Performance Measurement Method for Agriculture Informatization by Business Unit

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Abstract

This paper proposes a performance analysis method by business unit for informatization in public sector, specifically agriculture. Performance of informatization has been evaluated by indicators or hierarchies which affect the development or implementation of information systems. However, in public sector, business projects for informatization cannot be conducted unless the budget is assigned. This motivates us to evaluate the performance of informatization by business unit associated with the budget unit. In this paper, we suggest a performance measurement and analyse the performance of informatization of agriculture by business unit for government projects.

Keywords: Agriculture, Business Unit, Informatization, Performance Measurement, Public Sector

1. Introduction

Informatization presents a key process of information and communication technology (ICT)⁸. Advances of human society has been accompanied with informatization. Agriculture modernization has achieved by the help of agriculture informatization³.

This paper aims to propose a performance analysis method for informatization in agriculture. Quantified performance of agriculture informatization indicates the level of modernization of agriculture and provides the index which can be used to compare systems from a variety of different fields.

Informatization is quantified by the performance ratio which is derived from the ratio between target and outcome. The unit of budget is assigned to every business unit. This is the motivation of our newly proposed performance measurement method based on a business unit.

The validity of the presented method is identified with the real case study. The data is collected from the budget and fund management plan report of Ministry of Agriculture, Food and Rural Affairs in Korea.

The contributions of this paper are two-folds: Firstly, the proposed performance measurement is easy and objective to calculate the quantified performance. Secondly, the method is able to conduct the analysis such as cost/benefit of each government project.

2. Related Works

Porat and Rubin⁵ firstly introduced the measurement of information economy and used the ratio of labors and populations as the measurement factors. Kouzmin et al.⁶ proposed the method for performance measurement using benchmarking and charters which assess and award quality in the public sector. Patria de Lancer Julnes⁴ investigated the factors which affect the utilization of performance measurement in public sectors.

Tong and Li⁶ suggested a hybrid model that adopts three methods: AHP (Analytics Hierarchy Process), GHE (Gray Hierarchy Evaluation), and DEA (Data Envelopment Analysis). Liu and Zhang⁷ proposed an evaluation method to use fuzzy quantification for agriculture informatization in China. Gray system theory has been used to construct an assessment model for the enterprise informatization which employ the grey comprehensive correlation analysis⁷. The model has three
levels of hierarchy that consists of 3 first level indicators, 16 second level indicators, and 80 third level indicators. Zhang et al.\cite{8} proposed a catastrophe progression model for informatization level assessment of rural areas. Recent model for performance measurement of informatization is the model proposed by KISDI (Korea Information Society Development Institute)\cite{1}.

3. Performance Analysis Model

Let $M$ be a ministry in a government and $A = \{a_1, a_2, ..., a_k\}$ be a set of agencies. A set of business units is defined as $B = \{b_1, b_2, ..., b_k\}$. Ministry $M$ has $p$ year plan for informatization which is the plans from the 1st to the n-th year. Every year, there are $\tau$ major projects. Each major project consists of $q$ multiple sub-projects and each sub-project has $n$ unit projects which are the set of business unit $B_i$. 

Let $\Gamma = \{y_1, y_2, ..., y_q\}$ be the set of major projects and $\Delta = \{\delta_1, \delta_2, ..., \delta_q\}$ be the set of sub-projects. 

Thus, $i \in \{1, ..., \tau\}, k \leq q$ is the $i$th major project which contains several sub-projects and $\delta_{ij}$ is the $j$th sub-project within the $i$th major project. If $\delta_{ij} \in B_j = \{b_{i1}, b_{i2}, ..., b_{ij}\}$.

Likewise, $i \in \{1, ..., q\}, k \leq n$ is the $i$th sub-project which contains $n$ unit project and $b_{ij}$ is the $j$th unit project within the $i$th sub-project.

Assume that the unit project can be conducted in multiple sub-projects. Accordingly, $B_i \cap B_j = \emptyset, i \neq j \in \{1, ..., n\}$. On the other hand, we assume that $\Delta_i \cap \Delta_j = \emptyset, i \neq j \in \{1, ..., q\}$, which means that major projects have distinct sub-projects.

Each unit project has multiple performance indices which can be converted into the ratios. Define the performance indices for $i$th unit project be $\omega_i$ and the number of indices for the project be $e_i$. The ratio can be obtained by divide the outcome value with the target value for the specific index of the unit project. Thus, $\omega_i \in [0, 1]$.

Now, we define the performance of unit project at year $k$ as follows.

$$PB_{ki} = E[\omega_{ki}] = \frac{\sum_i \omega_{ki} \epsilon_{ki}}{e_{ki}} \quad (1)$$

where $i \in \{1, ..., n\}, k \in \{1, ..., p\}, e_{ki} \neq 0$.

The performance of sub-project at year $k$ can be calculated as follows.

$$PS_{ki} = E[PB_{ki}] = \frac{\sum_i PB_{ki}}{n(\delta_i)} \quad (2)$$

where $i \in \{1, ..., q\}, k \in \{1, ..., p\}, n(\delta_i) \neq 0$.

Using the performance of sub-projects, the major project at year $k$ can be evaluated as follows.

$$PM_{ki} = E[PS_{ki}] = \frac{\sum_i PS_{ki}}{n(\gamma_i)} \quad (3)$$

where $i \in \{1, ..., \tau\}, k \in \{1, ..., p\}, n(\gamma_i) \neq 0$.

The performance of overall projects at year $k$ can be obtained as follows.

$$PO_k = E[PM_{ki}] = \frac{\sum_i \{\sum_{\tau}PS_{ki}\}}{\tau} \quad (4)$$

where $k \in \{1, ..., p\}, n(\gamma_i) \neq 0$.

4. Case Study

The presented model for the performance of informatization is validated with agriculture informatization in Korean government. The data is sourced from budget and fund management plan report of ministry of agriculture, food and rural affairs. The data is for the period from 2012 to 2015.

The performance of the unit project can be obtained by the equation (1). Figure 1 shows the result of the performance of agriculture informatization for unit project during four years (2012–2015).

![Figure 1. Performance of unit project by year.](image-url)

Figure 2 shows the performance of overall projects by year included all five major projects which is calculated by equation (4).
5. Conclusions

This paper proposes a performance measurement method for informatization considering the budget assignment. It can be achieved by analysing the project with business unit associated with budget unit. By doing this, the presented method provides simple calculations of performance and allows to do the cost/benefit analysis for each project which can be used to make decisions for assignment of the next year budget. Case study of a ministry of agriculture, food and rural affairs in Korea has validated the proposed method viable.

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7. References