, guidelines, and procedures related to project management b. Failure to obtain evidence for the part of the implementation c. Failure to resolve any issues in the audits, review meeting, and tests
Data gathering method	<input type="checkbox"/> System <input checked="" type="checkbox"/> Data <input type="checkbox"/> Questionnaires <input type="checkbox"/> Interview
Data sources	Evidence of implementation of the regulations, guidelines, and procedures

Table 6 represents economic validity of the project. In the ex-project stage, the project was checked and selected with expected performance and estimated cost. After

project, this metric compares the achieved performance against actual cost, which includes all cost items in total cost of ownership, in the project.

Table 6. <Post-implementation metric #4> Benefit cost ratio.

Item	Description
Evaluation item	Economic validity
Metric	<Post metric #4> Benefit cost ratio
Explanation	Verify that the ratio of performance-to-cost is appropriate.
Measurement method	<input type="checkbox"/> Are the performance (performance targets or performance indicators) achieved in the project appropriate, considering the input costs? ----- ----- No Partial Yes ※ Cost should be in terms of total cost of ownership.
Data gathering method	<input type="checkbox"/> System <input checked="" type="checkbox"/> Data <input type="checkbox"/> Questionnaires <input type="checkbox"/> Interview
Data sources	Documents that can verify the achievement of the targets of the performance indicators, such as Project Plan, Project Closure Report, and Performance Report, and the reliability of the data

IV. CONCLUSION

The (post-implementation evaluation stage) evaluation system for the defense informatization project evaluates the informatization project from the viewpoint of achievement of performance, adherence to project plan, project management, and economic validity. There is a limitation in most of evaluation methods. The development of a theoretically complete evaluation system is important, but it is more important to develop and apply an evaluation system that is easy for users to understand or apply it. The evaluation system should be used continually in real projects and supplemented so that the evaluation system that is accepted by many stakeholders including the evaluated organizations as well as the evaluators can be developed.

For the future work, it is necessary to use and supplement the proposed evaluation system. One should practically use the evaluation system for various real projects, check its usability, and develop the best practices and lessons learned. As the evaluation cases are accumulated, if the evaluation system is not clear enough to mislead the evaluator, there should be a complementary work of the evaluation system. Moreover, it is necessary to ensure that there is sufficient consistency in the evaluation of the ex-project stage [9] and the evaluation of the post-implementation stage in this study, and it should

be verified whether the evaluation can proceed easily even if there is not a lot of expertise in the evaluation.

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REFERENCES

- [1] H. J. Kwon, J. S. Choi, S. T. Kim, H. J. Lee, and Y. P. Sung, "A study for improving an evaluation systems of defense informatization," Korea Institute for Defense Analyses, Seoul, Republic of Korea, Research Report, Feb. 2012. (In Korean)
- [2] S. Lee, H. S. Jung, and S. J. Yoon, "An application with an evaluation methodology for defense informatization and validating the methodology," Sun Moon University, Asan, Republic of Korea, Research Report, Nov. 2012. (In Korean)
- [3] Korea Ministry of National Defense (MND), "Defense Informatization Task Directive," MND Directive No. 2129, <http://www.law.go.kr/행정규칙/국방정보화업무훈령>, Feb. 2018. (In Korean)
- [4] W. H. DeLone and E. R. McLean, "Information systems success: The quest for the dependent variable," *Information System Research*, vol. 3, no. 1, pp. 60-95, 1992.
- [5] W. H. DeLone and E. R. McLean, "The DeLone and McLean model of information systems success: A ten-year update," *Journal of Management Information Systems*, vol. 19, no. 4, pp. 9-30, Spring 2003.
- [6] US General Accounting Office, "Measuring performance and demonstrating results of information technology investments," Tech. Rep. GAO/AIMD-98-89, <https://www.gao.gov/assets/80/76378.pdf>, Mar. 1998.
- [7] US General Accounting Office, "Information technology investment management: A framework for assessing and improving process maturity," Tech. Rep. GAO-04-394G, <https://www.gao.gov/assets/80/76790.pdf>, Mar. 2004.
- [8] Prime Minister, "Framework Act on the Evaluation of Government Activities," Act No. 14118, [http://www.law.go.kr/법령/정부업무평가기본법/\(14118\)](http://www.law.go.kr/법령/정부업무평가기본법/(14118)), Mar. 2016. (In Korean)
- [9] Ministry of Strategy and Finance, "National Finance Act," Act No. 15342, <http://www.law.go.kr/법령/국가>

재정법, Jan. 2018. (In Korean)

- [10] S. Lee, K. H. Baik, and B. G. Kim, "An evaluation system for a national defense informatization project at the pre-project stage," *Journal of Engineering and Applied Sciences*, Vol. 10, No. 2, pp. 22-27, 2015.

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APPENDIX

Table A1. <Ex-project metric #2-3> Propriety of target value of performance indicator

Item	Description
Evaluation item	Propriety of performance planning
Metric	<Ex metric #2-3> Propriety of target value of performance indicator
Explanation	The target value of performance indicator should be reasonable to achieve the performance objective in the project or on the trend.
Measurement method	<input type="checkbox"/> Has the target of the performance indicator been set appropriately? ----- No Yes
	▶ Mark at "Yes" when all criteria are satisfied

Table A1. <Ex-project metric #2-3> Propriety of target value of performance indicator (Continued)

Measurement method (Continued)	<p>a. If you set a target value that exceeds the level that can be automatically achieved through normal project execution without any special effort for performance enhancement</p> <ul style="list-style-type: none"> ※ In response to changes in the external environment that can be predicted sufficiently in advance, countermeasures should be prepared and the target values should be set reasonably ※ The level that can be achieved automatically is judged and set by itself through comparison between past trends and similar projects <p>b. When the target value of the performance indicator is set to reflect efforts to improve performance, such as improving the project method</p> <p>▶ Mark at "No" when it is applicable to any case below</p> <ul style="list-style-type: none"> a. If the target value of the performance indicators is set after the project is implemented b. If one sets the targets of the performance indicators below the level achievable without any special effort c. If you set the targets of the performance indicators without clear and reasonable grounds d. If "No" in <Ex-project metric #2-1> or <Ex-project metric #2-2> <ul style="list-style-type: none"> ※ After determining "Yes" or "No" for each performance indicator, the weights are applied
Data gathering method	<input type="checkbox"/> System <input checked="" type="checkbox"/> Data <input type="checkbox"/> Questionnaires <input type="checkbox"/> Interview
Data sources	<p>Document or data that can explain the targets of the performance indicators are concrete and reasonable</p> <p>Project Plan, Performance Plan that suggests the performance indicator and its target, Project Explanation Document</p>

Note: For <Ex-project metric #2-1> or <Ex-project metric #2-2>, readers are referred to Lee et al. [10].