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Preparation of Risk Management and Root Cause Analysis in the Middle Package Palapa Ring Operation

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Abstract:- In this research will be conducted on the Preparation of Risk Management and Root Cause Analysis in the Middle Package Palapa Ring Operation. The preparation of this risk management is limited to Supervision, Maintenance, Procurement and Shipment activities. The purpose of this research is to get identification, analysis and evaluation of risks. Then, an operational problem root analysis will be carried out especially for FO Cut incident to find out the problems and program proposals for project location 5 (P5). The research was conducted using qualitative research methods based on case studies. In compiling Risk Management using the ISO 31000 framework and conducting root cause analysis using a fishbone diagram. Data collection was carried out by in-depth interviews, distributing questionnaires and Focus Group Discussions. The results at the identification stage obtained 55 risk causes. The results of the analysis showed 30 low risks, 21 medium risks, and 4 high risks. Further risk evaluation is carried out on risks that have a high-risk category. Based on the evaluation results obtained action programs that can be proposed. Then, an analysis of the root causes of the FO Cut incident was carried out using a fishbone diagram and proposed action programs were obtained to reduce the occurrence of FO Cut.

Keywords:- *Fishbone Diagram; Risk Management ISO: 31000, Palapa Ring, Supervision, Maintenance, Procurement, Shipment.*

I. INTRODUCTION

The Palapa Ring project is one of the strategic projects in the development of a national fiber optic backbone network infrastructure in the Frontier, Remote and Disadvantaged regions which aims to integrate telecommunication providers and users in Indonesia with the existing network. One part of this project is the Middle Palapa Ring which has 6 link locations. The location chosen in this study is the Project 5 (P5) area which has the highest number of customers and the highest occupancy rate compared to other locations.

In every operating company there must be risks that can have a negative impact on the company, so that managerial positions are very important and are required to be able to suppress intuition and make more use of analytical tools in reducing risks that arise due to uncertainty. [1]. According to Darmawi (2014) quoted from Dewi and Sedana (2017), risks arise due to uncertainty so that risk management is needed to be able to identify, analyze and control risks in companies so that companies are more effective and efficient. [2].

Risk management carried out during the operational period of the middle ring palapa is in supervision, maintenance, procurement and shipment activities. These activities will be analyzed for any possible risks that will arise during the project's operational period. In this project, the network becomes the main factor for the company's service level availability. Therefore the company avoids incidents of broken cables (FO Cut) so that the network can still be used by network lease operators. However, actual events during the start of the operating period, namely from 2020 to September 2022, are still occurring FO Cut which can be seen in Fig 1.

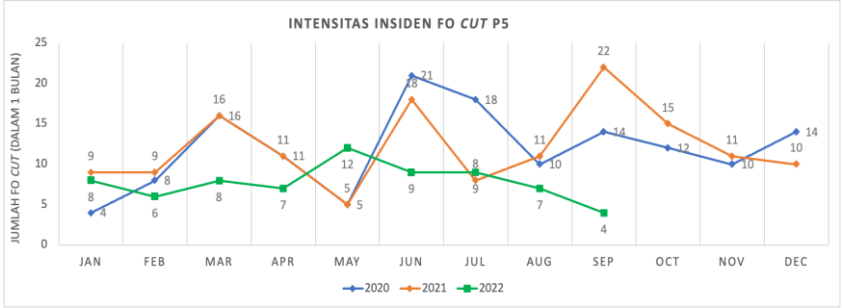

Fig. 1: Frequency FO Cut in P5 Graphic

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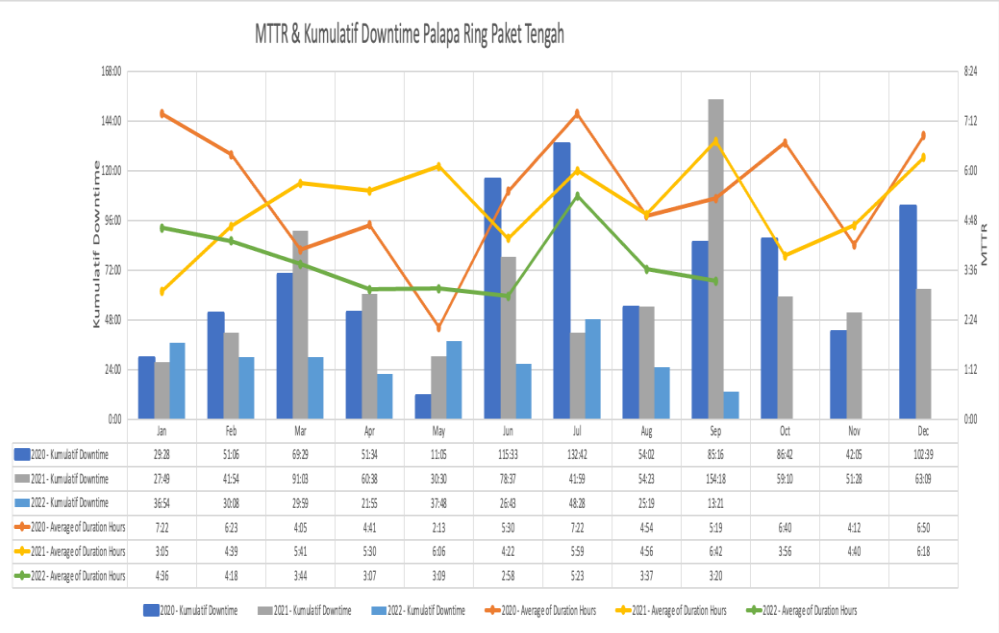
It can be seen that the total FO Cut incidents since the start of the operation period have occurred 358 incidents and have a financial impact. Apart from the financial impact, operational impacts also occur where the network experiences downtime which can be seen in Fig 2.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020 - Kumulatif Downtime	29:28	51:05	69:29	51:34	11:05	115:33	132:42	54:02	85:16	86:42	42:05	102:39
2021 - Kumulatif Downtime	27:49	41:54	91:03	60:38	30:30	78:37	41:59	54:23	154:18	59:10	51:28	63:09
2022 - Kumulatif Downtime	36:54	30:08	29:59	21:55	37:48	26:43	48:28	25:19	13:21			
2020 - Average of Duration Hours	7:22	6:23	4:05	4:41	2:13	5:30	7:22	4:54	5:19	6:40	4:12	6:50
2021 - Average of Duration Hours	3:05	4:39	5:41	5:30	6:06	4:22	5:59	4:56	6:42	3:56	4:40	6:18
2022 - Average of Duration Hours	4:36	4:18	3:44	3:07	3:09	2:58	5:23	3:37	3:20			

Fig. 2: Down Time and Mean Time To Repair Graphic

The existence of these incidents can reduce the quality of the interconnection network. So, company need to develop Risk Management to be able to avoid risks that will arise, especially in the activities of Supervision, Maintenance, Procurement and Shipment. The framework used in compiling risk management is ISO 31000. Based on this framework, there are processes that need to be carried out, especially in conducting risk assessments, such as Risk Identification, Risk Analysis and Risk Evaluation. Risk identification stage can record and identify risks that occur that may affect the company, such as risk events, risk causes and impacts. The second stage is risk analysis to assess risks based on the value of the consequences and the probability of occurrence of the risks in order to know category level of risks. The last is risk evaluation by comparing the level of risks with the criteria to see the gaps that exist so that decisions can be made in the treatment of risk [3]. Research on risk management was conducted by Pramudhita and Santoso (2022) and explained the ISO 31000 framework by Rahardian and Wijaya (2022). In the first study, the risk assessment used was based on a scale of probability and impact values which would later be mapped in the Risk Map into 3 categories namely low, moderate and high. The working process is the same as previous studies up to the proposed risk treatment, however fishbone analysis should be carried out to be able to visualize the causes of risk [4]. Then in the second study it was explained in a risk analysis using ISO 31000 obtained from various factors and assessing the likelihood and impact. By assessing this, only mad risk assessment evaluations are obtained which have a high scale so that suggestions for improvement can be given [5].

Potential risks in supervision, maintenance, procurement and shipment activities will continue to arise during the operational life of the project. Therefore, it is necessary to develop risk management to identify risk sources, risk analysis, risk evaluation and propose strategies that can be implemented to reduce risk, especially for FO Cut operational issues.

II. LITERATURE REVIEW

A. *Supervision*

Supervision is carried out to monitor whether a job is in accordance with the provisions and work plans that have been designed [6]. According to Handoko (2015) supervision must be carried out effectively which must be accurate, timely, objective, centralized, realistic, coordinated, flexible, as a guide and acceptable [7].

B. *Maintenance*

Maintenance is carried out to be able to maintain the condition of the equipment where there are 2 (two) types of maintenance which is preventive maintenance where repair activities are carried out periodically to avoid down time and corrective maintenance where repair activities if preventive activities fail and need repairs according to the level of urgency [8]

C. *Procurement*

Procurement of goods/services is a process of obtaining goods and services with the best value so that the needs of an organization can be met. In carrying out the procurement of goods/services through a 3 (three) stage process, including planning where the stage is to prepare what needs are needed. Then the preparation stage which determines how procurement is carried out. Finally, the implementation stage is the supplier selection process, the agreement contract and the handover of goods/services [9].

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D. Shipment

Shipments are made to move goods from one location to another because the production location has a different location from the location where the goods are needed. For shipment can use several modes of transportation such as by air, packages, trucks, rail, sea, pipe and multi-modal. The mode of transportation is selected according to the needs [10].

E. Risk Management

Risk Management is a way to direct or control an organization related to Risk. The risk management process based on ISO 31000 can be shown in Fig 3.

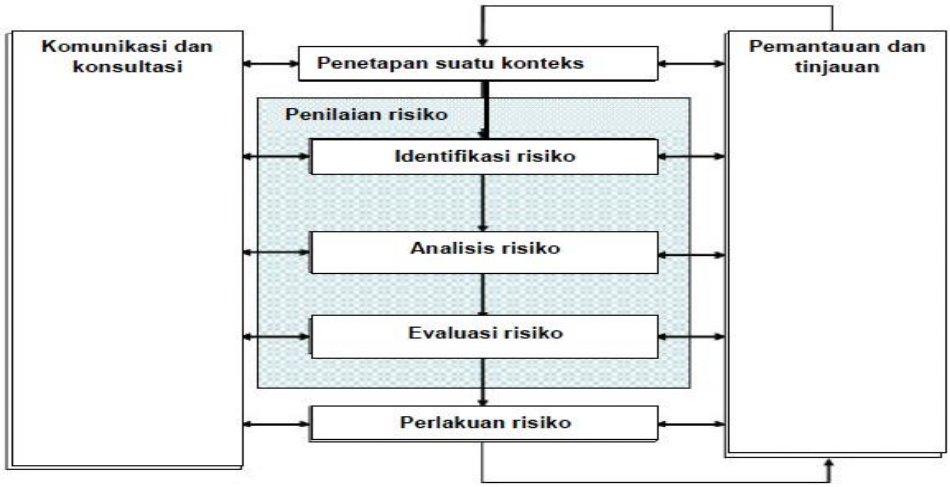

Fig. 3: Risk Management Process ISO 31000

The stages in carrying out Risk Management are setting the context, risk assessment (risk identification, risk analysis, risk evaluation) and risk treatment [11].

F. Fishbone Diagram

Fishbone diagram is an image to show a causal relationship. This diagram can find out the bad consequences in order to get corrective action proposed. "Effect" indicates characteristics that need to be improved while "Cause" to be able to provide details of common causes both from work methods, materials, people, measurement, equipment and environment shown in Fig 4 [12].

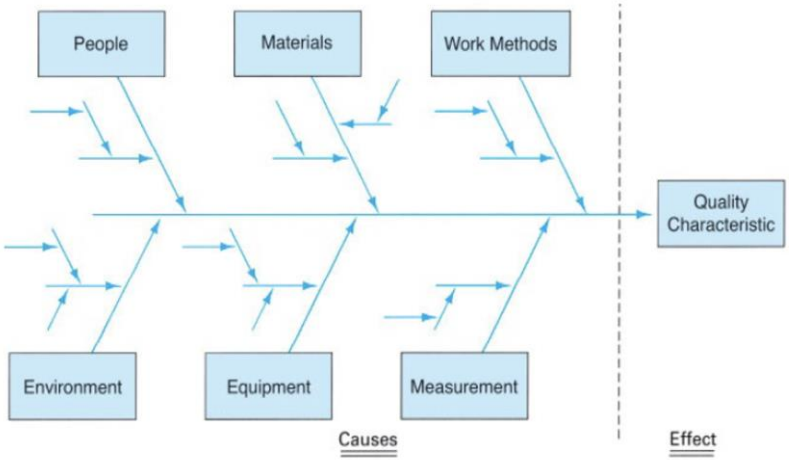

Fig. 4: Fishbone Diagram

Using a Fishbone Diagram can help to analyze existing conditions in order to improve conditions for both goods and services.

G. Framework

In the framework, there are 2 (two) stages that will be carried out by research, namely at the stage of operational risk assessment at the Middle Palapa Ring location P5 and also root cause analysis to get corrective actions which can be seen in the fig 5.

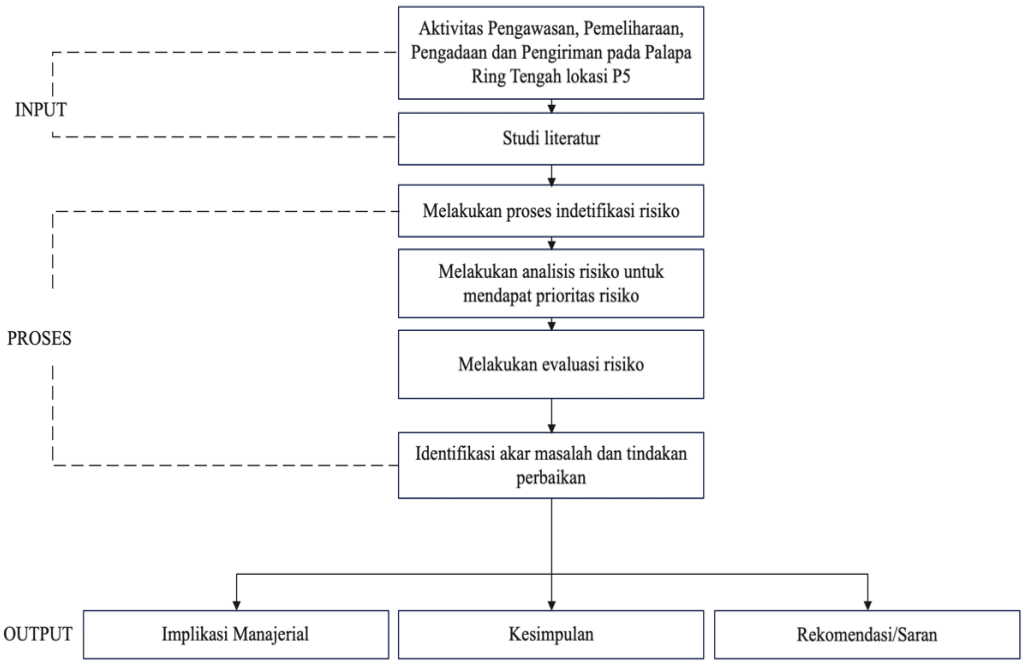

Fig. 5: Framework

In carrying out a risk assessment based on ISO 31000 where the first stage is to identify risks, at this stage it is necessary to know the objectives of each activity. From these targets, risk events and risk cause that may occur will be identified. The results of this identification can also cause negative consequences on quality (fulfillment of specifications or procedural). Then the risk analysis is carried out by giving a likelihood score and a consequence score on a scale of 1-5 to get the risk category level. Followed by a risk evaluation (for categories that have a high level that is not extreme). In addition, identification of the root causes of operational problems will be carried out to obtain corrective actions.

III. RESEARCH METHOD

This research was conducted using a qualitative method which in this study leads to the interpretation of the data obtained based on the results of the analysis [13]. As well as this research was carried out based on case studies on a phenomenon, time and certain activities so as to obtain in-depth knowledge and explanation of a phenomenon so as to produce a detailed description [14].

Qualitative research studied consists of aspects of place, actors and activities that interact synergistically. Location aspect namely the location of the P5 Project, for the aspect of actors including personnel responsible for related activities as well as aspects of activities consisting of supervision, maintenance, procurement and shipment. There were 2 key informants and 9 supporting informants in this study. Then, the sampling method used in this study used a purposive sampling technique in which the samples used were people who were believed to know the most about the topic under study.

The data collection method used in this study was by conducting in-depth interviews, distributing questionnaires and focus group discussions in order to obtain risk identification, results of risk analysis, results of risk evaluation and identification of the root causes of operational problems to obtain corrective actions.

IV. RESULT AND DISCUSSION

A. Risk Identification

In conducting risk identification aims to find, recognize and record potential risks that may occur that affect organizational goals [3]. Risk identification is carried out by conducting in-depth interviews and has been verified by Key Informant in each activity of supervision, maintenance, procurement and shipment. Based on these results, 14 risk events and 55 risk causes were obtained which can be seen in the Table I.

Table 1: Risk Identificarion (Risk Event dan Risk Cause)

Activity	Code	Risk Event	Code	Risk Cause
Supervision	R1	Non-routine patrol activities	A1	Operational vehicles cannot operate
			A2	Bad weather
			A3	HR negligence in conducting patrols
Maintenance	R2	FO Cut Incident	A4	Massive activities from other parties with heavy equipment
			A5	Vandalism
			A6	Deteriorating service life of assets and devices over network assets and devices
			A7	Force majeure
			A8	Cable repair process fault
			A9	The operational budget is limited in maintaining network quality
	R3	Service Level Availability is not met	A10	The DWDM device is off
			A11	Long repair time
			A12	Network breakdown on two different segments
			A13	Spare parts for maintenance are not available
	R4	Work space and storage shortage	A14	Collocation
			A15	Customer equipment stored in the shelter does not meet standards and specifications
			A16	Improper placement of customer equipment
	R5	Existing power supply shortage	A17	Overloaded power capacity
			A18	Decreased service life of assets and equipment to the existing power supply
Procurement	R6	Potential offers quotation above budget	A19	Miscalculation budget
			A20	Lack of HR knowledge of the latest market prices in determining the budget
			A21	Scarcity of raw materials
			A22	High exchange rates
	R7	Delays in the Request for Quotation Process	A23	Sudden demand for goods/services
			A24	There was no response from the prospective supplier of goods/services
			A25	Limited supplier of goods/services
	R8	Delays in the Technical and Commercial Meeting Clarification Process	A26	Lack of HR knowledge of the technical goods/services to be procured
			A27	Incomplete technical information on technical documents
			A28	The commercial offer of the goods/services supplier is not in accordance with the requirements
			A29	The techniques provided are not in accordance with the requirements
	R9	Delay in determining the winner bidding	A30	Inappropriate selection of goods/services supplier
			A31	There are no supplier of goods/services that fulfill technical and commercial requirements
	R10	Delay in PO/Agreement release	A32	Goods/service supplier cannot fulfill the provisions in the PO/Agreement
			A33	Technical document approval takes a long time
			A34	PO/Agreement approval takes a long time
	R11	Delay in the production of goods/services	A35	Supplier factory overload
			A36	Lack of raw materials
			A37	Supplier factory cannot operate
	R12	The results of the goods/ services are not in accordance with the Terms of Reference	A38	Bad performance supplier
			A39	Material quality that does not match the request
			A40	Changes in specifications and scope of work
			A41	Extra/less work
Shipment	R13	Delay during shipment	A42	Late delivery order issued

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Activity	Code	Risk Event	Code	Risk Cause
			A43	Incorrect pick-up location
			A44	Incorrect location Drop off goods
			A45	Lack of availability of containers
			A46	Vehicle damaged
			A47	Bad weather
			A48	Bad road
			A49	Communication with logistics is not good
			A50	Restrictions on delivery vehicles on major holidays
			A51	The lack of availability of shipping schedules via sea or air
			A52	Communication with consignees is difficult because destination is a blank spot area
	R14	Inappropriate goods arrived	A53	Thievery
			A54	Mishandling of loading/unloading of goods
			A55	Accident during delivery

One of the previous studies discussed marine patrol supervision activities carried out in Jakarta. There are 23 identified risks where these risks are combined with shipment activities [15]. However, the results of risk identification in this study based on in-dept interviews and verification have 3 risk causes, namely operational vehicles not being able to operate, bad weather conditions, and HR negligence in conducting patrols. There are differences in the number of risks due to different areas of supervision so there are differences in risks.

Furthermore, in the analysis results of Simanjuntak & Sitepu (2018) discussing risk analysis in maintenance activities in irrigation construction, there are 16 identified risks [16]. Whereas in this study, based on the results of in-depth interviews conducted on maintenance activities, 15 identified risk causes were identified based on actual conditions at the site.

In the procurement activities carried out by Kurniawan & Hariadi (2022) 22 risks were identified which would be continued at the analysis stage. The results of in-depth interviews conducted for procurement activities in this study identified 4 risk events and 23 risk [17]. The identification of these 7 risk events is based on events that affect the target. Sequentially R6 has 4 risk causes, R7 has 3 risk causes where that is, R8 has 4 risk causes, R9 has 2 risk causes, R10 has 3 risk causes, R11 has 3 risk causes and R12 has 4 risk causes. These results are obtained based on the experience that has been experienced by key informants due to internal and external factors of the company, both rare and recurring events.

In the shipment activity studied by Saputra & Perdana (2020), there were 17 risk events and 28 risk causes in the goods delivery process where the companies identified were companies engaged in the freight forwarding sector [18]. In this study, based on the results of in-depth interviews conducted for shipment activities, 2 risk events and 14 risk causes were obtained. The number of risk events and risk causes with previous research is because the industry is focused on shipping goods and working in the shipping sector. So that the identification of risk events and risk causes will increase. In this study, R13 has 11 risk causes and R14 has 3 risk causes where these risks are obtained based on the experiences that have been experienced by key informants.

Thus, it can be concluded that in overall supervision, maintenance, procurement and shipment activities, 14 risk events and 55 risk causes were identified, consisting of 3 risk causes in supervision activities, 15 risk causes in maintenance activities, 23 risk causes in procurement activities and 14 risks cause. Furthermore, this risk will be analyzed to find out how much the level of risk that is owned.

B. Risk Analysis

Analysis is carried out to be able to determine the consequences and likelihood of each risk occurring before making a decision [3]. Risk analysis which is carried out by providing a numerical assessment of the likelihood and consequences so as to get the result of how big the level of risk is. The scale values obtained based on the results of discussions with key informants can be seen in Table II and Table III.

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Table 2: Description Likelihood Scale

Scale	Description
Likelihood (L)	
1	Almost impossible Likelihood of occurrence ≤ 1 time in 1 month
2	Chances of it happening are small Likely to happen 2-3 times in 1 month
3	Might happen Possibility of occurrence 4-8 times in 1 month
4	likely to happen Possibility of occurrence 8-16 times in 1 month
5	Almost certain to happen Likely to occur > 16 times in 1 month

Table 3: Keterangan Skala Penilaian Consequences

Scale	Description	
Consequence (C)	**Financial Impact**	**Performance Impact**
1	Very little financial impact < IDR 10 million per event	Performance target achievement 100%
2	Small to moderate financial impact IDR 10 million to IDR 50 million per event	Performance targets achievement above 80% to 100%
3	Moderate to large financial impact IDR 50 million to 150 million per event	Performance targets achievement above 50% to 80%
4	Big financial impact IDR 150 million to IDR 300 million each event	Performance targets achievement above 25% to 50%
5	Huge financial impact of more than IDR 300 million each event	Performance targets achievement < 25%

The method used to obtain likelihood and consequence values is through the distribution of questionnaires and Focus Group Discussion (FGD). FGDs were carried out for the process of triangulating data sources as validation on qualitative data so as to obtain data that was mutually agreed upon in a forum. The results of the likelihood and consequence assessment obtained can be seen in Table IV.

Table 4: Risk Analysis

Code	*L*	*C*	*RR*	Level	Code	*L*	*C*	*RR*	Level
A1	1	3	3	L	A29	2	4	8	M
A2	2	3	6	M	A30	1	3	3	L
A3	3	3	9	H	A31	1	3	3	L
A4	3	3	9	H	A32	1	4	4	M
A5	1	3	3	L	A33	2	2	4	M
A6	1	3	3	L	A34	3	2	6	M
A7	1	4	4	M	A35	1	2	2	L
A8	1	3	3	L	A36	1	2	2	L
A9	2	3	6	M	A37	1	2	2	L
A10	1	3	3	L	A38	2	3	6	M
A11	1	3	3	L	A39	1	3	3	L
A12	1	3	3	L	A40	2	3	6	M
A13	1	3	3	L	A41	2	3	6	M
A14	1	1	1	L	A42	1	1	1	L
A15	2	2	4	M	A43	1	1	1	L
A16	1	1	1	L	A44	1	2	2	L
A17	1	2	2	L	A45	1	2	2	L
A18	2	3	6	M	A46	1	2	2	L
A19	2	3	6	M	A47	2	2	4	M
A20	3	3	9	H	A48	2	2	4	M
A21	1	3	3	L	A49	1	2	2	L
A22	2	3	6	M	A50	1	2	2	L
A23	1	4	4	M	A51	2	2	4	M
A24	1	2	2	L	A52	2	2	4	M
A25	1	3	3	L	A53	1	3	3	L

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Code	*L*	*C*	*RR*	Level	Code	*L*	*C*	*RR*	Level
A26	4	4	16	H	A54	1	3	3	L
A27	2	4	8	M	A55	1	2	2	L
A28	2	2	4	M					

Based on the results of the assessment of the likelihood and consequences scale, mapping will be carried out with a 5x5 risk matrix to clearly see the categories for each risk which can be seen in Fig.6. From figure belowed can be concluded that there are 30 risks in the low-risk category, 21 risks in the medium risk category and 4 risks in the high risk category. Furthermore, a risk evaluation will be carried out to obtain a proposed program that is only focused on risks that are in the high-risk category.

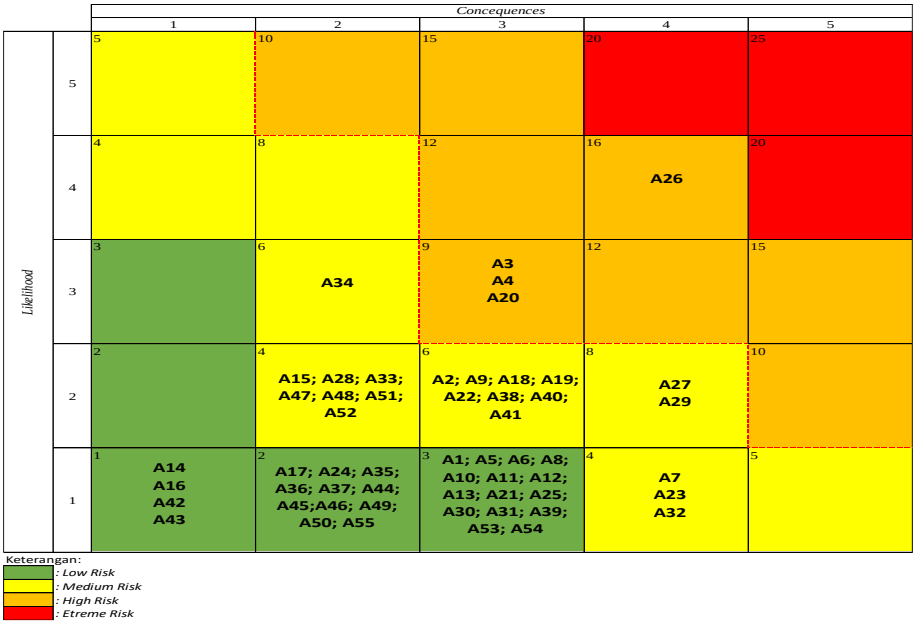

Fig. 6: Matrix Risiko

C. Risk Evaluation

Risk evaluation is carried out to be able to see the level of difference between the standard values of likelihood and consequences and the actual risk assessment. In addition, risk evaluation is a stage for obtaining decisions in handling which aims to reduce risk [3]. At the risk evaluation stage, it was carried out using the FGD method which was attended by key informants. Based on the FGD, the results of the risk evaluation assessment that must be achieved by the company are in accordance with Table V.

Table 5: Risk Evaluation

Code	*L*	*C*	*RR*	Level	Program Proposed
A26	2	4	8	M	Recruit human resources who have knowledge in technical evaluation of goods/services
A3	1	3	3	L	Collaborate with suppliers to design and develop existing applications to be able to monitor and track regional patrols such as road routes and patrol duration.
A4	1	3	3	L	1. Jumper temporary to avoid FO Cut with self-management; 2. Handing over to the supplier in providing tracking devices on heavy equipment and developing existing applications to be able to see the position of heavy equipment
A20	2	3	6	M	Recruit human resources who are experienced in determining budgets who understand market prices

Based on the table above, the expected assessment results for Risk A26 are expected to be in the medium risk category with a likelihood scale of 2 and consequences 4, Risks A3 and A4 are in the low-risk category with a likelihood scale of 1 and Consequences 3, while Risk A20 is expected to be in the medium risk with a scale of likelihood of 2 and consequences of 3. To achieve the results of the assessment, it is necessary to develop a proposed program as follows:

- *Recruit human resources who have knowledge in technical evaluation of goods/services*

Recruiting HR who already have qualified technical knowledge of goods/services is required. In the existing conditions, HR currently does not have in-depth knowledge, especially if there are technical changes (such as cable modifications for regional repair needs) as well as the need for tools/measuring instruments that have various types and

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features that are more advanced than the tools/measuring instruments that have been used so far in regionals.

- *Collaborate with suppliers to design and develop existing applications to be able to monitor and track regional patrols such as road routes and patrol duration.*

Currently there is an existing application for information related to Palapa Ring information related to incident information, regional document reporting. By designing and developing existing applications such as adding a GPS supervision menu so that HR can be monitored and tracked in the region. This is done to make it easier for the Head Office to check the validity of HR whether the supervision carried out is in accordance with company standards (both from the supervision route and the duration of the supervision time). In designing and developing the application it is submitted to the supplier to realize the system.

- *Jumper Temporary to avoid FO Cut with self-management*

Jumper Temporary are made to avoid FO cuts, which are handled by self-management in making temporary jumpers so that the cables are not exposed to heavy equipment activities such as being damaged by ground scouring.

- *Handing over to the supplier in providing tracking devices on heavy equipment and developing existing applications to be able to see the position of heavy equipment.*

The existing condition that occurs in the region is the uncertainty of the start time and duration of work carried out by outsiders when using heavy equipment located close to cable network positions. In dealing with these conditions, the risk needs to be overcome by installing a tracking device that is installed on the heavy equipment so that HR knows the location and can monitor with the application or go directly to the location to ensure that public works do not damage and approach the cable path.

- *Recruit human resources who have knowledge in determining budgets who understand market prices*

In the existing condition, HR currently determines the budget only on a historical basis without sourcing market prices. In determining the budget, there are many things to consider, such as the increase in exchange rates and prices. So that by recruiting competent human resources will facilitate the preparation of the budget for the procurement of goods/services

D. Root cause analysis of FO Cut incidents

This study also conducted a Root Cause analysis on the FO cut incident. Root cause analysis or commonly known as Fishbone Diagram analysis is used to determine the impact (effect) that exists in order to find out the cause (cause) as well as a way to take corrective action. The causes described can be in the form of work methods, materials, measurements, people and environment. In getting the explanation of the cause is done by brainstorming in the Forum Group Discussion. With FGDs, key informants can convey several causes that result in risks and actions that need to be taken. Using a fishbone diagram is useful for analyzing actual conditions, eliminating cause conditions, standardizing operations as well as education and training for human resources [12].

One of the journals that discusses root cause analysis was carried out by Sutawijaya & Marlapa (2016), the initial stage was carried out by conducting interviews with selected informants and analyzing using fishbone diagrams so that the results obtained were root causes of problems derived from methods, tools and humans [19]. In addition, there are other studies that discuss the causes of the FO cut, based on the results of research conducted by Hayford-Acquah & Asante in 2017 discussing the root causes of the FO cut incident in Ghana and identified 6 root causes of the FO cut with a total of 3 years. (2014-2016) as many as 849 with a total network of 5,000 kilometers [20]. In this study, according to Figure 1 over the past 3 years (2020-2022) there have been 358 incidents with a total network of 634 kilometers. In addition to conducting a Risk Management Analysis, this study will also carry out a Root Cause analysis of the FO Cut incident through Focus Group Discussions. The results of the FGD will be presented in the form of a fishbone diagram in the Fig 7.

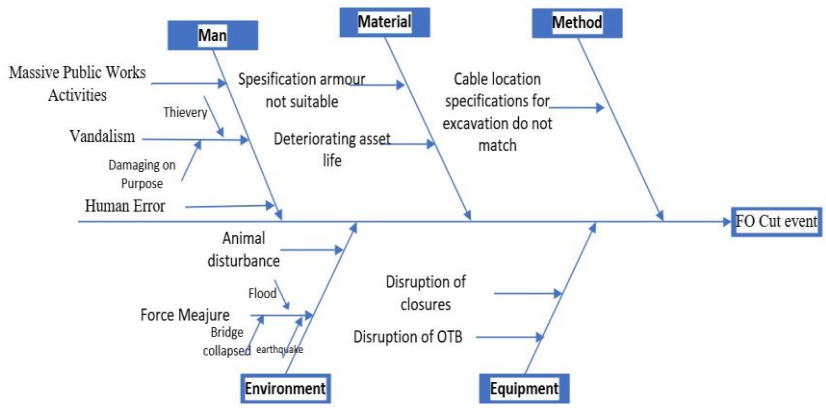

Fig. 7: Matrix Risiko

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Based on the results of the fishbone diagram, there are 8 proposed programs, among others.

- Transfer to supplier in providing device tracking on heavy equipment and developing existing applications to be able to see the position of heavy equipment when work starts
- The existing condition that occurs in the region is the uncertainty of the start time and duration of work carried out by outsiders when using heavy equipment located close to cable network positions. In dealing with these conditions, the risk needs to be overcome by installing a tracking device that is installed on the heavy equipment so that HR knows the location and can monitor with the application or go directly to the location to ensure that public works do not damage and approach the cable path.
- Jumper temporary to avoid FO Cut with self-management
- Jumper temporary jumpers are carried out to avoid FO cuts, which are handled by self-management in making temporary jumpers so that the cable is not exposed to heavy equipment activities such as being damaged by ground scouring
- Updating the Standard Operating Procedures (SOP) and Work Instructions (IK) as well as conducting HR socialization in the region
- With the latest proposed program, it is necessary to update the SOPs and IKs and conduct socialization for HR in the region so that they can carry out work according to the SOPs and IKs that have been set by the company
- Carry out inspections and social approaches to the surrounding area
- Carrying out inspections from one time to another as well as a social approach to the surrounding area can help network security in order to reduce the frequency of vandalism.
- Conduct training for HR
- This HR training is carried out especially in the repair process, this is done so that the repair process is correct and does not experience errors by damaging other cable networks that are still functioning
- Evaluate cable specifications and change cable specifications needed to be produced by suppliers
- With the disturbance of animals such as rodents and the presence of natural conditions that can appear suddenly, strengthening the armor on the cable core is needed to reduce the ease with which the cable is disconnected. This can be done by evaluating and testing or testing cables with suppliers
- Create a QA team to monitor the feasibility of materials and equipment
- There is no existing condition supervision related to the function of materials and other equipment that is still suitable for use. With the QA can check each period and provide replacement suggestions if needed
- Provide a cable locator to ensure the position of the cable so that excavation errors do not occur
- The existing condition of the cable map path is sometimes different from reality, therefore by providing a cable locator it can detect the position of the cable before any excavation activity from outsiders.

V. CONCLUSION

In this study, it was concluded that based on the results of risk identification, 55 risk causes were obtained, including 3 from supervision activities, 15 from maintenance activities, 23 from procurement activities and 14 from shipment activities. Then proceed with risk analysis and get 30 risk causes in the low-risk category, namely in codes A1, A5, A6, A8, A10, A11, A12, A13, A14, A16, A17, A21, A24, A25, A30, A31, A35, A36, A37, A39, A42, A45, A46, A49, A50, A53, A54 and A55. Then, there are 21 risk causes in the medium risk category consisting of codes A2, A7, A9, A15, A18, A19, A22, A23, A27, A28, A29, A32, A33, A34, A38, A40, A41, A47, A48, A51 and A52. Furthermore, there are 4 risk causes in the high-risk category consisting of codes A3, A4, A20 and A26. Then there is no risk cause that is in the extreme risk category. Finally, the risk evaluation was carried out at risk codes A3, A4, A20 and A26 were based on expert judgment, the expected assessments included A3 and A4 are in the low-risk category while A20 and A26 are in the medium risk category. Proposed programs were obtained based on the results of FGDs using fishbone diagram analysis in which 5 proposed programs were obtained consisting of 1 proposed maintenance program, 2 proposed supervision programs and 2 proposed procurement programs.

Root cause analysis in operations was also carried out especially for the FO cut incident. The root cause analysis was carried out using a fishbone diagram and 11 root causes were found. Based on the root of the problem, there are 8 proposed improvement programs for FO cut operational problems that can be applied by the company.

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