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House of Risk to Mitigate Operational Risk Strategy in Shipyards: A Case Study)

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Abstract:- This study uses the House of Risk (HoR) method in determining the dominant risk agent and operational risk mitigation measures at the Wahana Karya shipyard.Wahana Karya is a wooden shipbuilding business whose processing system is still relatively traditional due to its simple production tools and technology.This condition has an impact on the high level of risk faced during the shipbuilding production process which results in low ship quality.Wahana Karya has not considered the level of risk in the shipbuilding process starting from raw materials, manufacturing processes, to finished products, of course this will have a detrimental impact on the industry.The House of Risk method can be used to reduce operational risk because it has been widely used in various fields, including mitigating operational risk.The House of Risk uses two phases in its work process, which can be broadly called the identification phase and the mitigation phase.The results of the House of Risk mapping at the Wahana Karya shipyard, in the first phase obtained five dominant risk agents which will be taken into consideration in the preparation of mitigation actions.While the results of the second phase of House of Risk mapping obtained six risk mitigation action plans, namely routine briefings to operators, supervision and inspection of each process, direct supervision and inspection of each process, training for operators, supervision and inspection of machine components on a regular basis, and establishing relationships with other experienced shipbuilders.

Keywords:- *Shipyard, Risk, House of Risk.*

I. INTRODUCTION

The shipbuilding industry in Indonesia is currently in the development stage in increasing the number of the national shipbuilding fleet and continues to grow.Aceh Province, Indonesia is one area that has many shipbuilding businesses, especially in West Aceh, where the majority of shipyards use wood.The shipyards that are managed are classified as traditional, and the management is in the nature of fishing communities or fishing groups.The workforce in the shipyard comes from active fishermen who are experienced in traditional shipbuilding.Wahana Karya is a wooden shipbuilding business with a traditional work system because of its simple production tools and technology.This condition has an impact on the high level of risk faced during the shipbuilding production process which results in low ship quality.Until now, Wahana Karya has not paid attention to the level of risk in the shipbuilding process, starting from raw materials, manufacturing processes, to finished products.This will have an impact on business losses.

The results of initial observations through interviews with the owner of Wahana Karya regarding the job description, the process of building a ship with a capacity of three grosstons consists of twenty-five work activities.There are two work activities that require quite a long time compared to other work activities, namely the manufacture of the ship's base truss and the installation of a zinc-aluminum layer.Each work process has a level of difficulty that requires special skills and very precise shapes and sizes.Twenty-five work activity processes certainly allow the emergence of risks that occur without the worker realizing it.This can be detrimental to the place of business, especially the increase in operational costs which must be avoided. Required an analysis of risk management in the shipyard.Risk management is one of the approaches used to identify, assess and manage risk levels (Pamungkas, 2020).

House of Risk (HoR) is a risk management method that has been widely used in various fields such as supply chain risk management in manufacturing companies (Ma, 2018), operational risk (Han, 2007), operational risk in warship production (Amelia, 2017), the risk of developing beverage products (Wahyudin, 2016), risk analysis to determine the priority of crucial sectors (Katon, 2021).Basically, the HoR method uses a two-phase processing process.The first phase is to identify risks and risk agents, measure severity and incidence, and calculatevalues of aggregate risk priority (ARP).The second phase is risk management, where the selected risk agent will be determined based on the Pareto diagram which ultimately management needs to evaluate at the stage of direct action in the field. (Irawan, 2019).

The purpose of this study was to determine the dominant risk agent and operational risk mitigation measures at the Wahana Karya shipyard using the House of Risk (HoR) method.

II. RESEARCH METHOD

This research was conducted at the Wahana Karya business located in West Aceh Regency, Aceh Province, Indonesia.The type of research used is descriptive research.Descriptive research is done by examining the analysis of work and activities on an object.In this descriptive study, data collection was obtained from observation, literature study and field research in the form of interviews from confirmed sources to find out the information needed by researchers or direct observation of the actual situation in the company.The selected informants are stakeholders who have an interest, apply, and know in

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depth about the production process at Wahana Karya. The condition of the existing production process will be analyzed and recommendations for improvement are sought to increase the productivity of the production system and reduce risks in shipbuilding operations.

To answer the problem formulation regarding operational risk, data processing uses the house of risk method which consists of two phases.The explanation of the house of risk method is as follows(Pujawan, 2009).

A. *House of Risk Phase 1*

House of Risk phase 1 is used to identify risk events and risk agents that may arise so that the output of HoR phase 1 is the grouping of risk agents into priority agents according to the Aggregate Risk Potential (ARP) value.The determination of the priority risk agent category is carried out using Pareto's law or known as the 80:20 law, by focusing on the crucial 20% risk, 80% of the company's risk impact can be overcome.Then it is used to determine which risk sources are prioritized for preventive action.

B. *House of Risk Phase 2*

Phase 2 of the House of Risk will undertake the preparation of preventive actions against risk triggers (risk agents), which include several stages of work, namely,

- Calculate the total effectiveness (TEk) of each risk agent.
- Measuring the difficulty level of implementing mitigation actions (Dk) in an effort to reduce the emergence of risk agents.
- Calculating the total effectiveness to difficulty ratio (ETDk).
- Priority scale values start from the highest ETD value to the lowest.The main priority value is given to the mitigation action that has the highest ETD value.

III. RESULT AND DISCUSSION

The risk data is sourced from the literature and it is necessary to confirm to the respondents in the production division through interviews and questionnaires, then ensure that the risk event has occurred within the company.In addition, conducting interviews with the company to obtain new risk events that are not in the literature sources.Through interviews and questionnaires obtained 4 in the engineering or design planning, 4 in the purchasing department, 10 in the production process and 2 in the risk event finance section.the next stage is the identification of the causes of risk. Based on the results of interviews and confirmations, there are 20 in the engineering planning section, 19 in the purchasing department, 16 in the production process section, 10 in the finance section of risk sources or risk causes.These risk sources can be grouped into 4 risk events in each section referring to some literature (Basuki, 2012) (Fendi, 2012), (Lee, Park dan Shin, 2009) (Kurniawati dan Pribadi, 2008).

Measurement of the level of impact of a risk event on a business process states how much disruption is caused by a risk event to the business process.From the analysis results, 20 risk events were identified that have the potential to disrupt supply chain processes, which are presented in Table 1.

Code	Risk Event (E_i)	Severity
E1	Image Delay (Basic Design, Keyplan &Yardplan)	4
E2	There is a revision of the image	6
E3	Calculation of material requirements not appropriate	5
E4	Unclear determination of equipment specifications	4
E5	Material supply delay	5
E6	Long custom clearance process	4
E7	Item specifications do not match	5
E8	Incorrect material quantity	5
E9	Errors in production planning	4
E10	Inefficient process	4
E11	Production schedule delay	6
E12	Delay in receiving material from warehouse to production	5
E13	The final product is damaged	5
E14	Unable to fulfill order	4
E15	Decrease in product quality during the process	6
E16	Production can't meet the target	5
E17	Production process stopped	5
E18	Machine failure(downtime)	5
E19	Difficulty fulfilling contract requirements	6
E20	Late payments to suppliers and others	5

Table 1: Measuring the Impact Level of Risk Events

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Based on Table 1, there are six risk events that have an impact level value with a scale of four which indicates the risk posed has a small effect on the sustainability of ship production activities, ten risk events that have a scale value of five indicate the risk can have a moderate impact on the sustainability of ship production activities, and four events a risk that has an impact rating on a scale of six indicating the risk could have a serious impact on the sustainability of ship production.

Measurement of the probability value of the occurrence of a risk agent will be carried out to state the level of probability of the occurrence of a risk agent resulting in the emergence of one or more risk events that can cause disruption of business processes to a certain level. level of impact, which is presented in Table 2.

Kode	Penyebab Risiko A_j	Occurrence
A1	New ship design (prototype) or not made before	3
A2	Difficulty finding competent domestic design consultants	4
A3	Contract delay with design consultant	3
A4	The number of human resources is not sufficient compared to the number of ships built, especially the competence of human resources for piping and electricity	3
A5	Inadequate hardware and software design	3
A6	The length of the image approval process from the owner or class	3
A7	There is a request for revision from the owner regarding ship operations	3
A8	There is a change in the use of plate dimensions related to stock availability in the market	4
A9	Error due to lack of thoroughness from internal Engineering Planning and Consultants	5
A10	Delays in receiving data or image from equipment manufacturers	3
A11	Often there are changes in the stages of the production process related to field conditions	4
A12	There is a class recommendation that is late coming	3
A13	Request for revision from the production department related to field conditions	4
A14	The data or image from the equipment manufacturer do not match the actual equipment	3
A15	Don't have software to calculate material requirements yet	4
A16	No database and standard setter used	4
A17	There has been a change in material calculations related to stock availability in the market	5
A18	The technical specification data from the owner is incomplete or unclear	4
A19	Lack of coordination in determining equipment specifications from relevant departments	3
A20	Engineering planning, related production department, purchasing department and project leader	3
A21	Late submission of receipt of material request	4
A22	Long lead time from supplier	5
A23	Difficulty finding offers from suppliers and comparisons	4
A25	Late advances and supplier repayments from the finance department	4
A26	Late supplier	4
A27	Lack of supervision after the purchase order is issued	4
A28	Imported materials required are subject to prohibitions and restrictions	5
A29	Late payment of PIB from the Departement of Finance	3
A30	Hit the red line	5
A31	There must be material certification	4
A32	The length of the import licensing process is due to prohibitions and restrictions or changes to import regulations.	3
A33	Submission of material request receipts does not include clear specifications	3
A34	Lack of coordination between purchasing department and users	3
A35	Never bought the same material before	3
A36	Default supplier (the material sent does not match the specifications on the purchase order)	5
A37	Submission of receipt of material requisition stating the quantity does not match	4
A38	Subject to minimum orders from suppliers or manufacturers	4
A39	Default supplier(the material sent does not match the quantity on the purchase order)	5
A40	Lack of communication	4
A41	Calculation mismatch between layout and field conditions	4
A42	Unclear layout	5

A43	Operators are less focused and thorough	5
A44	Lack of operator monitoring of processes	3
A45	Raw material delay	5
A46	Lack of raw material availability	5
A47	Worker inaccuracies	5
A48	There is an improper process during the production process	4
A49	Damage to the heating engine	4
A50	Machine breakdown	5
A51	Limited machine capacity	3
A52	Production quality decreases	3
A53	Imbalance of number of workers with production time	3
A54	Fluctuating demand	3
A55	Lack of attention to machine maintenance	3
A56	Never had a contract with the same owner before	3
A57	There is a request for a bank guarantee with a large amount	3
A58	The length of the process of managing the issuance of Bank guarantees	3
A59	Late submission of payment requests	3
A60	Incomplete supplier payment submission data and others (purchase order/invoice/packing list/receipt of goods)	4
A61	Lack of coordination with related departments	3
A62	The length of the process for submitting a payment budget	3
A63	The length of the payment budget approval process	3
A64	Insufficient cash or bank balance	3
A65	Lack of monitoring of payment obligations or unpaid debts	4

Table 2: Measuring the Opportunity Value of Risk Causing Agents

Based on Table 2, there are sixty-five risk agents that have the potential to trigger risk events in the business.In accordance with the predetermined probability scale value, there are thirty-two risk agents with a probability value of 3 (three) indicating that the probability of a risk agent only occurs once a year, twenty risk agents with a probability value of 4 (four) indicating that the probability of the emergence of a risk agent is only once in several months of operation, and thirteen risk agents with a probability value of 5 (five) indicating that the risk agent appears once in several weeks of operation.

Measurement of the correlation value and the calculation of the value of the risk priority index (Aggregate Risk Potential / ARP) were carried out to find a relationship or correlation between a risk event and the agent causing the risk.The assessment was obtained based on the results of interviews and is explained as follows.

A. Correlation Value Measurement

The results of the correlation assessment were assessed by respondents using a scale of 0, 1, 3, and 9.The risk of delays in the production process schedule has a correlation with a new ship design (prototype) or has never been built before by 9 (high correlation).This shows that the correlation is not too large and the resulting impact is not too large.The correlation results obtained state that the emergence of risk and the causes of risk indicate that the emergence of risk needs to be calculated the magnitude of the correlation value generated by the causes of risk.

B. Calculation of the Risk Priority Index / Aggregate Risk Potential (ARP)

Calculate the ARP value using the following equation..

$$ARP_1 = 3 \times (9 \times 4) + (3 \times 5)$$

$$ARP_1 = 123$$

The ARP risk agent A1 value is 123.Likewise with the calculation of the ARP value for the next risk agent.

The selection of risk agents will use the Pareto diagram, where not all risk agents receive treatment.This is caused by several factors, namely in terms of the costs required in the handling process and the level of impact caused is considered too small. Therefore, not all risk agents are handled by the company, except for risk agents which are considered a priority.To determine the value of the priority risk agent, the cumulative percentage value of ARPj must be known first by using the following equation.

$$\%\, Cumulative\ ARP_J = \frac{Cumulative\ ARP_J}{\sum ARP} \times 100\%$$

$$= \frac{234}{1778} \times 100\% = 13\%$$

The percentage value of ARP in the first rank is 13%.The recapitulation of the ARP percentage value will be shown in Table 3 and Figure 1.

Ai	Risk Agent	ARP	%	%Cumulative
A48	There is an improper process during the production process	234	13,16	13%
A17	There has been a change in material calculations related to stock availability in the market	225	12,65	26%
A9	Error due to lack of thoroughness from internal Engineering Planning and Consultants	180	10,12	36%
A50	Machine breakdown	157	8,83	45%
A2	Difficulty finding competent domestic design consultants	144	8,10	53%

Table 3: Agent Risk Priority

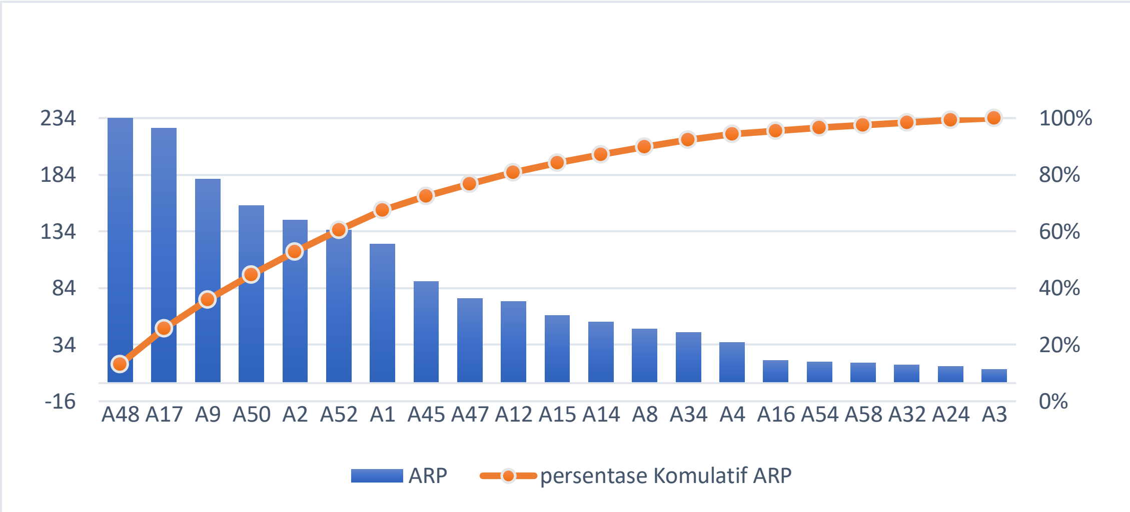

Fig. 1: Risk Agent Pareto Chart

Based on Figure 1, there are five risk causes that contribute 80% to the emergence of risk, namely A48, A17 A9, A50, A2.The cause of this risk will be taken preventive measures for the next phase.This preventive action proposal is included in the HOR 2 section, where at this phase the selected preventive action proposal is prioritized based on the ETDk value.

These risk agents will then be implemented in a phase 2 HoR model for the design of mitigation actions.Mitigation actions in question are actions to reduce the impact of risk agents before the risk occurs.Alternative mitigation actions are obtained from brainstorming.The focus of this mitigation action design is based on the selected risk agent.Alternative mitigation actions that can be taken are as shown in Table 4.

Risk Agent	Strategi (Pa)	Korelasi
There is an improper process during the production process	Regular briefing on production process operators	9
	Need supervision and inspection of every process	9
There has been a change in material calculations related to stock availability in the market	Carry out direct supervision and inspection every day	9
Error due to lack of thoroughness from internal Engineering Planning and Consultants	Regular briefing of technical planning operators and consultants	9
	Provide special training on operational processes to operators	3
Machine breakdown	Supervise and inspect machine components regularly	9
Difficulty finding competent domestic design consultants	Provide special training on operational processes to operators	9
	Establishing relationships with other experienced shipbuilders	3

Table 4: Correlation of Risk Causes with Strategy

Mitigation action mapping is carried out with the aim of seeing the effects of mitigation actions on risk agents, namely by mapping mitigation action options with selected risk agents. The first step that must be taken is to measure the correlation value between the mitigation action and the selected risk agent.The second step is to measure the level of difficulty (Dk).The purpose of this measurement is to determine the level of difficulty of implementing mitigation actions. The third step is to measure the total effectiveness, by multiplying the correlation value between the risk agent (j) and the preventive action (k). Calculation of total effectiveness aims to assess the effectiveness of mitigation actions. The fourth step is to measure the effectiveness to difficulty ratio, by dividing the total value of effectiveness (TEk) by the level of difficulty in carrying out the action.

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Weight	Information
3	Mitigation actions are easy to implement
4	Mitigation actions are a bit difficult to implement
5	Mitigation actions are difficult to implement

Table 5: Difficulty Scale (Dk)

The calculation of the effectiveness of the degree of difficulty aims to determine the priority ranking of all actions.Calculation of total effectiveness (TEk), which is to calculate the total value of effectiveness for each risk agent using the following equation.

$$TE_1 = (234 \times 9) + (180 \times 9)$$
$$TE_1 = 3726$$

The total value of effectiveness for risk agent or PA1 is 3726.The calculation of the total value of the effectiveness of the implementation of the effectiveness of the mitigation measures against the difficulty ratio (ETDk) uses the following equation.

$$ETD_1 = 3726 / 3$$
$$ETD_1 = 1242$$

The value of the effectiveness of the difficualty of ratio (ETDk) for mitigation actions on risk agents with PA1 is 1242.

Risk Agent (Aj)		Preventive Action (PAk)						(ARPj)
		PA1	PA2	PA3	PA4	PA5	PA6	
There is an improper process during the production process	A48	9	9					**234**
There has been a change in material calculations related to stock availability in the market	A17			9				**225**
Error due to lack of thoroughness from internal Engineering Planning and Consultants	A9	9			3			**180**
Machine breakdown	A50					9		**157**
Difficulty finding competent domestic design consultants	A2				9		3	**144**
Total efectiveness of action –k		**3726**	**2106**	**2025**	**1836**	**1413**	**432**	
Degree of difficulty perfoming action –k		**3**	**3**	**3**	**4**	**3**	**5**	
Effectiveness to difficulty ratio		**1242**	**702**	**675**	**459**	**471**	**86,4**	
Rank of priority		**1**	**2**	**3**	**4**	**5**	**6**	

Table 6: House of Risk Phase 2

Information:

PA1 : Regular briefing on production process operators
PA2 : Need supervision and inspection of every process
PA3 : Carry out direct supervision and inspection every day
PA4 : Provide special training on operational processes to operators
PA5 : Supervise and inspect machine components regularly
PA6 : Establishing relationships with other experienced shipbuilders

Mitigation Action	ETDk	Priority Rank
Regular briefing on production process operators	1.242	1
Need supervision and inspection of every process	702	2
Carry out direct supervision and inspection every day	675	3
Supervise and inspect machine components regularly	471	4
Provide special training on operational processes to operators	459	5
Establishing relationships with other experienced shipbuilders	86,4	6

Table 7: Mitigation Action

IV. CONCLUSSION

The results of the house of risk mapping at the WahanaKarya shipyard, in the first phase obtained five dominant risk agents which will be considered in the preparation of mitigation actions, namely A-48 (There is an improper process during the production process) with an ARP value of 234, A-17 (There has been a change in material calculations related to stock availability in the market) with an ARP value of 225, A-9 (Error due to lack of thoroughness from internal Engineering Planning and Consultants) with an ARP value of 180, dan A-50 (Machine breakdown) with an ARP value of 157, A-2 (Difficulty finding competent domestic design consultants) with an ARP value of144.The results of the risk house mapping in the second stage, obtained six risk mitigation action plans, namely PA-1 (Regular briefing on production process operators) with an ETDk value of 1.242, PA-2 (Need supervision and inspection of every process) with an ETDk value of 702, PA-3 (Carry out direct supervision and inspection every day) with an ETDk value of 675, PA-4 (Provide special training on operational processes to operators) with an ETDk value of 471, PA-5 (Supervise and inspect machine components regularly) with an ETDk value of459, dan PA-6 (Establishing relationships with other experienced shipbuilders) with an ETDk value of 86,4.

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