The model for estimation production cost of embroidery handicraft

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The model for estimation production cost of embroidery handicraft

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Abstract. Embroidery industry is one of type of micro industry that produce embroidery handicraft. These industries are emerging in some rural areas of Indonesia. Embroidery clothing are produce as scarf and clothes that show cultural value of certain region. The owner of an enterprise must calculate the cost of production before make decision how many product are received from the customer. A calculation approach to production cost analysis is needed to consider the feasibility of each order coming. This study is proposed to design the expert system (ES) in order to production management of embroidery industry. The model will design used Fuzzy inference system as model to estimate of production cost. Research conduct based on survey and knowledge acquisitions from stakeholder of supply chain embroidery handicraft industry at Bukittinggi, West Sumatera, Indonesia. This paper are use fuzzy input were the quality, the complexity of the design and the working hours required and the result of the model are useful to manage production cost on embroidery production.
Keywords :fuzzy inference system, embroidery handicraft, production cost

I. Introduction

Embroidery is a handicraft product that is widely used to increase the value added of clothing especially for aesthetic value. Indonesia has many variations of embroidery craft products. One of the famous cities with embroidered craft is Bukittinggi. Embroidered sales of embroidered scarves are often used at various custom events. One of the famous is the embroidered scarf known as kapalosamek. Kapalosamek is hand embroidery was having produce without using machine (handmade).

Handicraft industry had been used skill to make embroidery which is applied on many kind clothing that are dispersed widely as microenterprise in Indonesia. The design and production through the creative and innovative process have been used of thread with various types and colors as the main raw material.

Many embroidery handicraft have been exported to many countries and local, regional market regularly. Rapid changes in clothing trend and variations of customer trends requires an approach on production management, especially with regard to calculate of production cost on enterprise unit. These research developed software with expert management system approach. The model used in this application refers to a method of managing production in modern industry, especially to solve a lot of problem in estimating the need for raw materials to make embroidery handicraft. Production planning at handicraft industry is a complex concept that refers to make proper decisions under uncertainty and lack information about the product quality and the availability of working hours.

Research on utilization of information technology in the handicraft industry has been done to improve the competitiveness of handicraft carpet industry in India. Related to knowledge management

fuzzy expert system approach are used in order manage information and knowledge to achieve the company's goals [2]. The model based on fuzzy rules to simulate the behavior of the firms, is presented under the assumption of determined input parameters previously detected and an algorithm is developed to achieve the minimal structure of the model. Decision support system are used of fuzzy logic to consider inventory carrying, shortage and ordering cost as well as transportation cost [6]. Fuzzy Inference System are particularly suited for modeling the relationship between variables in complex environment because they introduce a process of decision making which is more human-like [2]. These system are based on fuzzy logic modeling approach, and allow reaching solution based on linguistic variables which makes reference to expert knowledge. They are useful in the cases were human knowledge is available and there is not enough information as quantitative value. FIS need parameters as inputs and outputs. The fuzzy numbers are quantified using fuzzy logic method using membership function. This research proposed to develop an expert system to make decision about production cost on embroidery handicraft. The embroidery handicraft enterprise has a representative to find the production cost.

2. Methods

Research methodology employed in the present study are used fuzzy inference system. The data have been collected from embroidery handicraft industry especially for scarf and clothing for women as cultural Minangkabau symbolic. In order to collect data, information about handicraft industry, the research have done at Bukittingi and the area of the surrounding that serves as part of the value chain embroidery bussiness. Data and information are collect from owners of business, craftman of embroidery, retailer where as selling the embroidery handicraft.

The lack of accuracy information about production cost on embroidery industry can be approached using fuzzy logic. This research are conducting with Fuzzy Rule-Based Inference System (FIS) to estimate production cost at handicraft embroidery. Despite the complexity of such decision making, FIS use linguistic value to define the input and output (figure1). FIS involves three important concepts : membership function, inference rules and fuzzy set operation. Membership functions represent the fuzzy sets of input and output variables, fuzzy set operations are main operations among fuzzy sets and inference rules are linguistic fuzzy rules in the form of " IF-THEN". In this study input fuzzy have been used to estimation of production cost on embroidery enterprise.

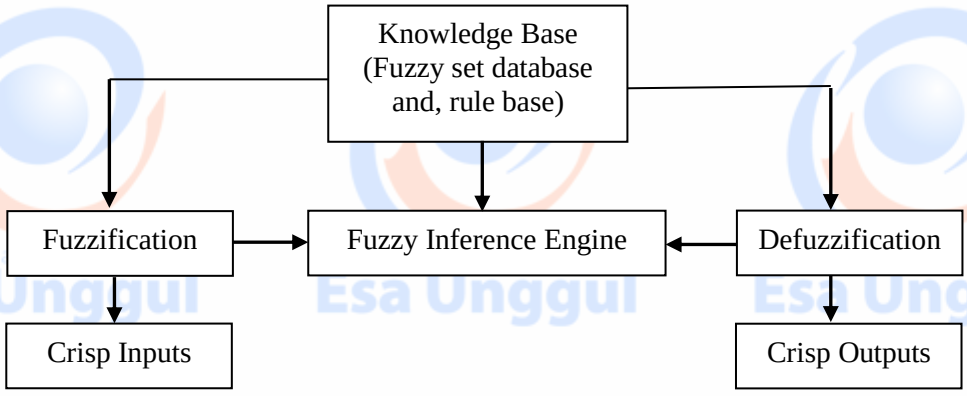

Figure 1. The inference process from fuzzification through defuzzification of FIS

3. Results and discussion

3.1. Value Chain and Production of Embroidery Handicraft

The expertise to make embroidery are usually as hereditary of rural people in Indonesia village. The process is not too complicated but require several days to obtain and patience in the create of embroidery. The main material were used are sheet of fabrics and yarn to be embroidered. Type and

various yarn are supplied from retailer at regions. The motif will design by order of costumer or used the motif are available. Many motif embroidery was produced has a good appearance in design style, construction and colours. The more intricate embroidery making and more colourfull the design will be increase the price. Some of handicraft embroidery product are shown in Figure 2.

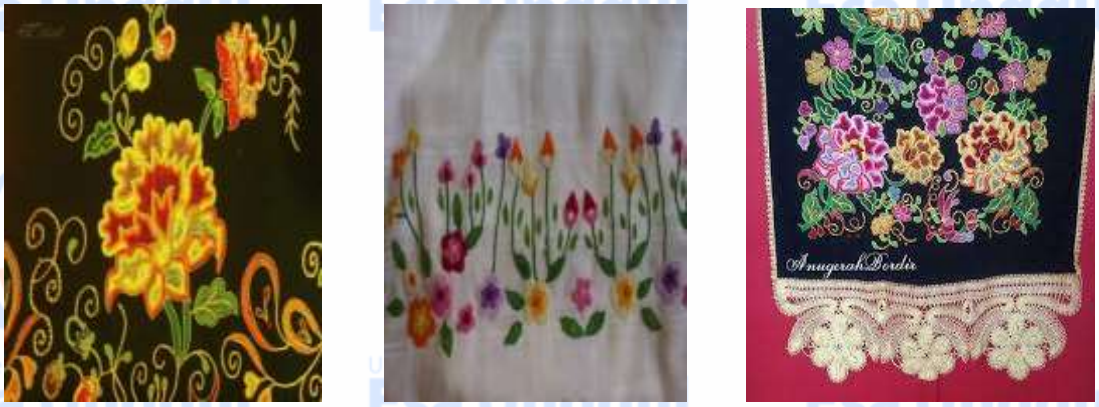

Figure 2. The sample of embroidery handicraft

The business activities of embroidery handicraft industry, based on observations and interviews with experts and respondents establish an order of the supply chain from upstream to downstream. Based on the viewpoint of the process sequence of the decision-making process and the implementation of the flow of products, information and funds, supply chain network embroidery industry shown in the Figure 3.

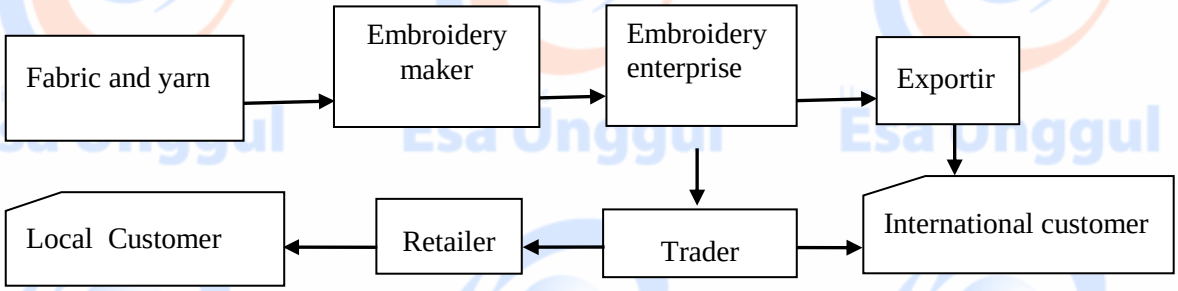

Figure 3. The structure of value chain embroidery handicraft industry

3.2. Developing Expert System

Knowledge management is an fundamental approach to collect and structuring the correct information transfer and dissemination within the organization. Knowledge is intellectual capital, it is critically important for organization. Knowledge is information that is contextual, relevant, and actionable. There are different meaning about data and knowledge. Where as data are collection of fact, measurement and statistic. Information is defined as organized or processed that are timely and accurate. While data, information and knowledge can all be viewed as asset of organization, knowledge provide a higher level of meaning about data and information. Knowledge encompasess the implicit and explicit restriction. There are conceptual difference and distinguished knowledge between an organization tacit knowledge and explicit knowledge. Tacit knowledge is usually in the domain of subjective, cognitive, and experimental learning, where as the explicit knowledge is the procedural guides, software, document.

There are many researchers who interest in how to acquisition knowledge in various research type. In order to construct knowledge stored in the minds of experts, are known methods of the expert

system. This method is capable of structuring knowledge and deposited into the machine to be used as a substitute for an expert in making decisions. Knowledge of embroidery handicraft businesses related to the production cost has not been compiled into a systematic knowledge and easy to navigate. Some of consideration in order calculate production cost of embroidery has not been calculated so as to ensure profit taking. The process for acquiring knowledge begins with the process of socialization is done through observation, focus group discussion and brainstorming.

3.3. Defining the criteria (inputs and outputs)

There are three fuzzy inputs used in preparing the FIS to calculate production cost of embroidery products. The significant consideration are the quality, the complexity of the design and the working hours required. The inputs have criteria such as :

1. Quality inputs are grouped into two categories such as high and low.
   a. High if the quality of embroidery product are use good material, tight embroidery, looks smooth.
   b. Low if the quality of embroidery product are used ordinary material, less tight embroidery, looks rough
2. The complexity of design determined by the complexity of embroidery maker based on decorative design and the usage of yarn. This input determined by variations in the color used. Criteria relating to the complexity design are grouped into three, namely
   a. Difficult if the embroidery product looks beautiful decoration design with embroidery surface area more than 50% of fabric and use yarn more than 8 colours
   b. Moderate if the embroidery product have ordinary decorative design with embroidery surface area 30 - 50% of fabric and use of yarn as many as5-7 colours
   c. Easy if the embroidery product have ordinary decorative design with embroidery surface area 10% to30% of fabric and use of yarn less than 4colours
3. Working hours is related to the required of working hours to make of embroidery handicrafts. The embroidery makers generally make embroidery as a side job to fill the spare time. Based on the required time are grouped into:
   a. High if work hours required as much 32 - 60 hours / (9 - 20 days)
   b. Moderate if work hours required as much 12 - 32 hours / (4 - 8 days)
   c. Low if work hours required as much 4 - 10 hours / (2-3 days)

In order to calculate the embroidery production costs are structured 3 category of production cost. There are the output criteria :

1. High if the production cost such as IDR 1.500.000 to 2.000.000
2. Moderate if the production cost such as IDR 700.000 to 1.499.000
3. Low if the production cost such as IDR 100.000 to 699.000.

3.4. Fuzzy Inference System

A fuzzy rules based system is developed by human operators with the aid of practical experience to face complex situations, with only a set imprecise linguistic if then rules and an imprecise system state. This system incorporate fuzzy inference and rule based expert system resembling what human do daily. Inputs and outputs are two basic elements in the system using handling approaches. The input constitutes some ambiguous verbal semantic or unclear concept for specific event. Following the fuzzy inference mechanism, the output can be fuzzy set or precise set certain features. Therefore, defuzzification is necessary to convert the output result into crisp number. Fuzzy inference infers the results from the existing rule-based system [4].

Expert systems are defined as consulting systems that simulate the reasoning behavior of human expert. The most important components of expert systems are the knowledge base and the inference engine. The main part of the FIS model is the rules. The behavior of a fuzzy system is characterized by a set linguistic rules which constitutes a rule base. The fuzzy “if-then” rules are defined on the basis of experts knowledge in each area. In Mamdani approach the premises and the consequences of

the if-then are linguistic variables associated with fuzzy concept. Every rules has a weight as the number between 0 and 1 which assign the importance of each rule. A fuzzy rule can be written " if x_1 is a , and x_2 is b, where $x_{1\ and}$ $x_2$are variables, y is solution variable, and a, b, and c are fuzzy linguistic terms. The linguistic rules are extracted based on FIS approach. Table 1.shown the fuzzy interpretation of some parameters based on fuzzy linguistic. The extracted rules are entered in to the rule editor of software developed.

Table 1. Rule of alternative for calculation of production cost

Rules	Fuzzy Input			Fuzzy Output
	Quality	Design complexity	Work hours	Production cost
1	Low	Difficult	Moderate	Moderate
2	Low	Difficult	Low	Low
3	Low	Difficult	High	Low
4	Low	Moderate	Moderate	High
5	Low	Moderate	Low	Moderate
6	Low	Moderate	High	Low
7	Low	Easy	Moderate	High
8	Low	Easy	Low	High
9	High	Easy	High	High
10	High	Difficult	Moderate	High
11	High	Difficult	Low	Moderate
12	High		High	Low
13	High		Moderate	High
14	High	Difficult	Low	High
15	High	Moderate	High	Moderate
16	High	Easy	Moderate	High
17	High	Easy	Low	Moderate
18	High	Easy	High	Low

The next step is fuzzification which is the process of converting precise or imprecise data into fuzzy data by assigning membership function. In this research are used triangular membership function is exploited due to its prevalent. The criteria linguistic are assigned as three categorize. The experts are involved in the formulation of criteria and their input factors are embroidery maker, the owner of enterprise who produce handicrafts, wholesalers and store that sent the embroidery products to end customers. Fuzzy set input and output model are entered to Matlab software. This rules will be construct in order develop application of expert system. Figure 4 shown relationship between fuzzy input data with fuzzy output data. Every input and ouput data based on rules are connecting as a rules under fuzzy value. An assessment of calculation production cost of embroidery handicraft in kind "kapalosamek" scarf using Matlab software, which is inputs data quality, complexity of design, work hours and output data as production cost has shown several fuzzy values.

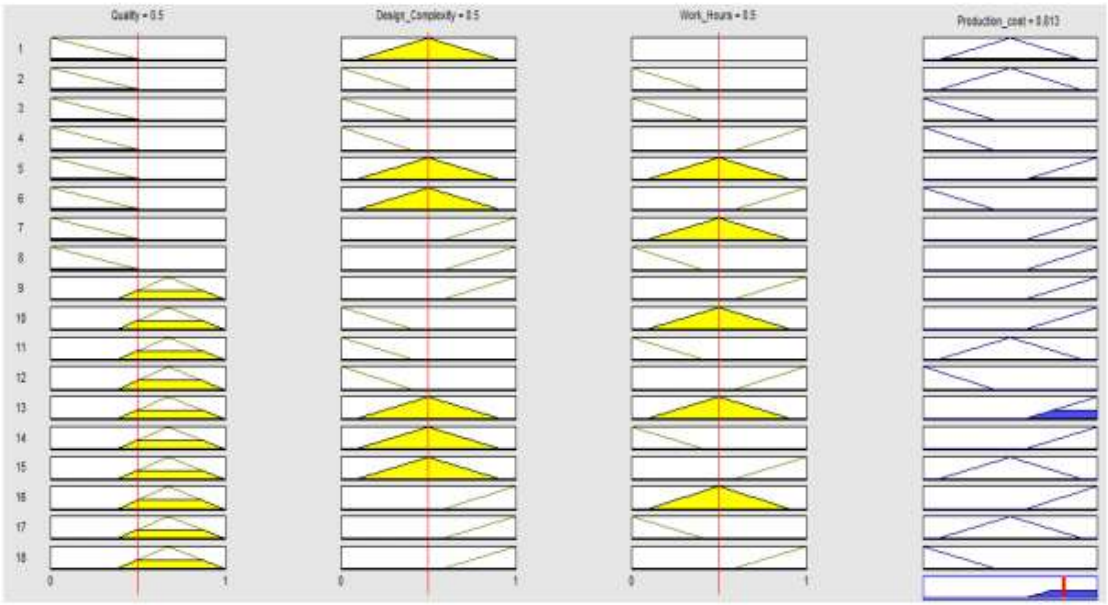

Figure 4. Relationship fuzzy input and output data

In order to calculate production cost using FIS system, each input data and output data were calculated using center of area under curved. An application to calculate production cost and result given shown at Figure 5.

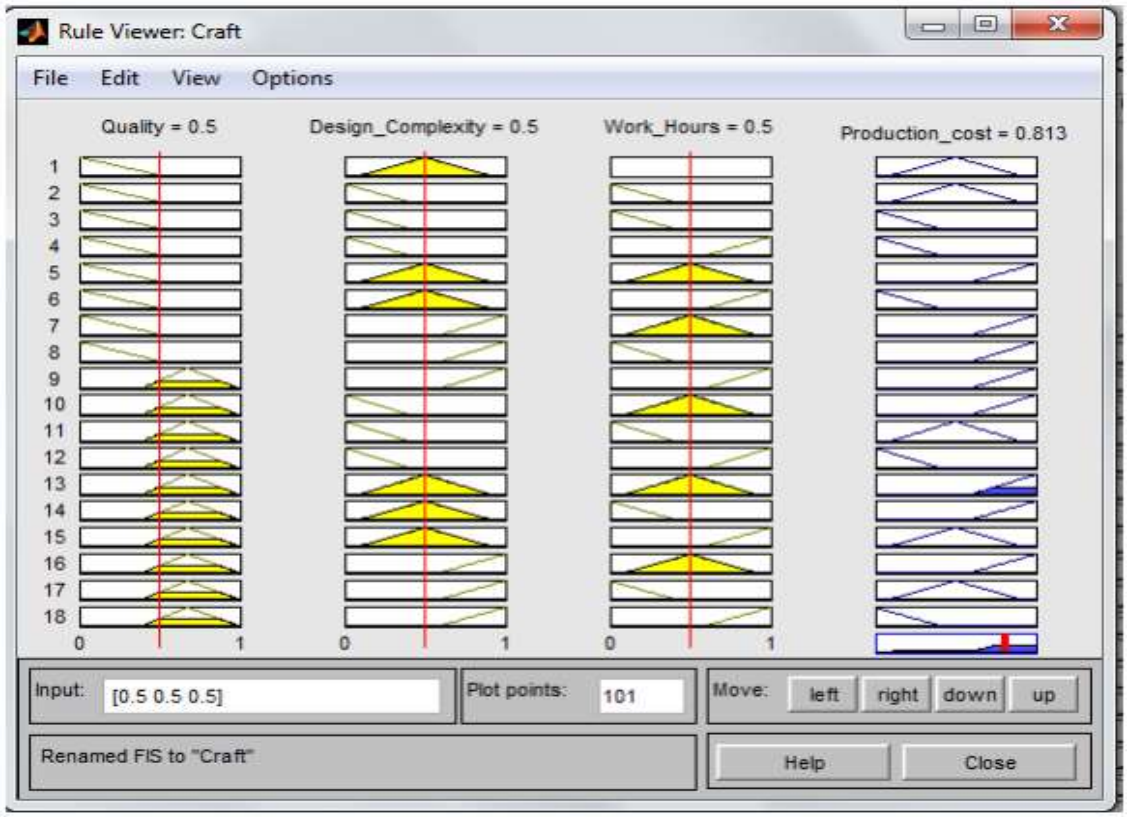

Figure 5. The sample of estimation cost using FIS on Matlab software

4. Conclusions

Based on the conducted present study, following conclusions are drawn.

a. A fuzzy inference system is proposed to solve the the problem for calculate cost of production of handicraft embroidery.

b. The production cost consider about quality, complexity design, availability working hours. The nature of the problem is complex due to the lack of accurate information as well as the need for knowledge of experts. The experts are involved in the formulation of criteria and their input factors are embroidery maker who make embroidery, embroidery business owner, local government, retailer, and customers.

c. Based on using FIS based on the expert opinions, the developing rules FIS can be helpful to develop the expert system. A fuzzy rule-based system with linguistic variables an some of set 'if-then" rules are applied to solve the production cost.

d. The output of this study to design software of expert system in order estimate embroidery production cost on dealing with quality, complexity design and working hours requirement.

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