# Tsukamoto Method in Decision Support System for Realization of Credit on Cooperative

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### Abstract

*In managing credit services, Cooperative in need of a system that can produce information that is more fast, precise, accurate, and relevant in order to improve the quality of service to customers as well as the performance of the employees. One way to strengthen the system of credit services business unit in Cooperative is to apply the method Tsukamoto Fuzzy Inference System (FIS). Tsukamoto FIS method is a computational framework that is based on fuzzy set theory, fuzzy rules in the form of IF - THEN, and fuzzy reasoning. To minimize errors in calculations, Tsukamoto FIS method to determine the actual credit application will be implemented in the Decision Support Systems. With the Decision Support System employees who handle credit services in Cooperative enough input data required by the systems, then the system will process these data by the method of Tsukamoto and will display the output a decision in accordance with the actual credit application existing provisions.*

***Keywords :*** *Tsukamoto FIS, Decision Support System, Credit*

## 1 INTRODUCTION

Cooperative is an autonomous association of persons who voluntarily join to meet needs and aspirations for economic, social and cultural separation of the same through-owned and democratically controlled (Hendrojogi, 1997). One function of the cooperative is to enhance the living standards of its members, increase production and realize a fair income and equitable prosperity (Kartasapoetra, G. et all, 2003). Furthermore, Indonesian cooperatives shall have and based on the values of self-help, self-responsible to themselves, democracy, equality, equity and solidarity. In carrying out its functions, the cooperative in Indonesia given the authority to manage the existing managerial system, one of which is to develop his own business unit. Likewise with Serba Guna Cooperative.

Serba Guna Cooperative is one of the cooperative located in the district of Brebes and has been established since 1996, according to the Decree of the Minister of Cooperatives No.: 10968a/BH/PAD/KWK.II/XII/96. In management for 18 years, Serba Guna Cooperative has had several business units, including: credit services, savings and loans, photocopy services and sales of stationery. However, from a variety of business units owned by the Serba
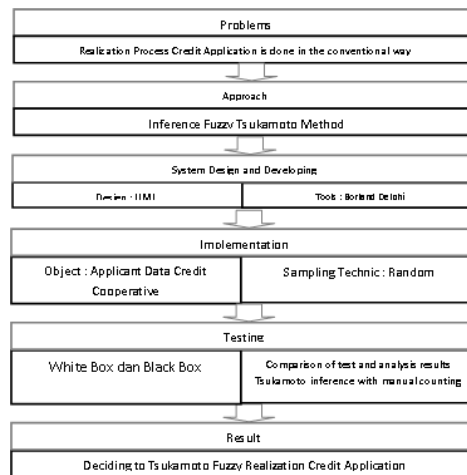
Figure 1: Frame Of Mind

Guna Cooperative, just credit business that can sustain the continuity of the other business units in the Serba Guna Cooperative.

In managing credit services, Cooperative in need of a system that can produce information that is more fast, precise, accurate, and relevant in order to improve the quality of service to customers as well as the performance of the employees. But the system is running on the credit services business unit in Cooperative sometime still very weak due to the processing of data and information that is recorded in the books so that the decision-making process takes a long time, the possibility of manipulation of data between prospective customers and employees in the loan portfolio as well as the difficulty menager make decisions for the realization of a credit application due to the cooperative task manager deals with many technical and operational activities for all cooperative efforts (Hendrojogi, 2002).
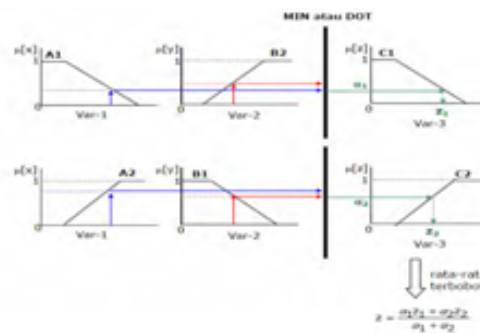


Figure 2: Tsukamoto Method Inference

One way to strengthen the system of credit services business unit in Cooperative is to apply the method Infrerence Tsukamoto Fuzzy System (FIS). According Kusumadewi & Hartati (2006) Tsukamoto FIS method is a computational framework that is based on fuzzy

set theory, fuzzy rules in the form of IF-THEN, and fuzzy reasoning. This method was chosen because each consequent to the rules in the form of IF-THEN represented by the fuzzy set membership functions are monotone. As a result, the output of each rule is given firmly based on , then the final result is obtained by using median centered.

To minimize errors in calculations, Tsukamoto FIS method to determine the actual credit application will be implemented in the Decision Support System. According Turban (2004) Decision Support System is a computer-based information system that combines models and data to provide support to decision makers in semi-structured problems solutions or dependency issues involving the user in depth.
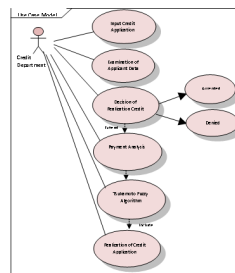


Figure 3: Use Case Diagram

Decision support system (DSS) could be used to simplify the existing procedures and improve decision-making.Several researchers have been applying decision support systems (DSS) approaches to some applications, such as: 1) Selection of Indonesian Workers (TKI) abroad (Ariani, 2013), 2) Bidik Misi Scholarships selection (Umami, 2014), etc. In this article author would like to apply DSS concept by usinf fuzzy in Credit cooperatives.

With the Decision Support System employees who handle credit services especially in Serba Guna Cooperative enough input data required by the system, then the system will process these data by the method of Tsukamoto and will display the output (output) a decision in accordance with the actual credit application existing provisions.

## 2 RESEARCH METHODOLOGY

### 2.1 Frame Of Mind

Frame Of Mind show in Figure 1.

### 2.2 Inference Fuzzy Tsukamoto System Method

In the Tsukamoto method, each consequent to the rules in the form of IF-Then shall be represented by a fuzzy set with the membership function is monotonous (Figure 3.2). As a result, the output result of each inference rule expressly given (crisp) based on -predicate (fire strength). The end result is obtained by using a weighted average. (Kusumadewi, 2003)

### 2.3 System Design

According Ambler (2005) Use Case is a diagram showing the relationship between actors and use cases. Use case used for the analysis and design of a system. Use case can describe

the interaction between the users of the system with the system itself, with gives a narrative of how the system used.(Fowler, 2004). Show in Figure 3.

## 2.4 Activity Diagram

Activity diagram is a diagram that illustrates the concept of data flow/control, structured action and well designed in a system.(Bock, 2003).Show in Figure 4.
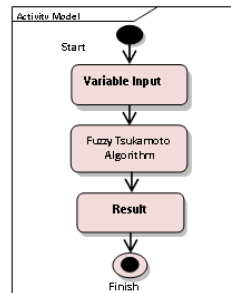


Figure 4: Activity Diagram

## 3 RESEARCH RESULT

### 3.1 Interface

According Kusnasriyanto (2003) Decision Support System Interface realization credit application created using Borland Delphi. Delphi is a programming language that has several advantages, including: the concept of open items, basic language PASCAL (Abdillah, 2009) is easy to learn, the result of a native compile to win 32.
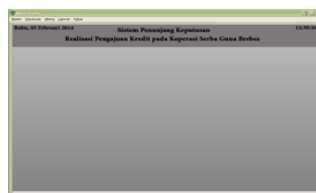


Figure 5. Main



Figure 6. Credit Request



Figure 7. Applicant Credit Guarantees



Figure 8. Decision Credit Application

## 3.2   Establishment of rules

Set of rules is one of the characteristics and conditions that must exist on the Fuzzy Inference System (FIS) (Ross, 2004). Fuzzy rules are created, using the input variables such as weight and condition guarantees nominal weights filing. The variable output of the actual decision whether a credit application is accepted or rejected. Format rule set as follows :

[R□] IF $x_{ij}$ is $A_{ij}$ °...° $x_{in}$ is $A_{in}$ THEN than is $B_i$.
explanation :
✓ R□   : rules of fuzzy number-i (i=1...m)
✓ $x_{ij}$   : weight bail conditions and nominal weights filing all relevant with rules number-1
✓ $A_{ij}$   : fuzzy sets for variable weight value j subjects relevant to number i rule
✓ °   : operators that can be used (AND or OR)
✓ n   : The value of collateral relevant to the rules number -i
✓ $B_i$   : Fuzzy sets for variable credit application decisions on rules number -i

The formation of this rule can be made by credit section by considering the condition of collateral in applying for a loan.

## 3.3   Composition Rules and Decision Credit Realization

Set of rules that have been compiled by the decision maker, will then be used as a reference for determining the actual credit application. Determination of the actual credit application will be obtained after the value of collateral provided and the nominal value of credit application. Furthermore, the composition made between the rules in order to find the value of $\alpha-$ predicate or fire strength of each rule ($\alpha i$). -predicate value is highly dependent on the service used. In the AND operator, value given predikat "x1 is A1 and x2 is A2" is given as follows (Cox, E, 1995) :

$$\alpha_i = \mu_{A1 \cap A2} = \min(\mu_{A1}(X_1), \mu_{A2}(X_2))$$
On Operator OR , α value predicate given by "$X_1$ is $A_1$ and $X_2$ is $A_2$" given as follows :
$$\alpha_i = \mu_{A1 \cup A2} = \max(\mu_{A1}(X_1), \mu_{A2}(X_2)).$$

Having obtained the value of $\alpha i$ , then the next will be the process of calculating the value of each consequent of each rule ($y_i$)in accordance with the membership functions are used. In the consequent "Decisions Denied", then the equation is based on Rejected $\mu$ (y)=1-y, the value of $y_i$ is: $y_i = 1 - \alpha i$

In the consequent "Decision Received", then the equation is based on be accepted (y) = y, the value of yi is: yi = i. After all consequent values obtained, then the value of y the end as the realization of the credit application decision value can be calculated :

$$y = \frac{\sum^{□}_{□} {}_{=1} a_i \bar{y}_i}{\sum^{□}_{□} {}_{=1} a_i}$$

### 3.4 Decision Support System Testing Results

The software development life cycle (System Development Life Cycle: SDLC) one of a process that must be done is the testing process. Software testing is a technique used to test whether a generated software has met the needs of users or business processes or not. Testing is the process of executing a program to find errors before use by end-user (Pressman, 2005).

Tests carried out on this system using the Black Box which checks whether the system can run properly as expected. The test techniques used in black box testing in this system, namely using sample testing techniques. The test is performed on the data input process. In addition, the method of testing UAT (User Acceptance Test) where the testing was conducted by lending or direct users to check if the system can run properly as expected by the user. This test involves real data obtained directly without regard to the internal details of the system.

### 4 CONCLUSION

Based on the research that has been done, then some conclusions can be drawn as follows:

1. Tsukamoto Fuzzy decision support system for the realization of this credit application can be implemented in cooperative with variables that have been obtained from the cooperative.

2. Tsukamoto Fuzzy decision support system for the realization of this credit application can provide a decision to reduce errors in calculation.

3. With the decision support system that handles part of credit services no longer depend entirely on the manager as decision makers.

4. This decision support system can help managers analyze the realization of the credit application.

5. From the tests concluded that the interpretation of the results of the decision support system was built considered successful because of the ease and convenience in using this system.

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