International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 652-662

Analysis Of Turnaround Time Delays In C-Check Of Airbus 330 Aircraft Using Root Cause Analysis Method

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Abstract—Turnaround Time (TAT) refers to the time required to perform aircraft maintenance. Delays in TAT can result in significant losses for companies and disrupt flight schedules. This issue occurred during the C-Check of Airbus 330 aircraft at PT. XYZ from 2019 to 2023, where a TAT deviation of 67.21% was observed. The purpose of this study is to identify the factors and root causes of these delays and propose improvements to minimize TAT delays. The method used is Root Cause Analysis, including Pareto Diagram, Fishbone Analysis, 5 Whys, and 5W+1H. The study results indicate that the main causes are nill stock material (46.34%), late findings (36.59%), robbing activity (12.20%), and tool availability (4.88%). The major contributors, nill stock material and late findings, accounted for 82.93% of the delays. The root causes include insufficient double checks, lack of manpower, long lead times, complacency, inadequate facilities, and limited funds. Suggested improvements include training for planners and technicians, strict supervision and double-checking, prioritization of fund allocation, forecasting, and RFQ for material needs..

Keywords— Turnaround Time, C-Check, Root Cause Analysis, Airbus 330

I. Introduction

The rapid development during globalization has led to an increasing demand for air transportation, particularly aircraft, in line with population growth, urbanization, and global connectivity [1]. Directorate General of Civil Aviation (Indonesia) recorded that the number of domestic and international air passengers across all airports in Indonesia continued to rise from 2020 to 2023, reaching 246.98 million [2]. Given the large number of passengers, it is essential to maintain aircraft in safe and airworthy conditions to ensure the safety and security of flights.

To ensure safety and security, an aircraft maintenance program is required, as outlined in Undang No.1 Tahun 2009 (Indonesia) Pasal 46 Ayat (1) dan (2). This law stipulates that anyone operating an aircraft must maintain it and establish a maintenance program approved by the Minister to ensure ongoing reliability and airworthiness. Aircraft maintenance can only be performed by organizations with an approved maintenance organization (AMO) certificate, as specified in Undang-Undang No.1 Tahun 2009 (Indonesia) Pasal 47 Ayat (1). Aircraft maintenance is a crucial aspect of aviation, as it involves activities essential for keeping aircraft in a condition that ensures their continued airworthiness [3].

PT. XYZ is a major company in aircraft maintenance capable of performing various types of aircraft maintenance, including C-Check, D-Check, and others, all scheduled within a TAT. Turnaround Time (TAT) is the time frame required from the start of maintenance work until the entire process is completed [4]. At PT. XYZ, deviations frequently occur, with many aircraft maintenance tasks, particularly C-Check, experiencing delays from the scheduled TAT. C-Check is a more intensive maintenance than A Check, conducted every 18 to 24 months and lasting approximately one to three weeks [5]. During C-Check, the aircraft

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is grounded for several weeks and cannot be included in the revenue schedule or the forecasted revenue list [6]. Data from 2019 to 2023 shows 41 instances of TAT delays, leading to losses for the company due to unmet operating profit targets caused by discrepancies between planned and actual material and manhours, as well as penalties due to TAT delays.

Trenggonowati [4] identified that the primary factors causing TAT delays include lack of manpower, material shortages, and late findings. Ayu and Edi [7] found that the causes of TAT delays during C Check for B737NG aircraft were discrepancies between the amount of work and available manpower, empty material stock, and numerous findings. Susanto and Aziz [8] identified that delays in turnaround time for CRJ1000 aircraft component pooling were due to errors in handling components.

II. Research Method

This study employs a qualitative approach using literature review, observation, interviews, and Focus Group Discussions (FGD). The literature review involves analyzing relevant sources such as books, articles, and documents to obtain necessary data [9]. In this case, the literature review includes analyzing TAT data for Airbus aircraft and Post Project Review data from 2019 to 2023. The observation conducted is moderate participatory observation, where the researcher participates in the observed phenomenon to a certain extent without full involvement [10]. Unstructured interviews are conducted with the Project Leader for Airbus 330 aircraft. The Focus Group Discussions (FGD) include discussions with the Project Manager, Project Leader, PPC, Engineer, and Technicians for Airbus 330 aircraft.

Data analysis is conducted using Root Cause Analysis (RCA), a method that provides significant contributions by offering a systematic and analytical understanding of the root problems. This enables the company to make informed decisions to address the issues [11]. In general, Root Cause Analysis (RCA) is a qualitative research analysis approach that involves constructing empirical, logical, and ethical meanings by detailing arguments and 3 interpretations of the phenomenon under investigation (De Fretes, 2022). This approach allows an analyst to focus attention on the specific causes that trigger the observed [12]. The approaches used in RCA include Pareto Diagram, Fishbone Diagram, 5 Whys, and 5W+1H [13].

The Pareto Diagram is used to identify and prioritize major quality issues from the most significant to the least significant [14]. The principle known as the 80/20 rule states that when the line reaches 80% or more, it indicates that the factors summed represent 20% of the causes [15]. The Fishbone Diagram illustrates various causal factors of a specific event or occurrence [13]. The Fishbone Diagram, also known as the Ishikawa Diagram, presents a structure resembling a fishbone with the head facing right, representing the effects and causes of a problem. The effect or outcome is recorded at the head, while the bones of the fish contain the causes organized according to the problem-solving approach [16]. The 5 Whys method helps identify the true root cause of a problem, rather than just conclusions drawn from other factors [17]. The 5W+1H approach is useful in formulating improvement proposals in research [18].

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III. Result and Discussion

Pareto Analysis

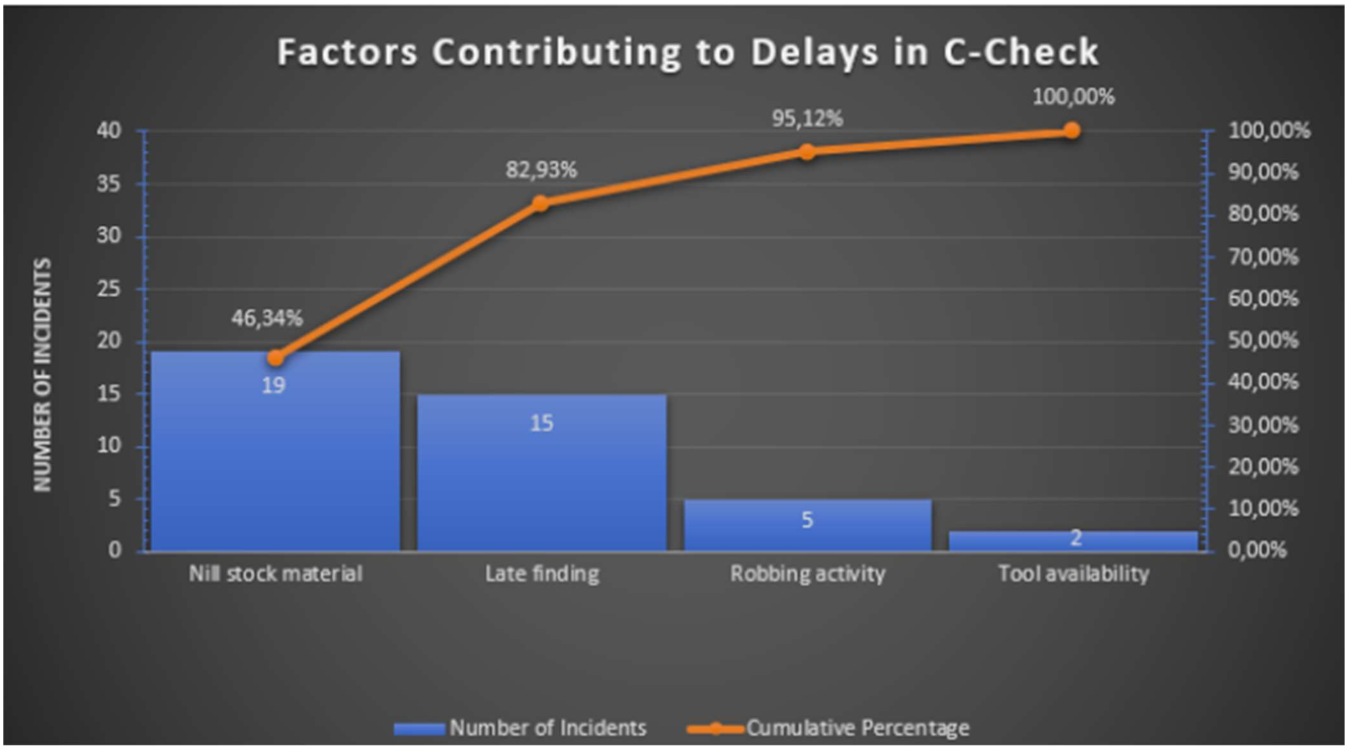

Fig 1. Result of pareto analysis

Figure 1 shows that the causes of TAT delays include nill stock material (46.34%), late findings (36.59%), robbing activity (12.19%), and tool availability (4.88%). The most significant issues causing delays in turnaround time are nill stock material with 19 occurrences (46.34%) and late findings with 15 occurrences (36.59%). According to the Pareto Diagram principle, the factors with the highest percentages are the most critical issues to address. Therefore, the two primary factors will be analyzed using Fishbone Analysis to identify the root causes of nill stock material and late findings.

Fishbone Analysis

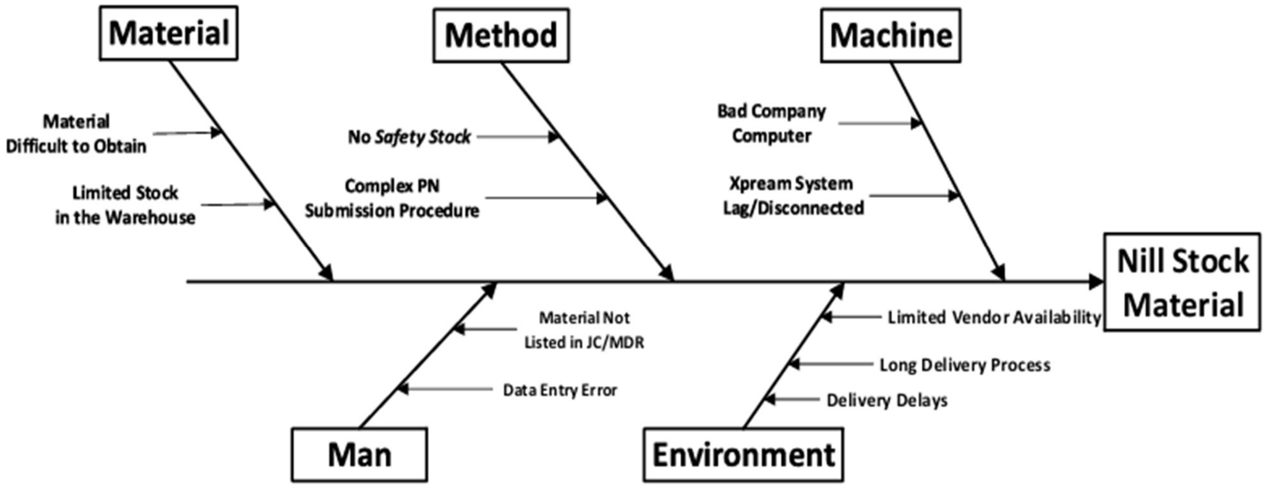

Fig 2. Results of the Fishbone Analysis for Nil Stock Material

Figure 2 reveals the causes of nill stock material. From the material perspective, the issues are difficulties in obtaining materials and limited warehouse stock. Method-related problems include the absence of safety stock and a complex process for requesting part numbers (PN). Machine-related causes involve slow company computers and the Xpream system. Human factors include materials not listed on jobcards or maintenance discrepancies, along with errors during data input. Environmental factors contributing to the issue are vendor limitations, lengthy shipping processes, and delays in delivery.

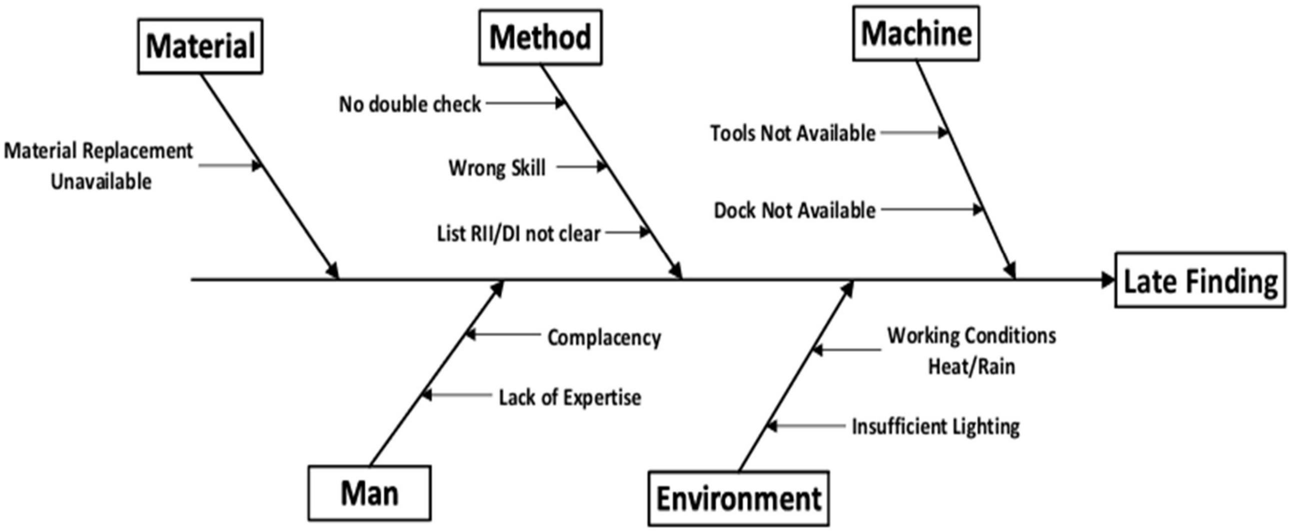

Fig 3. Results of the Fishbone Analysis for Late Finding

Figure 3 illustrates the causes of late findings. Material-related factors include the unavailability of replacement parts. Method-related issues involve the lack of double-check procedures, inspections that do not match expertise, and unclear RII/DI lists. Machine-related causes include equipment malfunctions, prolonged borrowing of tools, and insufficient dock availability for maintenance. Human factors are characterized by complacency and a lack of expertise. Environmental factors contributing to the issue are adverse weather conditions, such as rain during work, and inadequate lighting.

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5 Whys Analysis

In Figures 2 and 3, the causes of nill stock material and late findings were identified using Fishbone Analysis. Subsequently, the analysis was extended using the 5 Whys method to determine the root causes of these issues.

TABLE I. RESULTS OF THE 5WHY ANALYSIS FOR NILL STOCK MATERIAL

4M + 1 E	No	*Why*	*Why*	*Why*	*Why*	*Why*
Man	1.1	Materials not listed on the JC/MDR	Insufficient Planning	Lack of Understanding	Lack of Experience	Failure to Conduct Supervision/ Double Check
	1.2	Data Entry Errors	Lack of Attention to Detail	Accumulation of Work	Delayed Tasks	Insufficient Personnel
Method	2.1	No *safety stock*	*Material rotable/ repairable*	*Material Pooling*	High Material Costs	*Just in time material system*
	2.2	Complicated Part Number Procurement	PN Placard Not Available	AML Not Inputted	Slow Reporting Process	Requests Must Be Sent via Email to Various Units
Material	3.1	Difficult-to-Obtain Material	Dependence on a single resource	Limited raw materials	Raw materials are hard to source	*Long lead time*
	3.2	Stock Limitations in Warehouse	No stock replacements	No purchasing	No *budget*	Delayed customer payments
Machine	4.1	Company Computer Bad/Lag	Excessive data	Limited capacity	Outdated specifications	No upgrades yet
	4.2	Slow Xpream system	Weak internet connection	Excessive number of users	Limited internet access	Restricted range
Environment	5.1	Vendor Limitations	Block by vendor	Outstanding payment	Delayed Credit note	Late customer payments
	5.2	Slow material shipping	Packaging damage during shipping	Non-compliant packaging	Materials shipped as Dangerous Goods items	Non-compliance with DG item SOP
	5.3	Shipping Delays	Slow packaging process	*Part oversize*	Delivery via cargo aircraft	Limited cargo flights to CGK (Jakarta)

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Table 1 summarizes the root causes of nil stock material. From the perspective of manpower, issues include inadequate supervisor oversight, lack of double-checks leading to missing materials on jobcards (JC) or maintenance discrepancy reports (MDR), and insufficient personnel causing work delays. Method-related problems involve the just-in-time system and the complex part number request process requiring multiple unit coordination. Material issues are due to long lead times and delayed customer payments, which hinder new stock procurement. Machine-related challenges include outdated computers and restricted internet access affecting the Xpream application. Environmental factors include delayed customer payments, non compliance with shipping SOPs for dangerous goods, and limited cargo plane availability for material transport.

TABLE II. RESULTS OF THE 5WHY ANALYSIS FOR LATE FINDING

4M + 1 E	No	*Why*	*Why*	*Why*	*Why*	*Why*
Man	1.1	Complacency	Feels most senior	Feels most skilled	Underestimates work	Does not follow AMM
	1.2	Lack of Skill	Insufficient training	Hesitant to perform inspections/findings	No guidance available	New employees
Method	2.1	Failure to Double Check	No oversight	Inspector workload overload	Shortage of inspectors	Few inspectors
	2.2	Inspections not according to expertise	JC not aligned	No double check from Planner	Failure to update work to customer	Assumes JC is correct
	2.3	RII/DI list unclear	Not in finding review JC	Inspector does not receive latest list	No information from Planner	No updates to customer
Material	3.1	Replacement Material Unavailable	Warehouse stock empty	Hold shipment	Material awaiting payment	No budget allocation
Machine	4.1	Unavailable Tools	Minimal/ damaged tools	Slow tool addition	Still in search process	Tool becoming a worldwide issue
	4.2	No dock	No hangar slot	Hangar slot full	Slot used by other aircraft	Domino effect of maintenance delays
Environment	5.1	Rainy/hot weather during work	Unpredictable weather	No hangar slot	Maintenance Schedule Not Well-Managed	Poor maintenance schedule management
	5.2	Lighting Issues	Inadequate lighting	Aircraft outside hangar	No hangar slot	Limited hangar capacity

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Table 2 identifies the root causes of late findings across various factors, from the man perspective, the root causes are failure to adhere to Aircraft Maintenance Manuals (AMM) and a lack of expertise due to the presence of new employees. Method-related issues include an insufficient number of inspectors for overseeing and double-checking inspections, planners assuming jobcards are accurate or up-to-date, and a lack of communication with customers by planners. For material factors, the root cause is the absence of allocated funds for material purchases. Machine issues are related to a global shortage of tools, which results in a domino effect of maintenance delays and reduced effectiveness. Lastly, environmental factors include ineffective maintenance scheduling management and limited hangar capacity.

5W+1H Analysis

TABLE III. RESULTS OF THE 5W+1H ANALYSIS FOR NILL STOCK MATERIAL

4M + 1 E	No	*What*	*Why*	*How*	*Who*	*When*	*Where*
Man	1.1	Materials not listed on the JC/MDR	Failure to Conduct Supervision/ Double Check	Inspect jobcards before they are sent to the production team by quality control	Planner	Before starting each maintenance project	TBS Room
	1.2	Data Entry Errors	Insufficient Personnel	Provide training and hire additional personnel	Planner	Before peak periods or during low season and conduct recurrent training every 24 months	TBS Room
Method	2.1	No safety stock	Just in time material system	Implement forecasting for better planning	Planner/ PL	Periodically, such as quarterly or semi-annually	Samsat Room
	2.2	Complicated Part Number Procurement	Requests Must Be Sent via Email to Various Units	Develop new procedures for requesting part numbers	Engineering	As soon as possible and implement it at the beginning of the month	Engineering Room
Material	3.1	Difficult-to-Obtain Material	Long lead time	Implement forecasting for better planning	Planner/ project leader	Every quarter or before each long-term planning	Samsat Room
	3.2	Stock Limitations in Warehouse	Delayed customer payments	Create a priority scale for fund usage and establish payment regulations	Project Leader	At the beginning of the fiscal year or during budget planning	Samsat Room
	4.1	Company Computer Bad/Lag	No upgrades yet	Upgrade or acquire new computers	Facility Team	During low season or after the budget is approved	TUF Room

Machine	4.2	Slow Xpream system	Restricted range	Enhance internet connectivity	Facility Team	As soon as possible or after the budget is approved	TUF Room
Environment	5.1	Vendor Limitations	Late customer payments	Diversify vendors and establish long-term contracts	Purchaser	During annual contract renewals or when evaluating the performance of current vendors	TM Material building
	5.2	Slow material shipping	Non-compliance with DG item SOP	Use third-party services to ensure proper packaging	Purchaser	Each time material is shipped	TM Material building
	5.3	Shipping Delays	Limited cargo flights to CGK (Jakarta)	Explore alternative transportation options for delivery	Purchaser	When main transportation is unavailable or delayed	TM Material Room

Table 3 outlines several improvement to minimize nill stock material. For issues related to materials not listed on jobcards (JC) or maintenance discrepancy and rectification (MDR), as well as data input errors, it is recommended to implement jobcard checks by quality control, provide staff training, and increase personnel. Method-related issues, such as the lack of safety stock and complex part number (PN) procurement processes, can be addressed through periodic forecasting and the establishment of new procedures for PN requests. To manage material limitations, forecasting, prioritizing funds, and strict payment rules are necessary. Upgrading computers and internet networks during the low season, as well as diversifying vendors, establishing long-term contracts, and using third-party services and alternative transportation, are also advised to tackle limitations and shipping delays. Implementing these measures is expected to enhance the efficiency of scheduling and material procurement systems.

TABLE IV. RESULTS OF THE 5W+1H ANALYSIS FOR LATE FINDING

4M + 1 E	No	*What*	*Why*	*How*	*Who*	*When*	*Where*
Man	1.1	Complacency	Does not follow AMM	Carrying out supervision and monitoring	Supervisor	Each maintenance process, especially the inspection phase	Hangar 3
	1.2	Lack of Skill	New employees	Conducting comprehensive and continuous training	Manager	Before peak periods or during low season and conduct recurrent training every 24 months	Hangar 3

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Method	2.1	No *double Check*	Few inspectors for *double Check*	Recruiting new inspectors/providing inspector training to potential employees	Manager	Before peak periods or during low season and conduct recurrent training every 24 months	Hangar 3
	2.2	Wrong Skill	Assumes JC is correct	Performing a double check	Supervisor	Before each jobcard is sent to the production unit	Hangar 3
	2.3	RII/DI list unclear	No updates to customer	Conducting monitoring to ensure the planner performs regular updates	Manager	Before and during the creation of jobcards	Hangar 3
Material	3.1	Replacement Material Unavailable	No budget allocation	Establishing a priority scale for fund allocation	Project Leader	Every quarter or before each long-term planning	Samsat Room
Machine	4.1	Unavailable Tools	Tool becoming a worldwide issue	Conducting an RFQ (Request for Quotation) for loans	Purchaser	Whenever tools not owned by the company are needed	TM Material Room
	4.2	No dock	Domino effect of maintenance delays	Evaluating the aircraft maintenance scheduling system regularly	Planner	After each completed maintenance project	TBS Room
Environment	5.1	Rainy/hot weather during work	Poor maintenance schedule management	Conducting maintenance scheduling management training	Planner	Before peak periods or during low season	TBS Room
	5.2	Lighting Issues	Limited hangar capacity	Conducting inspections during the day/using a portable light	Supervisor	When not obtaining a hangar slot and during nighttime	Hangar 3

Table 4 presents several improvements to address the issue of late findings. For the man aspect, complacency and a lack of expertise can be mitigated through increased supervision by managers during maintenance and ongoing training before peak periods. Regarding the method aspect, the shortage of inspectors and inspections not matching expertise levels can be addressed by hiring new inspectors, providing training, and implementing double checks by supervisors before jobcards are sent to the production unit.

Material issues, such as the unavailability of replacement materials due to insufficient funds, can be addressed by establishing a fund prioritization system managed by the project leader on a quarterly basis. For the machine aspect, tool unavailability can be managed through a Request for Quotation (RFQ) for tool borrowing, and routine evaluations of the aircraft maintenance scheduling system by the planner after each project can help address dock limitations. Lastly, for the environment aspect, inefficient scheduling management and inadequate lighting can be improved by training planners in scheduling management before peak periods and using portable lights or conducting inspections during daylight hours when hangar slots are unavailable. Implementing these measures is expected to reduce delays and enhance efficiency in the aircraft maintenance process.

IV. Conclusion

1. The factors causing delays in turnaround time are as follows: nill stock material at 46.34%, late findings at 36.59%, robbing activity at 12.20%, and tool availability at 4.88%.
2. The primary factors contributing to delays in turnaround time (TAT) for the C-Check of Airbus 330 aircraft are nill stock material and late findings, which together account for 82.93% of the delays. Nill stock material contributes 46.34% of the delays, with root causes including inadequate double checks on jobcards, data input errors, lack of safety stock, complex part number procurement procedures, limited funding, outdated supporting tools, limited cargo aircraft for shipping, and packaging damage during delivery. On the other hand, late findings account for 36.59% of the delays and are attributed to a lack of expertise, complacency, empty replacement material stock, limited dock availability, unavailable C-Check tools, inspections not matching expertise levels, inadequate double checks, unclear RII/DI lists, and unpredictable weather conditions.
3. To reduce turnaround time (TAT) delays for C-Check maintenance of Airbus 330 aircraft, the company can implement several effective improvement measures. Firstly, the quality control unit should enhance the process by performing double checks on jobcards before distribution to the production unit and during inspections/findings, while also strengthening active oversight. Additionally, continuous training for planners in material inventory, forecasting, and maintenance schedule management should be conducted, alongside up-to-date training for technicians to improve their skills. The company should also establish a priority scale for material funding based on urgency and upgrade computers and expand internet coverage to avoid failures in material procurement or data entry. More effective procedures for inputting part numbers not yet recorded in the company's system should be implemented. Moreover, diversifying vendors and utilizing third parties can help address difficulties in obtaining materials and packaging damage not following SOP, while employing alternative transportation methods such as land or sea routes can mitigate limitations related to cargo aircraft availability.

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