Information gaps between irrigation establishment and farmer set-up

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Abstract. The level of a person's cognitive processing ability is different, which influences how to understand and utilize the knowledge and information obtained from the media. Organizations can assess their knowledge resources and capabilities by conceptually designing strategies to minimize the knowledge gaps, improve performance, and produce various innovations by identifying the knowledge possessed, targets to be achieved, training and collaboration, research, and surveys for knowledge development, etc. The widening of knowledge gaps related to information development, individual attitudes, and behavior that knowledge transfer is needed to minimize the gap. This study aims to identify knowledge gaps between farmer institutions and irrigation bureaucracies. The method used is knowledge gap (K-Gap) analysis by measuring the level of importance of knowledge required against the available resources by scaling the questionnaire Likert Scale. The K-Gap analysis of the knowledge needed and currently available can evaluate performance in the planning and evaluation stages and become one of the decision-making systems in the management of an organization's internal management, to increase motivation and represent the expectations of all users. The K-Gap value is obtained to indicate the direction of improvement that must be carried out.

1. Introduction

Information or knowledge is a valuable asset carrying out any ongoing process in the organization, while knowledge management is a systematic step to manage knowledge within the organization, create value, and increase competitive advantage [1]. The application of knowledge management in an organization can change the mindset of managers and users who essentially already have personal knowledge and experience, where this knowledge is in their minds, not documented and sometimes difficult to define or convey to others. Improving the knowledge and competence of each individual or organization can be done through training, seminars, education, workshops, meetings, discussions and others.

The development of knowledge management is not only related to technological devices but also depends on the understanding, awareness of farmers and managers and how to communicate through knowledge sharing to minimize knowledge gaps. [1] stated that the failure of an organization to transform itself into a learning organization could be caused by the organizational change process only
focusing on technology development but not paying attention to the management of change processes and organizational culture. The knowledge gap increases information in a society that is not evenly acquired by each member and has a probability of occurring in a pluralistic community compared to a homogeneous community [2,3]. Gap analysis aims to assess how big the gap is between the actual performance and the expected work standards, find out the required performance improvement, and become one of the bases for making decisions regarding priorities to fulfil service standards. The widening knowledge gap from time to time is caused by information related to individual attitudes and behaviour [4]. Knowledge transfer is needed to minimize the gaps that occur; the greater the number, variety, and size of the knowledge gaps, the more unstable the knowledge base required.

Irrigation management systems in primary and secondary networks is the authority and responsibility of the government through central, provincial, district or city institutions. In contrast, farmers through Water User Associations (WUA) or Water User Associations Federation (WUAF) institutions are responsible for management in tertiary networks. Organizations must assess their knowledge resources and capabilities to manage knowledge gaps by formulating gap strategies conceptually, improving performance, and generating various innovations by identifying their knowledge and targets to be achieved through training, collaboration, knowledge development through research, surveys, etc. The level of ability in cognitive processing is different, affecting the way of understanding and utilizing the media and the knowledge and information obtained from the media. The management of an irrigation area, especially in Indonesia, will involve farmer organizations (WUA) as users and irrigation bureaucracies (field staff and gate guards) as implementers. Each organization member has different knowledge and abilities in irrigation management, including differences in rules and realization of irrigation implementation procedures so that differences in knowledge result in knowledge gaps between implementers. This study aims to identify knowledge gaps between farmer institutions and irrigation bureaucracies by measuring the level of knowledge required.

Knowledge is data and information combined with experiences, abilities, intuition, ideas, motivation, values, contextual information and insights from competent experts or sources to solve problems, evaluate and combine new knowledge to produce better actions, decisions and organisational creativity [5,6]. Systematically, Organisations can be considered a collection of related information and productive resources to effectively achieve goals and view the organisation as creating knowledge in making certain decisions [1,7]. The theory of knowledge creation in organisations describes preparing and reinforcing knowledge created by individuals and linking it to organisational knowledge systems by developing the concept of group tacit knowledge quality. In developing human resources, it is necessary to have the ability to manage and develop the knowledge possessed to continuously improve competitiveness between explicit and tacit knowledge [8].

A knowledge-based organisation must be able to act intelligently and create knowledge by continuously; using knowledge both tacit (in the individual mind) and explicit (listed in work procedures, databases, etc.); creating and implementing organisational culture; hierarchical structure formed efficiently and integrated with multi-function, teamwork and ad-hoc; and the right combination of information and communication technology [9]. The challenge organisations knowledge is how to manage so that the knowledge in the minds and behaviour of individual employees (tacit knowledge) can be documented, maintained and always available for future learning [10].

Knowledge gap analysis could measure the knowledge possessed by an organisation to obtain a better understanding based on the currently available knowledge and what knowledge is needed to achieve goals [11]. Organisations need to design strategies to minimise knowledge gaps, improve performance, and produce various innovations by identifying their knowledge and achieving targets with acquisitions through training, cooperation, and knowledge development through research, surveys, etc [12]. Based on a map of strategic knowledge and capabilities, an organisation can identify the extent to which various categories of existing knowledge are in line with its strategic requirements. Underlying the strategic gap of organisations is a potential knowledge gap. The greater the amount, variety, or size of the current and future knowledge gap, and the more volatile the knowledge base because of a dynamic or uncertain competitive environment, the more aggressive the knowledge strategy required. An organisation can
determine which knowledge should be developed to close strategic knowledge gaps [13]. An objective gap analysis is expected to provide motivation and represent the expectations of all users implicitly. Gap analysis helps assess how big the gap is between actual performance and an expected work standard, knowing the performance improvements needed to close the gap, and becoming one of the bases for decision making related to managing the internal management of an organisation [11,14,15].

2. Materials and methods
The research was conducted in the Bendung Tegal Irrigation Area located in Imogiri, Bantul, DI Yogyakarta Province, one of the channels used for agricultural irrigation by the people of Siharjo Village and its surroundings. Irrigation water is channelled from the Bendung Tegal, which has an area of 155 ha of irrigation channels so that people can plant paddy three times a year. The driving organisation’s institutional of the agricultural sector in Sriharjo Village consists of WUA, WUAF, farmer groups, and farmer cadets.

The parameters in this study are to identify the indicators that influence the knowledge gaps in irrigation management. The respondent is WUA as farmer organizations and field staff and gate guards as irrigation bureaucracy. Influential variables will be compiled into a structural equation model using the SmartPLS model [16]. The indicators studied are based on five aspects of the pillars of irrigation (Y) as follows: (a) irrigation water availability (X1); (b) irrigation facilities and infrastructure (X2); (c) irrigation management system (X3); (d) irrigation management institutions (X4); and (e) human resources (X5).

2.1. Likert scale
Primary data were obtained through questionnaires with WUA respondents, field staff and gate guards. A Likert scale is used to measure the level of understanding of knowledge by converting qualitative data into quantitative ones [17]. The method used is a knowledge gap analysis by measuring the level of importance of knowledge required against the level of available resources and analysing the importance of performance to determine the level of suitability, importance, and performance and mapped into a Cartesian diagram.

2.2. Measurement model test analysis
The variables used in this study are dependent variables (Y) and independent (x), with indicators in the form of exogenous and endogenous variables. The stages of the SmartPLS analysis are as follows making a model of measurement models, making a structural model design, creating and constructing path diagrams, calculating path and cross-loading coefficients, and hypothesis testing. PLS algorithm is used to calculate the path coefficient (β). To make a path diagram using SmartPLS 3. [16]. Cronbach's alpha is a measuring model to assess internal consistency based on the intercorrelation of the observed values of the indicators. Cronbach's alpha and average variance extracted (AVE) formulas are as follows [18]:

\[
\text{Cronbach' alpha } (r_{11}) = \left( \frac{N}{N-1} \right) \left( 1 - \frac{\sum_{i=1}^{N} s_i^2}{s^2} \right)
\]

\[
\text{AVE} = \frac{\sum_{i=1}^{N} l_i^2}{N}
\]

Where, N = number of indicators, \(s_i^2\) = variance of indicator i of a particular construct, \(s^2\) = variance of the sum of all N indicators of a construct, \(l_i^2\) = the value of the outer loading of the i-th indicator to the corresponding construct.
2.3. Knowledge Gap Analysis (K-Gap Analysis)

K-Gap analysis uses a Likert Scale with a rating scale of 1-5 to measure the level of the gap in knowledge of each individual or organization. The data has collected from the K-Gap questionnaire is then calculated as the average level of importance and the average level of mastery of the required knowledge. The K-Gap value obtained will indicate the direction of improvement or development that should do with the following formula [19]:

- Calculation of importance value:
  \[ NK_i = \frac{(K_1 \times 1) + (K_2 \times 2) + (K_3 \times 3) + (K_4 \times 4) + (K_5 \times 5)}{R} \]  \[ (3) \]

- Calculation of mastery value:
  \[ NP_i = \frac{(P_1 \times 1) + (P_2 \times 2) + (P_3 \times 3) + (P_4 \times 4) + (P_5 \times 5)}{R} \]  \[ (4) \]

- The K-Gap calculation is:
  \[ K - Gap = NK_i - NP_i \]  \[ (5) \]

Where, \( NK_i \) = value of importance to knowledge, \( NP_i \) = value of mastery of knowledge, \( K \) and \( P \) = number of respondents with the answer "1", "2", "3", "4" or "5", and \( R \) = total number of respondents.

2.4. Importance Performance Analysis

Importance Performance Analysis (IPA) is method stages determine the level of conformity, calculate the average for each attribute, calculate the average of all attributes of importance and performance that are the limits on the Cartesian diagram, and map into the Cartesian diagram [20]. If the perception score is greater than the expected score, it is called a positive gap. Whereas if the expectation score is greater than the perception score, it is called a negative gap. The higher the expectation score and the lower the perception score, the gap is getting bigger. If the total gap is positive, the customer is considered very satisfied with the organization's services.

2.4.1. Conformity level. The IPA method of measuring conformity determines the level of satisfaction with the organization's performance and understanding. The level of conformity is the result of the comparison of the perception/performance score with the expected/important score [21]:

\[ Tk_i = \frac{\sum X_i}{\sum Y_i} \times 100\% \]  \[ (6) \]

Where, \(Tk_i\) = respondent's level of conformity, \(X_i\) = perception/performance assessment score and \(Y_i\) = Score of the respondent's expectations/interests

2.4.2. Cartesian Diagram. Cartesian diagrams aim to identify and correct all factors (attributes/statements) needed to make improvements to performance [21]:

- Calculating the average importance and performance rating of each statement:
  \[ \bar{X}_i = \frac{\sum_{k=1}^{n} X_i}{n} \]  \[ (7) \]

  \[ \bar{Y}_i = \frac{\sum_{k=1}^{n} Y_i}{n} \]  \[ (8) \]
Where, \( \bar{X}_i \) = the average weight of the performance appraisal level of the statement, \( \bar{Y}_i \) = the average weight of the importance rating of the statement, and \( n \) = number of respondents.

- Calculating the average importance and performance of the overall attribute/statement:

\[
\bar{X}_i = \frac{\sum_{k=1}^{k} X_i}{k} \quad (9)
\]
\[
\bar{Y}_i = \frac{\sum_{i=1}^{i} Y_i}{k} \quad (10)
\]

Where, \( \bar{X}_i \) = the average value of the performance of the statement, \( \bar{Y}_i \) = the average value of the importance of the statement, and \( k \) = number of attributes/statements.

The Cartesian diagram of each quadrant of the IPA model as shown in Figure 1.

3. Results and discussion

3.1. Measurement model test analysis

Indicator reliability shows how much the latent variable can explain the indicator variance. In indicator reliability, a reflective indicator must be eliminated or removed from the measurement model when the loading value (\( \lambda \)) is less than 0.5. The results of the outer model test before the indicator test and after the indicator test as shown in Figure 2.

![Figure 1. Cartesian diagram of the IPA model [21,22]](image)

![Figure 2. Outer model and loading factor (a) before indicator test; and (b) after the indicator test](image)
Based on Figure 2, the indicators of $X_{24}, X_{27}, X_{32}, X_{35}, X_{41}, X_{47}, X_{51}, X_{52}$ should be removed because they have a loading factor value less than 0.5, so the indicator is invalid. The indicator is said to be convergently valid if the loading factor value ($\lambda$) $\geq 0.5$ to explain its latent construct [25,26]. The testing of the measurement model in the form of construct reliability and validity to measure the reliability of a construct before predicting the relationship between latent variables in the structural model. The test value of the model based on the criteria of cronbach alpha value $> 0.6$ is reliable, composite reliability $> 0.6$ and average variance extract (AVE) $> 0.5$[23–25] as shown in Table 1.

| Variabel               | Cronbach's Alpha | rho_A | Composite Reliability | AVE  | Discriminant Validity |
|------------------------|------------------|-------|-----------------------|------|-----------------------|
| Human Resources        | 0.858            | 0.868 | 0.904                 | 0.703| 0.838                 |
| Infrastructure         | 0.835            | 0.849 | 0.878                 | 0.511| 0.715                 |
| Institution            | 0.788            | 0.803 | 0.876                 | 0.701| 0.837                 |
| Irrigation Performance | 0.802            | 0.809 | 0.910                 | 0.834| 0.913                 |
| Management             | 0.637            | 0.683 | 0.801                 | 0.577| 0.760                 |
| Water Availability     | 0.855            | 0.870 | 0.898                 | 0.640| 0.800                 |

Based on the analysis of Cronbach's alpha for all variables, the value obtained is 0.60, which means the reliability coefficient value is very high (valid). The composite reliability value above 0.6 means the indicator can measure each latent variable (construct) reliably and adequately. The better the convergent validity value, the higher the correlation between indicators of a construct. The AVE value shows the AVE value above 0.5 so that the size of the convergent validity is good enough to meet the convergent validity criteria, with the lowest AVE value being the infrastructure variable. The discriminant validity value tested also shows a value greater than the AVE root value, implying that discriminant validity correlates with each construct.

Testing the inner model can be done in three ways: testing $R^2$, $Q^2$ and GoF (goodness of fit.) The $GoF$ value by multiplying the average root value of Ave with the average value of $R^2$. Based on the test, it was obtained that the $R^2$ value of irrigation performance was 0.643, which indicated that the irrigation performance variable was 64.3% while other variables influenced 35.7%; thus, the model was classified as a moderate category. The value of $Q^2$ (predictive relevance) obtained is 0.706, meaning that the irrigation performance variable has an indirect effect on other variables. The GoF value obtained is 0.380, meaning that the model has the best goodness of fit value, where the more significant the GoF value, the more appropriate it is in describing the research sample. The value testing $R^2$, $Q^2$, and GoF show that the model is substantial. So the following equation is produced:

$$\text{Irrigation Performance} = 0.743X_1 + 0.175X_2 + 0.110X_3 - 0.054X_4 + 0.213X_5 \quad (11)$$

The above equation shows that the water availability variable has the most significant weight, namely 74.3%, and the institutional variable shows the most negligible weight at 5.4%. As shows that there are no problems in the availability of water in the research location, but still in dire need of improvements related to institutions in the irrigation system management.

3.2. Gap Analysis (K-Gap Analysis)

Based on the knowledge gap analysis between the value of interest (farmer's institution) and the value of mastery (irrigation bureaucracy), the most significant knowledge gap was water availability. One variable has a negative value, which means that the expected variable or indicator is not by reality.
smaller the difference between the interest levels, the smaller the knowledge gap, and vice versa. The average value of the K-Gap for each variable by shown in Table 2.

| Variable               | Average of Importance | Average of Performance | K-Gap |
|------------------------|-----------------------|------------------------|-------|
| Water availability (X₁) | 4.49                  | 3.87                   | 0.62  |
| Infrastructure (X₂)     | 4.38                  | 3.94                   | 0.43  |
| Management (X₃)         | 3.87                  | 3.55                   | 0.32  |
| Institution (X₄)        | 4.00                  | 3.84                   | 0.16  |
| Human Resources (X₅)    | 3.39                  | 3.89                   | -0.50 |

The results of the knowledge gap analysis become a description of the situation and conditions that occur between the parties involved in irrigation management. The involvement and cooperation between farmer institutions and irrigation bureaucracy are critical to support the smooth running of irrigation management activities. Farmers' institutions are part of the irrigation bureaucracy that can act as users, organizers and implementers to realize the sustainability of the irrigation system more effectively and efficiently [27]. The high knowledge gap on water availability can be overcome by involving and conducting more intensive and concrete coaching. Individual knowledge possessed by respondents is also a factor in the gap that occurs, where the individual knowledge of most respondents is obtained from work experience and in the tacit nature of farmers' minds. A small proportion of respondents have knowledge of irrigation management from experience, manuals on irrigation management procedures, modules, and other supporting books.

3.3. Importance Performance Analysis

The measurement of the level of conformity to show the relationship between the assessment of expectations and perceptions of farmers' institutions towards irrigation institutions is described in the Cartesian Diagram. The average level of conformity obtained is 77.93%, with the average level of performance (irrigation bureaucracy) and the average value of the level of importance (farmer's institution). The scores for performance and importance using to determine the Cartesian Diagram, as presented in Figure 3.
Based on Figure 3, it is shown that all indicator variables are spread across four quadrants as follows:

Quadrant I (Concentrate here) shows superior performance where indicators/attributes that affect the interests of farmer institutions (WUA) are considered essential and need to concentrate here. This indicator is by the irrigation service performance target. Farmer institutions are involved in irrigation management activities, and the irrigation bureaucracy carries out services according to performance targets. The indicators included in quadrant I are $X_{11}, X_{14}, X_{22}, X_{28}, X_{29}, X_{34}, X_{43}$ and $X_{51}$.

Quadrant II (Keep up the good work) shows that the indicators/attributes are mandatory and good to be maintained because they are considered essential by farmer institutions and have felt the maximum service performance carried out by the irrigation bureaucracy. All attributes are considered low satisfaction and high importance. The indicators included in quadrant II are $X_{12}, X_{13}, X_{15}, X_{16}, X_{21}, X_{23}, X_{24}, X_{25}, X_{26}, X_{31}, X_{33}, X_{42}, X_{45}, X_{46}$ and $X_{52}$.

Quadrant III (Low priority) shows that the indicators/attributes are less critical for farmer institutions, and the performance of the irrigation bureaucracy is less than optimal in service so that it is not too prioritized. The indicators included in quadrant III are $X_{35}, X_{41}, X_{44}, X_{53}$, and $X_{54}$.

Quadrant IV (Possible overskill) shows high satisfaction and low importance where indicators/attributes are less critical for farmer institutions, but the performance of the irrigation bureaucracy is exaggerating. The indicators included in quadrant IV are $X_{27}, X_{32}, X_{47}, X_{55}$, and $X_{56}$.

4. Conclusions

The study results conclude that the IPA method can be applied to determine the expectations or interests of farmer institutions on the performance of bureaucratic irrigation services in irrigation water management. Eight indicators need to consider so that the interests of farmers in the performance of irrigation services are increasing. The service performance of the irrigation bureaucracy has not fully met the expectations or interests of farmer institutions as indicated by several indicators in quadrant I (main priority), which are the main concern for improvement, consisting of water availability, infrastructure, irrigation management, institutions, and human resources. The high knowledge gap on water availability can be overcome by involving and conducting more intensive and concrete coaching. Individual knowledge possessed by respondents is also a factor in the gap that occurs, where the individual knowledge of most respondents is obtained from work experience and in the tacit nature of farmers’ minds.

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