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PERFORMANCE ANALYSIS AND RESPONSE TIME OPTIMIZATION FOR FIBER CUT HANDLING THROUGH A PROACTIVE MONITORING WEBSITE TO IMPROVE NETWORK OPERATIONAL EFFICIENCY

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ABSTRACT

This study focuses on analyzing the performance and optimizing the response time in handling fiber cut disruptions using a proactive website monitoring system to improve network operational efficiency. Fiber optic networks are critical infrastructure in telecommunication services; however, frequent fiber cut incidents can disrupt connectivity and affect service quality. The research employs a quantitative approach with descriptive and comparative analysis to evaluate the effectiveness of proactive monitoring systems. Data from fiber cut incidents in Kalimantan, covering periods before (September–October) and after (November–December) proactive monitoring implementation, were analyzed. Results indicate a significant improvement in operational efficiency, achieving 72.77% efficiency, primarily due to a reduction in response time by 70.83%. However, the resolution time increased by 33.70%, attributed to factors such as team adaptation, complexity of incidents, and external conditions like weather. The Root Cause Analysis (RCA) identified primary disruption causes: multiple cuts, animal interference, government activity, and vandalism. The proactive monitoring system significantly enhanced the detection and response to incidents, demonstrating its potential as a critical tool in network management.

KEYWORDS *Fiber Cut, Response Time, Proactive Monitoring, Operational Efficiency, Root Cause Analysis*

INTRODUCTION

In today's era of digital transformation, the growing long-distance transmission network offers higher speed and capacity facilities when compared to previous technologies. The current telecommunication network infrastructure has several small parts that are interconnected to achieve the purpose of information exchange where fiber optic is present as the medium of introduction (Nunggu &

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Nurhidayanti, 2023). Fiber optics are the main focus of a highly reliable type of internet network service, according to a report from the International Telecommunication Union (Martin, 2021), Fiber optic networks are one of the communication building media that is quite critical in many agencies (Kumala & Putra, 2024) Fiber optics are the main backbone component for various media providers of telecommunication and data services. The use of fiber optic cables is able to increase the speed of data communication and allow resistance to interference (Rojabi, 2024) However, in its implementation, there are often incidents of breaking or disconnecting the fiber optic cable (fiber cut), which is caused by various factors including natural factors and human daily activities that can cause significant disruption to the telecommunication service provider media (Fauzi, 2022). This kind of fiber cut incident can result in the loss of internet and communication network connectivity and can have a negative impact on various fields that depend on digital telecommunication network infrastructure (Xu & Yuan, 2023). To overcome this challenge, the need for the implementation of proactive monitoring technology is very curiose and important, the proactive monitoring system is able to enable early detection of potential fiber cut disturbances, so that response steps and resolutions can be taken that can be carried out more quickly and efficiently in handling the fiber cut.

There are many steps to improve the effectiveness of fiber optic handling (Perdana et al., 2022) In the context of network management, the need to calculate response time and resolution time is the main component that cannot be ignored, especially when faced with fiber cut interference. Response time refers to the time it takes to respond to a disturbance after it is detected, while resolution time is the time it takes to resolve the disturbance. These two components play an important role in maintaining service quality and user satisfaction. Research shows that the reduction of response time can significantly improve operational efficiency and reduce the adverse impact of network disruptions. Broadly speaking, fiber optic is inseparable from various obstacles and also existing challenges that greatly affect the process and performance of fiber optic, one of which is fiber cut (Zheng et al., 2020). Fiber cut transmission disruption can cause serious problems and must be addressed immediately (Darussalam et al., 2024)

Operational challenges that often occur in network management can include delays in responding to and resolving outages. This delay process often occurs due to various internal and external factors (Lestari, 2020). The impact of these delays can result in the loss of company revenue and a decrease in user satisfaction. When the consumption time required in a network management situation can result in a decrease in operational efficiency, in addition, the importance of automation in fiber optic network management is needed to reduce response time and improve the reliability of communication networks (Herrera et al., 2021). Research by Qian et al, shows that the formation of modeling and simulation can help in understanding the impact of network disruptions on transportation systems and emergency response (Qian et al., 2022). Therefore, it is important to consider the local context when designing a monitoring system and response to fiber cut interference (Bricheno et al., 2024).

This research focuses on performance analysis and response time optimization in handling fiber cuts through proactive website monitoring technology to improve network operational efficiency. The purpose of this study is to analyze the performance of handling fiber cut incidents through a proactive network monitoring website and identify factors that affect fiber cut and response time in handling fiber cut and also provide further recommendations for optimizing response time in the fiber cut handling process so that the incident handling process can be overcome faster and better.

RESEARCH METHOD

This type of research is included in quantitative research with descriptive and comparative analysis approaches to compare the results before and after using the implementation of proactive monitoring. Quantitative research is a type of research in which in the process and implementation of the research uses a lot of numbers in it, starting from the process of collecting data and then interpreting it to the results or drawing conclusions (Machali, 2021).

Quantitative research is included in a series of research analysis where in the process it contains calculations using numerical numbers in it (Veronica et al., 2022). Research that uses the quantitative method in it means research that has fulfilled a scientific rule that is concrete, objective, rational and systematic. The Quantitative Method is often called the discovery method, because using this method allows the acquisition of new findings and developments as research data in the form of numbers and statistical analysis.

Research with quantitative methods with descriptive and comparative approaches is aimed at finding facts with appropriate and comparative interpretation is a method used to find out whether there is a difference between the two variables used (Syahrizal & Jailani, 2023). Because of these things, the researcher feels that it is suitable for quantitative research with a descriptive and comparative analysis approach, where the purpose of this study is to obtain network operational efficiency in handling fiber cuts so that they can be resolved more quickly and properly when fiber cuts occur through proactive monitoring websites.

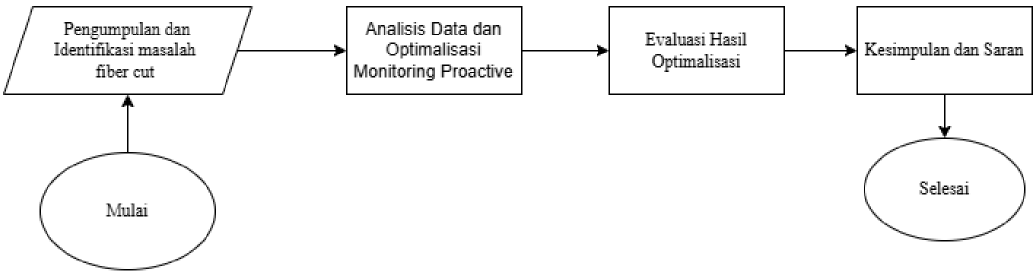

Figure 1. Research Flow Chart

a. Step 1. Start: This study began with the presence of fiber cut disturbances detected through the proactive monitoring website.
b. Step 2. Collection and identification of fiber cut problems: The first step is to collect data on fiber cut disturbances that occur specifically in the island area of Kalimantan. This data includes the start time of the disturbance, the time of completion of handling, the location of the disturbance and the cause of the disturbance starting from September-October (before the implementation of the proactive monitoring website) and November-December (after the implementation of the proactive monitoring website). This process aims to understand the main causes of the slow response time process in the Kalimantan island area and the impact that occurs on the performance of the operational network on the island of Kalimantan.
c. Step 3. Data Analysis and Proactive Monitoring Optimization: The fiber cut data that has been collected is analyzed to evaluate the performance of response time for handling disturbances before and after optimization. This proactive monitoring system is designed to detect disturbances early and speed up the process of identifying the location of disturbances and improve coordination in handling.
d. Step 4. Evaluation of Optimization Results: After the implementation of proactive monitoring, an evaluation of the optimization results was carried out specifically on the island of Kalimantan. Evaluation parameters include, response time: Is the time to handle disturbances faster than the data before optimization? And Operational Efficiency obtained from reducing network downtime and its impact on operational services on the island of Kalimantan. The results were compared with the preliminary data to determine the extent to which proactive monitoring succeeded in improving the operational efficiency of the network on the island of Kalimantan.
e. Step 5. Conclusions and suggestions: At this stage, the main results of the research that have been researched are summarized such as improving the response time of handling fiber cuts on the island of Kalimantan and its impact on improving network operational efficiency. Suggestions are given for further implementation.
f. Step 6. Completed: The research was completed and conclusions were obtained from the results of network operational efficiency after the implementation of proactive monitoring in handling fiber cuts.

The author searched for and collected historical data on fiber cut incidents that had occurred before and after the implementation of the proactive monitoring website in the Kalimantan island area during the period of September-October 2024 (Before the implementation) and November-December 2024 (After the implementation). This research applies several technological instrumentation used, namely using a proactive website monitoring (Proactive FLP) which is a website-based platform that functions to monitor the network in real-time, in addition to that this proactive monitoring website is able to detect fiber cut interference and generate ticket requests (TR).

In the process of handling fiber cuts on fiber optics, a fiber doctor is used which functions to diagnose the condition of the fiber optic network and is able to determine the prediction of the location of the fiber cut (cut point) if needed by the field team. In addition, OTDR is also used. OTDR (Optical Time Domain Reflectometer), functions to obtain real-time fiber cut point detection by manually tracing optical fibers(Fauziah, 2024). In this study, Data instruments and Measurement Instruments are also used.

In the data instrument uses Log TR (Ticket Request) which includes the time of creation, handling and resolution of the disturbance. Root Cause Analysis, is the cause of the disturbance in the fiber cut. In the measurement instrument to get the response time, the following formula is used:

$$\textit{Response Time} = \textit{Dispatch Time} - \textit{Start Time} \qquad (1)$$

Description: D is patch Time = Start time of fiber cut handling Start Time = Alarm time when fiber cut occurs

Furthermore, to calculate the resolution time, the following formula is used:

$$\textit{Resolution Time} = \textit{Resolve Time} - \textit{Dispatch Time} \qquad (2)$$

Remarks: Resolve Time = Completion Time of Fiber Cut handling Dispatch Time = Start time of Fiber Cut handling

Then to calculate operational efficiency, the following formula is used:

$$\text{Efisiensi Operasional} = \frac{\textit{Response Time Sebelum Optimalisasi} - \textit{Response Time Setelah Optimalisasi}}{\textit{Response Time Sebelum Optimalisasi}}\, x\ 100$$

Description: Response Time Before Optimization = Total Time generated from response time before optimization during the period of September-October 2024Response Time After Optimization = Total Time generated from response time after optimization during the period of November-December 2024.

RESULT AND DISCUSSION

In this section, the results of research obtained from data analysis regarding response time and resolution time before and after the implementation of the proactive website monitoring system are presented. In this study, an analysis was carried out to evaluate the improvement of network operational efficiency, especially in handling fiber cut incidents. The results of this study are displayed by comparing network performance before and after optimization, accompanied by calculations of network operational efficiency. Before entering into the results, the following is a presentation of fiber cut data during the period of September-October (Before Optimization) and November-December (After Optimization) (XL Axiata Dashboard Fiber Optic W50, 2024).

Table 1. Fiber Cut Historical Data from proactive monitoring websites

It	TR Ticket ID	Source Tower ID	Vendors	Month	Severity	Start Time	Dispatch Time	Resolve Time	Root Cause Analysis
1.	TR-20240930-00000016	KAL-KB-SAG-0777	TBG	Sep 24	P1	2024-09-29 20:31:58	30/09/2024 01:23	30/09/2024 05:22	Vandalism
2.	TR-20240929-00000347	KAL-KB-STG-0575	EBTEL	Sep 24	P1	2024-09-29 15:11:00	29/09/2024 18:01	29/09/2024 23:39	Closure/Adapter Broken
3.	TR-20240925-00000406	KAL-KB-SAG-0777	TBG	Sep 24	P1	2024-09-2516:46:22	25/09/2024 17:33	25/09/2024 19:45	Vandalism
4.	TR-20240923-00000329	KAL-KT-TML-0250-KAL-KT-TML-0252	EBTEL	Sep 24	P1	2024-09-2316:50:31	23/09/2024 17:08	24/09/2024 17:56	Hit by Vehicle
5.	TR-20240917-00000176	KAL-KB-KTP-0029-KAL-KB-KTP-0633	INDOSAT	Sep 24	P1	2024-09-1711:39:04	17/09/2024 12:06	17/09/2024 13:46	Hit by Vehicle
6.	TR-20240917-00000104	KAL-KI-TGT-0383	EBTEL	Sep 24	P1	2024-09-1709:26:06	17/09/2024 09:39	17/09/2024 17:22	Bitten by Animal
7.	TR-20240917-00000102	KAL-KI-TGT-0382	EBTEL	Sep 24	P1	2024-09-1709:26:06	17/09/2024 09:35	17/09/2024 17:28	Bitten by Animal
8.	TR-20240913-00000324	KAL-KI-TRG-0437	EBTEL	Sep 24	P1	2024-09-1314:33:05	13/09/2024 14:54	13/09/2024 16:14	Gov Activity
9.	TR-20240913-00000323	KAL-KI-SMR-0509	EBTEL	Sep 24	P1	2024-09-1314:33:05	13/09/2024 14:51	13/09/2024 16:12	Gov Activity
10	TR-20240913-00000251	KAL-KI-TRG-0510-KAL-KI-TRG-0467	EBTEL	Sep 24	P1	2024-09-1313:15:27	13/09/2024 13:22	13/09/2024 16:18	Gov Activity
11	TR-20240909-00000184	KAL-KT-TML-0250-KAL-KS-AMT-0010	EBTEL	Sep 24	P1	2024-09-0910:44:06	09/09/2024 11:04	09/09/2024 13:02	Hit by Vehicle
12	TR-20240903-00000131	KAL-KI-TRG-0344-KAL-KI-SGT-0238	EBTEL	Sep 24	P1	2024-09-0309:26:28	03/09/2024 09:41	03/09/2024 14:03	Vandalism
13	TR-20240901-00000137	KAL-KT-TML-0252-KAL-KT-BNT-0244	EBTEL	Sep 24	P1	2024-09-0111:23:12	01/09/2024 11:37	01/09/2024 17:56	Closure/Adapter Broken
14	TR-20240901-00000012	KAL-KT-TML-0252-KAL-KT-BNT-0244	EBTEL	Sep 24	P1	2024-09-0100:29:04	01/09/2024 00:44	01/09/2024 03:58	Bitten by Animal

15	TR-20241026-00000325	KAL-KI-BPP-0057	TBG	Oct 24	P1	2024-10-2617:42:04	26/10/2024 18:54	27/10/2024 00:34	Hit by Vehicle
16	TR-20241026-00000324	KAL-KI-BPP-0057	TBG	Oct 24	P1	2024-10-26 17:42:04	26/10/2024 18:51	27/10/2024 00:34	Hit by Vehicle
17	TR-20241022-00000491	KAL-KB-SAG-0489	TBG	Oct 24	P1	2024-10-22 17:39:08	22/10/2024 21:53	22/10/2024 22:03	Bending or Bad Core
18	TR-20241022-00000410	KAL-KB-SAG-0186	TBG	Oct 24	P1	2024-10-2217:39:08	22/10/2024 17:50	23/10/2024 00:32	Vandalism
19	TR-20241020-00000090	KAL-KB-SAG-0777	TBG	Oct 24	P1	2024-10-2007:01:04	20/10/2024 08:46	20/10/2024 12:40	Closure/Adapter Broken
20	TR-20241005-00000137	KAL-KI-SMR-0509	EBTEL	Oct 24	P1	2024-10-0509:09:04	05/10/2024 09:18	05/10/2024 12:00	Gov Activity
21	TR-20241130-00000290	KAL-KB-SAG-0184	TBG	Nov 24	P1	2024-11-3012:13:05	30/11/2024 12:27	30/11/2024 15:30	Vandalism
22	TR-20241126-00000085	KAL-KI-TRG-0440	EBTEL	Nov 24	P1	2024-11-2606:17:03	26/11/2024 06:42	26/11/2024 12:54	Vandalism
23	TR-20241126-00000083	KAL-KI-SMR-0711	EBTEL	Nov 24	P1	2024-11-26 06:17:03	26/11/2024 06:36	26/11/2024 08:53	Vandalism
24	TR-20241125-00000376	KAL-KS-BJM-0148	TBG	Nov 24	P1	2024-11-2514:37:55	25/11/2024 14:59	25/11/2024 19:16	Bitten by animal
25	TR-20241125-00000372	KAL-KS-BJM-0148	TBG	Nov 24	P1	2024-11-2514:37:55	25/11/2024 14:55	27/11/2024 01:16	Vandalism
26	TR-20241122-00000509	KAL-KT-KLK-0506-KAL-KT-BNT-0237	EBTEL	Nov 24	P1	2024-11-2217:30:04	22/11/2024 17:50	22/11/2024 18:40	Closure/Adapter Broken
27	TR-20241122-00000384	KAL-KT-TML-0246	EBTEL	Nov 24	P1	2024-11-2213:31:00	22/11/2024 13:57	22/11/2024 16:43	Multiple Cut
28	TR-20241122-00000380	KAL-KT-TML-0254	EBTEL	Nov 24	P1	2024-11-2213:31:00	22/11/2024 13:50	22/11/2024 16:07	Multiple Cut
29	TR-20241115-00000071	KAL-KS-PLI-0504	TBG	Nov 24	P1	2024-11-1503:57:06	15/11/2024 04:50	15/11/2024 17:27	Hit By Vehicle
30	TR-20241115-00000068	KAL-KS-MO-0246	TBG	Nov 24	P1	2024-11-1503:57:06	15/11/2024 04:20	15/11/2024 16:35	Tree fallen
31	TR-20241115-00000067	KAL-KS-MO-0250	TBG	Nov 24	P1	2024-11-1503:57:06	15/11/2024 04:17	15/11/2024 16:34	Tree fallen
32	TR-20241106-00000468	KAL-KS-TJG-0567	EBTEL	Nov 24	P1	2024-11-0617:59:04	06/11/2024 18:13	07/11/2024 08:23	Bitten by Animal
33	TR-20241104-00000421	KAL-KT-TML-0250	EBTEL	Nov 24	P1	2024-11-0415:37:06	04/11/2024 15:59	04/11/2024 22:23	Multiple Cut
34	TR-20241103-00003023	KAL-KT-TML-0250	EBTEL	Nov 24	P1	2024-11-0310:13:05	03/11/2024 10:25	03/11/2024 12:31	Bitten by Animal

35	TR-20241102-00000226	KAL-KB-SAG-0184	TBG	Nov 24	P1	2024-11-0212:23:05	02/11/2024 12:43	02/11/2024 16:00	Vandalism
36	TR-20241102-00000225	KAL-KB-SAG-0477	TBG	Nov 24	P1	2024-11-0212:23:05	02/11/2024 12:41	02/11/2024 23:29	Multiple Cut
37	TR-20241204-00000129	KAL-KB-KTP-0635-KAL-KB-KTP-0632	INDOSAT	Dec 24	P1	2024-12-0408:06:07	04/12/2024 08:16	04/12/2024 10:52	Closure/Adapter Broken

Judging from table 1 above, it is fiber cut data for a period of 4 months. For formulas used to get response time and resolution time, formulas (1) and (2) can be used. The results of response time and resolution time before optimization are obtained, the following results are obtained:

Table 2. Response time and resolution time results before optimization

It	Ticket	Vendors	Month	Response Time	Resolution Time
1	TR-20240930-00000016	TBG	Sep 24	04:51	03:58:11
2	TR-20240929-00000347	EBTEL	Sep 24	02:50	05:37:36
3	TR-20240925-00000406	TBG	Sep 24	00:46	02:11:54
4	TR-20240923-00000329	EBTEL	Sep 24	00:18	00:48:09
5	TR-20240917-00000176	INDOSAT	Sep 24	00:27	01:39:43
6	TR-20240917-00000104	EBTEL	Sep 24	00:12	07:43:25
7	TR-20240917-00000102	EBTEL	Sep 24	00:09	07:53:23
8	TR-20240913-00000324	EBTEL	Sep 24	00:21	01:19:55
9	TR-20240913-00000323	EBTEL	Sep 24	00:18	01:20:09
10	TR-20240913-00000251	EBTEL	Sep 24	00:07	02:56:00
11	TR-20240909-00000184	EBTEL	Sep 24	00:20	01:57:46
12	TR-20240903-00000131	EBTEL	Sep 24	00:14	04:21:47
13	TR-20240901-00000137	EBTEL	Sep 24	00:14	06:19:01
14	TR-20240901-00000012	EBTEL	Sep 24	00:15	03:14:00
15	TR-20241026-00000325	TBG	Oct 24	01:12	05:40:17
16	TR-20241026-00000324	TBG	Oct 24	01:09	05:42:43
17	TR-20241022-00000491	TBG	Oct 24	04:14	00:10:27

18	TR-20241022-00000410	TBG	Oct 24	00:11	06:41:32
19	TR-20241020-00000090	TBG	Oct 24	01:45	03:53:17
20	TR-20241005-00000137	EBTEL	Oct 24	00:09	02:41:50
Total				20 hours 2 minutes	76 Hours 30 Minutes 3 Seconds

The results above are the results of the Response Time and Resolution time before optimization, if the total response time before optimization is 20 Hours 2 Minutes, and for the resolution time is 76 Hours 30 Minutes 3 seconds.

Next is the result of response time and resolution time after optimization

Table 3. Response time and resolution time results after optimization

It	Ticket	Vendors	Month	Response Time	Resolution Time
1	TR-20241130-00000290	TBG	Nov 24	00:14	03:02:44
2	TR-20241126-00000085	EBTEL	Nov 24	00:25	06:12:00
3	TR-20241126-00000083	EBTEL	Nov 24	00:19	02:17:35
4	TR-20241125-00000376	TBG	Nov 24	00:21	04:16:53
5	TR-20241125-00000372	TBG	Nov 24	00:17	10:20:27
6	TR-20241122-00000509	EBTEL	Nov 24	00:20	00:49:52
7	TR-20241122-00000384	EBTEL	Nov 24	00:26	02:46:10
8	TR-20241122-00000380	EBTEL	Nov 24	00:19	02:16:57
9	TR-20241115-00000071	TBG	Nov 24	00:53	12:36:50
10	TR-20241115-00000068	TBG	Nov 24	00:23	12:14:35
11	TR-20241115-00000067	TBG	Nov 24	00:19	12:16:55
12	TR-20241106-00000468	EBTEL	Nov 24	00:14	14:10:13
13	TR-20241104-00000421	EBTEL	Nov 24	00:21	06:24:00
14	TR-20241103-00003023	EBTEL	Nov 24	00:11	02:06:00
15	TR-20241102-00000226	TBG	Nov 24	00:20	03:16:06
16	TR-20241102-00000225	TBG	Nov 24	00:18	10:47:29

17	TR-20241204-00000129	INDOSAT	Dec 24	00:10	02:36:40
Total				5 Hours 50 Minutes	102 Hours 6 Minutes 26 Seconds.

The results above are the result of response time and resolution time after optimization. If totaled, the response time after optimization is 05 Hours 50 Minutes, and the resolution time is 102 Hours 6 Minutes 26 Seconds.

The following is a comparison table of the results before and after optimization

Table 4. Comparison of results before and after optimization

Indicators	Before Optimization	After Optimization	Change (%)
Response Time	20 hours 2 minutes	05 Hours 50 Minutes	70.83%
Resolution Time	76 Hours 30 Minutes 3 Seconds	102 hours 6 minutes 26 seconds	-33.70%

From the results above, it is shown that the change in response time before and after optimization has a change of 70.83%, while for the resolution time the result is -33.70%. This means that the time to solve problems after the implementation of this proactive website monitoring increases, and this is due to several factors including:

a. The process of adaptation, The new implementation of this technology is accompanied by adaptation, during this adaptation process allows the field team to take time to understand the new
b. More complex types of interference, After optimization, it is possible that the disruption handled by the team may be more complex than before (e.g. interference in the main cable, backbone with a wider impact) it will have a longer handling impact that the team is working on
c. Weather factors, heavy rains/floods/other natural disasters greatly affect and can slow down the repair time even though the monitoring system is optimal.

To further understand the main causes that affect the interference in the handling of fiber cuts, an analysis based on Root Cause Analysis (RCA) data logs is needed. The data provides an overview of the factors that affect the occurrence of fiber cuts and are more often triggers for disruptions, both from a technical and operational perspective. The following is shown a graph that presents the distribution of the main causes of disturbances in fiber cuts.

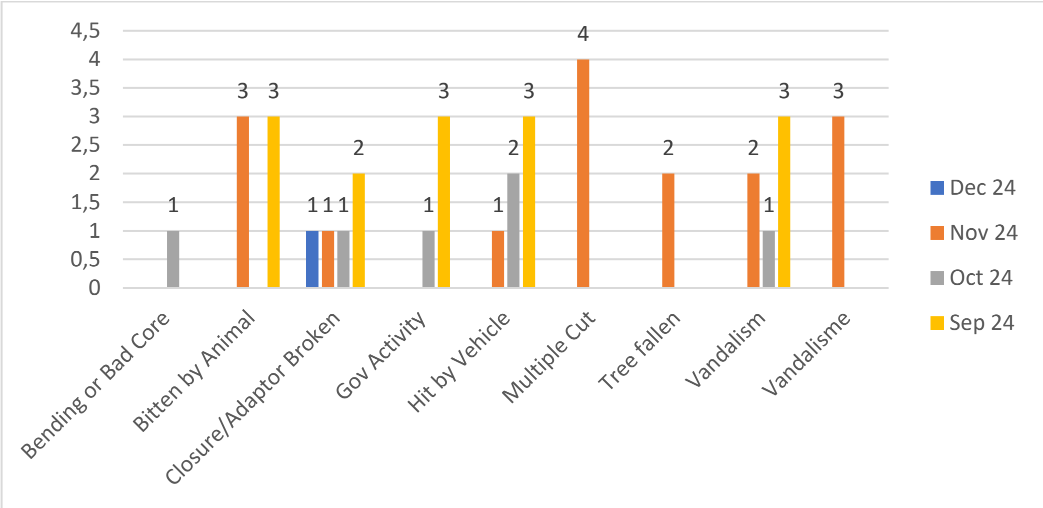

Figure 2. Root Cause Analysis Graph

From the graph above, it can be seen that the main causes of fiber cut transmission disruption are dominated by Multiple cut, Bitten By Animal, Government Activity, Hit By Vehicle and Vandalism. This shows that the Root Cause Analysis or the cause of fiber cut transmission disruption greatly affects the Resolution Time because a longer handling process is needed to handle the fiber cut and is also an important concern for coordination with the field team in handling this fiber cut interference. In addition, several other factors such as Bending or Bad Core, Closure/Adapter Broken and Tree Fallen also contribute to one of the causes of the disorder, although it can be seen in a smaller percentage.

After understanding and being able to identify the main cause of fiber cut interference through Root Cause Analysis (RCA) analysis, the author then calculates the operational efficiency of the network with the formula:

$$\text{Efisiensi Operasional} = \frac{20{,}2 - 05{,}50}{20{,}2} x\ 100 = 72{,}77\%$$

A value of 20.2 is the total time (hours) obtained from the total response time before optimization and a value of 05.50 is the total time (hours) obtained from the total response time after optimization. After calculating using the existing formula, the total network operational efficiency is 72.77%. These results show that there is a significant improvement in network performance.

CONCLUSION

This study shows that the implementation of a proactive monitoring system has succeeded in significantly improving network operational efficiency, with an efficiency level of 72.77%. This increase was mainly due to a 70.83% reduction in response time, which accelerated the process of identifying and responding to fiber cut interference. These findings confirm that the application of more sophisticated monitoring technology directly has a positive impact on network performance. However, even though the response time has improved, the resolution time has actually increased by -33.70%, which indicates that there are obstacles in resolving the problem. Factors that affect the improvement in resolution time include the team's adaptation process to new technologies, the complexity of the disruption such as damage to the main or backbone cables, as well as external factors such as inclement weather and hard-to-reach fault locations.

Root Cause Analysis (RCA) identified that the main causes of fiber cuts come from multiple cuts, animal bites, government activities, vehicle collisions, and vandalism. Other factors such as closure/adapter damage, fallen trees, and bending or bad cores also contribute to a smaller amount. Understanding these main causes is key to faster mitigation and handling efforts. The implementation of a proactive monitoring system also improves coordination between the Network Operation Center (NOC) and the field team, allowing for more accurate identification of the location of the disturbance. Supporting technologies such as Optical Time Domain Reflectometer (OTDR) and Fiber Doctor play an important role in real-time fault detection, although a specific approach is still needed in solving fiber cut problems.

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