AHP-COPRAS Model for Determination of Suitability of Surveyor Assignment for Survey of New Building Ships at PT. BKI Main Branch Surabaya

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ABSTRACT

Purpose: The purpose of this study is to (1) identify the criteria used as the basis for selecting surveyors who will conduct a survey of new building ships at new shipbuilding yards in East Java, (2) develop a measurement of the level of conformity of surveyors to survey activities of new building ships at new shipbuilding yards in East Java, and (3) provide recommendations for the assignment of surveyors who handle surveys of new building ships at new shipbuilding yards in East Java.

Design/methodology/approach: The model used in this study is the AHP–COPRAS model, which is combined to select surveyors who will survey a new shipbuilding yard. First, the results of AHP processing will be separated for each shipyard class to know each shipyard's criteria and alternative weights. The next stage is an analysis using COPRAS. The questionnaire used to collect COPRAS data uses an ordinal scale. Respondents who will be involved in filling out the COPRAS questionnaire are surveyors at BKI Main Branch Surabaya. Next, COPRAS assesses each surveyor using the criteria and alternatives identified in the AHP process. Calculations on COPRAS also use the weights that have been generated from the AHP. At the final stage, different scores will be obtained for each surveyor for each class of shipyard under study.

Findings: The highest utility value in Shipyard 1 was found in JX surveyors with a utility of 100%. Thus, at shipyard 1 the JX surveyor is the surveyor who is considered the most suitable to survey building ships at PT. BKI Main Branch Surabaya. The highest utility value in Shipyard 2 is found in surveyor AX with a utility of 100%. Thus, at Shipyard 2, the AX surveyor is the surveyor who is considered the most suitable for surveying shipbuilding at PT. BKI Main Branch Surabaya. The highest utility value at Shipyard 3 is found in JX surveyors with a utility of 100%. Thus, at Shipyard 3 the JX surveyor is the surveyor who is considered the most suitable to conduct a shipbuilding survey at PT. BKI Main Branch Surabaya.

Paper type: Research paper

Keywords: suitability of surveyor assignment, selection criteria, new building ship, AHP-COPRAS

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I. INTRODUCTION

Indonesia is the largest archipelagic country in the world. Indonesia consists of five large islands and about 30 small groups. The archipelago is located between the Pacific and Indian Oceans, bridging the continents of Asia and Australia. This strategic position has influenced the cultural, social, political, and economic life of the country (ADB, 2016: 3). Data from the Ministry of Transportation records that the number of commercial vessels operated by national shipping companies is around 32,000 units. With this number, the shipbuilding industry has promising potential and the Indonesian Association of Shipbuilding and Offshore Facilities (IPERINDO) has developed into 116 shipbuilding industry companies and 80 supporting industries. East Java also has adequate shipyards, there are 25 IPERINDO member shipbuilding industries, 23 IPERINDO member
supporting industries, and 3 IPERINDO member consulting companies, IPERINDO member shipbuilding companies in East Java have been able to build various types of ships including Pioneer ships (750 DWT, 1200 DWT & 2000 DWT), Livestock vessels, Ferry RO-RO vessels, Rede vessels, Perambuan carriers, Container ships, Patrol vessels, Tug Boats, Crew Boats, Mooring Boats Oil Barges, Deck barges, Water buses, and Supply vessels.

Indonesian Classification Bureau (BKI) is the only national classification body that carries out ship classification based on the Regulation of the Minister of Transportation of the Republic of Indonesia No. 7 of 2013 which has been amended by the Regulation of the Minister of Transportation of the Republic of Indonesia No. 61 of 2014 concerning obligations for Indonesian-flagged vessels to classification bodies and statutory surveys are carried out based on an authorization from the Indonesian government.

BKI surveyor services for the construction of new building ships in the East Java region have greatly increased with the Sea Toll project, to increase the productivity of BKI surveyors, it is necessary to place surveyors in branches according to the level of branch needs for services for inspection of new building ships by taking into account the suitability of the builders' shipyards, new building ship.

Inspection by BKI on the process of building new shipbuilding must be more detailed and thorough because the quality of the construction of new shipbuilding greatly determines the process of periodic inspection of the ship, in the inspection of a new shipbuilding BKI together with the applicant for a survey on acceptance of the new building ship class (shipyard or shipowner), agreed to carry out inspections of new building ships according to BKI standards/rules with 4 inspection stages namely Commencement, Keelaying, Launching and Completion to maintain the quality of the results of the inspection of new ships.

The number of new shipbuildings produced in East Java in the period 2016 to 2020 is quite large, so the tasks of surveyors, especially surveyors who are tasked with surveying new shipbuildings are also increasing. Inspection of new building ships must be carried out more carefully and thoroughly by a surveyor because the quality of the surveyor also determines the results of the survey conducted.

Some of the tasks of the surveyor are to carry out inspection, supervision, and testing of ship construction, mechanical and electrical installation systems, and issuance of class certificates. Especially in the process of inspecting a new building ship, the surveyor must carry out 4 stages in the process of accepting a new building class that has been agreed upon by the surveyor and shipowner. can register a new building ship by the class notation desired by the shipowner.

The performance of a surveyor in carrying out his duties cannot be separated from the suitability of the surveyor selection with the workload that will be carried out later. The survey of new shipbuilding conducted by Surveyor BKI at the shipbuilding yard with different shipyard capabilities in building new shipbuilding requires the accuracy of the surveyor selection because it will determine the survey results. Complaints that are sometimes submitted by shipyards to PT. BKI is a surveyor sent to conduct a survey that is not to the shipyard's expectations. Surveyors who should be able to provide consultation and direction during the monitoring process are sometimes unable to carry out this role.

Currently, in the BKI surveyor mutation process, there is no special method that is taken into consideration for surveyor mutation in fulfilling the inspection service for new ships by paying attention to its suitability with new shipbuilding shipyards, communicate) which greatly affects the suitability of a surveyor in a new building shipbuilding shipyard.

The request for submitting a survey of new shipbuilding also includes the physical plan of the ship to be worked on, the materials used, the human resources involved, as well as the stages of the shipbuilding process and agreeing on the Class Notation as desired by the shipowner. The surveyor's role is to check the completeness of the submission document and ensure that the document has complied with various applicable regulations or requirements. Often the documents (Welding Shop Certificate, Approval, WPS and Welder Certificate, and others) prepared by the shipyard related to the new shipbuilding plan and related matters have not complied with various classification regulations and applicable international provisions. In this condition, surveyors are also required to accompany the shipyard so that the submitted documents can meet various classification rules and applicable international provisions.

The process of building a new ship can be carried out when the Commencement process (Kick-off meeting) has been completed. When the shipbuilding process is running, cases often occur in the field where the existing process does not go according to plan or the results of shipbuilding do not comply with existing regulations or provisions. At this stage, surveyors are also required to play a role in providing recommendations to shipyards so that they can make improvements to the production process without having to reconstruct or rebuild from scratch. The next stage is the surveyor will provide a report on the survey results to BKI for the certification of newbuilding vessels. The series of surveys, assistance, and consultations provided by surveyors will greatly determine the suitability of the new shipbuilding to be included in the BKI register.

New problems arise, both for the shipyard and for BKI itself when there is a rotation or mutation of surveyors. BKI routinely conducts rotation and mutation activities to maintain the quality of survey results...
conducted by surveyors. Input for BKI was given by Mr. Soegeng Riyadi, Technical Director of PT. Orela Shipyard. The turn of this surveyor to be done with a smooth (Interview, 10 October 2021). The old surveyors usually have a good relationship with the shipyard and provide a strong foundation for cooperation between the shipyard and BKI. The replacement of surveyors that are not carried out properly will result in good relations and cooperation that has been established between the shipyard and BKI through surveyors will be lost and it is necessary to start over again. The existing phenomenon becomes the motivation for conducting research using the AHP-COPRAS method. The selection of the AHP-COPRAS method in this study was based on previous research studies conducted by Zolfani et al. (2012).

The Analytical Hierarchy Process (AHP) is a method of Multi-Criteria Decision Making (MCDM) that is very good in modeling the opinions of experts in decision support systems. AHP performs pairwise comparisons of the variables that are decisive in the decision-making process. The AHP method is not effectively used in cases with a large number of criteria and alternatives. To overcome this AHP requires other decision-making methods (Midyanti, Hidyati dan Bahri, 2018: 100).

One method that can be used to assist AHP is the COmplex Proportional Assessment (COPRAS). COPRAS is useful for evaluating maximum values as well as minimizing criteria. The AHP and COPRAS methods have been used by Yazdani-Chamzini et al. (2013) on the optimal selection of renewable energy. Renewable energy is different from one another and each has advantages and disadvantages so researchers find it difficult to evaluate various alternatives and choose the best alternative among all alternatives that are feasible to develop. The AHP Copras method has been used in research by Chamzini et al. (2013). In this research, AHP Copras is used to determine the best alternative by calculating the ratio of the ideal solution and the negative ideal solution. AHP is used to calculate the weights of the criteria. AHP-COPRAS was then compared with five other MCDM methods. The results of this study show the ability and effectiveness of AHP-COPRAS in choosing the most appropriate renewable energy option among the existing alternatives.

The formulation of the problem taken in this study are:

1. What are the criteria that can be used to select a surveyor who will conduct a survey of new construction ships at a new shipbuilding yard in East Java?
2. What is the level of conformity of the surveyors to the survey activities of new construction ships at the shipbuilding shipyards in East Java?
3. What are the recommendations that can be given to the company regarding the assignment of surveyors who handle surveys of new construction ships at new shipbuilding yards in East Java?

II. METHODOLOGY

A. Research Parameters

A research parameter is a characteristic or collection of the object under study (Timotius, 2017: 49). The object of this research is a surveyor whose job is to survey new shipbuilding shipyards in East Java. The suitability of the surveyor selection is the main parameter used as an indicator of the success of the surveyor selection. The suitability of the surveyor selection was assessed using several criteria developed based on theory and interviews with experts.

B. Models Used

The model used in this study is the AHP – COPRAS model which is combined in selecting surveyors who will survey new building ships. The Analytical Hierarchy Process (AHP) is a decision support system through pairwise comparisons and relies on expert judgment to get a priority scale. COmplex Proportional Assessment (COPRAS) can be used to rank alternatives where the value used is expressed in ordinal based on actual conditions in decision making (Leal 2020).

The stages carried out by this research are:

1. Stages of field research
   Stages of field research are carried out to find out the problems that have been experienced by the company. One problem that has been experienced by the company so far is the lack of suitability for the selection of surveyors who carry out survey activities for new construction ships on new shipbuilders in East Java.
2. Stages of problem formulation
   The formulation of the research problem was carried out after knowing the conditions in the field. The problems discussed in this study are related to the selection of surveyors who are in charge of surveying new building ships at the shipbuilding shipyards that are not by the tasks that must be done.
3. Data collection
Data collection was carried out after the research proposal was approved. Data collection was carried out by interviewing and distributing questionnaires to research respondents.

4. **Data processing**

The data that has been successfully collected is then processed. Research data processing is carried out with two models, namely AHP and COPRAS.

5. **Discussion.**

6. **Drawing Conclusions and Suggestions.**

C. **Research design**

The research design to determine the suitability of the surveyor assignment for the survey of new building ships with the AHP and COPRAS models is depicted in Figure 1.

Preliminary interviews have been conducted with experts to determine the criteria and alternatives that can be used in this study. These criteria and alternatives are initial criteria and alternatives that can later change according to the development of field data mining.

Based on the main duties and functions (Tupoksi) of BKI surveyors, a surveyor must have technical and non-technical capabilities in carrying out inspections at new shipbuilding shipyards, from the technical side one of which is a surveyor must be able to master national and international standards/rules and regulations, and for the non-technical side, a surveyor must be able to carry out survey activities appropriately and accurately, be able to make decisions quickly on any issues, be able to provide consultation and survey recommendations appropriately and be able to communicate well with stakeholders.

Figure 2 shows the AHP concept chart. There are three levels in this chart, namely objectives, criteria, and alternatives. The AHP chart has the aim of getting a surveyor that is by field conditions and also the needs of new shipbuilding shipbuilders. Three criteria can be raised and four alternatives can be developed.

The AHP chart in Figure 3 is a preliminary chart and is still being refined by conducting additional interviews with key informants. Interviews have been conducted with Mr. Soegeng Riyadi, Technical Director of PT. Orela Shipyard. The next interview will be conducted with representatives of other new shipbuilding shipbuilders and BKI employees who have experience in the field of classification, to complete the results of the interview with the first informant.

The chart in Figure 3 was then developed into a questionnaire that would be distributed to representatives of shipyards in East Java from the top management and middle management levels. There are several criteria for shipyards in East Java. The results of filling out the questionnaire are then processed and grouped based on the shipyard class. The results of AHP processing will be separated for each shipyard class so that the weight of criteria and alternatives can be known for each shipyard. The target number of respondents from the Shipyard who will be involved in each Class of the Shipyard is 10 people.

The next stage is an analysis using COPRAS. The questionnaire used for COPRAS data collection uses an ordinal scale. Respondents who were involved in filling out the COPRAS questionnaire were surveyors at PT. BKI Main Branch Surabaya. COPRAS is used to provide an assessment of each Surveyor using the criteria and alternatives that have been identified in the AHP process. Calculations on COPRAS also use the weights that have been generated from the AHP. In the final stage, different values will be obtained for each surveyor for each ship class under study.
Problems: The selection of surveyors who are in charge of surveying new building ships at the shipbuilding shipyards of new construction is sometimes not in accordance with the tasks that must be done in the field.

Objective: To determine surveyors according to the conditions in the field at the shipbuilding shipyard in East Java.

Phase 1: Intelligence

- Study of literature
- Identify attributes and alternatives through interviews with 5 experts

Phase 2: Design

- Compilation of attributes and alternatives
- Preparation of an assessment questionnaire with a pairwise comparison model
- Dissemination of questionnaires (Shipyard)
- Analysis of the AHP method (Software)
- Get the weight of each alternative
- CR < 0.1

Phase 3: Choice

- Preparation of questionnaire with ordinal scale (BKI)
- Entering the weight of the AHP calculation as input
- Calculation with the best alternative with COPRAS
- Obtained the best alternative (the most suitable surveyor)
- Sensitivity analysis

Finish

Figure 1 Research design
E. Data Processing Techniques

Data processing techniques used in this study include:

1. Criteria used for the selection of surveyors

   The selection criteria used for the selection of surveyors were carried out using the Analytical Hierarchy Process (AHP). The identification of the criteria and alternatives used was carried out through an interview process with experts. Several stages that need to be done in data processing with the AHP method are (Purwohandoyo and Sadali 2016):
   a. Determine the purpose of selecting alternatives,
   b. Determine the set of criteria/sub-criteria,
   c. Determine alternative sets based on predetermined criteria and sub-criteria,
   d. Develop a hierarchical structure/decision model,
   e. Composing a paired matrix,
   f. Perform synthesis using a scale of 1-9 (fundamental scale) above,
   g. Carry out the normalization process
   h. Calculating Consistency Ratio (CR), and
   i. Sensitivity analysis.

2. Surveyor suitability level

   The surveyor’s level of conformity analysis was analyzed using the COMplex proportional assessment (COPRAS). The stages in COPRAS analysis include (Goswami dan Mitra, 2020: 31):
   a. Create an m x n. decision matrix
   b. Normalization of the decision matrix by following the linear normalization method.
   c. Create a weighted normalized decision matrix (m x n) by multiplying the criterion weights by the respective column elements.
   d. The normalized weighted values of the favorable and unfavorable criteria are added separately for each alternative.
   e. Calculate the relative significance (Qi) of each alternative.
   f. Calculate the quantitative utility of each alternative (Ui)

3. Recommendations

   Recommendations to companies are given by evaluating the selection of surveyors conducted by PT. BKI at this time. The evaluation results are then compared with the results of the study, both in terms of selecting criteria and alternatives. The results of this research are expected to be input for companies in determining surveyors according to field conditions or new shipbuilding yards.
III. RESULTS AND DISCUSSION

A. Questionnaire Configuration

Questionnaires were distributed to 30 respondents representing ten shipyards in East Java.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Criteria</th>
<th>Alternative</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveys that are by field conditions and the needs of new shipbuilders</td>
<td>Mastering Regulation</td>
<td>Survey experience</td>
<td>21 items comparison</td>
</tr>
<tr>
<td></td>
<td>Able to make the right decisions</td>
<td>Ability to interact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Able to provide consultation</td>
<td>Network</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ability to adapt to shipyards</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 shows the configuration of the AHP questionnaire. There are three criteria and four alternatives used. The resulting combination of 21 comparison items. There are three classes of shipyards. The data can be seen in Table 2.

Table 2 The three shipyard classes studied

<table>
<thead>
<tr>
<th>No</th>
<th>Shipyard Class</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B1 (Big 1)</td>
<td>Shipyards capable of building steel vessels &gt; 10,000 DWT (GT)</td>
</tr>
<tr>
<td>2</td>
<td>B2 (Big 2)</td>
<td>Shipyard capable of building steel vessels between 3,000 DWT (GT) - 10,000 DWT (GT)</td>
</tr>
<tr>
<td>3</td>
<td>B3 (Big 3)</td>
<td>Shipyards capable of building steel vessels &lt; 3,000 DWT (GT)</td>
</tr>
</tbody>
</table>

Table 2 shows the three classes of shipyards studied. First are shipyards capable of building steel vessels > 10,000 DWT (GT); both shipyards capable of building steel vessels between 3,000 DWT (GT) - 10,000 DWT (GT); and three shipyards capable of building steel vessels < 3,000 DWT (GT).

The distribution of the questionnaires was done manually, namely by distributing printed questionnaires to research respondents. The questionnaires that have been successfully collected are then recapitulated. This data is processed using the Expert Choice program.

The second questionnaire was designed to collect the data used for the COPRAS analysis. Questionnaires were distributed to 3 respondents from PT. BKI Surabaya Main Branch knows the condition of all surveyors in the company. The three respondents are senior employees in the company so they know the condition of all the surveyors being assessed.

The questionnaire used in the analysis using the COPRAS method contains seven statement items. These seven items are the sum of the three criteria items and four alternative items.
Table 3 COPRAS Questionnaire Configuration

<table>
<thead>
<tr>
<th>Objective</th>
<th>Criteria</th>
<th>Alternative</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveyors that are by field conditions and the needs of new shipbuilders</td>
<td>Mastering Regulation</td>
<td>Survey experience</td>
<td>7 statement items, 3 criteria, and 4 alternatives.</td>
</tr>
<tr>
<td></td>
<td>Able to make the right decisions</td>
<td>Ability to interact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Able to provide consultation</td>
<td>Network</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ability to adapt to shipyards</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Determination of Suitability of Assignment of Surveyors for New Building Ship Surveys at PT. BKI Surabaya Main Branch Using AHP-CORPAS

1. AHP-CORPAS at Shipyard 1

The first stage in AHP-CORPAS begins with determining the weight of each criterion obtained from the AHP process. The answers of each respondent will be converted into a pairwise comparison matrix and then combined using the geometric mean. The weight calculation at the initial stage is carried out on the surveyor selection criteria, namely: 1) Mastering regulations; 2) Able to make the right decisions; and 3) Able to provide consultation.

At the evaluation stage, the weight of the sub-criteria based on the overall criteria is known to be consistent and the weight of the results of the AHP analysis on each sub-criteria. Acceptable consistency if the CR value is not more than 0.1 (CR 10%). In the Expert Choice output, the overall consistency (CR) value is 0.07, the CR value is less than 10% (0.07 < 0.1), indicating that everything is done consistently and the weighting results are acceptable based on the consistency of the filling. The results of the weighting of the sub-criteria as a whole based on all the criteria are described in detail in Table 4.

Table 1 Weight of Sub-criteria Based on Overall Criteria (Overall Result)

<table>
<thead>
<tr>
<th>Sub-criteria</th>
<th>Criteria Weight</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey experience</td>
<td>0.380</td>
<td>1</td>
</tr>
<tr>
<td>Ability to interact</td>
<td>0.241</td>
<td>2</td>
</tr>
<tr>
<td>Network</td>
<td>0.139</td>
<td>4</td>
</tr>
<tr>
<td>Ability to adapt to shipyards</td>
<td>0.240</td>
<td>3</td>
</tr>
</tbody>
</table>

Determine the priority of sub-criteria based on all the criteria in this study at shipyard 1 using AHP shows that survey experience is considered the most important for all criteria with a weight value of 0.380. The second priority is the ability to interact with a priority weight value of 0.241. The third priority is the ability to adapt to the shipyard with a weight of 0.240.

The last priority is a network with a criterion weight of 0.139. The weight of the sub-criteria based on all these criteria will be used in the CORPAS process to select the appropriate surveyors for shipyard 1. In CORPAS the assessment of alternative surveyors will be normalized and formed into an assessment matrix.

The normalized surveyor assessment matrix will be multiplied by the weight of each sub-criteria, then a weight calculation will be carried out based on the benefits of each sub-criteria. In this study, there were no non-benefit (S-) sub-criteria, therefore S+ was only found in the AHP assessment this study. After the weight value is obtained, the relative importance (Qi) and utility (Ui) will be calculated in percentage form.
The results of the utility calculation on the CORPRAS method show that the highest utility value in shipyard 1 is found in JX surveyors with a utility of 100%. Thus, in shipyard 1, JX surveyors are surveyors who are considered the most suitable for surveying building ships at PT. BKI Main Branch Surabaya.

### 2. AHP-CORPRAS at Shipyard 2

The first stage in AHP-CORPRAS begins with determining the weight of each criterion obtained from the AHP process. The answers of each respondent will be converted into a pairwise comparison matrix and then combined using the geometric mean. The weight calculation at the initial stage is carried out on the surveyor selection criteria, namely: 1) Mastering regulations; 2) Able to make the right decisions; and 3) Able to provide consultation.

At the evaluation stage, the weight of the sub-criteria based on the overall criteria is known to be consistent and the weight of the results of the AHP analysis for each sub-criteria. Acceptable consistency if the CR value is not more than 0.1 (CR 10%). In the Expert Choice output, the overall consistency (CR) = 0.02, the CR value is less than 10% (0.02 < 0.1), indicating that everything is done consistently and the weighting results can be accepted based on the consistency of the filling. The results of the weighting of the sub-criteria as a whole based on all the criteria are described in detail in Table 5.

#### Table 2: Weight of Sub-criteria Based on Overall Criteria (Overall Result)

<table>
<thead>
<tr>
<th>Sub-criteria</th>
<th>Criteria Weight</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey experience</td>
<td>0.412</td>
<td>1</td>
</tr>
<tr>
<td>Ability to interact</td>
<td>0.232</td>
<td>2</td>
</tr>
<tr>
<td>Network</td>
<td>0.144</td>
<td>4</td>
</tr>
<tr>
<td>Ability to adapt to shipyards</td>
<td>0.213</td>
<td>3</td>
</tr>
</tbody>
</table>

Determining the priority of sub-criteria based on all the criteria in this study at Shipyard 2 using AHP shows that survey experience is considered the most important for all criteria with a weight value of 0.412. The second priority is the ability to interact with a priority weight value of 0.232. The third priority is the ability to adapt to the shipyard with a weight of 0.213. The last priority is a network with a criterion weight of 0.144. The sub-criteria weights based on all these criteria will be used in the CORPRAS process to select the appropriate surveyors for Shipyard 2.

The normalized surveyor assessment matrix in Table 4.6 will be multiplied by the weight of each sub-criterion, then a weight calculation will be carried out based on the benefits of each sub-criterion. In this study, there were no non-benefit (S-) sub-criteria, therefore S+ was only found in the AHP assessment this study. After the weight value is obtained, the relative importance (Qi) and utility (Ui) will be calculated in percentage form.

The results of the utility calculation on the CORPRAS method show that the highest utility value at Shipyard 2 is found in surveyors AX with a utility of 100%. Thus, at Shipyard 2, the AX surveyor is the surveyor who is considered the most suitable for surveying shipbuilding at PT. BKI Main Branch Surabaya.

### 3. AHP-CORPRAS at Shipyard 3

The first stage in AHP-CORPRAS begins with determining the weight of each criterion obtained from the AHP process. The answers of each respondent will be converted into a pairwise comparison matrix and then combined using the geometric mean. The weight calculation at the initial stage is carried out on the surveyor selection criteria, namely: 1) Mastering regulations; 2) Able to make the right decisions; and 3) Able to provide consultation.

At the evaluation stage, the weight of the sub-criteria based on the overall criteria is known to be consistent and the weight of the results of the AHP analysis on each sub-criteria. Acceptable consistency if the CR value is not more than 0.1 (CR 10%). In the output of Expert Choice, the overall consistency (CR) value is 0.03, the CR value is less than 10% (0.03 < 0.1), indicating that everything is done consistently and the weighting results can be accepted based on the consistency of the filling. The results of the weighting of the sub-criteria as a whole based on all the criteria are described in detail in Table 6.
Tabel 3 of Sub-criteria Based on Overall Criteria (Overall Result)

<table>
<thead>
<tr>
<th>Sub-criteria</th>
<th>Criteria Weight</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey experience</td>
<td>0.369</td>
<td>1</td>
</tr>
<tr>
<td>Ability to interact</td>
<td>0.241</td>
<td>3</td>
</tr>
<tr>
<td>Network</td>
<td>0.139</td>
<td>4</td>
</tr>
<tr>
<td>Ability to adapt to shipyards</td>
<td>0.250</td>
<td>2</td>
</tr>
</tbody>
</table>

Determining the priority of sub-criteria based on all the criteria in this study at Shipyard 3 using AHP shows that survey experience is considered the most important for all criteria with a weight value of 0.369. The second priority is the ability to adapt to shipyards with a priority weight value of 0.250. The third priority is the ability to interact with a weight of 0.241. The last priority is a network with a criterion weight of 0.139. The sub-criteria weights based on all these criteria will be used in the CORPRAS process to select the appropriate surveyors for Shipyard 3.

The normalized surveyor assessment matrix will be multiplied by the weight of each sub-criteria, then a weight calculation will be carried out based on the benefits of each sub-criteria. In this study, there were no non-benefit (S-) sub-criteria, therefore S+ was only found in the AHP assessment this study. After the weight value is obtained, the relative importance (Qi) and utility (Ui) will be calculated in percentage form.

The results of the utility calculation on the CORPRAS method show that the highest utility value at Shipyard 3 is found in JX surveyors with a utility of 100%. Thus, at Shipyard 3 the JX surveyor is the surveyor who is considered the most suitable to conduct a shipbuilding survey at PT. BKI Main Branch Surabaya.

IV. CONCLUSION

The conclusions that can be drawn in this study are:

1. The criteria that can be used to select surveyors who will conduct a survey of new shipbuilding in East Java are:
   a. Shipyard B1
      The criteria that can be used to select surveyors at shipyard B1 are:
      1) Mastering regulations with a weight of 0.394.
      2) Able to make the right decisions with a weight of 0.365.
      3) Able to provide consultation with a weight of 0.241.
   b. Shipyard B2
      The criteria that can be used to select surveyors at shipyard B2 are:
      1) Mastering regulations with a weight of 0.419.
      2) Able to make the right decisions with a weight of 0.312.
      3) Able to provide consultation with a weight of 0.269.
   c. Shipyard B3
      The criteria that can be used to select surveyors at the B3 shipyard are:
      1) Mastering regulations with a weight of 0.377.
      2) Able to make the right decisions with a weight of 0.316.
      3) Able to provide consultation with a weight of 0.307.

2. The level of conformity of the surveyors to the survey activities of new building ships at the shipbuilding shipyards in East Java are:
   a. Shipyard B1
      The highest utility value in Shipyard 1 was found in JX surveyors with a utility of 100%. Thus, at shipyard 1 the JX surveyor is the surveyor who is considered the most suitable to survey building ships at PT. BKI Main Branch Surabaya.

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b. Shipyard B2
   The highest utility value in Shipyard 2 is found in surveyor AX with a utility of 100%. Thus, at Shipyard 2, the AX surveyor is the surveyor who is considered the most suitable for surveying shipbuilding at PT. BKI Main Branch Surabaya.

c. Shipyard B3
   The highest utility value at Shipyard 3 is found in JX surveyors with a utility of 100%. Thus, at Shipyard 3 the JX surveyor is the surveyor who is considered the most suitable to conduct a shipbuilding survey at PT. BKI Main Branch Surabaya.

3. Recommendations that can be given to the company regarding the assignment of surveyors who handle surveys of new construction ships at new shipbuilding shipyards in East Java are:
   a. The company needs to evaluate the surveyor selection process that has been implemented in the company.
   b. The company already has criteria for the selection of surveyors, but the company can use the utility value generated from this study as a consideration for selecting surveyors.

Suggestions that can be given are:
1. PT. BKI Surabaya Main Branch should be able to use the results of this research as a material consideration in selecting surveyors who will be assigned to survey the new shipbuilding.
2. Other researchers can continue research in other work areas so that later it can be compared the results of research conducted in the East Java working area with other work areas.

REFERENCES