Implementation of SWOT-FAHP Method To Determine The Best Strategy on Development of Traditional Shipyard in Sumenep

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ABSTRACT

Selection of a traditional shipyard development strategy in Sumenep is a complex issue, this is caused by several alternative strategies should be selected, but each alternative contains several criteria that must be assessed based on priorities. Selection of this alternative strategy generated from development SWOT analysis of traditional shipyard industry. Because faced with a situation that is complex and uncertain, so the difficulty in determining the decision-making. Usually decision makers using intuition and subjectivity alone. SWOT-FAHP approach is one method that can answer the question ini.Karena these methods can lead decision makers to assess each of the criteria, sub-criteria and alternatives. The criteria used in this study were (S) = strenghts, (W) = Weaknesses, (O) = oppurtunities, (T) = Treats. Based on the research results of the application of the method SWOT-FAHP to determine the best strategy of the development of traditional shipyard strategy priorities obtained as follows: [1] Increasing weakness and reducing threats (WT = 0.47769), [2] Optimizing strengths and maximize opportunities (SO = 0.47455), [3] Optimizing the power to reduce the threat (ST = 0.40451), [4] reduces the weakness to increase opportunities (WO = 0.40139).

Keywords: *SWOT, fuzzy AHP, Strategy, traditional shipyard*

INTRODUCTION

Potential of Marine and Fisheries in Sumenep very large, including traditional shipyard industry developed in Sumenep, since 2009 the traditional shipyard industry in Sumenep have started ignored by the Local Government caused many industries that have closed due to a lot of people are switching professions.

The fundamental problem for traditional shipyard industry in Sumenep are: decreased vessel booking request, ship repair process tends to be done by the community, reduced raw material wood, high operating costs resulted in ship building prices more expensive ships, equipment available in the traditional shipyard still result in the shipyard process is difficult to reach the size of ships that have been set by the buyer, high mistake rate reached 25% resulting in a loss.

Sumenep is one area that is minimal in the utilization of natural resources primarily in the fields of marine, this can be evidenced by the lack of fish processing industry and the lack of interest of the community to develop the natural resources owned. These conditions make traditional shipyard in Sumenep left behind by other regions in East Java, Indonesia. The lag is caused by several things, namely: lack of infrastructure support traditional shipyard, lack of awareness of human resources for learning, reduced demand for fishing vessels, to lack of attention to local government, low budget coaching, more and more shipyards closed and the people who lack the technology used. Hence the need for a research strategy development to improve the quality and quantity back shipyard industry traditionally in Sumenep.

This study aims to identify the potential of traditional shipyard industry in Sumenep, strategize traditional shipyard industry development, determining the best strategy for prioritized in the decision-making process. The process of developing a policy strategy selection of traditional shipyard

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in the most appropriate to use a combination of methods Sumenep SWOT - FAHP. SWOT analysis is used to capture the perceptions of an expert assessment of the internal and external factors of traditional shipyard industry, which in turn obtained the power factor, factor weaknesses, opportunities factors, the threat factor. Assessment of the weight of IFAS *(Internal Factor Analysis System)* and EFAS *(External Factor Analysis System)* obtained some alternative strategies that can be used in the development of traditional shipyard industry in the region Sumenep.

Having obtained some alternative strategies, it is necessary to priority under the selection criteria set. This prioritization needs to be done as to make the whole strategy that has been obtained through the SWOT analysis will require enormous resources, and not all of them can be accommodated by the Local Government. To perform the selection of strategic priorities, then used the approach of Fuzzy Analytical Hierarchy Process (FAHP) based on consideration of four (4) criteria, 12 (twelve) sub-criteria and 4 (four) alternatives.

TRADITIONAL SHIPYARD IN SUMENEP

Sumenep traditional shipyard potential is quite large compared with other districts in Madura, the potential is supported by the geographical conditions that have some small islands scattered around ± 15 islands, as shown in Figure 1.

Figure 1. Map of small islands in Sumenep *(source:www.nadafm.net)*

Based on Figure 1 above, Sumenep has the potential needs of a large transport ships to connect between remote islands with the Central Government in Sumenep. The potential of the traditional shipyard, began to decline from year to year due to a lack of local government support to make a center of shipyard industry in Sumenep. Since the 2009-2013 traditional shipyard conditions decreased by 75% of the total number of 20 traditional shipyard industry, now the remaining five (5) spread across several industries, namely the District: Saronggi, Pasongsongan, Sapeken, Giligenteng and Talango.

USING FAHP IN SWOT ANALYSIS

In the following discussion, the fundamentals of SWOT analysis and fuzzy AHP are given. Later, these techniques are combined to prioritize the traditional shipyard strategies.

SWOT analysis

SWOT analysis is the most common techniques that can be used to analyze strategic cases [5]. SWOT is a frequently used tool for analyzing internal and external environments to attain a systematic approach and support for a decision situation [14]. The internal and external factors are referred to as strategic factors, and they are summarized within the SWOT analysis. Strengths and weaknesses constitute factors within the system that enable and hinder the organization from achieving its goal, respectively. Opportunities and threats were considered as external factors that facilitate and limit the organization in attaining its goals, respectively [15]. SWOT analysis suggests the appropriate strategies in four categories SO, ST, WO and WT. The strategies identified as SO, involve making

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good use of opportunities by using the existing strengths. The ST is the strategies associated with using the strengths to remove or reduce the effects of threats. Similarly, the WO strategies seek to gain benefit from the opportunities presented by the external environmental factors by taking into account the weaknesses. The fourth and last is WT, in which the organization tries to reduce the effects of its threats by taking its weaknesses into account [18].

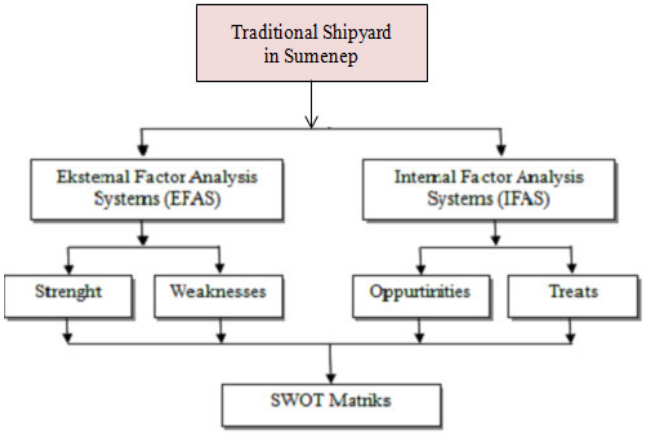

Figure 2. SWOT analysis framework

Figure 2 shows how SWOT analysis fits into an traditional shipyard in Sumenep. The final goal of a strategic planning process, of which SWOT is an early stage, is to develop and adopt a strategy resulting in a good fit between internal and external factors [16].

Fuzzy Analytic Hierarchy Process (FAHP)

The concept of fuzzy sets was first presented by Zadeh [17], which was oriented to the rationality of uncertainty due to imprecision or vagueness. Fuzzy sets theory providing a more widely frame than classic sets theory, has been contributing to capability of reflecting real world [4]. Human beings are heavily involved in the process of decision analysis [8]. AHP is a decision analysis technique aiming at assessing multi-attribute alternatives [1]. AHP was proposed by Saaty [12,13]. AHP has been applied extensively to cope with situations with multiple criteria where subjective judgment is inherent. Furthermore, the AHP approach encourages and assists the user to methodically and logically appraise the importance of each criterion in relation to the others in a hierarchical structure [9]. The traditional AHP still cannot really reflect the human thinking style [6]. The traditional AHP method is problematic in that it uses an exact value to express the decision maker's opinion in a comparison of alternatives [15]. AHP method is often criticized due to its use of unbalanced scale of judgments and its inability to adequately handle the inherent uncertainty and imprecision in the pairwise comparison process [16]. To overcome the shortcomings, FAHP was developed for solving the hierarchical problems. In the literature, fuzzy AHP has been widely used in solving many complicated decision making problems [17]. Chang [3] introduced a new approach for handling FAHP, with the use of triangular fuzzy numbers for pairwise comparison scale of FAHP, and the use of the extent analysis method for the synthetic extent values of the pairwise comparisons. Ataei [2] used multi-criteria decision making for the selection of the alumina cement plant location in the East-Azerbaijan province of Iran. Lee and Lin [26] combined fuzzy AHP with SWOT to evaluate the environmental relationships of international distribution centers in the pacific asian region. Kahraman et al. [27] used FAHP in SWOT analysis to evaluate and determine the alternative strategies for e-government applications in Turkey. Nepal et al. [11] proposed a fuzzy-AHP approach to prioritize customer satisfaction attributes in target planning for automotive product development. Finally, Angga AR [1] studied the development of shipyard in the region of Madura, Indonesia using SWOT-FAHP method.

SWOT-FAHP analysis

Conventional SWOT does not provide the means to analytically determine the importance of the factors or to assess decision alternatives according to the factors [18]. Furthermore, SWOT analysis

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cannot appraise the strategic decision-making situation comprehensively [5]. The results of a SWOT analysis are often only a listing or an incomplete qualitative examination of internal and external factors [6,7,3]. FAHP is utilized in the SWOT approach to eliminate the weaknesses in the measurement and evaluation steps of the SWOT analysis. In this paper SWOT is used in combination with FAHP to provide a quantitative measure of the importance of each factor and to determine the priorities of the strategies. FAHP is applied in order to determine the overall priorities of the alternative strategies identified with SWOT analysis. To this end, these steps should be taken:

Step 1. *Identifying SWOT sub-factors and determining the alternative strategies*
As a first step, the factors in the SWOT groups and alternatives strategies should be identified. SWOT sub-factors should be recognized and the alternative strategies might be defined according to SWOT sub-factors. Using SWOT matrix, four alternative strategy categories including SO, ST, WO and WT are proposed.

Step 2. *Developing hierarchical structure based on the SWOT factors and sub-factors*
In this step, the problem to be solved is divided into a hierarchical structure with decision elements *(Goal, Criteria, Sub-criteria and alternatives).*

Step 3. Creating a hierarchical structure problems
Creating a hierarchical structure of the problem to be solved and determine pairwise comparison matrix between elements using a scale TFN [3] as Tabel 1.

Tabel 1. Skala triangular fuzzy numbers (TFN)

The intensity of interest AHP	Linguistics Association	Tringular Fuzzy Number	Reciprocal
1	equally important	(1, 1, 1)	(1, 1, 1)
2	mid (equally important)	(1/2, 1, 3/2)	(2/3, 1, 2)
3	quite important	(1, 3/2, 2)	(1/2, 2/3, 1)
4	mid (quite important)	(3/2, 2, 5/2)	(2/5, 1/2, 2/3)
5	strong critical	(2, 5/2, 3)	(1/3, 2/5, 1/2)
6	mid (strong critical)	(1/2, 3, 7/2)	(2/7, 1/3, 2/5)
7	stronger important	(3, 7/2, 4)	(1/4, 2/7, 1/3)
8	mid (stronger important)	(7/2, 4, 9/2)	(2/9, 1/4, 2/7)
9	absolutely more important	(4, 9/2, 9/2)	(2/9, 2/9, 1/4)

Step 4. *Determining the value of Fuzzy Synthetic Extents*
Determining the value of fuzzy synthetic extents to get the weight vector of priority weights

$$Si = \sum_{j=1}^{m} M_{gi}^{j} \bigotimes \sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^{j} \; ^{-1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where

$$\sum_{j=1}^{m} M_{gi}^{j} = \sum_{j=1}^{m} l_i , \sum_{j=1}^{m} m_i , \sum_{j=1}^{m} u_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

Is the sum of each row of numbers TFN members, and to get the value of the inverse of the number of columns in the calculations done by summing the number of lines above with the following formula:

$$\sum_{i=1}^{n} \sum_{j=1}^{m} = \sum_{i=1}^{m} l_i , \sum_{i=1}^{m} m_i , \sum_{i=1}^{m} u_1 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Later

$$\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^{j} \; ^{-1} = \frac{1}{\sum_{i=1}^{n} u_i} , \frac{1}{\sum_{i=1}^{n} m_i} , \frac{1}{\sum_{i=1}^{n} l_i} \dots\dots\dots\dots (4)$$

Step 5. Determining the value of *Degree of Possibility*
The degree of probability of $M_2 = (l_2,m_2,u_2) \geq M_1 (l_1,m_1,u_1)$ defined as follows:

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$V(M_2 \geq M_1) = \text{sub} [\min (\mu_{m1}(X), \mu_{m2}(y))]\ y \geq x$ and can be written as follows:

$$V (M2 \geq M1) = \text{hgt} (M1 \cap M2) = \mu_{m2} (d)$$

$$= \begin{cases} 1, & \text{if } m_2 \geq m_1 \\ 0, & \text{if } l_1 \geq u_2 \text{ moreover} \\ \frac{l1-u2}{(m2-u2)-(m1-l1)} & \end{cases} \qquad (5)$$

Where d is the ordinate of the highest point of the slices, to be able to compare, the second takes the value of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$.

Step 6. Determining the value of the degree of probability (*Confex Fuzzy Number)*
The degree of possibility for confex fuzzy number is greater than k confex fuzzy number for $M_1(i=1,2,\ldots,k)$ can be defined as follows:

$$V (M \geq M1.\ M_2 \ldots M_k) = V[(M \geq M_1) \text{ dan } X (M \geq M_1) \ldots \text{and } (M \geq M_k)]$$

$$= \min V(M \geq Mi),\ i= 1,2,..k$$

Assumed: $d' (Ai) = \min V(Si \geq Sk)$ ……………………..............….(6)

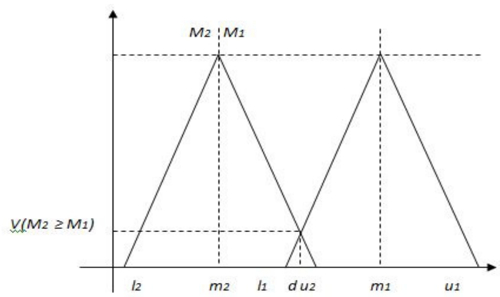

Figure 4. Wedge between M1 and M2

For $k = 1,2,\ldots n; k \neq i$. Then the weight vector obtained by:

$$W' = (d' (A_1), d'(A_2) \ldots d' (A_n))^T \qquad (7)$$

Where A_i $(I = 1,2,\ldots,n)$ is the n elements.

Step 7. Determining the value of Normalization
Normalization aims to gain weight weight vector, can be represented as follows:

$$W = (d(A_1), d(A_2) \ldots d(An))^T \qquad (8)$$

Where W is the number of *non fuzzy number*

IMPLEMENTING THE SWOT - FAHP ANALYSIS FOR TRADITIONAL SHIPYARD IN SUMENEP

To implement the SWOT- FAHP analysis for traditional shipyard in Sumenep, first an external environment analysis is performed with the help of an expert team familiar with the traditional shipyard. In this way, external SWOT sub-factors *(opportunities, threats)* are identified. In addition, an internal analysis is performed to determine the internal sub-factors *(strengths, weaknesses).* Based on these analyses, the strategically important sub-factors can be determined. Identified sub-factors are shown in Table 2.

Alternative strategies based on the SWOT factors and sub-factors are developed using the SWOT matrix are shown in Table 3. Four alternative strategy groups exist in SWOT matrix. The aim of the current study is to determine priorities of these strategies and to find the best of them for traditional shipyard.

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Table 2. SWOT factors and sub-factors for the strategy selection

	Factor	Sub factor
Internal Factor	**Strenght (S)**	S1: Salary cheap labor
		S2: hardworking labor
		S3: Labor has your relationship
		S4: Self-owned capital
	Weakness (W)	W1: The difficulty of the banking confidence
		W2: Production management is still traditional
		W3: Limited knowledge of human resources
		W4: Limited shipyard facilities
Eksternal Factor	**Oppurtunities (O)**	O1: The lack of attention from the local government
		O2: The potential is very large marine
		O3: Market opportunities outside the area is still large
		O4: Development of maritime policy
	Treats (T)	T1: traditional shipbuilding industry threatened closures
		T2: Loss of interest in traditional shipbuilding business
		T3: the destruction of ecosystems fish
		T4: difficulties in obtaining raw materials

Table 3. SWOT matrix

	Internal Factor	
	Strenght (S)	**Weakness (W)**
	S1: Salary cheap labor	W1: The difficulty of the banking confidence
	S2: hardworking labor	W2: Production management is still traditional
	S3: Labor has your relationship	W3: Limited knowledge of human resources
	S4: Self-owned capital	W4: Limited shipyard facilities
Eksternal Factor		
Oppurtunities (O)	**SO Strategies**	**WO Strategies**
O1: The lack of attention from the local government	1 - Increased marketing opportunities to diversify the types of timber vessels	1 - Making on the development of traditional shipbuilding industry
O2: The potential is very large marine	2 - Synchronization ship industry sector with other sectors within the framework of the development of the	2 - Making on the development of traditional shipbuilding industry
O3: Market opportunities outside the area is still large		
O4: Development of maritime policy		
Treats (T)	**ST Strategies**	**WT Strategies**
T1: Traditional shipbuilding threatened closures	1 - Improving the quality of human resources in the field of design of timber ship wake modern;	1 - Increased ability to design and build a modern timber ship
T2: Loss of interest in traditional shipbuilding business	2 - Increased ability to field a local or national marketing boat	2 - Increased entrepreneurial management capabilities that effectively and efficiently
T3: The destruction of ecosystems fish	3 - Diversification of various materials and the use of alternative fuel engines	3 - Setting up the market, the banking to jointly develop the potential of traditional shipbuilding industry perawatan kapal kayu
T4: Difficulties in obtaining raw materials		

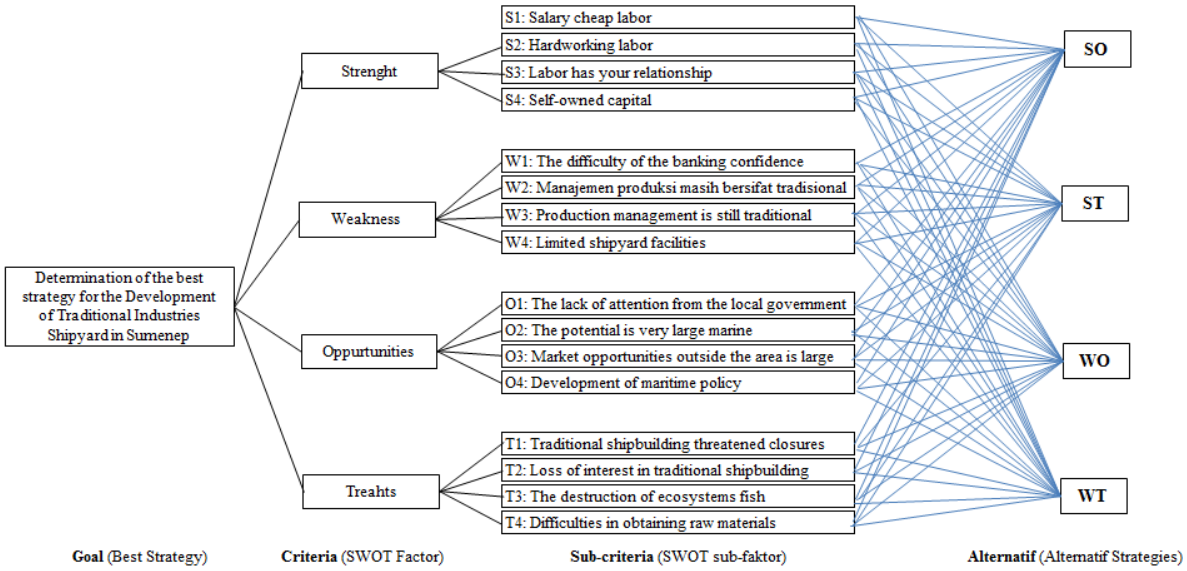

Figure 3. Hierarchical structure of SWOT traditional shipyard in Sumenep

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The problem is converted into a hierarchical structure (Figure. 3) in order to transform the sub-factors and alternative strategies into a state in which they can be measured by the FAHP. The aim of "Determining the best strategy" is placed in the first level of the structure, the SWOT factors in the second level, the SWOT sub-factors in the third level and the alternative strategies in the last level of the model.

In the pair-wise comparison step, first the SWOT factors are compared with respect to the goal using the Saaty's scale. This study proposes a group decision based on FAHP. Firstly, each decision maker (Di) individually carries out pairwaise comparison by using Saaty (1-9) scale. Then, a comprehensive pair-wise comparison matrix is built as in Table 5 by integrating five decision makers.

Table 4. Fuzzy pair-wise comparison of SWOT factors

Criteria	Strenght (S)			Weakness (W)			Oppurtunitiy (O)			Treat (T)		
	L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4
Strenght (S)	1,000	1,000	1,000	2,000	2,500	3,000	3,500	4,000	4,500	3,000	3,500	4,000
Weakness (W)	0,222	0,222	0,250	1,000	1,000	1,000	1,000	1,500	2,000	0,500	1,000	1,500
Oppurtunitiy (O)	0,286	0,333	0,400	0,400	0,500	0,667	1,000	1,000	1,000	2,000	2,500	3,000
Treat (T)	0,250	0,286	0,333	0,222	0,250	0,286	0,500	0,667	1,000	1,000	1,000	1,000

Table 5. *Fuzzy Systhetic Extents* (FSE) value of criteria (SWOT factors)

Criteria	Number of Line		
	L	M	U
Strenght (S)	9,500	11,000	12,500
Weakness (W)	2,722	3,722	4,750
Oppurtunitiy (O)	3,686	4,333	5,067
Treat (T)	1,972	2,202	2,619

Number of Columns		
L	M	U
17,880	21,258	24,936

Invers		
L	M	U
0,040	0,047	0,056

Table 5. Above describes the sum of the line (L, M, U) in each of the criteria *(Strength-Opportunity-Threat-Wekness)* by summing from left to right to obtain the total number of L, M and N each row as the table above using the following formula:

$$\sum_{i=1}^{n}\sum_{j=1}^{m} = \sum_{i=1}^{m} l_i , \sum_{i=1}^{m} m_i , \sum_{i=1}^{m} u_1$$

Next is the summation of each column of L, M and U. The next will be the inverse matrix of the value of the sum of the column, matrix inverse formula as follows:

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j\ -1} = \frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}$$

So to calculate *fuzzy synthetic extents* (FSE) obtained by multiplying the value of L, M and N each line with the value of the inverse of L, M and N to obtain the value of FSE. Formula of *fuzzy synthetic extents* as follows:

$$Si = \sum_{j=1}^{m} M_{gi}^{j} \otimes \sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j\ -1}$$

The process above calculation applies to all search *Fuzzy Systhetic Extents* (FSE) on each of the criteria (SWOT factor), sub-criteria (SWOT sub-factor) and alternatives (alternatif strategies).

Tabel 6. *Weight vektor* value of criteria (SWOT factor)

Criteria	V(S1 >= S2)	1 M2>=M1			0 L1>=U2			otherwise (LI-U2)/(M2-U2)-(M1-L1)	summary of degree	Min of degree	Weight Vektor
		M2	M1	degree	l1	u2	degree	degree			
Strenght (S)	S >= W	0,517	0,175	1					1		
	S >= O	0,517	0,204	1					1	1	0,318
	S >= T	0,517	0,104	1					1		
Weakness (W)	W >= S	0,175	0,517	Next	0,381	0,266	1		Next		
	W >= O	0,175	0,204	Next	0,148	0,266	Next	0,804	0,804	0,804	0,255
	W >= T	0,175	0,104	1					1		
Oppurtunitiy (O)	O >= S	0,204	0,517	Next	0,381	0,283	1		Next		
	O >= W	0,204	0,175	1					1	1	0,318
	O >= T	0,204	0,104	1					1		
Treat (T)	T >= S	0,104	0,517	Next	0,381	0,146	1		Next		
	T >= W	0,104	0,175	Next	0,109	0,146	Next	0,343	0,343	0,343	0,109
	T >= O	0,104	0,204	Next	0,148	0,146	1		Next		
									Jumlah Total	**3,147**	

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The weights for the SWOT sub- factors and the alternative strategies are calculated in a similar way to the fuzzy evaluation matrices. Pair-wise comparison matrices for the SWOT sub-factors are given in Tables 7-10 together with the calculated local weights.

The local weights of the alternative strategies with respect to each SWOT sub- factors are calculated. The details of the pair- wise comparison matrices and the calculated local weights are provided in Table 11. Figure 4 illustrates the priority weights of the categorized sub- factors. In the last stage of the analysis, overall priority weights of the alternative strategies are calculated as shown in Table 12.

Tabel 7. Fuzzy pair-wise comparison of strength

Criteria	Fuzzy pair-waise comparison of strengths												Local Weight
	S1			S2			S3			S4			
	L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
S1	1,000	1,000	1,000	1,000	1,000	1,000	0,500	1,000	1,500	0,667	1,000	2,000	0,245
S2	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,500	2,000	0,667	1,000	2,000	0,273
S3	0,667	1,000	2,000	0,500	0,667	1,000	1,000	1,000	1,000	0,500	0,667	1,000	0,205
S4	0,500	1,000	1,500	0,500	1,000	1,500	1,000	1,500	2,000	1,000	1,000	1,000	0,276

Tabel 8. Fuzzy pair-wise comparison of weakness

Criteria	Fuzzy pair-waise comparison of weaknesses												Local Weight
	W1			W2			W3			W4			
	L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
W1	1,000	1,000	1,000	0,250	0,417	0,500	1,000	2,333	3,000	0,167	0,031	0,500	0,150
W2	2,000	2,400	4,000	1,000	1,000	1,000	1,000	2,670	4,000	0,250	0,528	1,000	0,254
W3	0,333	0,430	1,000	0,250	0,375	1,000	1,000	1,000	1,000	0,250	0,528	1,000	0,097
W4	2,000	3,273	6,000	1,000	1.89	4,000	1,000	1,890	4,000	1,000	1,000	1,000	0,247

Tabel 9. Fuzzy pair-wise comparison of opportunity

Criteria	Fuzzy pair-waise comparison of Opportunities												Local Weight
	O1			O2			O3			O4			
	L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
O1	1,000	1,000	1,000	1,000	1,670	2,000	1,000	1,333	2,000	1,000	3,000	5,000	0,245
O2	0,500	0,600	1,000	1,000	1,000	1,000	0,330	0,610	1,000	0,500	1,500	3,000	0,160
O3	0,500	0,750	1,000	1,000	1,636	3,000	1,000	1,000	1,000	2,000	3,330	5,000	0,240
O4	0,200	0,333	1,000	0,330	0,670	2,000	0,200	0,300	0,500	1,000	1,000	1,000	0,110

Tabel 10. Fuzzy pair-wise comparison of treath

Criteria	Fuzzy pair-waise comparison of Treath												Local Weight
	T1			T2			T3			T4			
	L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
T1	1,000	1,000	1,000	3,000	0,333	4,000	1,000	2,000	3,000	1,000	2,000	3,000	0,252
T2	0,250	0,300	0,333	1,000	1,000	1,000	0,250	0,581	1,000	0,200	0,511	1,000	0,052
T3	0,333	0,500	1,000	1,000	1,760	4,000	1,000	1,000	1,000	0,200	0,567	1,000	0,194
T4	0,333	0,500	1,000	1,000	1,956	5,000	1,000	1,765	5,000	1,000	1,000	1,000	0,249

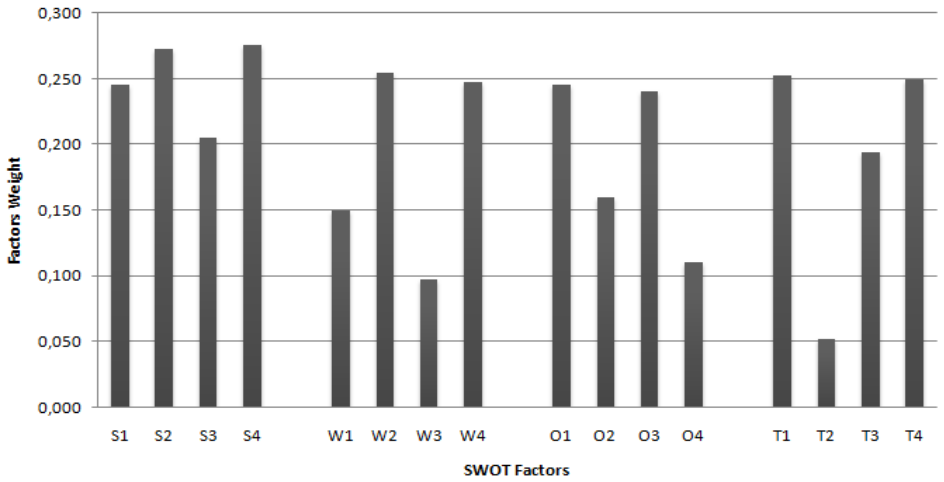

Figure 4. The priority weights of the SWOT sub-factors

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Tabel 11. Pair-wise comparisons of the alternative strategies based on the SWOT sub-factors

Sub - Criteria	Alternatif	SO			ST			WO			WT			Local Weinghts
		L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
S1	SO	1,000	1,000	1,000	2,000	3,000	4,000	3,000	5,000	7,000	6,000	6,670	7,000	0,563
	ST	0,250	0,333	0,500	1,000	1,000	1,000	3,000	3,670	5,000	7,000	7,670	8,000	0,461
	WO	0,140	0,200	0,333	0,200	0,273	0,333	1,000	1,000	1,000	2,000	3,330	4,000	0,293
	WT	0,143	0,150	0,167	0,125	0,130	0,143	0,250	0,300	5,000	1,000	1,000	1,000	0,245
S2	SO	1,000	1,000	1,000	0,500	0,830	1,000	3,000	4,330	6,000	1,000	3,000	5,000	0,562
	ST	1,000	1,200	2,000	1,000	1,000	1,000	2,000	3,000	4,000	2,000	4,000	6,000	0,563
	WO	0,167	0,217	0,333	0,143	0,200	0,333	1,000	1,000	1,000	1,000	2,000	3,000	0,415
	WT	0,200	0,333	1,000	0,167	0,250	0,500	0,333	0,500	1,000	1,000	1,000	1,000	0,392
S3	SO	1,000	1,000	1,000	0,333	0,780	1,000	1,000	2,670	4,000	1,000	3,000	5,000	0,546
	ST	1,000	1,286	3,000	1,000	1,000	1,000	1,000	2,330	3,000	2,000	3,330	4,000	0,563
	WO	0,250	0,375	1,000	0,333	0,429	1,000	1,000	1,000	1,000	2,000	3,000	4,000	0,467
	WT	0,200	0,333	1,000	0,250	0,300	0,500	0,250	0,333	0,500	1,000	1,000	1,000	0,404
S4	SO	1,000	1,000	1,000	1,000	2,000	3,000	5,000	6,000	7,000	4,000	6,000	8,000	0,563
	ST	0,333	0,500	1,000	1,000	1,000	1,000	4,000	5,670	7,000	4,000	6,000	8,000	0,511
	WO	0,143	0,167	0,200	0,143	0,176	0,250	1,000	1,000	1,000	0,500	1,170	2,000	0,331
	WT	0,125	0,167	0,250	0,125	0,167	0,250	0,500	0,857	2,000	1,000	1,000	1,000	0,328

Sub - Criteria	Alternatif	SO			ST			WO			WT			Local Weinghts
		L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
W1	SO	1,000	1,000	1,000	2,000	3,330	5,000	0,110	0,167	2,000	0,250	0,310	0,330	0,712
	ST	0,200	0,333	0,500	1,000	1,000	1,000	0,110	0,120	0,130	0,130	0,160	0,200	0,503
	WO	5,000	6,279	9,000	8,000	8,301	9,000	1,000	1,000	1,000	1,000	2,330	3,000	0,712
	WT	3,000	3,273	4,000	5,000	6,400	8,000	0,333	0,429	1,000	1,000	1,000	1,000	0,497
W2	SO	1,000	1,000	1,000	0,500	0,830	1,000	0,200	0,260	0,330	0,250	0,310	0,330	0,622
	ST	1,000	1,200	2,000	1,000	1,000	1,000	0,200	0,340	0,500	0,200	0,290	0,330	0,712
	WO	3,000	3,830	5,000	2,000	2,903	5,000	1,000	1,000	1,000	0,330	0,330	0,330	0,545
	WT	3,000	3,270	4,000	3,000	3,460	5,000	3,000	3,000	3,000	1,000	1,000	1,000	0,712
W3	SO	1,000	1,000	1,000	0,500	0,830	1,000	0,110	0,130	0,140	0,140	0,170	0,200	0,578
	ST	1,000	1,286	2,000	1,000	1,000	1,000	0,110	0,130	0,140	0,140	0,230	0,330	0,712
	WO	7,000	8,000	9,000	7,000	7,900	9,000	1,000	1,000	1,000	2,000	3,000	5,000	0,712
	WT	5,000	5.89	7,000	3,000	4,437	7,000	0,200	0,300	0,500	1,000	1,000	1,000	0,356
W4	SO	1,000	1,000	1,000	1,000	1,000	1,000	0,110	0,130	0,140	0,140	0,160	0,170	0,664
	ST	1,000	1,000	1,000	1,000	1,000	1,000	0,110	0,120	0,140	0,140	0,230	0,330	0,712
	WO	7,000	7,900	9,000	7,000	8,000	9,000	1,000	1,000	1,000	2,000	3,000	4,000	0,712
	WT	6,000	6,300	7,000	3,000	4,430	7,000	0,250	0,333	0,500	1,000	1,000	1,000	0,420

Sub - Criteria	Alternatif	SO			ST			WO			WT			Local Weinghts
		L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
O1	SO	1,000	1,000	1,000	4,000	5,670	7,000	1,000	2,000	3,000	5,000	6,670	8,000	0,524
	ST	0,143	0,176	0,250	1,000	1,000	1,000	0,170	0,250	0,330	0,500	0,830	1,000	0,299
	WO	0,333	0,500	1,000	3,000	4,000	6,000	1,000	1,000	1,000	3,000	4,330	6,000	0,398
	WT	0,125	0,158	0,200	1,000	1,200	1,000	0,167	0,230	0,330	1,000	1,000	1,000	0,303
O2	SO	1,000	1,000	1,000	0,500	6,670	8,000	1,000	2,330	4,000	5,000	6,330	4,000	0,524
	ST	0,125	0,150	0,200	1,000	1,000	1,000	0,140	0,230	0,330	0,500	1,170	2,000	0,311
	WO	0,250	0,429	1,000	3,000	4,430	7,000	1,000	1,000	1,000	3,000	4.33	5,000	0,345
	WT	0,125	0,158	0,200	0,500	0,857	2,000	0,200	0,231	0,333	1,000	1,000	1,000	0,308
O3	SO	1,000	1,000	1,000	0,333	1,120	2,000	2,000	2,670	3,000	3,000	3,330	4,000	0,524
	ST	0,500	0,900	3,000	1,000	1,000	1,000	1,000	1,670	3,000	1,000	2,000	3,000	0,000
	WO	0,330	0,380	0,500	0,333	0,600	1,000	1,000	1,000	1,000	5,000	6,330	8,000	0,524
	WT	0,250	0,300	0,330	0,330	0,500	1,000	0,125	0,158	0,200	1,000	1,000	1,000	0,308
O4	SO	1,000	1,000	1,000	3,000	4,330	6,000	0,500	1,830	3,000	3,000	5,670	8,000	0,524
	ST	0,167	0,231	0,330	1,000	1,000	1,000	0,170	0,390	0,500	0,500	1,170	2,000	0,360
	WO	0,330	0,545	2,000	2,000	2,570	6,000	1,000	1,000	1,000	3,000	3,670	5,000	0,427
	WT	0,125	0,170	0,333	0,500	0,857	2,000	0,200	0,273	0,330	1,000	1,000	1,000	0,355

Sub - Criteria	Alternatif	SO			ST			WO			WT			Local Weinghts
		L1	M1	U1	L2	M2	U2	L3	M3	U3	L4	M4	U4	
T1	SO	1,000	1,000	1,000	0,170	0,290	0,500	0,250	0,360	0,500	0,130	0,240	0,330	0,478
	ST	2,000	3,460	6,000	1,000	1,000	1,000	2,000	3,000	4,000	0,170	0,560	1,000	0,701
	WO	2,000	2,760	4,000	0,250	0,330	0,500	1,000	1,000	1,000	0,170	0,190	0,250	0,522
	WT	3,000	4,250	8,000	1,000	1,800	6,000	4,000	5,143	6,000	1,000	1,000	1,000	0,701
T2	SO	1,000	1,000	1,000	0,170	0,250	0,330	0,170	0,330	0,500	0,110	0,170	0,250	0,000
	ST	3,000	4,000	6,000	1,000	1,000	1,000	0,500	0,830	1,000	0,200	0,240	0,330	0,701
	WO	2,000	3,000	6,000	1,000	1,200	2,000	1,000	1,000	1,000	0,330	0,610	1,000	0,504
	WT	4,000	5,500	9,000	3,000	4,090	5,000	2,000	3,273	6,000	1,000	1,000	1,000	0,701
T3	SO	1,000	1,000	1,000	0,333	0,780	1,000	0,140	0,180	0,200	0,140	0,180	0,200	0,532
	ST	1,000	1,286	3,000	1,000	1,000	1,000	0,200	0,345	0,500	1,000	1,330	2,000	0,701
	WO	5,000	5,526	7,000	2,000	2,900	5,000	1,000	1,000	1,000	0,330	0,610	1,000	0,701
	WT	5,000	5,530	7,000	0,500	0,750	1,000	1,000	1,636	3,000	1,000	1,000	1,000	0,638
T4	SO	1,000	1,000	1,000	1,000	1,330	2,000	0,110	0,120	0,140	0,130	0,140	0,170	0,701
	ST	0,500	0,750	1,000	1,000	1,000	1,000	0,110	0,150	0,200	0,130	0,150	0,200	0,589
	WO	7,000	8,000	22,900	5,000	6,800	9,000	1,000	1,000	1,000	0,500	0,830	1,000	0,701
	WT	6,000	6,900	8,000	5,000	6,660	8,000	1,000	1,200	2,000	1,000	1,000	1,000	0,684

Tabel 12. Priority weights of SWOT factors, sub-factors and alternative strategies

Kriteria & Sub Kriteria	Bobot Kriteria / Subkriteria	Alternatif SO	ST	WO	WT
STRENGTHS (S)	**0,318**	Bobot A1	Bobot A2	Bobot A3	Bobot A4
S1: Salary cheap labor	0,244	0,563	0,461	0,293	0,245
S2: hardworking labor	0,277	0,562	0,563	0,415	0,392
S3: Labor has your relationship	0,203	0,546	0,563	0,467	0,404
S4: Self-owned capital	0,277	0,563	0,511	0,331	0,328
	Jumlah	0,17778	0,16649	0,11844	0,24261
WEAKNESSES (W)	**0,255**	Bobot A1	Bobot A2	Bobot A3	Bobot A4
W1: The difficulty of the banking confidence	0,150	0,712	0,503	0,712	0,497
W2: Production management is still traditional	0,277	0,622	0,712	0,545	0,712
W3: Limited knowledge of human resources	0,097	0,578	0,712	0,712	0,356
W4: Limited shipyard facilities	0,247	0,664	0,712	0,712	0,420
	Jumlah	0,12752	0,13221	0,12845	0,10466
OPPORTUNITIES (O)	**0,318**	Bobot A1	Bobot A2	Bobot A3	Bobot A4
O1: The lack of attention from the local government	0,245	0,524	0,299	0,398	0,303
O2: The potential is very large marine	0,160	0,524	0,311	0,345	0,308
O3: Market opportunities outside the area is still large	0,240	0,524	0,000	0,524	0,308
O4: Development of maritime policy	0,110	0,524	0,360	0,427	0,355
	Jumlah	0,12578	0,05172	0,10340	0,07509
TREATS (T)	**0,109**	Bobot A1	Bobot A2	Bobot A3	Bobot A4
T1: Traditional shipbuilding threatened closures	0,252	0,478	0,701	0,522	0,701
T2: Loss of interest in traditional shipbuilding business	0,052	0,000	0,701	0,504	0,701
T3: The destruction of ecosystems fish	0,194	0,532	0,701	0,701	0,638
T4: Difficulties in obtaining raw materials	0,250	0,701	0,589	0,701	0,684
	Jumlah	0,04347	0,05408	0,05110	0,05533
		SO	**ST**	**WO**	**WT**
	Total Bobot alternatif	**0,47455**	**0,40451**	**0,40139**	**0,47769**
	Rangking	2	3	4	1

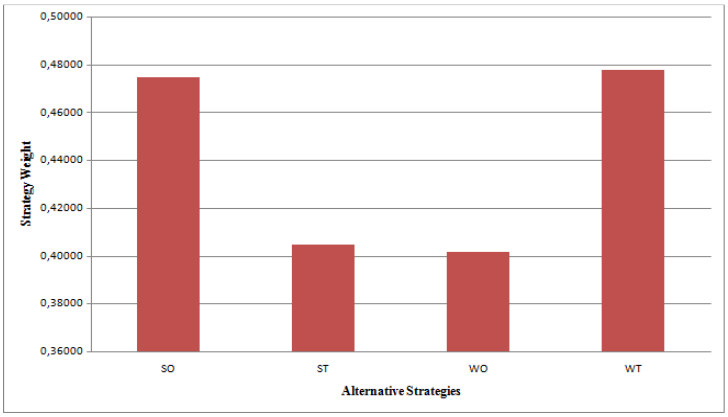

Figure 5. Ranking of the strategies

The results obtained from the SWOT-FAHP analysis are shown in Figure 5. According to the analysis, alternative strategies are ordered as WT, SO, ST and WO. The results indicate that WT is the best strategy group with an overall priority value of 0.47769.

DISCUSSION AND CONCLUSIONS

In this study, the SWOT-FAHP hybrid method has been used to prioritize the alternative strategies and select the best strategy for traditional shipyard. In the SWOT analysis, strategic alternatives are selected in the view of the strengths, weaknesses, threats and opportunities as determined through internal and external environment analysis. FAHP is used in the SWOT approach to eliminate the weaknesses in the measurement and evaluation steps of the SWOT analysis. An environment analysis was performed and the SWOT sub-factors, which have significant effect on the shipyard, were identified. The factors from the SWOT analysis and the alternative strategies based on these factors were transformed into an FAHP model.

The first four levels of the FAHP model consist of a goal (determining the best strategy group), 4 SWOT factors, 16 SWOT sub-factors and, 4 alternative strategies respectively. The relative importance of the alternative strategies and the overall priorities of the alternative strategies were calculated. The results of the SWOT-analysis implementation FAHP method is obtained that the

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criteria be the primary consideration of the results of a SWOT analysis (strengths, weaknesses, opportunities and threats) are as follows: [1] Improving weakness and reducing threats (WT = 0.47769), [2] Optimizing strengths and maximize opportunities (SO = 0.47455), [3] Optimizing the power to reduce the threat (ST = 0.40451), [4] Reducing weakness to increase opportunities (WO = 0.40139).

According to the FAHP analysis, alternative strategies are ordered as WT, SO, ST and WO. The results indicate that WT is the best strategy for traditional shipyard. Therefore, according to the SWOT matrix, Increasing the ability of human resources to design and build a modern timber ship, the increase in business management capabilities (financial, production and marketing), fix documentation system attempts to obtain a loan from a bank, expanding the market. The strategy is the best strategy to minimize the weaknesses and threats.

The results of this study emphasize the importance of using new technologies, improving human resource capacity, improving business management and market opportunities outside the region. in addition, the importance of local government policies that support the development of traditional shipbuilding industry and provide capital to support future traditional shipbuilding industry can be developed so as to absorb new labor more.

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