

## CHAPTER 4

### Results and Discussions



The aim of this research is to study criteria and indicators used for evaluating OTOP wood handicraft products in order to develop a recommendation system for entrepreneurs who want to develop their products according to the selection criteria before submitting their products to the OTOP project. The researcher is conducted according to the research framework developed in the Chapter 3. Results of the study according to research objectives are discussed as follows;

#### **Objective 1: To study Criteria and indicators used for evaluating OTOP wood handicraft products**

##### **Analysis of criteria and indicators used for evaluating OTOP wood handicraft products**

1. According the study about criteria and indicators used for evaluating OTOP wood handicraft products, the researcher found that only 41.1% of products were ready for the selection process to raise quality and standard of the products; however, 85.9% of products were not qualified for the selection process. Among the products applied for the selection process, products in the categories of handicrafts/decorations/

souvenir had the highest proportion. However, only 13.13% of the products in these categories were qualified. Moreover, the researcher also found that among the unqualified products, wood handicraft products had the highest proportion.

2. After information from printed media, websites, relevant studies about selection processes of OTOP products were collected, the researcher further analyzed information and facts about criteria and indicators used for evaluating OTOP wood handicraft products, and found that the criteria can be classified into 3 sections with a total of 22 indicators (Appendix A).

### **Analysis of quality indicators and their corresponding weight**

According to guidelines and criteria for evaluating OTOP products (Appendix A), the researcher found that criteria and indicators used in the selection process based on meticulousness in production and quality of materials were qualitative indicators, which could not be used for quantitative analysis. Therefore, the researcher decided to conduct interviews with 5 experts by using questionnaires (Appendix B) based on meticulousness in production and quality of materials. Answers of the experts were then analyzed and formulated by the researcher into the following indicators;

#### **1. Meticulousness in production**

##### **1.1 General characteristics**

- Mold forming on the surface
- Insect damages
- Splinter
- Dust/stain
- Crack/fracture

## 1.2 Components

- Seamless
- Durability
- Damages from tools

## 1.3 Patterns and design

- Cleanness
- Unevenness
- Distinct and clear

## 1.4 Color

- Homogeneity
- Peeling and cracking
- Stain

## 1.5 Waxing/Glue

- Crack
- Homogeneity

## 2. Quality of materials

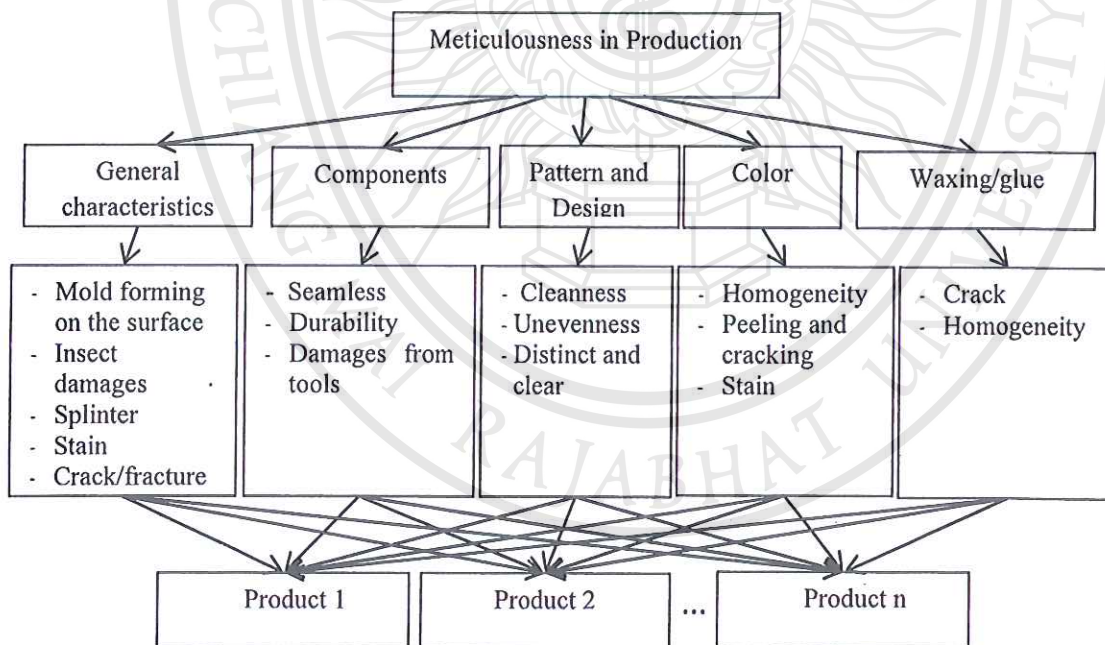
- Undergoing drying processing
- Damages from insects
- Crack/fracture
- Distorted/bent

The researcher found that the most appropriate approach to analyze qualitative indicators is to assign weights of each indicators by using the Analytic Hierarchy Process (AHP). The AHP method is a tool used for decision making based on the priority of each indicator. In this study, the researcher determined the priority of



criteria and indicators. The criteria were classified into 2 aspects; meticulousness in production (Figure 4.1), and quality of materials (Figure 4.3). The researcher calculated the net weight of each criteria and each indicator by asking opinions of 10 experts using questionnaires (see Appendix C for questionnaire, and see Appendix D for the net weights of criteria and indicators). This method allows the researcher to interpret quality criteria and indicators quantitatively. The processes are described as follows;

1. The researcher analyzed the weights of criteria and indicators on meticulousness in production by using the AHP method as shown in the Figure 4.1. The results of analysis by using the AHP method were presented in the 3<sup>rd</sup> National Consference of Kamphaeng Phet Rajabhat University (Tarapitakwong *et al.*, 2016) as follows;



**Figure 4.1 A hierarchical structure of meticulousness in production**



According to the hierarichical structure of meticulousness in production as shown in the Figure 4.1, the researcher calculated weights of each indicator by using the AHP method as follows;

#### 1.1 Analysis of criteria based on meticulousness in production

**Step 1** The researcher filled in the results of comparison of quality criteria in pairs made by 10 experts (see Appendix for comparison of net weights) in the Table 4.1-4.10.

**Table 4.1 Comparison of weights of each criteria for meticulousness in production made by expert No. 1**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	4	7	5	5
Components	$1/4=0.25$	1	7	6	6
Pattern and Design	$1/7=0.14$	$1/7=0.14$	1	$1/3=0.33$	$1/3=0.33$
Color	$1/5=0.20$	$1/6=0.17$	3.00	1	1
Waxing/Glue	$1/5=0.20$	$1/6=0.17$	3.00	1	1

**Table 4.2 Comparison of weights of each criteria for meticulousness in production by expert No. 2**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	3	5	5	7
Components	$1/3=0.33$	1	7	7	8
Pattern and Design	$1/5=0.20$	$1/7=0.14$	1	1	3
Color	$1/5=0.20$	$1/7=0.14$	1	1	3
Waxing/Glue	$1/7=0.14$	$1/8=0.13$	$1/3=0.33$	$1/3=0.33$	1

**Table 4.3 Comparison of weights of each criteria for meticulousness in production made by expert No. 3**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	$1/7=0.14$	$1/5=0.20$	$1/3=0.33$	3
Components	7	1	4	5	7
Pattern and Design	5	$1/4=0.25$	1	3	5
Color	3	$1/5=0.20$	$1/3=0.33$	1	4
Waxing/Glue	$1/3=0.33$	$1/7=0.14$	$1/5=0.20$	$1/4=0.25$	1

**Table 4.4 Comparison of weights of each criteria for meticulousness in production made by expert No. 4**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	$1/5=0.20$	$1/3=0.33$	3.	5
Components	5	1	3	6	7
Pattern and Design	3	$1/3=0.33$	1	3	5
Color	$1/3=0.33$	$1/6=0.17$	$1/3=0.33$	1	3
Waxing/Glue	$1/5=0.20$	$1/7=0.14$	$1/5=0.20$	$1/3=0.33$	1

**Table 4.5 Comparison of weights of each criteria for meticulousness in production made by expert No. 5**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	$1/4=0.25$	4	4	4
Components	4	1	6	7	6
Pattern and Design	$1/4=0.25$	0.17	1	4	2
Color	$1/4=0.25$	$1/7=0.14$	$1/4=0.25$	1	$1/3=0.33$
Waxing/Glue	$1/4=0.25$	$1/6=0.17$	$1/2=0.50$	3	1



**Table 4.6 Comparison of weights of each criteria for meticulousness in production made by expert No. 6**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	1	1	1	1
Components	1	1	1	1	1
Pattern and Design	1	1	1	1	1
Color	1	1	1	1	1
Waxing/Glue	1	1	1	1	1

**Table 4.7 Comparison of weights of each criteria for meticulousness in production made by expert No. 7**

Criteria s for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	$1/3=0.33$	3	5	7
Components	3	1	5	7	9
Pattern and Design	$1/3=0.33$	$1/5=0.20$	1	3	5
Color	$1/5=0.20$	$1/7=0.14$	$1/3=0.33$	1	3
Waxing/Glue	$1/7=0.14$	$1/9=0.11$	$1/5=0.20$	$1/3=0.33$	1

**Table 4.8 Comparison of weights of each criteria for meticulousness in production made by expert No. 8**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	3	5	6	6
Components	$1/3=0.33$	1	3	5	5
Pattern and Design	$1/5=0.20$	$1/3=0.33$	1	3	3
Color	$1/6=0.17$	$1/5=0.20$	$1/3=0.33$	1	1
Waxing/Glue	$1/6=0.17$	$1/5=0.20$	$1/3=0.33$	1	1

**Table 4.9 Comparison of weights of each criteria for meticulousness in production made by expert No. 9**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	$1/3=0.33$	$1/3=0.33$	5	5
Components	3	1	1	7	7
Pattern and Design	3	1	1	7	7
Color	$1/5=0.20$	$1/7=0.14$	$1/7=0.14$	1	1
Waxing/Glue	$1/5=0.20$	$1/7=0.14$	$1/7=0.14$	1	1

**Table 4.10 Comparison of weights of each criteria for meticulousness in production made by expert No. 10**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	1	1	1	1
Components	1	1	1	1	1
Pattern and Design	1	1	1	1	1
Color	1	1	1	1	1
Waxing/Glue	1	1	1	1	1

**Step 2** The researcher calculate the average net weight of each indicator from 10 experts by using the formula (4.1) reported in (Ssebuggwawo, 2009) as shown in the Table 4.11

$$V_{ij} = \left[ \prod_{j=1}^n a_{ij} \right]^{1/n} \quad (4.1)$$

Where

$a_{ij}$  = an element in a weight matrix

$V$  = the geometric mean

$n$  = numbers of experts participating in the evaluation



**Table 4.11 The average net weights of each criteria for meticulousness in production made by 10 experts**

Criteria for Meticulousness in Production	General characteristics	Components	Pattern and Design	Color	Waxing/ Glue
General characteristics	1	0.70	1.47	2.62	3.67
Components	1.43	1	2.97	4.30	4.62
Design and Pattern	0.68	0.34	1	1.94	2.36
Color	0.38	0.23	0.51	1	1.43
Waxing/Glue	0.27	0.22	0.42	0.70	1

**Step 3** The researcher calculate weights of quality indicators from each expert and examine whether the weights obtained from the previous step is higher than the acceptable Consistency Ratio (CR) of 0.1 or lower. If a CR is higher than that of the acceptable value, re-evaluation of criteria and indicator has to be made as shown in the following equation;

Calculation of the Consistency Ratio (CR) from the summation of each column ( $A_{ij}$ ) can be done as follows;

$$A_{ij} = \frac{a_{ij}}{\sum_{l=1}^n a_{lj}} \quad (4.2)$$

Where  $a_{ij}$  = n element in a weight matrix

(where, i = row ith and j = column jth)

n = the numbers of criteria and indicators used in the calculation

$\sum_{l=1}^n a_{lj}$  = summation of elements in a column j<sup>th</sup> from a weight matrix

Calculation of weight ( $W_i$ ) can be done as follows;

$$W_i = \frac{\sum_{l=1}^n A_{il}}{n} \quad (4.3)$$

Weights of each criteria can be calculated by using the equation (4.2) and (4.3) as follows;

Weights of criteria in general characteristic ( $W_i$ )

$$= \left[ \left( \frac{1.00}{3.76} + \frac{0.70}{2.49} + \frac{1.47}{6.37} + \frac{2.62}{10.55} + \frac{3.67}{13.08} \right) / 5 \right] = 0.26$$

Weights of criteria in components ( $W_i$ )

$$= \left[ \left( \frac{1.43}{4.17} + \frac{1.00}{2.61} + \frac{2.97}{6.47} + \frac{4.30}{10.55} + \frac{4.62}{13.08} \right) / 5 \right] = 0.40$$

Weights of criteria in pattern and design ( $W_i$ )

$$= \left[ \left( \frac{0.68}{4.17} + \frac{0.34}{2.61} + \frac{1.00}{6.47} + \frac{1.94}{10.55} + \frac{2.36}{13.08} \right) / 5 \right] = 0.17$$

Weights of criteria in color ( $W_i$ )

$$= \left[ \left( \frac{0.38}{4.17} + \frac{0.23}{2.61} + \frac{0.52}{6.47} + \frac{1.00}{10.55} + \frac{1.43}{13.08} \right) / 5 \right] = 0.10$$

Weights of criteria in waxing/glue ( $W_i$ )

$$= \left[ \left( \frac{0.27}{4.17} + \frac{0.22}{2.61} + \frac{0.42}{6.47} + \frac{0.70}{10.55} + \frac{1.00}{13.08} \right) / 5 \right] = 0.07$$

The weights of the Consistency Ratio (CR) can be examined by using the following equation,

$$CR = \frac{CI}{RI} \quad (4.4)$$

Where

RI is the Random Index

CI is the Consistency Index

Where CI can be calculated from the following equation,

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (4.5)$$

Where  $\lambda_{max}$  can also be calculated from the following equation

$$\lambda_{max} = \frac{\sum_{i=1}^n k_i / W_i}{n} \quad (4.6)$$



Where  $\sum_{i=1}^n k_i$  is the summation of products of each weight pair

**Table 4.12 Values of RI and alternatives**

n	1	2	3	4	5	6	7	8	9	10	11	12	13
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49	1.51	1.48	1.56

$\lambda_{\max}$  can be calculated as follows;

$$\sum_{i=1}^n k_i = \begin{bmatrix} 1.00 & 0.70 & 1.47 & 2.62 & 3.67 \\ 1.43 & 1.00 & 2.97 & 4.30 & 4.62 \\ 0.68 & 0.34 & 1.00 & 1.94 & 2.36 \\ 0.38 & 0.23 & 0.51 & 1.00 & 1.43 \\ 0.27 & 0.22 & 0.42 & 0.70 & 1.00 \end{bmatrix} \times \begin{bmatrix} 0.26 \\ 0.40 \\ 0.17 \\ 0.10 \\ 0.08 \end{bmatrix} = \begin{bmatrix} 1.31 \\ 2.02 \\ 0.84 \\ 0.48 \\ 0.37 \end{bmatrix}$$

$$\sum_{i=1}^n k_i / w_i = \begin{bmatrix} 1.31 \\ 2.02 \\ 0.84 \\ 0.48 \\ 0.37 \end{bmatrix} \div \begin{bmatrix} 0.26 \\ 0.40 \\ 0.17 \\ 0.10 \\ 0.08 \end{bmatrix} = \begin{bmatrix} 5.01 \\ 5.04 \\ 5.02 \\ 5.01 \\ 5.01 \end{bmatrix}$$

$$\lambda_{\max} = \frac{5.01 + 5.04 + 5.02 + 5.01 + 5.01}{5}$$

$$\lambda_{\max} = 5.018$$

The Consistency Index (CI) can be calculated by using the  $\lambda_{\max}$  obtained from the previous step as shown in the equation (4.4), where n equals to 5 which is the size of the comparison matrix or quality indicators, and RI equals to 1.11 which is the Average Random Consistency (Table 4.12).

$$CI = \frac{\lambda_{\max} - n}{n - 1} = \frac{5.018 - 5}{5 - 1} = 0.004$$

$$CR = \frac{CI}{RI} = \frac{0.004}{1.11} = 0.004$$

In this case, the CR equals 0.004 or 0.4% which is lower than 0.10 or 10%. This indicated that the experts considered that there was correlation among the indicators.

## 1.2 Analysis of quality indicators on general characteristic

**Step 1** The researcher filled in the results of comparison of quality indicators in pairs made by 10 experts (comparison of net weights, Appendix D) in the Table 4.13-4.22.

**Table 4.13 Comparison of weights of each indicator in general characteristics of products made by expert No.1**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	$1/3=0.33$	$1/3=0.33$	3	$1/3=0.33$
Insect damages	3	1	1	4	1
Splinter	3	1	1	4	1
Stain	$1/3=0.33$	$1/4=0.25$	$1/4=0.25$	1	$1/6=0.17$
Crack/fracture	3	1	1	6	1

**Table 4.14 Comparison of weights of each indicator in general characteristics of products made by expert No. 2**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	$1/7=0.14$	3	1	$1/9=0.11$
Insect damages	7	1	5	7	$1/3=0.33$
Splinter	$1/3=0.33$	$1/5=0.20$	1	$1/2=0.50$	$1/9=0.11$
Stain	1	$1/7=0.14$	2	1	$1/7=0.14$
Crack/fracture	9	3	9	7	1



**Table 4.15 Comparison of weights of each indicator in general characteristics of products made by expert No. 3**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	$1/9=0.11$	$1/8=0.13$	1	$1/9=0.11$
Insect damages	9	1	3	7	1
Splinter	8	$1/3=0.33$	1	7	$1/3=0.33$
Stain	1	$1/7=0.14$	$1/7=0.14$	1	$1/8=0.13$
Crack/fracture	9	1	3	8	1

**Table 4.16 Comparison of weights of each indicator in general characteristics of products made by expert No. 4**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	$1/5=0.20$	$1/3=0.33$	1	$1/7=0.14$
Insect damages	5	1	5	7	$1/5=0.20$
Splinter	3	$1/5=0.20$	1	3	$1/5=0.20$
Stain	1	$1/7=0.14$	$1/3=0.33$	1	$1/7=0.14$
Cracks/fracture	7	5	5	7	1

**Table 4.17 Comparison of weights of each indicator in general characteristics of products made by expert No. 5**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	5	1	1	1
Insect damages	$1/5=0.20$	1.	$1/5=0.20$	$1/3=0.33$	$1/4=0.25$
Splinter	1	5	1	$1/3=0.33$	$1/3=0.33$
Stain	1	3	3	1	$1/3=0.33$
Crack/fracture	1	4	3	3	1

**Table 4.18 Comparison of weights of each indicator in general characteristics of products made by expert No. 6**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	1	1	1	1
Insect damages	1	1	1	1	1
Splinter	1	1	1	1	1
Stain	1	1	1	1	1
Crack/fracture	1	1	1	1	1

**Table 4.19 Comparison of weights of each indicator in general characteristics of products made by expert No. 7**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Cracks/ fracture
Mold forming on the surface	1	$1/6=0.17$	$1/6=0.17$	$1/5=0.20$	$1/7=0.14$
Insect damages	6	1	1	3	$1/4=0.25$
Splinter	6	1	1	3	$1/5=0.20$
Stain	5	$1/3=0.33$	$1/3=0.33$	1	$1/4=0.25$
Crack/fracture	7	4	5	4	1

**Table 4.20 Comparison of weights of each indicator in general characteristics of products made by expert No. 8**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/ fracture
Mold forming on the surface	1	$1/5=0.20$	3	$1/3=0.33$	$1/7=0.14$
Insect damages	5	1	5	3	$1/3=0.33$
Splinter	$1/3=0.33$	$1/5=0.20$	1	$1/3=0.33$	0.14
Stain	3	$1/3=0.33$	3	1	$1/5=0.20$
Crack/fracture	7	3	7	5	1



**Table 4.21 Comparison of weights of each indicator in general characteristics of products made by expert No. 9**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	$1/3=0.33$	3	1	$1/7=0.14$
Insect damages	3	1	5	3	$1/3=0.33$
Splinter	$1/3=0.33$	$1/5=0.20$	1	$1/3=0.33$	$1/7=0.14$
Stain	1	$1/3=0.33$	3	1	$1/5=0.20$
Crack/fracture	7	3	7	5	1

**Table 4.22 Comparison of weights of each indicator in general characteristics of products made by expert No. 10**

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1	1	1	1	1
Insect damages	1	1	1	1	1
Splinter	1	1	1	1	1
Stain	1	1	1	1	1
Crack/fracture	1	1	1	1	1

**Step 2** The researcher calculate the average net weight of each indicator from 10 experts by using the formula (4.1) as shown in the Table 4.23.

**Table 4.23** The average net weights of each indicator in general characteristics made by 10 experts

Indicators of General characteristics	Mold forming on the surface	Insect damages	Splinter	Stain	Crack/fracture
Mold forming on the surface	1.00	0.38	0.76	0.85	0.27
Insect damages	2.65	1.00	1.81	2.57	0.46
Splinter	1.32	0.55	1.00	1.17	0.32
Stain	1.17	0.39	0.86	1.00	0.26
Crack/fracture	3.77	2.16	3.16	3.84	1.00

**Step 3** The researcher calculate weights of quality indicators from each expert and examine whether the weights obtained from the previous step is higher than the acceptable Consistency Ratio (CR) of 0.1 or lower. If a CR is higher than that of the acceptable value, re-evaluation of criteria and indicator has to be made as shown in the equation (4.2) and (4.3) as follows;

Weights of indicators about mold forming on the surface of products

$$= \left[ \left( \frac{1.00}{9.92} + \frac{0.38}{4.48} + \frac{0.76}{7.58} + \frac{0.85}{9.43} + \frac{0.27}{2.31} / 5 \right) \right] = 0.10$$

Weights of indicators about insect damages

$$= \left[ \left( \frac{2.65}{9.92} + \frac{1.00}{4.48} + \frac{1.81}{7.58} + \frac{2.57}{9.43} + \frac{0.46}{2.31} / 5 \right) \right] = 0.24$$

Weights of indicators about splinter

$$= \left[ \left( \frac{1.32}{9.92} + \frac{0.55}{4.48} + \frac{1.00}{7.58} + \frac{1.17}{9.43} + \frac{0.32}{2.31} / 5 \right) \right] = 0.13$$

Weights of indicators about dust/stain

$$= \left[ \left( \frac{1.17}{9.92} + \frac{0.39}{4.48} + \frac{0.86}{7.58} + \frac{1.00}{9.43} + \frac{0.26}{2.31} / 5 \right) \right] = 0.11$$

Weights of indicators about crack/fracture

$$= \left[ \left( \frac{3.77}{9.92} + \frac{2.16}{4.48} + \frac{3.16}{7.58} + \frac{3.84}{9.43} + \frac{1.00}{2.31} / 5 \right) \right] = 0.42$$

$$\lambda_{\max} = 5.018, \quad CI = 0.005, \quad CR = 0.004$$

The Consistency Index (CI) can be calculated by using the  $\lambda_{\max}$  obtained from the previous step as shown in the equation (4.4), where n equals to 5 which is the size of the comparison matrix or quality indicators, and RI equals to 1.11 which is the Average Random Consistency (Table 4.12). In this case, the CR equals 0.004 or



0.4% which is lower than 0.10 or 10%. This indicated that the experts considered that there was correlation among the indicators. (for more details about the calculation see Appendix E)

The net weights of indicators in meticulousness in production can be calculated by multiplying the weight of the indicator to the weight of each criteria as shown in the Table 4.24 and a hierarchical structure of meticulousness in production as shown in the Figure 4.2.

**Table 4.24 Net weights of indicators in meticulousness in products**

<b>Meticulousness in production</b>	<b>Weight</b>	<b>Indicator</b>	<b>Criteria</b>	<b>Net weight</b>
General characteristic	0.26	Mold forming on the surface	0.10	0.026
		Insect damages	0.24	0.062
		Splinter	0.13	0.034
		Stain	0.11	0.029
		Crack/fracture	0.42	0.109
Components	0.40	Seamless	0.24	0.096
		Durability	0.32	0.128
		Damages from tools	0.44	0.176
Patterns and design	0.17	Cleanness	0.44	0.075
		Unevenness	0.35	0.060
		Distinct and clear	0.21	0.036

Table 4.24 Net weights of indicators in meticulousness in products (Continued)

Meticulousness in production	Weight	Indicator	Criteria	Net weight
Color	0.10	Homogeneity	0.20	0.020
		Peeling and cracking	0.36	0.036
		Stain	0.44	0.044
Waxing/Glue	0.07	Crack	0.70	0.049
		Homogeneity	0.30	0.021

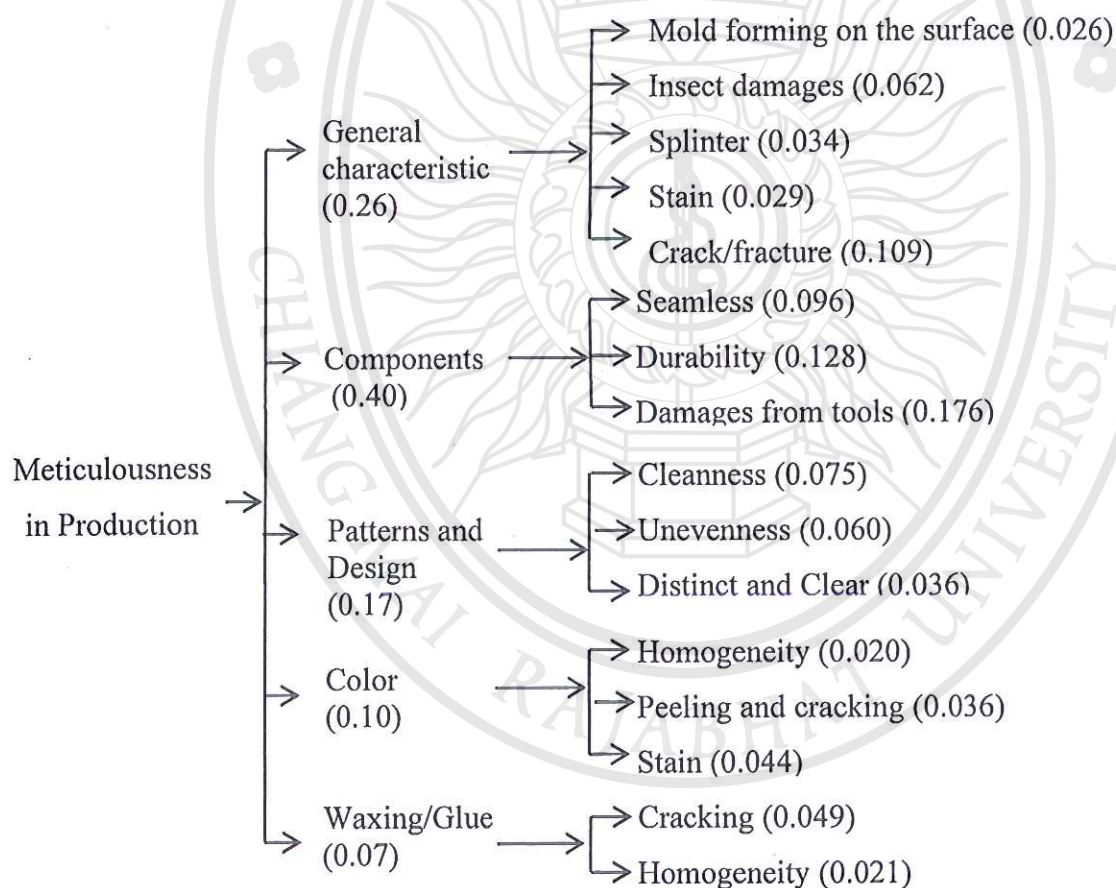
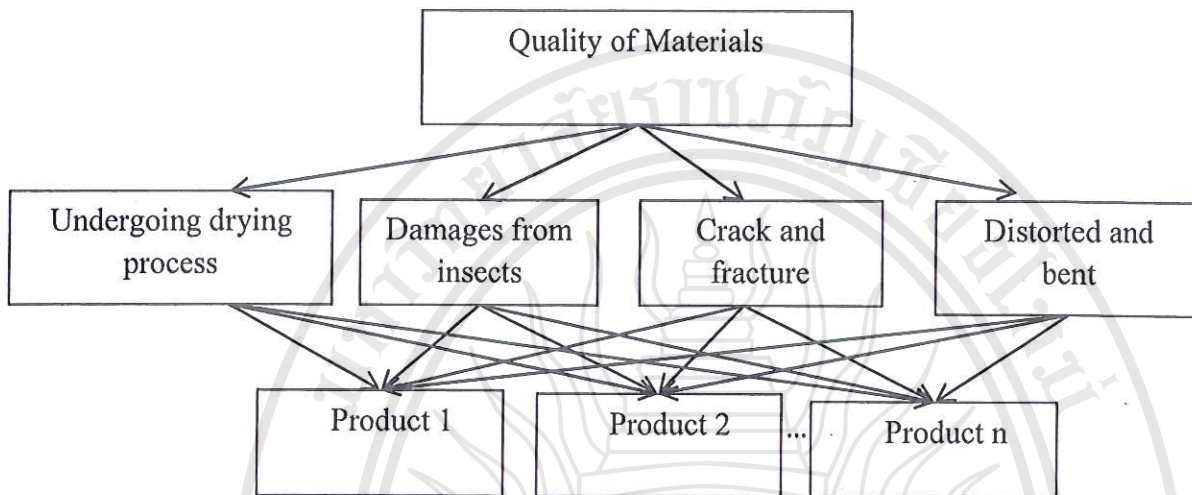


Figure 4.2 A hierarchical structure of weight of indicators and criteria in meticulousness in production

## 2. Analysis of weight of each indicator in quality of materials by using the AHP method



**Figure 4.3 A hierarchical structure of quality of materials**

According to the hierarchical structure of quality of materials as shown in the Figure 4.2, the researcher calculated weights of each indicator by using the AHP method as follows;

### 2.1 Analysis of indicators based on meticulousness in production

**Step 1** The researcher filled in the results of comparison of quality indicators in pairs made by 10 experts (see Appendix D for comparison of net weights) in the Table 4.25-4.34.



**Table 4.25 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 1**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	$1/4=0.25$	$1/4=0.25$	$1/5=0.20$
Damages from insects	4	1	1	2
Crack/Fracture	4	1	1	3
Distorted and bent	5	$1/2=0.50$	$1/3=0.33$	1

**Table 4.26 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 2**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	$1/7=0.14$	$1/9=0.11$	$1/5=0.20$
Damages from insects	7	1	$1/3=0.33$	3
Crack/Fracture	9	3	1	5
Distorted and bent	5	$1/3=0.33$	$1/5=0.20$	1

**Table 4.27 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 3**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	$1/5=0.20$	$1/9=0.11$	$1/8=0.13$
Damages from insects	5	1	$1/5=0.20$	$1/3=0.33$
Crack/Fracture	9	5	1	3
Distorted and bent	8	3	$1/3=0.33$	1

**Table 4.28 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 4**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	$1/3=0.33$	$1/7=0.14$	$1/7=0.14$
Damages from insects	3	1	$1/3=0.33$	$1/3=0.33$
Crack/Fracture	7	3	1	1
Distorted and bent	7	3	1	1

**Table 4.29 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 5**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	2.	$1/5=0.20$	$1/5=0.20$
Damages from insects	$1/2=0.50$	1	$1/5=0.20$	$1/3=0.33$
Crack/Fracture	5	5	1	3
Distorted and bent	5	3	$1/3=0.33$	1

**Table 4.30 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 6**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	1.	1	1
Damages from insects	1	1	1	1
Crack/Fracture	1	1	1	1
Distorted and bent	1	1	1	1



**Table 4.31 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 7**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	$1/5=0.20$	$1/5=0.20$	$1/5=0.20$
Damages from insects	5	1	1	1
Crack/Fracture	5	1	1	1
Distorted and bent	5	1	1	1

**Table 4.32 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 8**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	$1/5=0.20$	$1/7=0.14$	$1/6=0.17$
Damages from insects	5	1	$1/5=0.20$	$1/3=0.33$
Crack/Fracture	7	5	1	2
Distorted and bent	6	3	$1/2=0.50$	1

**Table 4.33 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 9**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	$1/5=0.20$	$1/9=0.11$	$1/7=0.14$
Damages from insects	5	1	$1/5=0.20$	$1/3=0.33$
Crack/Fracture	9	5	1	3
Distorted and bent	7	3	$1/3=0.33$	1

**Table 4.34 Comparison of weights of each criteria and indicators for quality of materials made by expert No. 10**

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ Fracture	Distorted and bent
Undergo Drying process	1	1	1	1
Damages from insects	1	1	1	1
Crack/Fracture	1	1	1	1
Distorted and bent	1	1	1	1

**Step 2** The researcher calculate the average net weight of each indicator from 10 experts by using the formula (4.1) as shown in the Table 4.35.

**Table 4.35** The average net weights of each criteria and indicators for quality of materials made by 10 experts

Criteria for Quality of Materials	Undergo Drying process	Damages from insects	Crack/ fracture	Distorted and bent
Undergo Drying process	1.00	0.36	0.22	0.24
Damages from insects	2.77	1.00	0.42	0.69
Cracks/Fracture	4.52	2.37	1.00	1.95
Distorted and bent	4.14	1.45	0.51	1.00

**Step 3** The researcher calculate weights of quality indicators from each expert and examine whether the weights obtained from the previous step is higher than the acceptable Consistency Ratio (CR) of 0.1 or lower. If a CR is higher than that of the acceptable value, re-evaluation of criteria and indicator has to be made as shown in the equation (4.2) and (4.3) as follows;

Weights of indicators about undergoing drying processing

$$= \left[ \left( \frac{1.00}{12.43} + \frac{0.36}{5.18} + \frac{0.22}{2.15} + \frac{0.24}{3.88} \right) / 4 \right] = 0.08$$



Weights of indicators about insect damage

$$= \left[ \left( \left( \frac{2.77}{12.43} + \frac{1.00}{5.18} + \frac{0.42}{2.15} + \frac{0.69}{3.88} \right) / 4 \right) \right] = 0.20$$

Weights of indicators about crack/fracture

$$= \left[ \left( \left( \frac{4.52}{12.43} + \frac{2.37}{5.18} + \frac{1.00}{2.15} + \frac{1.95}{3.88} \right) / 4 \right) \right] = 0.44$$

Weights of indicators about distorted/bent

$$= \left[ \left( \left( \frac{4.14}{12.43} + \frac{1.45}{5.18} + \frac{0.51}{2.15} + \frac{1.00}{3.88} \right) / 4 \right) \right] = 0.28$$

To validate weights of each indicator, the Consistency Ratio (CR) was used to compare weights in pairs as follows;

$\lambda_{\max}$  can be calculated

$$\sum_{i=1}^n k_i = \begin{bmatrix} 1.00 & 0.36 & 0.22 & 0.24 \\ 2.77 & 1.00 & 0.42 & 0.69 \\ 4.52 & 2.37 & 1.00 & 1.95 \\ 4.14 & 1.45 & 0.51 & 1.00 \end{bmatrix} \times \begin{bmatrix} 0.08 \\ 0.20 \\ 0.44 \\ 0.28 \end{bmatrix} = \begin{bmatrix} 0.32 \\ 0.79 \\ 0.81 \\ 1.12 \end{bmatrix}$$

$$\lambda_{\max} = \begin{bmatrix} 0.32 \\ 0.79 \\ 0.81 \\ 1.12 \end{bmatrix} \div \begin{bmatrix} 0.08 \\ 0.20 \\ 0.44 \\ 0.28 \end{bmatrix} = \begin{bmatrix} 4.01 \\ 4.03 \\ 4.53 \\ 4.04 \end{bmatrix}$$

$$= \frac{4.01 + 4.03 + 5.43 + 4.04}{4}$$

$$\lambda_{\max} = 4.032$$

The Consistency Index (CI) can be calculated by using the  $\lambda_{\max}$  obtained from the previous step as shown in the equation (4.4), where n equals to 4 which is the size of the comparison matrix or quality indicators, and RI equals to 0.89 which is the Average Random Consistency (Table 4.12, p106).

$$CI = \frac{\lambda_{\max} - n}{n - 1} = \frac{4.032 - 4}{4 - 1} = 0.011$$

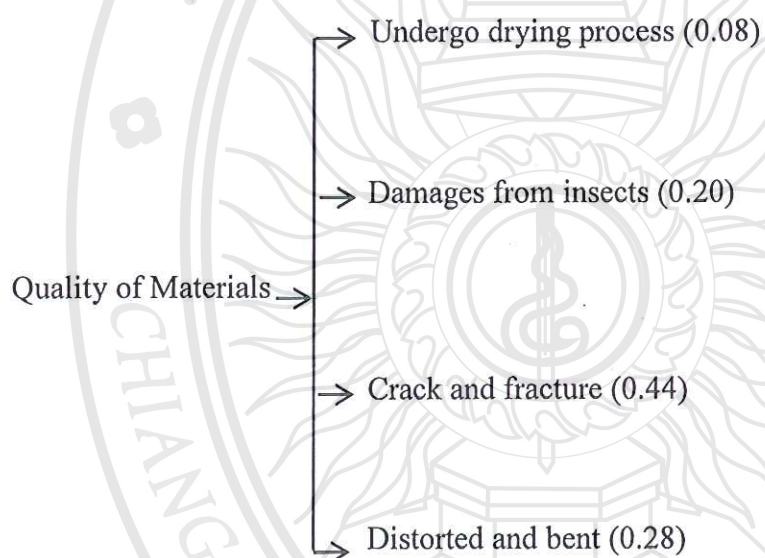
$$CR = \frac{CI}{RI} = \frac{0.011}{0.89} = 0.012$$

In this case, the CR equals 0.012 or 1.2% which is lower than 0.10 or 10%. This indicated that the experts considered that there was correlation among the indicators.

The net weights of indicators in meticulousness in production can be calculated by multiplying the weight of the indicator to the weight of each criteria as shown in the Table 4.36 and a hierarchical structure of meticulousness in production as shown in the Figure 4.4.

**Table 4.36 Net weight of criteria and indicators for quality of materials**

Criteria for Quality of Materials	Weight	Net weight
Undergo drying process	0.08	0.08
Damages from insects	0.20	0.20
Crack and fracture	0.44	0.44
Distorted and Bent	0.28	0.28

**Figure 4.4 A hierarchical structure of weight of criteria and indicators for quality of materials**



## Objective 2: Recommendation system development

### Content validity analysis of questionnaires

The researcher collected information from printed media, websites, relevant studies, and interviews of experts in the evaluation process of OTOP products, developed questionnaires (Appendix F), and performed content validity analysis and appropriateness of wording of the questionnaires by collecting opinions of 5 experts; 3 experts who were members of an OTOP product selection committee in the upper Northern region of Thailand, and 2 experts who were members of an OTOP product selection committee in the lower Northern region of Thailand. The content validity can be described by using the (Index of item objective congruence: IOC as shown in the Table 4.37.

**Table 4.37 Content validity analysis**

Questions		Expert					Sum	IOC
		1	2	3	4	5		
Section A. Products and strength of the community								
Issue 1: Manufacturing								
1.1	Percentage of raw materials used in the production supplying by local sources within the country	1	1	1	1	1	1.00	Pass
1.2	Percentage of expansion of production factors, such as land, capital, labor, machinery, and raw materials from the previous year	1	1	1	1	1	1.00	Pass

**Table 4.37 Content validity analysis (Continued)**

Questions		Expert					Sum	IOC
		1	2	3	4	5		
1.3	How is the environment conservation involved in the production process?	1	1	1	1	1	1.00	Pass
1.4	Percentage of products and quality of production that meet the standards of production from the previous year	1	1	1	1	1	1.00	Pass
Issue 2: Product development								
2.1	How has the products product developed in the last one year?	1	1	1	1	1	1.00	Pass
2.2	Has the packaging developed at least a few times a year?	1	1	1	1	0	0.80	Pass
2.3	What is the format of the packaging for the product?	1	1	1	1	1	1.00	Pass
Issue 3: Strength of the community								
3.1	How many years since the group started of business?	1	1	1	1	1	1.00	Pass
3.2	What aspects of community engagement are there?	1	1	1	1	1	1.00	Pass
3.3	How is the accounting system of the group?	1	1	1	1	1	1.00	Pass

Table 4.37 Content validity analysis (Continued)

Section B. Marketing and background of the product									
Issue 1: Marketing									
4.1	Where are the main channels-sources of distribution?	1	1	1	1	1	1.00	Pass	
4.2	Percentage increase of income from the previous year	1	1	1	1	1	1.00	Pass	
4.3	Do you have continuity in ordering from customers?	1	1	1	1	1	1.00	Pass	
Issue 2: Product development									
5.1	What kind of product stories are recorded or displayed?	1	1	1	1	1	1.00	Pass	
5.2	How is the product development of the group?	1	1	1	1	0	0.80	Pass	
Section C. Criteria and indicators for product quality									
Issue 1: Product quality									
1. Meticulousness in production									
A. General characteristic									
1	Do you found mold forming on the product?	1	1	1	1	1	1.00	Pass	
2	Do you found a bug or insect bite on the product?	1	1	1	1	1	1.00	Pass	



**Table 4.37 Content validity analysis (Continued)**

Questions		Expert					Sum	IOC
		1	2	3	4	5		
3	Do you found hairs or burrs on the surface of the product?	1	1	1	1	1	1.00	Pass
4	Do you found dust or stain on the product?	1	1	1	1	1	1.00	Pass
5	Are there any cracks/fracture on the product?	1	1	1	1	1	1.00	Pass
B. Components								
6	Assembling workpieces are seamless or not?	1	1	1	1	1	1.00	Pass
7	Is the assembly fastened/durable?	1	1	1	1	1	1.00	Pass
8	Assembling workpieces have any damage from tools?	1	1	1	1	0	0.80	Pass
C. Design and patterns								
9	Is the product design consistent?	1	1	1	1	1	1.00	Pass
10	Product pattern is distorted/uneven?	1	1	1	1	1	1.00	Pass
11	Does the pattern design of products?	1	1	1	1	1	1.00	Pass

Table 4.37 Content validity analysis (Continued)

Questions		Expert					Sum	IOC
		1	2	3	4	5		
D. Color								
12	The color of the product is smooth, not forming pellets.	1	1	1	1	1	1.00	Pass
13	No peeling when using the hand rubbing on the product.	1	1	1	1	1	1.00	Pass
14	Are there any smudges and flecks of paint on the product?	1	1	1	1	1	1.00	Pass
E. Waxing/glue								
15	Is there a cracking / breaking out of the varnish or glue?	1	1	1	1	1	1.00	Pass
16	Is the varnish or glue free?	1	1	1	1	1	1.00	Pass
2. General characteristic/Design/Compatability of Each Components (Choose Either A or B)								
A. Using Local Wisdom								
1	Is the uniqueness reflecting Thai wisdom as a product developed from local wisdom by bringing knowledge, skills, abilities from the ancestors?	1	1	1	1	1	1.00	Pass

**Table 4.37 Content validity analysis (Continued)**

Questions		Expert					Sum	IOC
		1	2	3	4	5		
2	Do the patterns associated with the local way of life, tradition or culture?	1	1	1	1	1	1.00	Pass
3	Is there any story or the legend of the product?	1	1	1	1	0	0.80	Pass
4	Pattern is even along the piece	1	1	1	1	1	1.00	Pass
5	The color is smooth	1	1	1	1	1	1.00	Pass
6	Is the coating not smooth / not cracked throughout the work?	1	1	1	1	1	1.00	Pass
7	Keep details neat / neatly decorated throughout the work.	1	1	1	1	1	1.00	Pass
8	Use natural materials / not decorated with other materials too?	1	1	1	1	1	1.00	Pass
9	Products are available in many sizes. Suitable for use?	1	1	1	1	1	1.00	Pass
10	The balance of the shape / shape (distorted, deflected, or tilted to one side) throughout the workpiece.	1	1	1	1	1	1.00	Pass



Table 4.37 Content validity analysis (Continued)

Questions		Expert					Sum	IOC
		1	2	3	4	5		
B. Creativity								
1	Have creative ideas on Thai wisdom?	1	1	1	1	1	1.00	Pass
2	Colorful patterns according to market demand, such as customer orders or market survey	1	1	1	1	1	1.00	Pass
3	Is there any indication of the legendary product story?	1	1	1	1	0	0.80	Pass
4	Pattern is even along the piece	1	1	1	1	1	1.00	Pass
5	The color is not flat/smooth, not broken throughout the work.	1	1	1	1	1	1.00	Pass
6	Is the coating not smooth/not cracked throughout the work?	1	1	1	1	1	1.00	Pass
7	Keep details neat & neatly decorated throughout the work.	1	1	1	1	1	1.00	Pass
8	Is it natural?	1	0	1	1	0	0.60	Pass
9	Use natural materials or raw materials to produce?	1	1	1	1	0	0.80	Pass

Table 4.37 Content validity analysis (Continued)

Questions		Expert					Sum	IOC
		1	2	3	4	5		
10	Products are available in many sizes. Suitable for use?	1	1	1	1	1	1.00	Pass
11	The balance of the shape / shape (distorted, deflected, or tilted to one side) throughout the workpiece.	1	1	1	1	1	1.00	Pass
3. Features that the products should have								
1	There are features that the product has such as durability, strength, fragility or wear and tear. The color / coating is not a grain, not baked, baked or broken throughout the work.	1	1	1	1	1	1.00	Pass
4. Quality of materials								
1	Do you found mold on the material/raw material used for drying?	1	1	1	1	1	1.00	Pass
2	Raw materials used in the production have moths/insect bites.	1	1	1	1	1	1.00	Pass
3	Raw materials used in the production of cracks/cracks/broken or not.	1	1	1	1	1	1.00	Pass
4	Raw materials used in the production of distortion/bend/bent.	1	1	1	1	1	1.00	Pass

Table 4.37 Content validity analysis (Continued)

Questions		Expert					Sum	IOC
		1	2	3	4	5		
5. Uniqueness of design								
1	Can products be made available commercially?	1	1	1	1	0	0.80	Pass
2	Are the products made up of their own?	1	1	1	1	1	1.00	Pass
3	Are the products made up of Thai wisdom?	1	1	1	1	1	1.00	Pass
6. Practicality								
1	Has the specification <u>or practicality</u> of the product been specified?	1	1	1	1	1	1.00	Pass
Issue 2: Market opportunity								
1.Market Opportunity								
1	Detailed information <u>about the product identifier</u> (eg, address, place of manufacture, storage method) is provided. How to use How to care How to assemble / install a product The size of the product) and there is a story of the product?	1	1	1	1	1	1.00	Pass



**Table 4.37 Content validity analysis (Continued)**

	Questions	Expert					Sum	IOC
		1	2	3	4	5		
2	Has the product details been displayed in Thai and foreign languages to convey the product information?	1	1	1	1	1	1.00	Pass
3	Contain concealed/protected products that can maintain a certain quality	1	1	1	1	1	1.00	Pass
4	There is a material that prevents the product from being damaged when it is carried or transported	1	1	1	1	1	1.00	Pass
5	Damage preventing materials are made of Polystyrene foam, Polyurethane foam Polyethylene foam, Plastic sheet, and etc.	1	1	1	1	1	1.00	Pass
6	Are prices clearly displayed on the packaging?	1	1	1	1	1	1.00	Pass

According to the Table 4.37, the researcher asked the experts to provide suggestions about the wording of the questions that had the values of IOC more than 0.5 as follows;

Section A: Product and strength of the community

Issue 1: Manufacturing

Question No. 1.4

Original: Percentage of products and quality of production that meet the standards of production from the previous year

Revision: Percentage of products that meet the standards of production from the previous year

## Issue 2: Product development

### Question No. 2.1

Original: How has products developed in the last one year?

Revision: How has the product developed in the last one year?

## Issue 3: Strength of the community

### Question No. 3.2

Original: Community engagement, what aspects are there?

Revision: What aspects of community engagement are there?

## Section B Marketing and background of the product

### Issue 1: Marketing

Original: Where are the major sources of distribution?

Revision: Where are the major channels of distribution?

## Section C General characteristic/Design/Compatability of Each Components

### Issue 1: Product Quality

#### 1. Meticulousness in prodcution

#### C. Design and pattern

#### Question No. 11

Original: Does the pattern of products distinct and clear?

Revision: Does the design of products distinct and clear?

## 6. Practicality

### Question No. 1

Original: Has the specification of the product been specified?

Revision: Has the specification or practicality of the product been specified?

## Issue 2: Marketing potential

### Question No. 1

Original: 1. Detailed information about (eg, address, place of manufacture, storage method) is provided. How to use How to care How to assemble / install a product The size of the product) and there is a story of the product?

Revision: 1. Detailed information the product identifier (eg, address, place of manufacture, storage method) is provided. How to use How to care How to assemble / install a product The size of the product) and there is a story of the product?

### Question No. 2

Original: Has the product details been displayed in Thai to convey the product information?

Revision: Has the product details been displayed in Thai and foreign languages to convey the product information?



### **K-Nearest Neighbor Analysis by Using the k-Fold Cross-Validation**

After the content validity and appropriateness of wording evaluated by the experts was performed, the researcher created a questionnaire (Appendix G) and asked 163 OTOP entrepreneur (119 from the upper Northern region, and 44 from the lower Northern region) to evaluate their own products. The answers were analyzed by using the k-Nearest Neighbor Algorithm base on the Euclidean distance function to compare similarities and to help predict the results. In this study, the performance of the algorithm will be evaluated by using the k-Fold Cross-Validation. There were 5 rounds of evaluation. Each round was divided into 5 group with 1 group being the testing set and the rest were the training set. The researcher found that the Euclidean distance of  $K=3$  has the lowest distance with the accuracy was 88.34%, recall was 88.30% and precision was 83.4% (The results of analysis is shown in the Appendix H). In this study, the researcher has adopted the most common k-Nearest Neighborhood evaluating algorithm, which is the k- Fold Cross-Validation. The results were also present as a research article for publication in International Journal of the Computer, the Internet and Management (Tarapitakwong *et al.*, 2017)

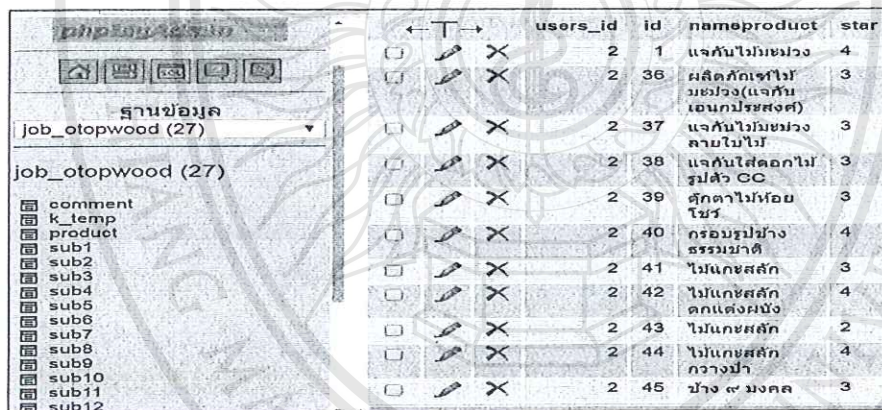
### **The results of the analysis, design and development of recommendation system for entrepreneur of OTOP wood handicraft products**

After the efficiency of the k-Nearest Neighbor Algorithm was performed by using the Euclidean distance function, the researcher developed a recommendation system based on the Euclidean distance and k-Nearest Neighbor Algorithm to suggest product improvement for entrepreneur of OTOP wood handicraft products. In this study, the recommendation system was developed by using PHP programming

language and MySQL database platform. The development of the system is described as follows;

1. In this study, the researcher classified evaluation guidelines into 3 parts with a total of 22 criteria (Appendix A). The AHP technique was used to transform qualitative into quantitative indicators (Appendix E). The questionnaire was developed (Appendix G) to collect information from OTOP products that have been selected in the previous years to store in the case-based database.

2. The researcher stored rating of OTOP products (1-5 stars) in the case-based database as shown in Figure 4.5 below. Information about improvement of OTOP product is also shown in the Figure 4.6.



users_id	id	nameproduct	star
2	1	แจกันไม้มะม่วง	4
2	36	ผลิตภัณฑ์ไม้ มะม่วง(แจกัน เขนกลีประสงศ)	3
2	37	แจกันไม้มะม่วง ลายไม้ไม้	3
2	38	แจกันไม้ดอกไม้ รูปสัตว์ CC	3
2	39	ตุ๊กตาไม้มะ ม่วง	3
2	40	กรอบรูปไม้ ธรรมชาติ	4
2	41	ไม้แกะสลัก	3
2	42	ไม้แกะสลัก ตกแต่งผนัง	4
2	43	ไม้แกะสลัก	2
2	44	ไม้แกะสลัก กวาดบ้าน	4
2	45	ไม้แกะสลัก	3

**Figure 4.5 The case-based databases for OTOP products that have been evaluated**



[illegible]

**Figure 4.6 Displaying the case-based database for storage information about improvement of OTOP products**

3. The recommendation system was developed by using the reasoning process of case studies as follows;

### 3.1 Retrieve Case

To evaluate a new case, the similarity of the data in the case-based database and the case study was calculated by using similarity between the existing data and the new case. In this study, we examined the similarity of cases in terms of the Nearest Neighborhood by using the Euclidean distance functions with  $K = 3$  (Appendix K) as shown in the equation (4.7).

$$\text{dist}(x_i, x_j) = \sqrt{\sum_{k=1}^n (x_{i,k} - x_{j,k})^2} \quad (4.7)$$

Where  $\text{dist}(x_i, x_j)$  is the distance between  $x_i$  and  $x_j$

$n$  is the total number of attributes

$x_{i,k}$  is attribute  $k$  of  $x_i$



### 3.2 Reuse Case

According to the theory, the Euclidean distance will be smaller if there is higher similarity between the data in the case-based database and the new case study. In this study, the system will perform a similarity check based on the Euclidean distance of the case study to the baseline data in all cases. The system then selects the data from the lowest case ( $k = 3$ ) to determine the most likely answer to the new case.

### 3.3 Revise Case

In this step, the system will adopt a new case study that has the similarity to the case-based database. To predict the outcome of a new case and update the database, the condition of the Euclidean distance can be set as follows;

If the Euclidean distance is  $< 3$ , then the system can predict the result by learning from the case-based database.

If the Euclidean distance is  $\geq 3$ , then the case study should be carried out through the processing process.

### 3.4. Retain Case

In order to prevent problems, the system indexes and stores new cases into the case-based database.

### 3.5 Construction

The researcher developed the system with a user-friendly interface that is easy to use

3.5.1 Screen for entering user account and password. In this screen, the user must register to the system, and then enter the username and password to login. Non-registered user can not access the system as shown in Figure 4.7.

**Figure 4.7 Screen showing fields to enter user account and password before login**

3.5.2 Screen for explanation and entering the name of the product to be evaluated. In this screen, the user can enter the product name into the input field, and click on the start button to send the evaluation form. In case the product name is not entered, the user will not be able to select the button and will be prompted to enter the product name as shown in Figure 4.8.

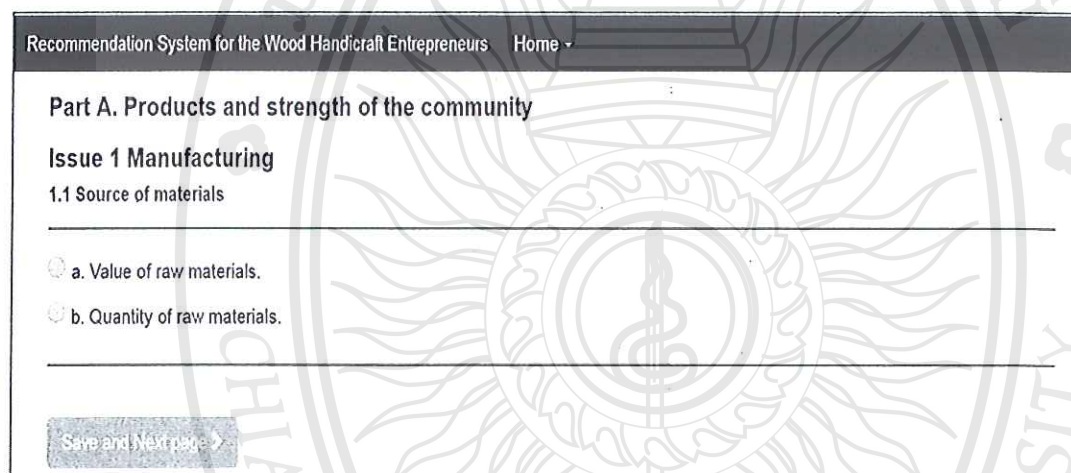
**Figure 4.8 Screen showing explanation and a field for entering the name of the product to be evaluated**

3.5.3 Screen for evaluation. The screen is divided into 3 parts:

Product and strength of community. There are 3 criteria including 10 indicators as shown in the Figure 4.9 (below).

Marketing and background of the product. There are 2 criteria, including 5 indicators as shown in the Figure 4.10.

Product quality. There are 2 criteria, including 7 factors as shown in the Figure 4.11.



Recommendation System for the Wood Handicraft Entrepreneurs Home ▾

**Part A. Products and strength of the community**

**Issue 1 Manufacturing**

**1.1 Source of materials**

☐ a. Value of raw materials.

☐ b. Quantity of raw materials.

Save and Next page >

**Figure 4.9 Screen showing product evaluation based on product and strength of community**



Recommendation System for the Wood Handicraft Entrepreneurs Home ▾

**Issue 1 Marketing**

4.1 Major places for distributing products

---

☐ a. Considering the volume of orders.

☐ b. Considering sales / orders.

---

◀ Back    Save and Next page ▶

**Figure 4.10** Screen showing product evaluation based on marketing and background of the product

Recommendation System for the Wood Handicraft Entrepreneurs Home ▾

1.1 Meticulousness in production

---

**1.1.1 General characteristic**

Indicators	Yes	No
Do you found mold forming on the product?	<input type="radio"/>	<input type="radio"/>
Do you found a bug or insect bite on the product?	<input type="radio"/>	<input type="radio"/>
Do you found hairs or burrs on the surface of the product?	<input type="radio"/>	<input type="radio"/>
Do you found dust or stain on the product?	<input type="radio"/>	<input type="radio"/>
Do you found dust or stain on the product?	<input type="radio"/>	<input type="radio"/>

**Figure 4.11** Screen showing product evaluation based on product quality

The evaluation is designed as Q&A. The questions and answers are provided to the user. Answers can be made in several ways, such as the check box is shown in the Figure 4.12, the radio button as shown in the Figure 4.13, and the text box for entering data as shown in Figure 4.14.

Recommendation System for the Wood Handicraft Entrepreneurs Home ▾

1)How is the environment conservation involved in the production process?

- ☐ No impact on the environment.
- ☒ Take into account the effects of pollution / Management of waste arising from the operation.
- ☒ Take into account the utilization of resources and the balance of natural resources.
- ☐ Environmental management development is in accordance with international law or standards or relevant requirements.

**Figure 4.12 Checkbox (multiple choice)**

Recommendation System for the Wood Handicraft Entrepreneurs Home ▾

**Part A. Products and strength of the community**

**Issue 1 Manufacturing**

**1.1 Source of materials**

☐ a. Value of raw materials.

☐ b. Quantity of raw materials.

Save and Next page >

**Figure 4.13 Radio button**

Recommendation System for the Wood Handicraft Entrepreneurs Home ▾

**Part A. Products and strength of the community**

**Issue 1 Manufacturing**

**1.1 Source of materials**

☒ a. Value of raw materials.

Ordered price of raw materials used in domestic production  Baht.

Ordered price of raw materials used in all production  Baht.

Ordered price of raw materials used in abroad production  Baht.

☐ b. Quantity of raw materials.

Save and Next page >

**Figure 4.14 Text box**

3.5.4 Screen for displaying reports. This screen will show the evaluation results from the questionnaire of the user. It shows the product score on each factor and summarizes the total score of each assessment as shown in the Figure 4.15. The system will summarize the total score of the product being evaluated including a summary of the standard rating (1-5 stars), as shown in the Figure 4.16, and provide suggestions to the user. The recommendation for improvement is shown in the Figure 4.17.

Recommendation System for the Wood Handicraft Entrepreneurs Home >	
<b>Entrepreneur name : Jittaporn Taraporn</b> <b>Product name : Vases made from mango wood.</b>	
<b>Section A. Products and strength of the community (30 score)</b>	
<b>Issue 1: Manufacturing (12 score)</b>	
Indicators	Score
1.1 : Source of materials (3 score)	3
1.2 : Expansion of factors of production (3 score)	3
1.3 : Environmental protection in production process (3 score)	2
1.4 : Potential of mass production (3 score)	2

**Figure 4.15 Screen showing evaluation results of indicators in Section B and its total score**

Recommendation System for the Wood Handicraft Entrepreneurs Home >	
<b>The result of evaluation for OTOP Product Champion</b> The score is 85 from 100 score ★★★★★	
4-star products refer to the products with high quality, national level approval and export potential.	
[Icon] <a href="#">Suggestion for product improvement for part A, B, C.</a> [Icon] <a href="#">Suggestion for product improvement for part A.</a> [Icon] <a href="#">Suggestion for product improvement for part B.</a> [Icon] <a href="#">Suggestion for product improvement for part C.</a>	

**Figure 4.16 Screen showing product ratings (1-5 Stars)**



**Suggestions for Entrepreneurs of Wooden Handicraft.**

Entrepreneurs name : Jittaporn Taraporn

Product name : Vases made from mango wood.

Part A. Products and strength of the community

Issue 1 Manufacturing

\* Expansion of factors of production \*

suggestion

Consider factors such as land, capital, raw materials / materials, labor, machinery, any one grill. Or include all factors. Then calculated.

Percentage of current production factor = (Current year factor \* 100) / factor of the past year

Percentage of current production factor increased = Percentage of current production factor - 100

**Figure 4.17 Show showing recommendation as a guide to improve product**

### **Evaluation of Satisfaction of the recommendation system for OTOP wood handicraft products.**

The recommendation system developed in this study was evaluated by 5 experts and 32 OTOP entrepreneurs. The satisfaction of the experts is shown in the Table 4.38, and the satisfaction of the entrepreneur is shown in the Table 4.39.

**Table 4.38 Levels of satisfaction of using the recommendation System evaluated by the experts (N = 5)**

Details	Frequency	Percent	Levels of Satisfaction
<b>1. Functionality</b>			
1.1 User ID and password authentication for users.	2	40	Good
	3	60	Excellence

**Table 4.38 Levels of satisfaction of using the recommendation System evaluated by the experts (N = 5) (Continued)**

Details	Frequency	Percent	Levels of Satisfaction
1.2 The system has a description or usage instructions	1	20	Good
	4	80	Excellence
1.3 The completeness of the information used to assess the potential of OTOP products in the system is in accordance with the criteria used in evaluating OTOP products	5	100	Excellence
1.4 Ability to evaluate the total scores of both criteria in the section B and C	5	100	Excellence
1.5 Product Rating (1-5 stars)	5	100	Excellence
1.6 The suitability of the system for providing advice to improve OTOP products in section A and C.	5	100	Excellence
1.7 Appropriateness of the system in providing advice to improve OTOP products as a whole.	5	100	Excellence

**Table 4.38 Levels of satisfaction of using the recommendation System evaluated by the experts (N = 5) (Continued)**

Details	Frequency	Percent	Levels of Satisfaction
1.8 System is responsive and fast.	5	100	Excellence
1.9 Integrity of the system as a whole	5	100	Excellence
<b>2. Efficiency</b>			
2.1 Accuracy in evaluating product quality, including sections B and C;	5	100	Excellence
2.2. Accuracy in the assessment of the standard rating (1-5 stars)	5	100	Excellence
2.3. Information meet the needs of users.	5	100	Excellence
2.4 Warnings when errors are encountered in the event that the user does not enter the required data.	1	20	Good
	4	80	Excellence
2.5 Ability to provide advice that can be used to develop product potential.	5	100	Excellence



**Table 4.38 Levels of satisfaction of using the recommendation System evaluated by the experts (N = 5) (Continued)**

Details	Frequency	Percent	Levels of Satisfaction
2.6 Ability to use it all the time, with no time and place constraints.	5	100	Excellence
<b>3. Usability</b>			
3.1. The system provides instructions on how to use the system to make the user easy to understand and operate the system.	1	20	Good
	4	80	Excellence
3.2 Simple and easy to use	1	20	Good
	4	80	Excellence
3.3. The system is interesting and encourage the user to use it again	5	100	Excellence
3.4 Use easy-to-use data acquisition tools.	5	100	Excellence
3.5 Accuracy of results	5	100	Excellence
3.6 Data integrity	5	100	Excellence
3.7 Appropriate use of the system as a whole.	1	20	Good
	4	80	Excellence

**Table 4.38 Levels of satisfaction of using the recommendation System evaluated by the experts (N = 5) (Continued)**

Details	Frequency	Percent	Levels of Satisfaction
<b>4. Design</b>			
4.1 Appropriateness of color, font, background and image	2	40	Good
	3	60	Excellence
4.2 Appropriate alignment of monitor components	5	100	Excellence
4.3. The tool design is easy to use.	5	100	Excellence
4.4 Appropriateness of the amount of information presented on each screen.	5	100	Excellence
4.5 Data display is standardized	5	100	Excellence
<b>5. Benefits</b>			
5.1 The system is responsive and fast	5	100	Excellence
5.2 It meets the intended purpose.	5	100	Excellence
5.3 Evaluation results and recommendation for improvement of OTOP products	5	100	Excellence
5.4 Overall Satisfaction with the system	5	100	Excellence

According to the Table 4.38, the results of evaluation made by 5 experts on satisfaction of using the recommendation system are summarized as follows.

#### 1. Functionality

1.1 60% of experts had an excellence level of satisfaction for having user authentication

1.2 80% of experts had an excellence level of satisfaction for having explanations or instructions to use.

1.3 100 % of experts had an excellence level of satisfaction for having the completeness of the information used to assess the potential of OTOP products in the system is in accordance with the criteria used in evaluating OTOP products.

1.4. 100% of experts had an excellence level of satisfaction for having the ability to evaluate the total score of the criteria for both section B and C.

1.5. 100% of experts had an excellence level of satisfaction for having the ability to evaluate a standard rating (1-5 stars).

1.6 100% of experts had the excellence level of satisfaction for having the suitability of the system to provide advice to improve the OTOP product of the evaluation in section A and C.

1.7 100% of experts had an excellence level of satisfaction for having the suitability of the system to provide advice to improve the OTOP product as a whole.

1.8 100% of experts had an excellence level of satisfaction for having the system that is responsive and fast.

1.9 100% of experts had an excellence level of satisfaction for having the accuracy of the overall system performance.



Overall, it was found that an experts had the excellence level of satisfaction (60-100%) for the Functionality of the system.

## 2. Efficiency

2.1 100% of experts had an excellence level of satisfaction for having the accuracy of the evaluation of the scores, including section B and C.

2.2 100% of experts had an excellence level of satisfaction for having the accuracy in the assessment of stand rating (1-5 stars).

2.3. 100% of experts had an excellence level of satisfaction that information meets the needs of users.

2.4 80% of experts had an excellence level of satisfaction for having warnings when errors are found in the case where the user does not enter the required data.

2.5. 100% of experts had an excellence level of satisfaction for having the ability to provide advice that could be used to develop the potential of the product.

2.6 100% of experts had an excellence level of satisfaction for having the ability to use it all the time, with no time limit and place constraint.

Overall, it was found that an experts had the excellence level of satisfaction (80-100%) for the efficiency of the system.

## 3. Usability

3.1. 80% of experts had an excellence level of satisfaction that the system offers systematic recommendations that make it easy for users to understand and use the system.

3.2 80% of experts had an excellence level of satisfaction that the system is simple and easy to use.

3.3. 100% of experts had an excellence level of satisfaction that the system is interesting, and encourage the user to use it again.

3.4 100% of experts had an excellence level of satisfaction that the system use easy-to-use data acquisition tools.

3.5 100% of experts had an excellence level of satisfaction for having accuracy of the results.

3.6 100% of experts had an excellence level of satisfaction for having the completeness of the data.

3.7 80% of experts had an excellence level of satisfaction for having the suitability of the system as a whole.

In summary, it is found that experts had an excellence level of satisfaction (80-100%) for the Usability of the system.

#### 4. Design

4.1 60% of experts had an excellence level of satisfaction for having the appropriateness of using color, font, background and image.

4.2 100% of experts had an excellence level of satisfaction for having the appropriateness of aligning the components of the monitor.

4.3. 100% of experts had an excellence level of satisfaction for having an easy-to-use tool design.

4.4 100% of experts had an excellence level of satisfaction for having the appropriateness of the amount of data presented on each screen.

4.5 100% of experts had an excellence level of satisfaction that data display is standardized.

Overall, it was found that experts had an excellence level of satisfaction (60-100%) for the Design of the system.

## 5. Benefits

5.1 100% of experts had an excellence level of satisfaction that the system is responsive and fast,

5.2 100% of experts had an excellence level of satisfaction that it meets the objectives of users.

5.3. 100 of experts had an excellence level of satisfaction that the results of the evaluation and recommendations help improving the product

5.4 100% of experts had an excellence level of satisfaction for having overall satisfaction with the system.

Overall, it was found that all experts are satisfied with the benefits of excellence (100%).

**Table 4.39 Levels of satisfaction of using the recommendation system evaluated by entrepreneur of OTOP wood handicraft products (N = 32)**

Details	Frequency	Percent	Levels of Satisfaction
<b>1. Functionality</b>			
1.1 User ID and password authentication for users.	8	25	Good
	24	75	Excellence
1.2 The system has a description or usage instructions	9	28.1	Good
	23	71.9	Excellence



**Table 4.39 Levels of satisfaction of using the recommendation system evaluated by entrepreneur of OTOP wood handicraft products (N = 32)**  
(Continued)

Details	Frequency	Percent	Levels of Satisfaction
1.3 The completeness of the information used to assess the potential of OTOP products in the system is in accordance with the criteria used in evaluating OTOP products	1	3.1	Good
	31	96.9	Excellence
1.4. Ability to evaluate the total scores of both criteria in the section B and C	1	3.1	Good
	31	96.9	Excellence
1.5 Product Rating (1-5 stars)	3	9.4	Good
	29	90.6	Excellence
1.6 The suitability of the system for providing advice to improve OTOP products in section A and C.	7	21.9	Good
	25	78.1	Excellence
1.7 Appropriateness of the system in providing advice to improve OTOP products as a whole..	6	18.8	Good
	16	81.2	Excellence
1.8 System is responsive and fast.	2	6.2	Good
	30	93.8	Excellence
1.9 Integrity of the system as a whole	1	3.1	Good
	31	96.9	Excellence

**Table 4.39 Levels of satisfaction of using the recommendation system evaluated by entrepreneur of OTOP wood handicraft products (N = 32)**  
(Continued)

Details	Frequency	Percent	Level of Satisfaction
<b>2. Efficiency</b>			
2.1 Accuracy in evaluating product quality, including sections B and C;	4	12.5	Good
	28	87.5	Excellence
2.2. Accuracy in the assessment of the standard rating (1-5 stars)	4	12.5	Good
	28	87.5	Excellence
2.3. Information meet the needs of users.	7	21.9	Good
	25	78.1	Excellence
2.4 Warnings when errors are encountered in the event that the user does not enter the required data.	2	6.2	Good
	30	93.8	Excellence
2.5 Ability to provide advice that can be used to develop product potential.	3	9.4	Good
	29	90.6	Excellence
2.6 Ability to use it all the time, with no time and place constraints.	5	15.6	Good
	27	84.4	Excellence
<b>3. Usability</b>			
3.1. The system provides instructions on how to use the system to make the user easy to understand and operate the system.	3	9.4	Good
	29	90.6	Excellence

**Table 4.39 Levels of satisfaction of using the recommendation system evaluated by entrepreneur of OTOP wood handicraft products (N = 32)**  
(Continued)

Details	Frequency	Percent	Level of Satisfaction
3.2 Simple and easy to use	8	25	Good
	24	75	Excellence
3.3. The system is interesting and encourage the user to use it again	4	12.5	Good
	28	87.5	Excellence
3.4. Use easy-to-use data acquisition tools.	7	21.9	Good
	25	78.1	Excellence
3.5 Accuracy of results	1	3.1	Good
	31	96.9	Excellence
3.6 Data integrity	1	3.1	Good
	31	96.9	Excellence
3.7 Appropriate use of the system as a whole.	3	9.4	Good
	29	90.6	Excellence
<b>4. Design (Design)</b>			
4.1 Appropriateness of color, font, background and image	1	3.1	Average
	8	25.0	Good
	23	71.9	Excellence
4.2 Appropriate alignment of monitor components	7	21.9	Good
	25	78.1	Excellence



**Table 4.39 Levels of satisfaction of using the recommendation system evaluated by entrepreneur of OTOP wood handicraft products (N = 32)**  
(Continued)

Details	Frequency	Percent	Level of Satisfaction
4.3. The tool design is easy to use.	5	15.6	Good
	27	84.4	Excellence
4.4 Appropriateness of the amount of information presented on each screen.	7	21.9	Good
	25	78.1	Excellence
4.5 Data display is standardized	3	9.4	Good
	29	90.6	Excellence
<b>5. Benefits Benefits</b>			
5.1 The system is responsive and fast	3	9.4	Good
	29	90.6	Excellence
5.2 It meets the intended purpose.	2	6.2	Good
	30	93.8	Excellence
5.3 Evaluation results and information on OTOP product improvement recommendations.	5	15.6	Good
	27	84.4	Excellence
5.4 Overall Satisfaction with the system	3	9.4	Good
	29	90.6	Excellence

According to the Table 4.39, the results of evaluation made by 32 entrepreneur on satisfaction of using the recommendation system are summarized as follows.

### 1. Functionality

1.1 75% of entrepreneurs had an excellence level of satisfaction for having user authentication

1.2 71.9% of entrepreneurs had an excellence level of satisfaction for having explanations or instructions to use.

1.3 96.9 % of entrepreneurs had an excellence level of satisfaction for having the completeness of the information used to assess the potential of OTOP products in the system is in accordance with the criteria used in evaluating OTOP products.

1.4. 96.9% of entrepreneurs had an excellence level of satisfaction for having the ability to evaluate the total score of the criteria for both section B and C.

1.5. 90.6% of entrepreneurs had an excellence level of satisfaction for having the ability to evaluate a standard rating (1-5 stars).

1.6 78.1% of entrepreneurs had an excellence level of satisfaction for having the suitability of the system to provide advice to improve the OTOP product of the evaluation in section A and C.

1.7 81.2% of entrepreneurs had an excellence level of satisfaction for having the suitability of the system to provide advice to improve the OTOP product as a whole.

1.8 93.8% of entrepreneurs had an excellence level of satisfaction for having the system that is responsive and fast.

1.9 96.9% of entrepreneurs had an excellence level of satisfaction for having the accuracy of the overall system performance.

Overall, it was found that all entrepreneurs had an excellence level of satisfaction (71.9-96.9%) for the Functionality of the system.

## 2. Efficiency

2.1 87.5% of entrepreneurs had an excellence level of satisfaction for having the accuracy of the evaluation of the scores, including section B and C.

2.2 87.5% of entrepreneurs had an excellence level of satisfaction for having the accuracy in the assessment of stand rating (1-5 stars).

2.3. 78.1% of entrepreneurs had an excellence level of satisfaction that information meets the needs of users.

2.4 93.8% of entrepreneurs had an excellence level of satisfaction for having warnings when errors are found in the case where the user does not enter the required data.

2.5. 90.6% of entrepreneurs had an excellence level of satisfaction for having the ability to provide advice that could be used to develop the potential of the product.

2.6 84.4% of entrepreneurs had an excellence level of satisfaction for having the ability to use it all the time, with no time limit and place constraint.

Overall, it was found that all entrepreneurs had an excellence level of satisfaction (78.1-93.8%) for the efficiency of the system.

## 3. Usability

3.1. 90.6% of entrepreneurs had an excellence level of satisfaction that the system offers systematic recommendations that make it easy for users to understand and use the system.

3.2 75% of entrepreneurs had an excellence level of satisfaction that the system is simple and easy to use.



3.3. 87.5% of entrepreneurs had an excellence level of satisfaction that the system is interesting, and encourage the user to use it again.

3.4 78.1% of entrepreneurs had an excellence level of satisfaction that the system use easy-to-use data acquisition tools.

3.5 96.9% of entrepreneurs had an excellence level of satisfaction for having accuracy of the results.

3.6 96.9% of entrepreneurs had an excellence level of satisfaction for having the completeness of the data.

3.7 90.6% of entrepreneurs had an excellence level of satisfaction for having the suitability of the system as a whole.

In summary, it is found that entrepreneurs had an excellence level of satisfaction (75-96.9%) for the Usability of the system.

#### 4. Design

4.1 71.9% of entrepreneurs had an excellence level of satisfaction for having the appropriateness of using color, font, background and image.

4.2 78.1% of entrepreneurs had an excellence level of satisfaction for having the appropriateness of aligning the components of the monitor.

4.3. 84.4% of entrepreneurs had the an excellence level of satisfaction for having an easy-to-use tool design.

4.4 78.1% of entrepreneurs had an excellence level of satisfaction for having the appropriateness of the amount of data presented on each screen.

4.5 90.6% of entrepreneurs had an excellence level of satisfaction that data display is standardized.

Overall, it was found that all entrepreneurs had an excellence level of satisfaction (71.9-90.6%) for the Design of the system.

## 5. Benefits

5.1 90.6% of entrepreneurs had an excellence level of satisfaction the system is responsive and fast.

5.2 93.8% of entrepreneurs had an excellence level of satisfaction that it meets the objectives of users.

5.3. 84.4 of entrepreneurs had the an excellence level of satisfaction that the results of the evaluation and recommendations help improving the product.

5.4 90.6% of entrepreneurs had an excellence level of satisfaction for having overall satisfaction with the system.

Overall, it was found that all experts are satisfied with the benefits of excellence (84.4-93.8%).

## Discussion

According to the study of Pholprakarn (2013) about the results of selection of OTOP project in 2012, the researcher found that only 13.13% of products in the category of wares/decorations/souvenirs were qualified for the rating standard of 1-5 stars. Moreover, wood handicraft products also comprised of the highest proportion of products in this category. The researcher suggested that in order to be qualified, OTOP entrepreneurs have to prepare their products to meet criteria and indicators in 3 aspects; such as the product and strength of the community, marketing and background of the products, and product quality (Department of Community Development, 2012). However, problems in the 3 aspects can be found as reported by



Wongchitwan *et al.* (2011) who suggested that the problems occurred from misunderstanding of entrepreneurs towards criteria and indicators of the evaluation, lack of assessment in order to improve their products, and lack of information about criteria and indicators. These reasons result in the lack of readiness or improvement of products, because the entrepreneurs cannot identify their weak points. However, are Kusol (2005) and Natsuda *et al.* (2012) found that entrepreneurs are lack of knowledge and understanding about criteria and indicators used in the evaluation. Moreover, the entrepreneurs are also lack of experts who can provide suggestions. This result is consistent with the study of Jitcharat (2006) who suggested that OTOP entrepreneurs who usually have knowledge related only to their products should have more knowledge about criteria and indicators of OTOP selection process. By having this knowledge, the entrepreneurs can improve their products to meets the standards. The solution for this problems is to consult with experts frequently in order to continuously develop their products. Similarly, Punnarong (2011) found that several community products were not successful because entrepreneurs were lack of knowledge for improving their products. Decision of community business, therefore, has to rely on guidance from the government or suggestions from experts.

According to preliminary results of the study, the researcher found that a majority of entrepreneurs are lack of knowledge and understanding about criteria and indicator, and have no experts for consulting. The researcher, therefore, decided to develop a recommendation system for entrepreneurs who want to evaluate their products in order to meet the standards of the OTOP Product Champion Project. The recommendation system is based on criteria and indicators used in the evaluation made by the OTOP selection committee. The results of this study can benefit OTOP



entrepreneurs and persons who are interested in developing OTOP products by allowing them to evaluate their product without constraint of time, location, travel, and expense on human experts. Moreover, associate organizations, such as the Department of Community Development can use the recommendation system developed in this study to assist entrepreneurs who want to develop their products.

