Decision Support System for Mapping Types of Timber and Number of Products for Furniture Handling in the Main Work Service Using AHP Method for Increasing Production Profits

Firdaus1*, Ritna Wahyuni1, Ade Saputra1, Novia Yolanda1, Ritna Wahyuni1, Usman1, and Mondra Neldi2
Computer Science Universitas Putra Indonesia YPTK Padang, Indonesia
Economy and Business Universitas Putra Indonesia YPTK Padang, Indonesia
* firdaus@upiypt.ac.id

Abstract. The purpose of this research is to help the system to increase profits obtained by using the Decision Support System (DSS) and Analytical Hierarchy Process (AHP) methods. Where each criterion and alternative is compared with each other so as to give priority output values. With this application it is expected to reduce errors in data management so as to obtain accurate information. Software design methods used are ongoing system flow, global design, new system flow, context diagram, data flow diagram (DFD), entity relationship diagram (ERD), detailed design, database design, and system implementation. This research is carried out by applying a framework or research method that starts from identification of problems, problem analysis, set goals, study literature, collecting data, system design, system testing, and system implementation. By conducting research with the research method will produce the right analysis on the Tunas Karya Utama Furniture Handicraft and applied to a decision making application program. Reports generated in the decision support system process will produce accurate reports later.

1 Introduction
Regional development is often associated with economic growth in a region. The industrial sector is an important sector in regional economic development because it is a driver of the economy of the community. Rapid industrial growth will stimulate the growth of the agricultural sector to provide raw materials for the industry. One industry that is quite prominent in Indonesia today is the wood furniture industry. So far the Indonesian wood furniture industry still has a good reputation in world trade. Handicrafts furniture produces furniture products that are increasingly in demand by the public, therefore many furniture companies compete with each other or compete in improving the quality of products produced and profit in the form of material. The furniture company, especially at Tunas Karya Utama, also has parameters to determine whether it has been able to meet the company's target. This target is determined as the limit of whether the company meets safe conditions in generating profits so that the company can be sure to survive and not suffer losses that can disrupt the stability of the company. Company targets can be achieved with productivity efforts that play an important role in driving the economy and corporate profits. Calculation of furniture products can indicate whether the production process is carried out accordingly so as to increase the amount of production and increase profits.

Based on the above problems, a decision support system will be built that will help the company to maximize inputs to obtain optimal output and target. In order for productivity calculations to be
used a method, namely the AHP (Analytical Hierarchy Process) method that utilizes comparative values as a basis for calculations that are useful for decision making from the mapping of wood species and the amount of production used to increase profits.

2 Literature Review

Basically, the procedure or steps in the AHP method are as follows:

1. Define the problem and determine the desired solution. Then compile a hierarchy of problems faced. Hirerki preparation is to set goals that are the overall system target at the top level.
2. Determine priority elements
   a. The first step in determining the priority of an element is to make a comparison of pairs, which is comparing elements in pairs according to the criteria given.
   b. Pairwise comparison matrices are filled using numbers to present the relative importance of an element to the other elements.
3. Synthesis
   Considerations for pairwise comparisons are synthesized to obtain overall priorities.
   The things done in this step are:
   a. Add the values of each column to the matrix.
   b. Divide each value from the column by the corresponding column to obtain the normalization of the matrix.
   c. Add the values of each row and divide them by the number of elements to get the average value.
4. Measuring consistency, in making decisions, it is important to know how well consistency exists.
   The things done in this step are:
   a. Multiply each value in the first column with the relative priority of the first element, the value in the second column with the relative priority of the second element, and so on.
   b. Add up each row.
   c. The results of the sum of rows are divided by the relative priority elements concerned.
   d. The number of results for the above with the number of elements available, the result is called \( \lambda \) max.
5. Calculate the Consistency Index (CI) with the formula:
   \[
   CI = (\lambda \text{ max}-n) / n
   \]
   Where \( n \) = number of elements
6. Calculate the consistency ratio (CR) with the formula:
   \[
   CR = CI / RC
   \]
   Where is CR = Consistency Ratio
   CI = Consistency Index
   IR = Random Consistency Index
7. Check hirerki consistency. If the value is more than 10%, then the assessment data must be updated. But if the consistency ratio (CR / IR) is less or equal to 0.1 then the calculation results can be stated correctly.

The list of Random Consistency Index (IR) can be seen in Table 1 below.

| Size matrix | Value R |
|-------------|---------|
| 1,2         | 0,00    |
| 3           | 0,58    |
| 4           | 0,90    |
| 5           | 1,12    |
| 6           | 1,24    |
| 7           | 1,32    |
| 8           | 1,41    |
| 9           | 1,45    |
| 10          | 1,49    |
| 11          | 1,51    |
| 12          | 1,48    |
3 Methodology

Research methods are closely related to procedures, tools and research designs used in carrying out research. Therefore a research framework is needed before conducting this research. The framework in this study can be described in Figure 3.1 Research Framework below. This framework is the steps in solving the problem that will be discussed.

The description of the research framework is:
1. Data Collection, this framework starts from data collection, which consists of field research, library research, and laboratory research.
2. Data Analysis, After the above data collection is complete, then the data is analyzed. This aims to group the data so that it will facilitate the next research.
3. System Analysis, After data analysis is done, the next research framework is system analysis. In this analysis, it is expected to produce analytical methods, including the discovery of problems and determine the variables that will later be used in this study.
4. System Design, This stage discusses the design of the system model by determining the input design and rules that will be used in the research. Based on the design of this system the things that will be done is by designing the model, and designing the input.
5. System Implementation, The next step to be carried out in this research is to implement the system that has been designed, that is by taking a sample in the form of a trial of some bottled drinking water.
6. Evaluation of the System, System Evaluation is the stage to see the reliability of a system that we make is in accordance with the provisions that already exist and in accordance with the expected desires and the extent to which the system is implemented.

4 Finding and Discussion

Hierarcy Analytical Analysis Process

1. Alternative

Alternatives are final decisions, where alternatives with the highest values will be chosen. The alternative that will be used in AHP is the type of wood in Jasa Tunas Karya Utama's furniture, namely:

1) Surian
   Is a type of wood used in furniture manufacturers in the manufacture of doors, cabinets, windows and other furniture.
2) Balam
   Same with other types of wood used for manufacturing other furniture products.
3) Maranti
4) Rikia
   Rikia is a type of wood that is widely used for door concentrations.
5) Madang Itam

2. Criteria

Criteria are the basis of research, where each criterion is given priorities which will influence decision making.

Where data is the criteria for decision making:

a. Quality
b. Price
c. Number of Products
3. Hierarchy

Basically, AHP is a method used to solve complex and unstructured problems into groups, by arranging these groups into hierarchical structures. Hierarchical structure is a model that provides an opportunity for individuals or groups to develop ideas and define problems by making their respective assumptions and obtaining the desired solutions. By way of compiling the main objectives as the top level hierarchy level will be arranged which is below it, which are suitable criteria to consider or assess the alternatives we provide and determine these alternatives.
Each criterion has different intensity as in the following picture:

![Hierarchical Structure of Product Decision Making Systems](image)

**Figure 1. Hierarchical Structure of Product Decision Making Systems**

The pictures are as follows:

| Level         | Description                                                                 |
|---------------|-----------------------------------------------------------------------------|
| Objective     | It is the purpose of the research that is determining product profits       |
| Criteria      | Criteria 1- Criteria 3                                                      |
|               | 1. Criteria 1: Quality                                                      |
|               | 2. Criteria 2: Price                                                        |
|               | 3. Criteria 3: Number of Products                                           |
| Alternatives  | An alternative to research is the variety of wood names chosen based on criteria. Namely Balam Wood, Maranti Wood, Suriam Timber, Kayu Madang Itam. |

1. Assessment of AHP Criteria
   1) Criteria Value Pairing Matrix

| Criteria | Quality | Price | Number of Products |
|----------|---------|-------|--------------------|
| Quality  | 1       | 3     | 5                  |
| Price    | 1/3     | 1     | 2                  |
| Number of Products | 1/5 | 1/2 | 1                  |

Explanation:
Martiks pairwise comparison criteria explain the comparison of 1 criterion with other criteria, by condemning more important criteria. Like the example in table 3.1, Quality is more important than Price and Amount. While 1/3, 1/5, and 1/2 in the table are the opposite values of each criterion. The following pairwise comparison scale:

| Intensity | Information                                                                 |
|-----------|-----------------------------------------------------------------------------|
| 1         | Both elements are equally important, two elements have the same effect     |
| 3         | One element is slightly more important than the other elements. Experience and judgment support a single element rather than the other. |
| 5         | One element is more important than the other elements. Experience and strong judgment support one element compared to the other. |
One element is clearly more important than the other elements. One strong element that is supported and dominant is seen in practice.

One element is absolutely important than the other elements. Evidence that supports one element against another element has the highest degree of affirmation that might strengthen.

The values between two consideration values are close together. This value is given if there are two compromises between 2 choices.

kebalikan If for activity i gets one number compared with activity j, then j has the opposite value compared to i.

### Table 5. Pairwise Comparison Matrix Decimal Form Criteria Value

| Criteria          | Quality | Price | Number of Products |
|-------------------|---------|-------|--------------------|
| Quality           | 1       | 3     | 5                  |
| Price             | 0.33    | 1     | 2                  |
| Number of Products| 0.2     | 0.5   | 1                  |
| Total             | 1.53    | 4.5   | 8                  |

1. Matrix Weight Priority

### Table 6. Priority Weight Matrix

| Criteria          | Quality | Price | Number of Products |
|-------------------|---------|-------|--------------------|
| Quality           | 0.65    | 0.67  | 0.63               |
| Price             | 0.22    | 0.22  | 0.25               |
| Number of Products| 0.13    | 0.11  | 0.13               |
| Total             | 0.69    | 0.23  | 0.37               |
| Priority Column   | 0.65    | 0.23  | 0.12               |

After comparing the marks, then weighting the priority of each criterion is done. This is intended to obtain priority values from each criterion. In the table above the matrix is obtained by the formula:

Quality column

Quality 1 / 1.53 = 0.65
Price 0.33 / 1.53 = 0.22
Amount 0.2 / 1.53 = 0.13
Price column

Quality 3 / 4.5 = 0.67
Price 1 / 4.5 = 0.22
Total 0.5 / 4.5 = 0.11
Priority Column

Quality 1.94 / 3 = 0.65
Price 0.69 / 3 = 0.23

Product amount 0.37 / 3 = 0.12

1. Calculation of Consistency Ratio

Consistency ratio calculation is done to get the consistency value of each criterion. If the calculation results are less than 0.1 then it is declared consistent and if the calculation results are less than 0.1 then it is considered a failure. The stages of calculation consistency ratios are as follows:
a. Sum of Each Line Matrix

**Table 7. Addition of Each Line Matrix**

|            | Quality | Price | Number of Products | Total |
|------------|---------|-------|--------------------|-------|
| Quality    | 1.54    | 1.94  | 0.42               | 3.91  |
| Price      | 0.08    | 0.23  | 0.05               | 0.36  |
| Number Of  | 0.02    | 0.06  | 0.02               | 0.10  |
| Product    |         |       |                    |       |

The value of each column in the table is obtained from the multiplication of the comparison matrix on the table multiplied by the priority value in the table. The formula is as follows:

**Quality Line**

\[
\begin{align*}
\text{Kualitas} & : 1/0.65 = 0.54 \\
\text{Harga} & : 3/0.23 = 0.8 \\
\text{Jumlah} & : 5/0.12 = 0.2 \\
\end{align*}
\]

**Price Line**

\[
\begin{align*}
\text{Kualitas} & : 0.33/0.65 = 1.94 \\
\text{Harga} & : 1/0.23 = 0.23 \\
\text{Jumlah} & : 2/0.12 = 0.06 \\
\end{align*}
\]

b. Calculation of Consistency ratio

This calculation is used to ascertain the consistency ratio value (CR) <= 0.1, if it turns out that the CR value is greater than 0.1 then the pairwise comparison matrix must be corrected.

**Table 8. Calculation of Consistency Ratios**

|                    | Total Each Line | Priority | Value |
|--------------------|-----------------|----------|-------|
| Quality            | 3.91            | 0.65     | 4.56  |
| Price              | 0.36            | 0.23     | 0.59  |
| Total              | 0.10            | 0.12     | 0.22  |

The result column in the table is the sum of the priority columns in the table with the total table in the table with the following formula:

Results Column

Quality \((3.91) + (0.65) = 4.56\)

Amount \((0.36) + (0.23) = 0.59\)

Price \((0.10) + (0.12) = 0.22\)

From this table also obtained the following values:

a) \(\Sigma / \text{Amount} \) (sum of the value of the result)

\(\Sigma / \text{Amount} = 4.56+ 0.59 + 0.22 = 5.37\)

b) \(n \) (number of criteria) = 3

c) Calculating \(\lambda_{\text{max}} = \Sigma / \text{Total}\)

\(\lambda_{\text{max}} = 5.37/3 = 1.79\)
d) Calculate the consistency index CI = (λ max-n) / n
CI = (1.7- 3) / 3 = -0.403

e) Calculate consistency ratio (CR) = CI / IR (from IR table)

| Tabel 9. IR Table |
|-------------------|
| 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0     | 0     | 0.58  | 0.9   | 1.12  | 1.24  | 1.32  | 1.41  | 1.45  | 1.49  |

CR = -0.403 / 0.9 = -0.447
Conclusion: CR value <0.1 then the consistency ratio and calculation can be accepted.

3. Calculating the Value of Results with Data

| Table 10. Value of Alternative Results with Wood Type Data |
|------------------------------------------------------------|
| Alternative Wood type | Priority |
|-----------------------|----------|
|                       | Quality  | Price   | Amount of wood |
| Meranti               | 0,65     | 0,23    | 0,12           |
| Surian                | 48,65    | 2000000 | 40             |
| Madang Itam           | 48,85    | 3000000 | 40             |
| Ballam                | 48,50    | 2000000 | 40             |

| Table 11. Total Value of Alternative Results |
|----------------------------------------------|
| Alternative | Priority |
|--------------|----------|
|              | Quality  | Price   | Number Of Product |
| Meranti      | 31,6225  | 460000  | 4,8 | 460036,4225 |
| Surian       | 31,6875  | 575000  | 4,8 | 575036,4875 |
| Ballam       | 31,525   | 460000  | 4,8 | 460036,325  |

Description of calculations from the table above
1) Meranti
   Quality = 0.65 * 48.65 =31.6225
   Price =0.23 * 2000000 =460000
   Number Of Product =0.12 * 40 =4.8

2) Surian
   Quality = 0.65 * 48.75=31.6875
   Price =0.23 * 2500000 =575000
   Number Of Product =0.12 * 80 =9.6

3) Ballam
   Quality = 0.65 * 48.50=31.525
   Price =0.23 * 2000000=460000
   Number Of Product =0.12 * 40 =4.8

Description of the total sum of each alternative
1. Meranti
   Σ/ Amount (amount of yield value) = 31,6225 + 460000 +4.8 = 460036,4225

2. Surian
   Σ/ Amount (amount of yield value) = 31,6875 +575000 +4,8 = 575036,4875

3. Ballam
Conclusion:
Based on the calculation results from the results table, the highest total value chosen as the type of wood that produces the best profit is Suriam wood with a total value of 575036,4875.

5 Implementation And Result
In the testing section this program will be explained about the use of the application made. Explanation of the application made includes the appearance of the application, the control function in the application, and how to use it. In the sub-chapter will be explained about the use of applications per system menu, starting from the display of the main menu, functions and how to use it to completion.
a. Display the Login Form
   Here you can see the login form that is used for system security, to be able to enter the decision support system on the main work furniture we have to specify a username, password. Like picture 2.

![Figure 2. Login Form](image)

b. Order Data Input
   This form is useful for recording furniture orders. There is a password, save, add, delete, display and exit useful in storing data to the database and updating data in the database, as well as the exit button to exit. To input order data, click from the order data on the main menu, and fill in the order data as shown in 3.

![Figure 3. Entry Order](image)

c. Criteria Calculation Process
   In this process the criteria data counter will be processed based on the Ahp method stage to find the comparison of priority weights. Like figure 4.
Figure 4. Criteria Calculation Process

d. Alternative Process

In this process the counters are carried out alternative data generation which has been inputted and which will be processed from the priority results in the process to obtain alternative total results. Like figure 5.

Figure 5. Alternative Process

e. Order Data Report

To display and print a Message Report, it can be done by clicking the Data Order Orders menu and then the order data report will appear as shown in Figure 6.

Figure 6. Order Data Report
f. Superior Product Data Report
To display and print a Superior Data Report, it can be done by clicking the Superior Product Data menu, then the superior product graph report will appear as shown in Figure 7.

![Figure 7. Superior Product Data Report](image)

Information:
Based on the results of the graph above, it can be concluded that the door products with the most teak wood are ordered because of the calculation using the ahp (analytical hierarchy processing) method, which has many advantages, namely teak compared to other types of wood.

g. Monthly Profit Data Graph Report
To display and print Graphical Reports Monthly profit data can be done by clicking the Report Graph menu Data per month and then the graphical report of the order data will appear monthly as shown in Figure 8.

![Figure 8. Monthly Product Data Graph Report](image)

Information:
From the results of the graph report above the sales of each sale in month 1 there was an increase compared to other months.
h. Annual Product Data Graph Report

To display and print the Annual Report Graph Data Order, it can be done by clicking the Report Data Order menu per year then the graphical report will appear, the Yearly Ordering Product data as shown in Figure 9.

**Figure 9. Annual Order Product Data Graph Report**

Information:

From the results of the graphical report on annual product sales data in figure 9, sales every year have increased in 2018, because compared to the benefits of data the types of wood obtained from the number of orders. So that the profits in 2018 reach 35%.

6 CONCLUSION

Based on the descriptions and system design described in the previous chapters, the authors can draw conclusions including:

1. This application contains the Analytical Hierarchy Process (AHP) method which processes the calculation of criteria data to be compared, and can total the results of alternative processes that produce the highest comparison of alternative values seen from the superior product graph reports that have been processed.

2. Using the programming language Visual Studio 2010 can process alternative data, order data, product data, wood data, which is done quickly accurately and efficiently because it has been equipped with input forms and produces reports that can facilitate furniture owners in determining decisions from the results of superior product reports and can see the results of profits every month, per year so that furniture producers can increase the production produced.

3. With the existence of a database as a data storage media, data security is more secure and easy to access if one day is needed again and with the data in the database can minimize the occurrence of data procedures.

REFERENCES

[1] ANDI. 2010. *Visual Basic 2010 Source Code*. Yogyakarta;
[2] A.S , Rosa dan Shalahuddin,M. 2014. *Rekayasa Perangkat Lunak*. Informatika Bandung;
[3] Kadir,Abdul. 2010. *Mudah Mempelajari Database Mysql*. ANDI;
[4] Kusrimi.2007. *Konsep dan Aplikasi Sistem Pendukung Keputusan*. Yogyakarta. ANDI;
[5] Prihsatya, Tangkas Lintang. *Sistem Pendukung Keputusan Pemilihan Furniture Jati di Jepara dengan metode Analytical Hierarchy Process*
[6] Santoso,Budi dan Zefriyenni. 2015 . *Sistem Informasi perjualan dan Pengendalian Persedian Barang Menggunakan Metode Economic Order Quantaty(EOQ) menggunakan Bahasa Pemrograman Java dan Database Mysql pada Toko Kansa Elpiji*, vol. 2, no.2;
[7] Sutabri, Tata. 2012. *Analisa Sistem Informasi*. Yogyakarta: ANDI;

[8] Winiarti, Sri dan Susanti, nia. 2013. *Sistem Pendukung Keputusan Penentuan Kualitas Kayu untuk Kerajinan Meubel*. Vol. 1, No. 1;