Application of the Analytic Hierarchy Process (AHP) in the Selection of River Basin Organizations Models in Toba Asahan River Basin - Indonesia

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Abstract

Toba Asahan River Basin development started in 1976, based on the Master Agreement between the Government of the Republic of Indonesia with Japanese investors who signed on June 7th 1975 in Tokyo for development of Asahan Hydro Power Electric and aluminum smelting factory belonging to the project Asahan under the supervision of the Asahan Authority. Government policy declared that the Master Agreement between the Government of Indonesia and Japan investors will not be extended. So, after the end of Master Agreement, it should be formed management organizations of Toba Asahan River Basin.

After the expiration of the Master Agreement, Toba Asahan River Basin as a national strategic river basin has grown and has a huge potential resources should be managed by the water resources management organizations that has experienced and professional. In this paper, Regional Owned Company, Regional Public Utility River Basin Organization, Central Public Utility River Basin Organization, Independent Corporate River Basin Organization, Part of Existing Corporate River Basin Organization were used as organizations model.

The method used for analyzing of organizations model is the Analytic Hierarchy Process. Analysis result were found that Part of Existing Corporate River Basin Organization is the most appropriate organizations model to manage Toba Asahan River Basin. Because of water has economic value and also has a social function, so that organization should be State Owned Company shaped Public Corporation.

Keywords: Stakeholders, Organizational Development, Internal Business Processes, Finance, Analytic Hierarchy Process and River Basin Organizations

1. Introduction

River basin management organization in the Central and Regional who have duties and functions of water resources management, is still more dominant role in infrastructure development and rehabilitation of water resources compared with operation and maintenance as well as service. Lack of operation and maintenance activities, the lack of professional and independent organization able to resulted a lot of water resources infrastructure damaged post built by the Government.

To maintain the water resources in the river basin that have been developed and provide public benefit need to established corporate river basin organizatios by integrating all stakeholders in the planning and decision making. The integration of these aspects are important elements in keep balance and sustainability of water resources management.

Hooper (2003) the problem in many countries interrelated water needs for human life and the environment turns out to be a crisis on governance as compared with the water crisis, so it is necessary to effective management, have sufficient capacity, and is able to handle a variety of challenges water issues. Meanwhile, according to Soekrasno (2005) the problem of water resources management in a river basin is generally from the lack of finance, management and independent organization. Sarwoko *et al.* (2003) water resources management which is too complex and associated with many sectors require institutional support strong and structured.

Toba Asahan River Basin development started in 1976 by the Master Agreement between the Government of the Republic of Indonesia with Japanese investors who signed on June 7, 1975 in Tokyo for hydro electric power plant development and aluminium smelting plant belonging to the Asahan Project, while management conducted since 1982 in line with the completion construction of Siruar Dam, Siguragura Dam and Tangga Dam.

Government policy states that the Master Agreement between the Government of Indonesia and Japan investors will not be extended and will be terminated. This was declared by Minister of State Owned Company through his letter to the Chairman of the Asahan Authority dated October 29, 2010 regarding the termination of the Master Agreement. Government policies will affect the operation of water resources infrastructures in the Toba Asahan River Basin that had been done by PT. Indonesia Asahan Alumunium, and more specifically the problem is how the organization manages the water resources in the Toba Asahan River Basin.

This problem is very interesting to be analyzed, so that after the end of the Master Agreement has been created

and operating model of water resources management organization in the Toba Asahan River Basin that can perform the exertion. In Law No. 7/ 2004, article 45 paragraph (2) explained that the exertion of surface water resources in the river basin only can be undertaken by State Owned Company or Regionally Owned Company or cooperation between that companies. In Law 7/2004 does not mention specific shape or model of water resources management organizations that have shaped what. Walujo (2011) models of organizational management of water resources in the river basin can be the River Basin Commission, the Public Utility River Basin Organization, the Corporate River Basin Organization.

2.   View of Theory
2.1   *River Basin Organization Models*
Water resources management issues in the river basin is very complex and dynamic, complex as it involves many sectors or stakeholders such as governments, farmers, industry, non-governmental organizations, and dynamic because of the availability of water can change with the time change, climate and environment. This problem led to the management of water resources can not be done only with the technical approach, but it must be done in an integrated manner with the involvement of the community and the industry as users of water resources. Water resources management system in the future, in addition to addressing issues of physical and financing, as well as ongoing organizational issues, including regulatory, human resources, equipment, and training.

Mochtar (2001) in water and water resources management to date there has not been a standard form of management organization. When interrelated with the current field conditions, opinions of Mochtar is very true. Of 131 river basins are spread in Indonesia, just only three river basins managed base on the exertion and have standard form, ie Citarum River Basin, Bengawan Solo River Basin and Brantas River Basin.

The existence of water resources management organization in Indonesia began in 1970 with the establishment of the Jatiluhur Authority in the Citarum River Basin and 1990 with the establishment of Jasa Tirta Public Corporation as water resource management agencies in the Brantas River Basin. At first understanding the management of water resources over connotes a narrower, operation and maintenance of water resources infrastructure. With regard to the issuance of Law No. 7/2004, meaning expanded water resources management including planning, construction and operation and maintenance in order to conserve natural resources, exploitation of water resources and the control of destructive force of water.

In this paper, alternative of water resources management organization that will be created or implemented to manage water resources in the Toba Asahan River Basin are Regional Owned Company, Regional Public Utility River Basin Organizations (RPURBO), Central Public Utility River Basin Organizations (CPURBO), Independent Corporate River Basin Organizations (ICRBO), and the Part of Existing River Basin Organizations (PERBO).

2.2   *Analytical Hierarchy Process*
Saaty (1993) analytic hierarchy process (AHP) is a simple and flexible method to accommodate the creativity of a problem (made according to each user). AHP strength lies in the hierarchical structure that can incorporate all the important factors, and set it up from top to bottom starting with the most important to a level that provides an alternative to choose which one is best. According Atmanti (2008) analytic hierarchy process is a model that provides an opportunity for individuals or groups to generate ideas and define problems in a way to make their assumptions and perform in accordance with the desired solution.

Saaty (1993) to resolve problems with AHP there are some basic principles that must be understood, namely: decompocition, comparative judgment, priority synthesis and logical consistency.

Decomposition is the process of constructing a hierarchy, which break down the problem into separate elements (Suyono 2010). To get accurate results, solving problems to do with the elements is not possible to further split, so we get some level of problems faced. Further Atmanti (2008) explains that there are two types of hierarchy, ie complete and incomplete hierarchy. In the complete hierarchy of all elements on a level has all the elements that exist on the next level. Otherwise, the hierarchy is called incomplete.

A hierarchical structure complete with shape decomposition structure consisting of:

    The first level   :   Goal
    The second level   :   Criteria
    The third level   :   Subcriteria
    The fourth level   :   Alternatives

The first level is a goal to be achieved in this study, namely the creation of a model of organization based water resources utilization in the basin. The second level, the criteria indicate the variables used in the analytic hierarchy process, third level the subcriteria that are indicators of the criteria. The fourth level is an alternative model of organization that will be created.

The most important stage of the analytic hierarchy process is an assessment of the comparison pair. This

assessment is done by comparing the number of combinations of elements that exist at any level of hierarchy in pairs, so that the obtained value of interest rate element in the form of qualitative opinion. To qualify qualitative opinion of the rating scale used in the form of numbers or quantitative. Saaty (1993) assessment is done by comparing the ratio of the components based on grading scale (see Table 1). The results Saaty (1980) for a variety of problems, the scale of 1 - 9 is the best scale to qualify the opinion, which is based on its accuracy as indicated by the value of the root mean square deviation and median absolute deviation.

Pairwise comparison of assessment results can be presented in the form of a comparison matrix, which forms the symmetric matrix with the main diagonal is 1, which is the ratio of the two elements of the same, while the non-diagonal elements in the form of a reciprocal matrix. Of each pairwise comparison matrix (pairwise comparison) and then searched his Eigen vector to get a local priority. Because there is a pairwise comparison matrix at each level, then the global priority to get to do the synthesis between local priority. Sorting elements according to the relative importance through the synthesis called priority setting (Suryanda 2002). According Iryanto (2005) to obtain priority level for each element in the hierarchy, it is necessary to synthesis considerations are incorporated into the matrix of pairwise comparisons, ie by way of weighting and summing to produce a single number that thorough.

Furthermore the values of pairwise comparisons were carried out should be checked for consistency. Atmanti (2008) about the size of the logical consistency indicate consistent or unconsistent of an assessment or weighting pairwise comparisons. This testing is necessary, actually happen a few deviations from the relationship with one another, so that the matrix is not perfectly consistent. Saaty (1990) the consistency of the order matrix n written in the equation:

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \tag{1}$$

where:

CI = deviation ratio consistency (consistency index)

λ_{max} = the largest Eigen value of a matrix n

n = order matrix (alternative / criteria compared)

Of equation (1), must be obtained λmax ≥ n matrix appeal to pairs, so that will be produced CI values > 0. λ max closer to the size of the matrix, the matrix is more consistent. Limit inconsistencies (inconsistency) as determined by Thomas L Saaty using the consistency ratio (CR), which is the ratio of consistency index (CI) with random index (RI).

$$CR = {CI}/{RI} \tag{2}$$

There is no limit how many standard consistency index which is acceptable or not. According to Saaty (1993) which received the assessment result is a matrix with consistency ratio ≤ 0.10. If the value is > 0.10 then the decision should be reviewed and revised the pairwise comparison matrix.

2.3   Research Methodology

The criteria used in analyzing the organizational model of water resources management in the Toba Asahan River Basin is divided into four (4) criteria, ie stakeholders, learning and organizational development, internal business processes, and finance. Criteria of stakeholders consists of subcriteria (a) water users involvement, (b) water users response, (c) environmental audits, (d) living conditions in the basin. Criteria of learning and development organization consists of subcriteria (a) establishment of the organization, (b) technology development, (c) organizational development. Criteria of internal business processes consists of subcriteria (a) planning organizational governance, (b) water allocation, (c) data processing. Criteria of finance consists of subcriteria (a) resource and cost allocation , (b) cost efficiency, (c) financial control.

To speed up the analysis process used Expert Choice Software 11, wherein the process is carried out by dividing the principal problem areas smaller until the alternatives are taken into a decision. In the process of this analysis will be carried out several stages in accordance with the basic principle of analytic hierarchy, namely:

a. Constructing the structure/hierarchy scheme, which break down the problem into separate elements, and a scheme or chart the relationship between the criteria, subcriteria and alternatives for achieving the goal. Hierarchical scheme in this analysis are shown in Figure 1.

b. Priority setting, which rank the elements according to relative importance.

c. Logical consistency, namely to ensure that all criteria and subcriteria are grouped logically and are ranked according to the consistency of a logical criteria.

d. Pairwise comparisons, this assessment is done by comparing the number of combinations of variables/criteria and subcriteria at each level of the hierarchy. Assessment is done by comparing the criteria and subcriteria based on a rating scale.

3. Result and Discussion

As an explanation, in this paper the consistency of pairwise comparison sample calculation based on the four criterias, as follows:

1. Stakeholders (X_1) to learning and organizational development (X_2) is 0.33.
2. Stakeholders (X_1) to internal business processes (X_3) is 2.
3. Stakeholders (X_1) to finance (X_4) is 0.17.
4. Learning and development organization (X_2) to internal business processes (X_3) is 6.
5. Learning and development organization (X_2) to finance (X_4) is 2.
6. Internal business processes (X_3) to finance (X_4) is 0.17.

Comparison of all the above stated criteria in the matrix Table 3.

Calculation matrix for all criteria:

$$\begin{vmatrix} 1.00 & 0.33 & 2.00 & 0.17 \\ 3.00 & 1.00 & 6.00 & 2.00 \\ 0.50 & 0.17 & 1.00 & 0.17 \\ 6.00 & 0.50 & 6.00 & 1.00 \end{vmatrix}$$

∑ Coloum   10.50   2.00   15.00   3.34   =   30,84 (total)

With the elements in each column divided by the sum of the column in question, obtained by the following matrix:

$$\begin{vmatrix} 0.10 & 0.17 & 0.13 & 0.05 \\ 0.29 & 0.50 & 0.40 & 0.60 \\ 0.05 & 0.08 & 0.07 & 0.05 \\ 0.57 & 0.25 & 0.40 & 0.30 \end{vmatrix}$$

From the matrix above, taken the average value for each row, with the results for each line = 0.111; 0.446; 0.620; 0.380 and vector multiplied by the original matrix, yielding a value for each row and then each value divided by the value of the corresponding vector the following:

$$\begin{vmatrix} 0.11 \\ 0.45 \\ 0.06 \\ 0.38 \end{vmatrix} \begin{vmatrix} 1.00 & 0.33 & 2.00 & 0.17 \\ 3.00 & 1.00 & 6.00 & 2.00 \\ 0.50 & 0.17 & 1.00 & 0.17 \\ 6.00 & 0.50 & 6.00 & 1.00 \end{vmatrix} = \begin{matrix} 0.45 \\ 1.91 \\ 0.26 \\ 1.64 \end{matrix} : \begin{matrix} 0.11 \\ 0.45 \\ 0.06 \\ 0.38 \end{matrix} = \begin{matrix} 4.02 \\ 4.28 \\ 4.12 \\ \underline{4.32} \\ 16.75 \end{matrix}$$

λ max = 16.75/4 = 4.19

Consistency index (CI) is obtained from the equation CI = (λmax - n) / (n - 1) further consistency ratio (value inconsistency) is calculated based on the equation CR = CI / RI with random index value = 0.90 for n = 4, based these equations, the obtained results:

- λ max   =   4.190 (close to n = 4),
- CI   =   0.062 (quite small),
- CR   =   0.069 (quite small).

thus it can be concluded that the results of pairwise comparisons for the four criterias is quite consistent and acceptable outcome assessment. With the same process and using the Expert Choise software, inconsistency values obtained for each of the subcriteria and indicators as shown in Table 4.

Can be seen in the table 4, that the value of the resulting inconsistency is 0.00013 to 0.09. This value indicates that the results of the calculation are qualified and acceptable consistency, because the value of inconsistency is smaller than required, ie < 0.10 so that the calculation is acceptable and need not be repeated.

3.1   Priority Weights Pairwise Comparison Criteria

This weight is obtained by analysis of pairwise comparison matrix priority for all the criteria (stakeholders, learning and organizational development, internal business processes and finance). As an explanation for the weight gain priority, each of the elements in each row of the matrix Table 3 should be multiplied and subsequently withdrawn root rank 4 (in accordance with his order number). Results of each row is divided by the sum of each row, as follows:

1.00	0.33	2.00	0.17	(1 x 0.33 x 2 x 0.17)^0.25	=	0.577
3.00	1.00	6.00	2.00	-----> (3 x 1 x 6 x 2)^0.25	=	2.450
0.50	0.17	1.00	0.17	(0.50 x 0.17 x 1 x 0.17)^0.25	=	0.343
6.00	0.50	6.00	1.00	(6 x 0.50 x 6 x 1)^0.25	=	2.060
						5.430

Priority weights:

0.577	:	5.430	=	0.122
2.450	:	5.430	=	0.419
0.343	:	5.430	=	0.063
2.060	:	5.430	=	0.395

From manual calculation shows that the criterion of learning and development organization has the highest weight, ie 0.419 and when compared to using the software Expert Choice 11 obtained similar results as shown in Figure 2.

Figure 2 shows that the learning and development of the organization is the most important criterion in the analysis of the organizational model of water resources management in the Toba Asahan River Basin, with a weight priorities is 0.418. Second priority, third, and fourth is the finance, stakeholders, and internal business processes with their respective weights 0.398; 0.123 and 0.060. Weights result above shows that the objectives set out in the finance criteria, the stakeholders and internal business process management identifies that organizations should be able to play a role in the operation and maintenance activities and utilization of water resources.

On the whole the same process can be obtained by weighting of each pairwise comparison (see table 5). From Table 5, for stakeholders criteria found subcriteria of living conditions in the basin and the water users involvement gain the greatest percentage, ie 37.40% and 37.20%. This indicate that the living conditions in the basin and the water users involvement are the most important aspect to consider in the selection of the model of water resources management organization in the Toba Asahan River Basin. The water users involvement is a major source of income for water resources management organization that performs the exertion. Therefore, efforts to increase the water users involvement still need to be done, among others, included involved in the decision making of water resources management.

Analysis results for the criteria of organizational learning and development, organizational development subcriteria obtained the greatest percentage, ie 64.50%. This indicates that organizational development is an important aspect to consider in the selection of the model management organization. Future, the results of the analysis of internal business processes criteria, subcriteria planning organizational governance has the largest percentage, ie 54.20%, this showns that in carrying out its activities, the organization managers must apply the principles of good corporate governance (GCG). Meanwhile, analysis of the results of the finance criteria, subcriteria resource and cost allocation has the largest percentage, ie 54.70%, this indicates that the financing is an important aspect especially for operational of organization, where the water users should be paid water service through the service costs of water resources management.

While results of the analysis weights for each alternative models of water resources management organization based subcriteria are showed as follows (see Table 6 – Table 9):

From Table 6 – Table 9, results of the analysis weights for each alternative of water resources management organization models based on subcriteria are obtained as follows:

1. Regional Owned Company   = 15.12%
2. Center PU RBO   = 7.52%
3. Regional PU RBO   = 6.31%
4. Independent CRBO   = 31.13%
5. Part of Existing CRBO   = 39,92%

So that, the best model will be choosen in this case is Part of Existing Corporate River Basin Organization. Where, weighting the three major models of organizational of water resources management in the Toba Asahan River Basin, first is Part of Existing CRBO with a weight of 0.399 or 39.92%, the second is to establish Independent CRBO with a weight of 0,311 or 31.13% and the last is Regional Owned Company with a weight of 0.151 or 15.12%.

To obtain a water resources management organization model from the fifth alternatives, then look for the average percentage from the fifth alternative models by summing the weight of each criterion for each alternative models, and then averaged (result, see Table 10).

On Table 10 showed that organization model of Part of Existing CRBO has the highest weight for stakeholders and financial criteria, respectively 0.441 and 0.432 or 44.10% and 43.20%. As for development of organizational learning and internal business processes criteria, organization model is a Independent CRBO with respectively weights 0,348 and 0,381 or 34.80% and 38.10%. When the weight of the four criteria were averaged for each model of organization, the obtained results: Regional Owned Company (15.34%), Center PU RBO (7.71%), Regional PU RBO (6.64%), Independent CRBO (33,07%), and Part of Existing CRBO (37.24%).

Finally, based on the analysis above showed that the model of organization is Part of Existing CRBO obtain the highest weight, ie 37.24%, so it can be concluded that the best organizational model and can be applied to the management of water resources in the Toba asahan River Basin is an organization that is Part of Exixting RBO. Besides having economic value, water also has a social function, and Toba Asahan River Basin is a strategic national river basin, so Part of Exixting CRBO will be shaped Public Corporation on the State Owned Company . In Law No. 7/2004 on Water Resources Article 45 paragraph (2) stated that the exertion of water resources in the river basin can only be carried out by state owned company or regional owned company or cooperation between two that company. As a reference, in Indonesia there are two institutions that manage water resources in the river basin, ie Jasa Tirta I Public Corporation and Jasa Tirta II Public Corporation, which are the State Owned Company.

Based on the analysis of this study, another river basin that has been developed to the determination of management organization that performs exploitation by using the same variables and indicators in this study, but should be noted for the apparent ability of water users and the support of local government, as well as forms or organizational models.

4.   Conclusion

After the expiration of the Master Agreement between the Government of Indonesia and Japanese investors, Toba Asahan River Basin as a national strategic river basin has grown and has a huge potential resources should be managed by the water resources management organizations that have experienced and professional.

From the analysis of the five models of organization, ie Regional Owned Company, Center Public Utility River Basin Organizations, Regional Public Utility River Basin Organizations, Independent Corporate River Basin Organizations and Part of the Corporate River Basin Organizations, the highest weight obtained results that the model organization with the highest weight is Part of the Corporate River Basin Organizations that already exists with 37.24% weight, so it can be concluded that the best organizational model and can be applied to manage water resources in the Toba Asahan River Basin is Part of the Corporate River Basin Organizations that already exist (ie Jasa Tirta I Public Corporation and Jasa Tirta II Public Corporation).

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Table 1. Pairwise Comparisons between Variables

Intensity of Importance	Variable Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective
3	Somewhat more important	Experience and judgement slightly favour one over the other
5	Much more important	Experience and judgement strongly favour one over the other
7	Very much more important	Experience and judgement very strongly favour one over the other. Its importance is demonstrated in practice
9	Absolutely more important.	The evidence favouring one over the other is of the highest possible validity
2,4,6,8	Intermediate values	When compromise is needed

Table 2. Random Value Index

n	1	2	3	4	5	6	7	8	9	10	11	12
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.54

Source: Saaty, (1993)

Table 3. Comparison matrix for all the criteria

	X_1	X_2	X_3	X_4
X_1	1.00	0.33	2.00	0.17
X_2	3.00	1.00	6.00	2.00
X_3	0.50	0.17	1.00	0.17
X_4	6.00	0.50	6.00	1.00

Table 4. Inconsistency Value

Comparison matrix	Inconsistency
Comparison Matrix Criteria	0.07
Comparison of Subcriteria Matrix	
a. Stakeholders	0.06
b. Learning and Organizational Development	0.06
c. Internal Business Processes	0.07
d. Finance	0.00013
Alternatives Comparison Matrix based on Subcriteria	
a. Stakeholders	
1) Water Users Involvement	0.09
2) Water Users Response	0.06
3) Environmental Audits	0.05
4) Living Conditions in the Basin	0.04
b. Learning and Organizational Development	
1) Establishment of an Organization	0.05
2) Technology Development	0.06
3) Organizational Development	0.07
c. Internal Business Processes	
1) Planning Organizational Governance	0.03
2) Water Allocation	0.07
3) Data Processing	0.06
d. Finance	
1) Resource and Cost Allocation	0.05
2) Cost Efficiency	0.07
3) Financial Control	0.03

Source: Data processed, (2013)

Table 5. Weight of each Criteria - Subcriteria

No	Criteria	Subcriteria	Weight
1.	Stakeholders	- Water Users Involvement - Water Users Response - Environmental Audits - Living Conditions in the Basin	0.372 0.174 0.080 0.374
2.	Learning and Organizational Development	- Establishment of an Organization - Technology Development - Organizational Development	0.274 0.081 0.645
3.	Internal Business Processes	- Planning Organizational Governance - Water Allocation - Data Processing	0.542 0.289 0.169
4.	Finance	- Resource and Cost Allocation - Cost Efficiency - Financial Control	0.547 0.102 0.350

Source: Results of analysis, (2013)

Table 6. Results Analysis of Subcriteria Weights based on Stakeholders Criteria

No	Subcriteria	Alternative Organizational Models	Weight
1.	Water Users Involvement	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.151 0.048 0.086 0.246 0.469
2.	Water Users Response	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.159 0.061 0.062 0.269 0.448
3.	Environmental Audits	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.161 0.100 0.057 0.310 0.372
4.	Living Conditions in the Basin	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.149 0.063 0.081 0.277 0.429

Source: Results of analysis, (2013)

Table 7. Result Analysis of Subcriteria Weights based on Learning and Organizational Development Criteria

No	Subcriteria	Alternative Organizational Models	Weight
1.	Establishment of the Organization	- Regional Owned Company	0.236
		- Center PU RBO	0.172
		- Regional PU RBO	0.098
		- Independent CRBO	0.245
		- Part of Existing CRBO	0.249
2.	Technology Development	- Regional Owned Company	0.154
		- Center PU RBO	0.085
		- Regional PU RBO	0.046
		- Independent CRBO	0.324
		- Part of Existing CRBO	0.390
3.	Organizational Development	- Regional Owned Company	0.158
		- Center PU RBO	0.078
		- Regional PU RBO	0.056
		- Independent CRBO	0.426
		- Part of Existing CRBO	0.283

Source: Results of analysis, (2013)

Table 8.   Results Analysis of Subcriteria Weights based on Internal Business Processes Criteria

No	Subcriteria	Alternative Organizational Models	Weight
1.	Planning Organizational Governance	- Regional Owned Company	0.161
		- Center PU RBO	0.083
		- Regional PU RBO	0.077
		- Independent CRBO	0.457
		- Part of Existing CRBO	0.223
2.	Water Allocation	- Regional Owned Company	0.114
		- Center PU RBO	0.054
		- Regional PU RBO	0.044
		- Independent CRBO	0.289
		- Part of Existing CRBO	0.499
3.	Data Processing	- Regional Owned Company	0.141
		- Center PU RBO	0.056
		- Regional PU RBO	0.052
		- Independent CRBO	0.282
		- Part of Existing CRBO	0.468

Source: Results of analysis, (2013)

Table 9. Results Analysis of Subcriteria Weights based on Finance Criteria

No	Subcriteria	Alternative Organizational Models	Weight
1.	Resource and Cost Allocation	- Regional Owned Company	0.133
		- Center PU RBO	0.060
		- Regional PU RBO	0.049
		- Independent CRBO	0.355
		- Part of Existing CRBO	0.403
2.	Cost Efficiency	- Regional Owned Company	0.130
		- Center PU RBO	0.046
		- Regional PU RBO	0.053
		- Independent CRBO	0.283
		- Part of Existing CRBO	0.489
3.	Financial Control	- Regional Owned Company	0.118
		- Center PU RBO	0.071
		- Regional PU RBO	0.059
		- Independent CRBO	0.284
		- Part of Existing CRBO	0.467

Source: Results of analysis, (2013)

Table 10. Weighting Recapitulation of each Alternative Organizational Models

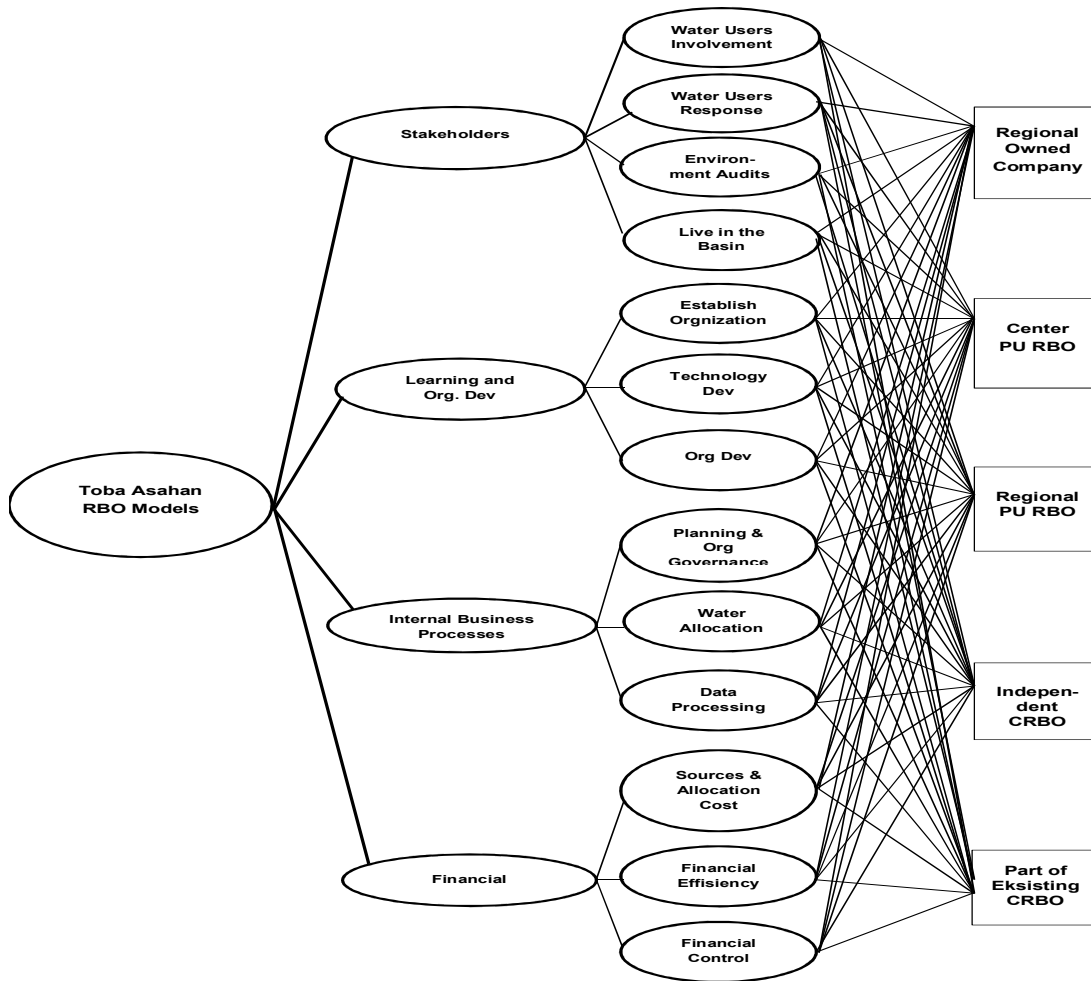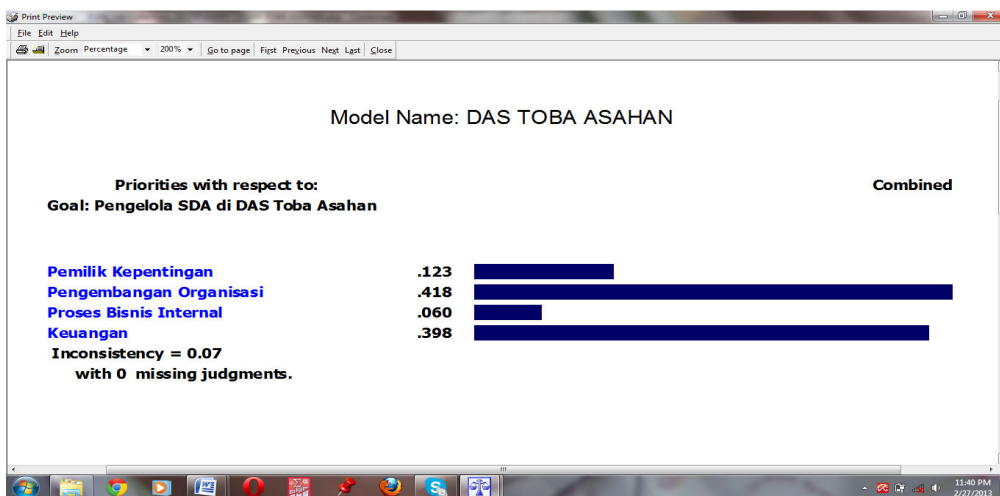| No	Subcriteria	Alternative Organizational Models	Weight
1.	Stakeholders	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.153 0.061 0.077 0.268 0.441
2.	Learning and Organizational Development	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.188 0.115 0.072 0.348 0.277
3.	Internal Business Processes	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.145 0.071 0.064 0.381 0.340
4.	Finance	- Regional Owned Company - Center PU RBO - Regional PU RBO - Independent CRBO - Part of Existing CRBO	0.128 0.062 0.053 0.326 0.432

Source: Results of analysis, (2013)

Figure 1. Scheme Hierarchy Analysis Models for Toba Asahan
River Basin Organizations

Source: Results of data processing, (2013)

Figure 2. Priority Weights Result of Pairwise Comparison Matrix for All Criteria

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