

STUDY ON AMORTIZATION IN IRRIGATION SYSTEM MANAGEMENT USING KNOWLEDGE MANAGEMENT APPROACH

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ABSTRACT

National food security depends on paddy production. Eighty two percent of the national production of paddy is produced at irrigated land. Irrigation is an important component of the national food security, but it has many problems. The problems are 23% irrigation networks are damaged, only 11% of irrigation systems deliver water effectively, and irrigation management is inefficient. These problems were caused by the low quality of intangible assets of irrigation as an effect of amortization. The research aimed at finding the amortization level in irrigation system, finding correlation between intangible assets and performance of irrigation system, and building the amortization model in the irrigation system. The research approach applied was knowledge management; tacit and explicit knowledge management through socialization, externalization, and internalization for improving the performance of irrigation system.

The research method consisted of three stages. The first stage was building the measurement system of intangible assets in irrigation system including morality intelligence, emotional intelligence, creative attitude, institutional culture and farmer participation. Those intangible assets were measured from the comparison between two conditions (1998 and 2008). The second stage was building the model of amortization in irrigation system using neuro-fuzzy. The third stage was evaluating the model. The model had been evaluated in the irrigation system of Molek and Bondoyudo in East Java, Sapon and Mejing in Yogyakarta.

The research result indicated that there were amortization in Molek, Bondoyudo, Sapon and Mejing irrigation system. For decreasing the amortization, the intangible assets should be improved. This effort should give different priorities in each irrigation system, that are: morality intelligence and farmer participation in Molek; farmer participation in Bondoyudo; emotional intelligence and farmer participation in Sapon; emotional intelligence, creative attitude, institutional culture and farmer participation in Mejing.

Keywords: *amortization, irrigation system, knowledge management*

INTRODUCTION

National food security depends on paddy production. Eighty two percent of the national production of paddy is produced at irrigated land (Santosa, 2005). Irrigation is an important component for the national food security. However, it has many problems. The problems are 23% of irrigation networks are damaged (Santosa, 2005) with only 11% of irrigation systems deliver water effectively (Santosa, 2005), and irrigation management is

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inefficient (Maksum, 1999; Hussain, 2005; Santosa, 2005).

These problems are caused by the low quality of intangible assets of irrigation (Hutagaol, 2001; Santosa, 2005). The intangible assets influenced in management process the organization (Stewart, 1999; Sidarto, 2006) and played a role as a mobilizer and dynamist (Sutiono and Ambar, 2004). The low quality of intangible assets is an effect of amortization. Amortization is decreasing of intangible assets. Intangible assets consist human capital, structural capital and relation capital (Stewart, 1999).

The research aimed at finding the amortization level in irrigation system, finding correlation between intangible assets and performance of irrigation system, and building the amortization model in the irrigation system.

In the information era, innovation is the important component for improving of organization performance. The innovation can be created from knowledge management through socialization, externalization, and internalization (Setiarso, 2002; Tobing, 2007). Accordingly, the research approach applied was knowledge management.

RESEARCH METHOD

The research method consisted three stages. The first stage was building the measurement system of intangible assets in irrigation system including morality intelligence, emotional intelligence, creative attitude, institutional culture and farmer participation. Moral intelligence is measured by using a scale of moral intelligence with reference to Lennick & Kiel (2005) which states that moral intelligence has four principles: integrity, responsibility, caring and forgiving. Emotional intelligence is measured by using a scale of emotional intelligence with reference to Bradberry & Greaves (2005) which states that emotional intelligence has five dimensions: self awareness, self control, self motivation, empathy and relationship managing. Creative

attitude is measured by using creative attitude scales with reference to Munandar (1992) which states that creative attitude as describing the behavior that reflects the ability of fluency, flexibility, originality in thinking and the ability of elaboration. Institutional culture is measured by using a scale of institutional culture with reference to Miller (1987) which states that there are eight principles in the institutional culture: objective, consensus, solidarity, unity, integrity, excellence, empirical and achievement. Farmer participation is measured by using a scale participation with reference to Davis and Newtorm (1990) which states that there are four elements of farmer participation: physically farmer involvement, mentally farmer involvement, willingness to accept responsibility for the tasks given to the farmers, and feel responsible for complete the tasks as a farmer. Those intangible assets are measured from the comparison between two conditions (1998 and 2008).

The second stage was building the model of amortization in irrigation system using analogy principle and neuro-fuzzy. The model used straight line depreciation and Artificial Neuro Fuzzy Inference System (ANFIS) (equation 1-3).

$$A = (IA_1 - IA_2) / (t_1 - t_2) \dots\dots\dots (1)$$

$$IA_1 = a_1 + b_1 MI + c_1 EI + d_1 CA + e_1 IC + f_1 FP \dots\dots\dots (2)$$

$$IA_2 = a_2 + b_2 MI + c_2 EI + d_2 CA + e_2 IC + f_2 FP \dots\dots\dots (3)$$

where

- A = Amortization
- IA₁ = Intangible Assets in t₁ (1998)
- IA₂ = Intangible Assets in t₂ (2008)
- MI = Moral Intelligence

- EI = Emotional Intelligence
- CA = Creative Attitude
- IC = Institutional Culture
- FP = Farmer Participation
- a₁-f₂ = model parameters

Model of relationship between intangible asset and performance of irrigation

system used Artificial Neuro Fuzzy Inference System (ANFIS) (equation 4-6).

$$\text{AIDR} = m_1 + n_1 \text{ MI} + o_1 \text{ EI} + p_1 \text{ CA} + q_1 \text{ IC} + r_1 \text{ FP} \dots\dots\dots (4)$$

$$\text{SUWD} = m_2 + n_2 \text{ MI} + o_2 \text{ EI} + p_2 \text{ CA} + q_2 \text{ IC} + r_2 \text{ FP} \dots\dots\dots (5)$$

$$\text{EF} = m_3 + n_3 \text{ MI} + o_3 \text{ EI} + p_3 \text{ CA} + q_3 \text{ IC} + r_3 \text{ FP} \dots\dots\dots (6)$$

where

AIDR = Adequacy of Irrigation Delivery Ratio

SUWD = Spatial Uniformity of Water Distribution

EF = Effectiveness; m_1 - r_2 = model parameters

The third stage was evaluating the model. The model had been evaluated in the irrigation system of Molek and Bondoyudo in East Java, Sapon and Mejing in Yogyakarta. Data collection was conducted by questionnaire and interview starting from July to December 2008 at the Irrigation Area (IA) Molek, Bondoyudo, Sapon, and Mejing, Objects of the study were permanent employees of Malang Irrigation District Office, Jember District Irrigation Office, Bantul District Irrigation Office, Sermo Water Resources Management Office. There were three irrigation system performances: Adequacy of Irrigation Delivery Ratio (AIDR), Spatial Uniformity of Water Distribution (SUWD) and Effectiveness (EF). Models were tested by correlation coefficient, the Mean Absolute Percentage Error (MAPE), and Root Mean Square Error (RMSE).

RESULTS AND DISCUSSION

Amortization

Amortization in irrigation systems derived from intangible asset value at the end of the new order (1998) and the reform period (2008). Average annual amortization in the period of irrigation systems are presented in table 1.

Table 1. showed that the average annual amortization in the irrigation system was 0.036. This situation implied that the amortization was potential to be improved or lowered into better circumstances.

Table 1. Average Amortization In Irrigation System (annual)

Intangible Asset	Molek	Bondoyudo	Sapon	Mejing	Average
Moral Intelligence	0,030	0,046	0,027	0,022	0,030
Emotional Intelligence	0,037	0,036	0,043	0,022	0,035
Creative Attitude	0,050	0,032	0,040	0,032	0,036
Institutional Culture	0,034	0,030	0,048	0,030	0,040
Farmer Participation	0,045	0,049	0,033	0,041	0,039
Average	0,042	0,039	0,038	0,028	0,036

Amortization Model Testing

Amortization models were tested by comparing the predictions amortization (Apr) model output with actual amortization (Aob) measurement results. The test results amortization models are presented in table 2. The table shows that the correlation coefficient (r) between the amortization prediction (Apr) and the actual amortization (Aob) value from 0.97 to 0.99. This implies that the relationship between amortization predictions and the actual amortization is very strong. Model error in predicting the amortization is small value of indicated by the value of MAPE and MRSE between 0.02 and 0.15.

Table 2. Model Testing Results of Amortization in Irrigation Systems

Irrigation System	Aob (/ yr)	Apr (/ yr)	r	MAPE	MRSE
Molek	0.042	0,038	0,99	0,15	0,06
Bondoyudo	0,039	0,040	0,99	0,03	0,03

Sapon	0,040	0,040	0,97	0,02	0,03
Mejing	0,028	0,030	0,99	0,04	0,03

Relationship Between Intangible Asset And Irrigation System Performance

Relations between intangible assets and irrigation system performance were analyzed by using neuro-fuzzy. Intangible asset was as input, while the performance of irrigation systems was as the outcome. The equation between intangible assets and irrigation system performance is presented in Table 3.

Table 3 shows that moral intelligence (MI), emotional intelligence (EI), creative attitude (CA), institutional culture (IC) and farmer participation (FP) affect on Adequacy of Irrigation Delivery Ratio (AIDR), Spatial Uniformity of Water Distribution (SUWD) and Effectiveness (EF) of Molek, Bondoyudo, Mejing and Sapon irrigation systems.

Table 3. Relationship Between Intangible Asset And Irrigation System Performance

Irrigation System	Equation
Molek	AIDR = 0,017 + 0,054 MI + 0,048 EI + 0,041 CA + 0,039 IC + 0,027 FP
	SUWD = 0,018 + 0,053 MI + 0,058 EI + 0,060 CA + 0,063 IC + 0,071 FP
	EF = 0,032 + 0,094 MI + 0,081 EI + 0,076 CA + 0,078 IC + 0,011 FP
Bondoyudo	AIDR = 0,020 + 0,063 MI + 0,062 EI + 0,071 CA + 0,063 IC + 0,075 FP
	SUWD = 0,018 + 0,056 MI + 0,054 EI + 0,058 CA + 0,058 IC + 0,062 FP
	EF = 0,019 + 0,060 MI + 0,059 EI + 0,061 CA + 0,061 IC + 0,062 FP
Sapon	AIDR = 0,012 + 0,030 MI + 0,042 EI + 0,041 CA + 0,032 IC + 0,040 FP
	SUWD = 0,017 + 0,055 MI + 0,058 EI + 0,057 CA + 0,054 IC + 0,058 FP
	EF = 0,015 + 0,053 MI + 0,043 EI + 0,046 CA + 0,047 IC + 0,055 FP
Mejing	AIDR = 0,019 + 0,049 MI + 0,063 EI + 0,056 CA + 0,054 IC + 0,060 FP
	SUWD = 0,019 + 0,065 MI + 0,058 EI + 0,067 CA + 0,065 IC + 0,067 FP
	EF = 0,015 + 0,049 MI + 0,046 EI + 0,049 CA + 0,051 IC + 0,048 FP

That conditions was influenced by several factors: the educational system, government policy, modernization, and culture.

Education system affected amortization in irrigation system. Education system during the new order until the period of reform emphasized on teaching, knowledge transfer. This education system will shrink the human capital that consists moral intelligence, emotional intelligence, and creative attitude. Four principles of moral intelligence: integrity, responsibility, caring and forgiving were the outcome of the heart quality of a person. Five principles of emotional intelligence: self-awareness, self-control, motivation, empathy and relationship management were the outcome of someone's feeling. Existing education has not emphasized the hearts and feelings; accordingly, it shrink the moral intelligence and emotional intelligence. This was according to the opinion of education experts, Rachman (2008) stated that the national education system emphasize on teaching, not education. Teaching is the process of knowledge transfer, while education is a process of building character, attitude, morals and mindset. The impact of the education system was not coherence with moral intelligence and emotional intelligence.

Government policies also affected the amortization in irrigation system. At the time the new order, the concept of development that emphasizes economic growth with the approximation of technical and policy development that top-down caused shrinkage institutional culture and creative attitude in the irrigation system. Top-down policy did not encourage the growth of creative attitudes of employees because of all the rules and decisions were from above, employees were not given opportunity to initiate. Familiarity and consensus as a principle of institutional culture were difficult to achieve in these conditions, so the institutional culture in the irrigation system were shrunk.

New Order government was dominant in all sectors of development, including irrigation sector, irrigation network construction was based on initiatives and government resources alone, without involving the community. That situation reduced the

participation of farmers. This was in accordance with Hutagaol (2001) which stated that the ignorance towards public participation made the community perceive the irrigation network built by the government as public goods. Every public goods were treated as goods which had no price, so its usage tends to be exaggerated. Excessive usage will damage network and caused deterioration service capabilities if there was no maintenance efforts. The use of irrigation networks as public goods was open and thus reduced the participation of farmers in maintenance.

In the reform period, government policies also affected the shrinkage participation of farmers in irrigation systems. Viewed from social psychology, social and political reforms lead to more unruly society, free of the transgressors. This can be understood because for more than 30 years at the new order period, citizens were given less freedom to express. Starting from 1998, people were given freedom to express, but it led a lack of controlled freedom, less responsible freedom. This resulted in the declining of participation among farmers due to their disobedience.

Reformation impacts on the legislation in irrigation. In 1999, the irrigation sector started updating the release of Presidential Instruction No. 3 of intimation Irrigation Management Policy Reform (IMPR) (Arif, 2002). Updates were followed by the release of Government Regulation 77/2001 on Irrigation. In 2004, the government made the renewal of public policy in the field of water resources by the issuance of Act 7 of 2004 on Water Resources. In a detailed study, Government Regulation No.77/2001 was not in accordance with Act No. 7/2004, so in 2006 Government Regulation No. 20/2006 on Irrigation in lieu of Government Regulation No. 77/2001 was set. Government Regulation No. 77/2001 states that the farmer is the manager of the irrigation network starting primary to tertiary levels, while Government Regulation 20/2006 states that farmers only manage the tertiary level. This indicates that the water resources and irrigation sector do

not have an established global planning. This situation resulted in the shrinking of intangible assets in irrigation system.

Modernization also affects the amortization in irrigation system. Modernization is a process of change which assumes that the ratio is a tool of human self-liberation. The ratio integrates in science and technology capable of controlling nature and society. The growth of science and technology, the development of Western capitalism as a form of rational economic life and political culture rooted in the legal-rational legal procedures that are part of the process of increasing rationalization in the areas of life are increasingly widespread. Modernity is a whole social and cultural characteristics produced by modernization. Rationalization of modernity produces less flexible and scientifically programmed society. The actualization of rationality results in the tendency of dehumanization (Sastrapratedja, 1995). The situation, thus, deplete human capital in irrigation system.

Culture in the irrigation area affects the irrigation system performance. Bondoyudo irrigation system performance is influenced by the *Pendalungan* culture (a fusion of cultural characteristics Java and *Madura* culture), whose farmers have strong and egalitarian. Molek irrigation system performance is influenced by the *Arek* culture that have an open character, more religious, egalitarian, willing to accept differences and input, high solidarity, and apply the principles of mutual relationship. Sapon and Mejing irrigation system performance are influenced by *Mataraman* Javanese culture whose farmers have basic characters and nationalist political views, do not prominently show their religious. The culture is less suitable for the concept of development that emphasizes economic growth with the technical approach and top-down development policies. As a result, farmer participation in irrigation system decreases.

Table 3 also shows that moral intelligence and farmer participation had the

highest effect coefficient towards the performance of Molek irrigation system. Farmer participation had the highest effect coefficient towards the performance of Bondoyudo irrigation system. Emotional intelligence and farmer participation had the highest effect coefficient towards the performance of Sapon irrigation system. Emotional intelligence, creative attitudes, institutional culture, and farmer participation had the highest effect coefficient towards the performance of Mejing irrigation system. Therefore, the improvement of irrigation system performance was conducted with different priority in every irrigation system which was moral intelligence and farmer participation in Molek; farmer participation in Bondoyudo; emotional intelligence and farmer participation in Sapon; emotional intelligence, creative attitude, institutional culture and farmer participation in Mejing.

CONCLUSION

The study concluded that there were annual amortization in the irrigation systems, namely accounted for Molek 0.043; Bondoyudo accounted for 0.038; Sapon accounted for 0.038 and Mejing accounted for 0.027. For decreasing the amortization, intangible assets should be improved. This effort should give different priorities in each irrigation system, that were: morality intelligence and farmer participation in Molek; farmer participation in Bondoyudo; emotional intelligence and farmer participation in Sapon; emotional intelligence, creative attitudes, institutional culture, and farmer participation in Mejing. This efforts were conducted through a cultural approach for knowledge management by *Arek* culture on Molek, *Pendalungan* culture on Bondoyudo, *Mataraman* Javanese culture on Sapon, and Mejing irrigation system.

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