



Proposed Strategy For Reducing Expired Consumables Using Kepner-Tregoe Approach And Analytical Hierarchy Process

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ABSTRACT

As an aerospace company in Indonesia, AE Company has a goal expand its capabilities and collaboration for various aerospace manufacturing projects. However, AE Company could not fully utilize its production capacity due to occasional production delays and large quantity of consumables procured. This condition affects AE Company's capability to fully utilize limited shelf-life consumables, leading to financial loss of more than US\$200,000 worth of consumables due to the expiration. The objectives of this study are to propose an improvement strategy to reduce expired consumables at AE Company, focusing on the limited shelf-life consumables which has maximum shelf-life of twelve months by using Kepner-Tregoe approach and Analytical Hierarchy Process (AHP). Root Cause and alternative solution is obtained using Kepner-Tregoe approach, while the preferred alternative solution is chosen using Analytical Hierarchy Process (AHP). From the Analytical Hierarchy Process (AHP), it is decided that "Optimization of Procurement Cycle and Quantity" is chosen as the alternative solution to reduce expired consumables at AE Company.

INTRODUCTION

The aerospace supply chains are highly complex, particularly in the perspective of the aftermarket. While aircraft have a short production cycle, they tend to have very long service cycle, with their operational lifespan could reach as long as 30 years. This leads a demand for service supply chain with specific requirements for maintenance, repair and overhaul (MRO), as well as steady supply of spare parts (Ivan and Lucia, 2013). An effective aerospace supply chain ensures that products, from aircraft parts to its components are delivered on-time, which is crucial to maintain operational efficiency and customer satisfaction.

Ivan and Lucia (2013) also emphasized the importance of adherence to strict traceability and compliance standards. As any instance of noncompliance can have serious consequences,

such as expensive delays or, more critically, safety risks. Effectively management of these complexities requires an excellent supply chain strategy, supported by strong process discipline and systems that are aligned with both the strategy and operational procedures.

AE Company has established long-time partnerships with leading aerospace manufacturers worldwide to produce various components for various aerospace industries. By taking on various manufacturing program, AE Company manufactures critical aerostructures for various aircraft components. To support its aerostructure manufacturing operations for their global partners, AE Company relies on specialized consumables to meet strict aerospace standards. However, securing these materials creates significant procurement challenges that impact both timelines and costs

After the consumables arrived, they are checked for their remaining shelf-life, which could be reduced up to 80% of the original shelf-life. Unfortunately, production delays would occur periodically due to unexpected breakdowns of critical manufacturing equipment, delaying the use of these consumables and reducing consumables utilization, leading to expiration of limited shelf-life consumables.

Unfortunately, unused and expired consumables must be disposed according to the customer requirements, which prohibits reuse or re-testing. The disposal of these consumables has already wasted money and time to procure these consumables. In 2024 alone, AE Company has lost more than US\$200,000 worth of consumables due to expiration.

Table 1. Procurement & Usage of Limited Shelf-life Consumables of AE Company

Material Code	MOQ	Order Qty 2024	Used Qty 2024	Scrap Qty 2024	Order Amount (USD)	Lost Amount (USD)
Mat-1	420.000.000	420.000.000	0	420.000.000	35310,51	40310,51
Mat-2	420.000.000	420.000.000	2.532	419.997.468	25814,50	30814,32
Mat-3	50.000	75.000	2.988	72.012	23000,61	26885,06
Mat-4	50.000	250.000	5.976	244.024	33760,65	37834,12
Mat-5	50	50	0	50	8226,48	10226,48
Mat-6	20	20	1	19	4155,98	5848,18
Mat-7	3.500.000	3.500.000	0	3.500.000	8098,29	10098,29
Mat-8	10	10	0	10	11918,51	13918,51
Mat-9	8.000	8.000	3.444	4.556	8680,73	6082,67
Mat-10	1.000	1.250	0	1.250	2070,51	4070,51
Mat-11	12.000	12.000	3.708	8.292	4924,78	4785,02
Mat-12	12.000	12.000	36	11.964	7184,80	9157,25
Mat-13	8.000	8.000	4.800	3.200	3062,68	2025,07
Mat-14	35.000	175.000	112.572	62.428	47435,85	17635,32
Mat-15	12	48	36	12	5136,75	1784,19
Total (USD)					228781,63	221475,50

(Source: Internal Documents, 2024)

This study aims to propose an improvement strategy to reduce expired consumables at AE Company using Kepner-Tregoe approach to obtain the root causes and alternative solution. The alternative solution obtained from Kepner-Tregoe approach will be processed using Analytical Hierarchy Process (AHP) to choose the preferred alternative solution as the improvement strategy.

In the short term, reduction of expired consumables benefits AE Company financially. Hopefully, this reduction also improving the utilization of consumables and creating a defined consumables demand based on consumables usage data and its shelf-life. In the long term, this improvement strategy would create an accurate demand to negotiate with the supplier. Additionally, utilization of these consumables would increase the productivity, which would bring more customer satisfaction and trust, and potentially increasing AE Company's profit.

LITERATURE REVIEW

A literature review is generally understood as a structured approach to gathering and synthesizing existing research. By combining insights and results from multiple empirical studies, it can address research questions more effectively than any individual study (Snyder, 2019).

Kepner-Tregoe Approach

(KT) is a problem-solving and decision-making method developed by Charles H. Kepner and Benjamin B. Tregoe. It offers a systematic framework for analyzing complex issues and making decisions across different organizational settings (Markopoulos et al., 2022). Kepner-Tregoe approach is designed to tackle complex problems and make decisions through four key components: situation analysis, problem analysis, decision analysis, and potential problem analysis.

Figure 1. Kepner-Tregoe Analysis Model

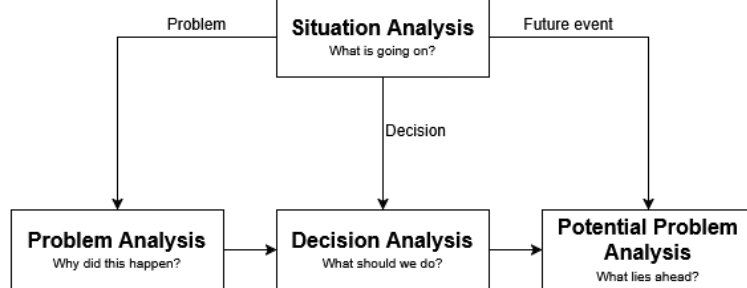


Figure 2. Kepner-Tregoe Analysis Template (Ido et. al, 2005)

Situation Analysis				
Problems	Timing (H,M,L)	Trend (H,M,L)	Impact (H,M,L)	Process (PA,DA,PPA)
1.				
2.				
3.				

Problem Analysis				
Problem Statement:				
Specification	IS	IS NOT	DISTINCTIONS	Probable Cause
What?				
Where?				
When?				
How much?				
Possible Causes			The Most Possible Causes	
Verification				

Decision Analysis							
Alternative:	A		B		C		
Musts	1. GO	GO	GO	GO	GO	GO	
	2. GO	GO	NO GO	GO	GO	GO	
Wants	Weight	Rating	Score	Rating	Score	Rating	Score
1.							
2.							
		Total A =		Total B =		Total C =	

Potential Problem Analysis				
Potential Problems	Consequences	Possible Causes	Preventive Actions	Contingency Plan
A	1.	1.	1.	1.
	2.	2.	2.	2.
B	1.	1.	1.	1.
	2.	2.	2.	2.
C	1.	1.	1.	1.
	2.	2.	2.	2.

KT methodology started from situation analysis of the problem, understanding what is currently happening. This process is started by breaking down complex issues into manageable components, separating relevant information from the irrelevant, and establishing priorities while delegating responsibilities accordingly.

The second KT methodology is problem analysis, which applies a cause-and-effect reasoning to identify the root cause. This structured method helps gathering relevant and meaningful information, leading to a more thorough understanding of the problem.

The third KT approach is decision analysis, focusing on determining the most appropriate course of action from a number of alternatives by employing a structured, choice-making thinking pattern. It provides a methodical approach to examine the purpose behind a decision, evaluating the available options, and assessing the risks associated with each alternative.

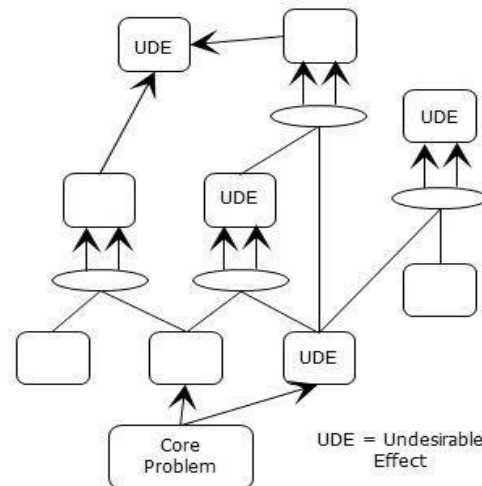
The fourth KT approach is potential problem analysis, focusing on anticipating future challenges. It provides a structured approach to avoid possible negative consequences before they occur and developing strategies to prevent or mitigate them.

Current Reality Tree (Root Cause Analysis Framework)

One of the forms of RCA is Current Reality Tree (CRT), which is an RCA tool derived from the Theory of Constraints methodology. CRT is designed to clearly identify root problems that cause surface issues or undesirable effects within an organization. By understanding these core problems, organizations can propose effective solutions without inadvertently creating new issues (Walker & Cox, 2006)

Figure 3 illustrates how CRT begins with the undesirable effects (UDEs) from the problem. These UDEs help pinpoint one or more root causes or a single core issue that give rise to all the negative outcomes. This core problem is often the constraint that must be identified and addressed (Dettmer, 1997).

Figure 3. Current Reality Tree (CRT) Diagram (Dettmer, 1997)

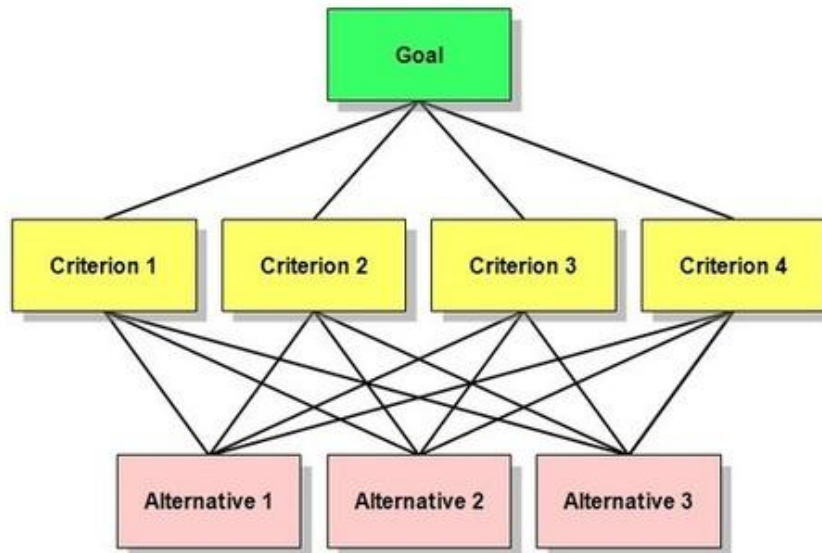


CRT illustrates a chain of cause-and-effect reasoning (if, and, then). The reasoning links between any UDEs needs to be elaborated to ensure it is sound and plausible. Each of the remaining UDEs should be linked to the existing tree. Chain of cause and effect will be built until reaching the root cause, followed up by addressing the root causes.

Analytical Hierarchy Process

Analytical Hierarchy Process (AHP) is a Multi-Criteria Decision-Making (MCDM) method originally developed by Thomas L. Saaty. According to Thomas L. Saaty (1980), AHP is a multi-criteria decision-making method that organizes factors into a hierarchical structure. The process breaks down the problem into different levels, starting with the overall goal at the top, followed by criteria, sub-criteria, and finally the alternatives.

Figure 3. Current Reality Tree (CRT) Diagram (Dettmer, 1997)



AHP uses pairwise comparisons for measurement and depends on expert judgments to establish priority scales. AHP uses a scale developed by Thomas L. Saaty to quantify subjective judgments in the pairwise comparisons. By analyzing the pairwise comparisons, AHP calculates the relative weights or priorities of each criterion and alternative. The calculated priorities are used to rank the alternatives and make informed decisions based on the multiple criteria.

Figure 4. Fundamental scale of AHP (Saaty, 1980)

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment strongly favor one activity over another
5	Essential of strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is strongly favored and its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgment	When compromise is needed

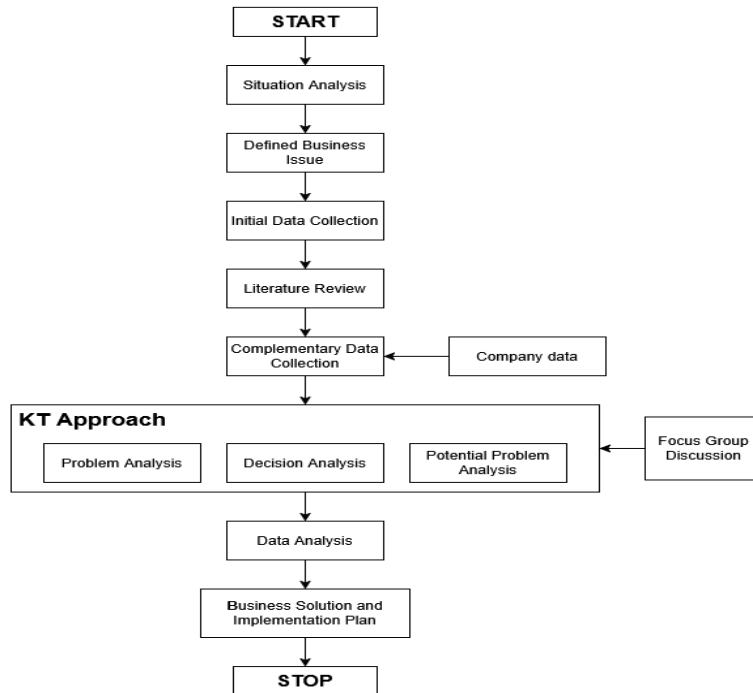
The implementation of AHP can be summarized into three fundamental principles: breaking down the problem (decomposition), conducting pairwise comparisons, and combining the resulting priorities (synthesis of priorities) (Yadav and Jayswal, 2013).

METHODS

Research methodology is a structured approach to solving a research problem, involving a logical sequence of steps to address the issue systematically (Patel & Patel, 2019). Research methodology refers to a systematic approach used to explain and investigate a research problem. It can be described as the science of understanding how research is conducted in a

scientific manner, focusing on the various steps typically followed by a researcher and the reasoning behind them. It is essential for a researcher to not only select appropriate research methods or techniques but also to understand and define the underlying methodology (Swarooprani, 2022).

Figure 5. Research Methodology Diagram



Methods used for this research is divided into data collection and data analysis, which involves Focus Group Discussions (FGD) with several Subject Matter Experts (SMEs) from Aerostructure Supply Chain department. The framework for these methods also based on KT approach that was discussed in the previous chapter, which consists of Problem Analysis (PA), Decision Analysis (DA) and Potential Problem Analysis (PPA).

The first step is data collection for PA, which was conducted through an FGD, focusing on the root cause analysis for the business issue and the problems related to the business issue to provide a deeper understanding. Data analysis for PA was verified using CRT as RCA method and adjusted the data with the template of PA in KT approach.

The second step is data collection for DA, which was mainly focusing on assessment using AHP. However, the criterion and business solution alternatives were discussed first through FGD based on the findings from PA. Collected data from DA then processed using AHP method to calculate total score for every criterion and business solution alternative.

The implementation of AHP can be summarized into three fundamental principles: breaking down the problem (decomposition), conducting pairwise comparisons, and combining the resulting priorities (synthesis of priorities). Conducting pairwise comparisons needs to be evaluating using Saaty's fundamental scale of AHP. Results from pairwise comparisons needs to be calculated to obtain the results. The following steps outline how to calculate results from the pairwise comparisons using the Geometric Mean (GM) method (Yadav and Jayswal, 2013).

1. Multiply all the values in each row of the pairwise comparison matrix, then take the n th root of the product, where n is the total number of elements. Below is the formula for the geometric mean of row i in a pairwise comparison matrix A of size $n \times n$:

$$GM_i = \left(\prod_{j=1}^n a_{ij} \right)^{\frac{1}{n}}$$

GM_i = Geometric mean of the i^{th} row

a_{ij} = Element on the i^{th} row and j^{th} column of the matrix

n = Total number of elements in a row, according to the matrix size

2. Calculate the sum of the geometric means of all rows.
3. Normalize each row total to derive the priority vector by dividing it by the overall sum of all rows using the formula:

$$w_i = \frac{GM_i}{\sum_{k=1}^n GM_k}$$

w_i = Priority vector on the i^{th} row

$\sum_{k=1}^n GM_k$ = sum of the geometric means for all compared n elements

Once the normalized weight for each row is calculated, the sum of all priority vector values in each method should be equal to 1.

4. Calculate consistency ratio (CR). It can be obtained by dividing consistency index (CI) by random consistency index (RI) shown in Figure 6.

The value of Consistency Index (CI) and Consistency Ratio (CR) can be calculated using the formula:

$$CI = \frac{(\lambda_{max} - n)}{(n - 1)}$$

$$CR = \frac{CI}{RI}$$

n = Number of elements in the row (size of the matrix)

λ_{max} = Sum of all the rows (step #2)

According to Golany and Kress (1993), the matrix is considered acceptable if the Consistency Ratio (CR) is less than or equal to 0,1.

Figure 6. Random Consistency Index (Saaty, 1980)

Matrix size	Random consistency index (RI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

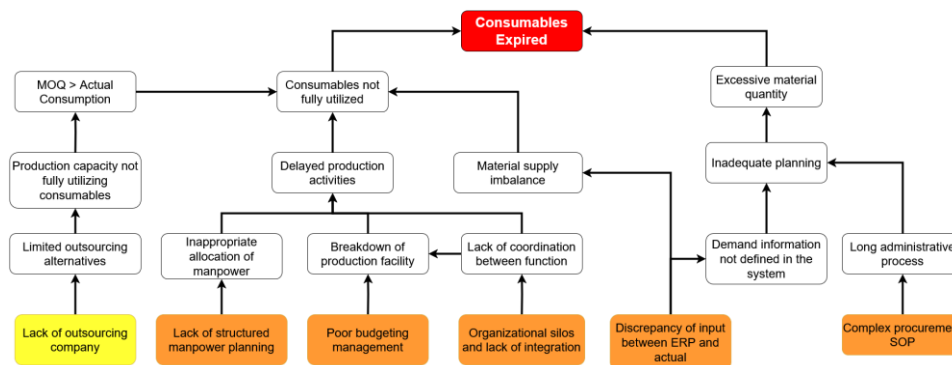
The third step is data collection for PPA, conducted through FGD to identify potential risks that may arise from preferred business solution alternative. Through an FGD, data analysis for PPA was processed using PPA template of KT to develop mitigation plan and strategies to anticipate potential problems and manage risks effectively.

RESULTS

According to Brown (2014), Data analysis is the process of examining, cleaning, transforming, and modelling data to discover valuable insights, draw conclusions, and support effective decision-making. Data Analysis for this study is based on KT analysis, with several additional methods for verifying the results for each step.

Problem Analysis for this research was conducted through an FGD, focusing on expired limited shelf-life consumables at AE Company. The problem statement was analyzed using several questions (What, Where, When, How much) to identify the probable causes. However, these probable causes are not deep enough and needs to be verified further using other methods of RCA, where CRT comes in to further analyze possible root causes of this problem.

Figure 7. Current Reality Tree (CRT) Diagram



From the CRT analysis, we can conclude six root causes related to the business issue. However, root cause #1 (yellow square) is heavily dependent on the external factor, which is out of the scope and will be ruled out. In conclusion, it is decided that we have five root causes for further analysis. Root causes obtained from CRT is further analyzed for their alternative solution, along with their pros and cons.

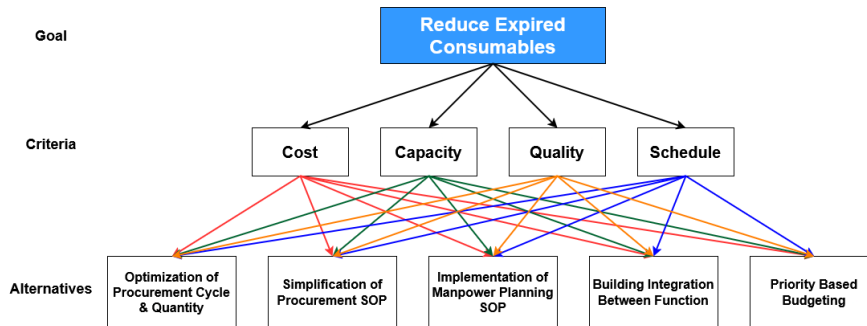
Table 2. Root Cause and Alternative Solution Matrix

No	Root Cause	Alternative Solution	Pros	Cons
1	Lack of structured manpower planning	Implement a standardized manpower planning SOP	+ Ensures consistency across projects + Enables better coordination between HR and project teams	-Needs periodic updates with evolving project types -Requires time and effort to develop
2	Poor budgeting management	Priority-Based Budgeting	+Focuses resources on high-impact projects +Aligns budget with strategic goals	- Requires clear prioritization criteria - May lead to conflict among departments
3	Organizational silos and lack of integration	Establish Cross-Functional Integration	+Breaks down silos +Improves decision-making speed	-Requires ongoing coordination effort -May slow down decision-making initially
4	Discrepancy of input between ERP and actual	Procurement Cycle Optimization	+Minimizes waste and loss +Improves inventory accuracy and forecasting	-Requires precise and timely data -Initial implementation effort
5	Complex procurement SOP	Simplification of SOP	+Enhances agility during procurement process +Reduces administrative burden	-Requires strong oversight and clear justification documentation -Increase risk of dependency with one vendor

(Source: Focus Group Discussion, 2025)

Based on the root causes and alternative solutions, the important criteria that highlighted AE Company's objectives were highlighted from the Focus Group Discussion. It is decided that AE Company has four criteria—Cost, Capacity, Schedule, Quality—for the next decision-making process using AHP and combined with the previously selected five alternative solution.

Figure 8. Analytical Hierarchy Process Diagram



The results of pairwise comparison are collected from questionnaire with SMEs, and the calculation of pairwise comparison is using geometric mean of pairwise comparisons. Calculation results of pairwise comparison for both criteria and alternative solution is shown in Table 3 and Table 4.

Table 3. Pairwise Comparison Matrix of Criteria

Criteria	Capacity	Cost	Quality	Schedule
Capacity	1	1,01	5,10	0,27
Cost	0,99	1	1,86	0,37
Quality	0,20	0,54	1	0,28
Schedule	3,65	2,69	3,63	1

(Source: Processed Data, 2025)

Table 4. Pairwise Comparison Matrix of Alternative Solution

Criteria : Capacity					
Alternatives	Optimization of Procurement Cycle and Quantity	Implement Manpower Planning SOP	Establishing Cross-Function Integration	Priority Based Budgeting	Simplify Procurement SOP
Optimization of Procurement Cycle and Quantity	1	1,39	1,25	4,66	3,79
Implement Manpower Planning SOP	0,72	1	0,47	1,32	0,72
Establishing Cross-Function Integration	0,80	2,14	1	1,29	0,69
Priority Based Budgeting	0,21	0,76	0,78	1	0,59
Simplify Procurement SOP	0,26	1,38	1,46	1,70	1
Criteria : Cost					
Alternatives	Optimization of Procurement Cycle and Quantity	Implement Manpower Planning SOP	Establishing Cross-Function Integration	Priority Based Budgeting	Simplify Procurement SOP
Optimization of Procurement Cycle and Quantity	1	5,88	5,67	2,34	3,02
Implement Manpower Planning SOP	0,17	1	2,05	0,35	0,78
Establishing Cross-Function Integration	0,18	0,49	1	0,69	0,70
Priority Based Budgeting	0,43	2,83	1,46	1	0,34
Simplify Procurement SOP	0,33	1,28	1,44	2,95	1
Criteria : Quality					
Alternatives	Optimization of Procurement Cycle and Quantity	Implement Manpower Planning SOP	Establishing Cross-Function Integration	Priority Based Budgeting	Simplify Procurement SOP
Optimization of Procurement Cycle and Quantity	1	2,21	2,45	4,07	1,03
Implement Manpower Planning SOP	0,45	1	2,05	2,10	0,65
Establishing Cross-Function Integration	0,41	0,49	1	0,72	0,72
Priority Based Budgeting	0,25	0,48	1,39	1	0,28
Simplify Procurement SOP	0,97	1,54	1,39	3,55	1
Criteria : Schedule					
Alternatives	Optimization of Procurement Cycle and Quantity	Implement Manpower Planning SOP	Establishing Cross-Function Integration	Priority Based Budgeting	Simplify Procurement SOP
Optimization of Procurement Cycle and Quantity	1	6,01	5,12	4,58	3,84
Implement Manpower Planning SOP	0,17	1	1,70	1,01	0,28
Establishing Cross-Function Integration	0,20	0,59	1	0,79	0,46
Priority Based Budgeting	0,22	0,99	1,27	1	0,33
Simplify Procurement SOP	0,26	3,58	2,18	3,02	1

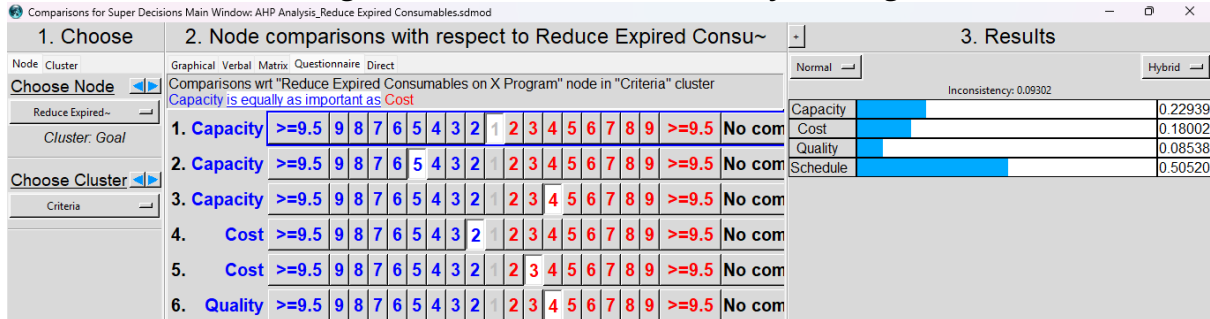
(Source: Processed Data, 2025)

Table 5. Results of Consistency Ratio Calculations

Type	Consistency Ratio	Status
Alternatives	0,093	Acceptable
Criteria : Cost	0,093	Acceptable
Criteria : Quality	0,036	Acceptable
Criteria : Schedule	0,035	Acceptable
Criteria : Capacity	0,071	Acceptable

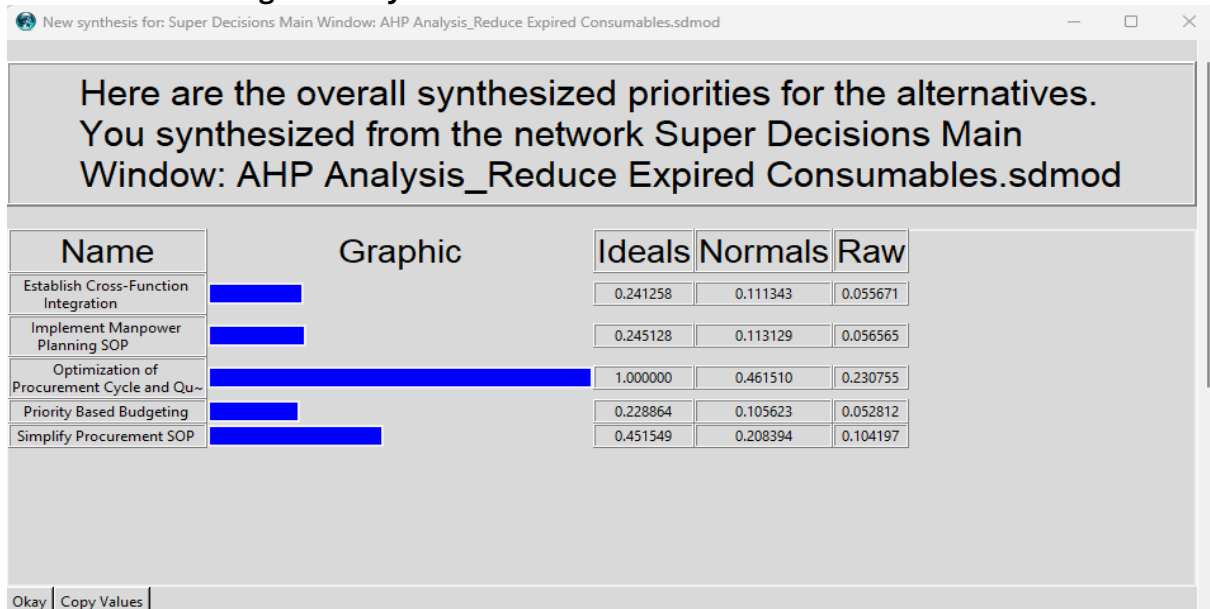
(Source: Super Decision Software, 2025)

Figure 9. Results of Criteria Priority Ranking



(Source: Super Decision Software, 2025)

Figure 10. Synthesized Priorities for Alternative Solution



(Source: Super Decision Software, 2025)

Based on the results of decision-making analysis using AHP method above, it is concluded that the priority score for criteria is as follows:

- Schedule = 50,5%
- Capacity = 22,9%
- Cost = 18%
- Quality = 8,5%

Furthermore, the results from synthesis of pairwise comparison using Super Decision software for alternative solution is as follows:

- Optimization of Procurement Cycle and Quantity = 46,15%
- Simplify Procurement SOP = 20,83%

- Implement Manpower Planning SOP = 11,31%
- Establishing Cross-Function Integration = 11,13%
- Priority Based Budgeting = 10,56%

From the results above, it can be concluded that “Optimization of Procurement Cycle and Quantity” has the highest value and become the preferred solution to reduce expired consumables at AE Company.

Based on the decision analysis in the previous chapter, it is decided that “Optimization of Procurement Cycle and Quantity” is chosen as the alternative solution. However, it is essential to define Potential Problem Analysis (PPA) for the chosen alternative solution.

Figure 11. Potential Problem Analysis for for Optimization of Procurement Cycle and Quantity

Potential Problem Analysis : Optimization of Procurement Cycle & Quantity				
Potential Problems	Consequences	Possible Causes	Preventive Actions	Contingency Plan
Procurement & Production Schedule Misalignment	- Material shortages or excess - Production delays	- Uninformed changes to production schedule	- Establish regular coordination meetings	- Enable rapid reallocation of resources
Inaccurate Forecasting	- Overstock or stockouts - Production delays	- Demand fluctuation	- Maintain safety stock or buffer inventory	- Implement rapid procurement strategy - Implement flexible production scheduling
Demand Fluctuation	- Overstock or stockouts - Production delays	- Demand changes - Unexpected disruptions	- Maintain safety stock or buffer inventory	- Communicate with customers about changes - Implement rapid procurement strategy
MOQ too large	- Risk of Material Expiration and waste	- Supplier-imposed MOQ policies - Limited Production Capacity	- Negotiate GPA with suppliers for flexible MOQ - Implement VMI - Collaborate with External Vendors	- Negotiate with customers about the price adjustments or order quantity

Implementation plan of optimization of procurement cycle and quantity is focused on fifteen limited shelf-life consumables with manufacturer’s shelf-life of twelve months. The implementation plan is based on a modified Gantt chart with the monthly and yearly quantities of required consumables, along with their base prices and delivery costs.

Figure 12. Modified Gantt Chart for Improvement Strategy

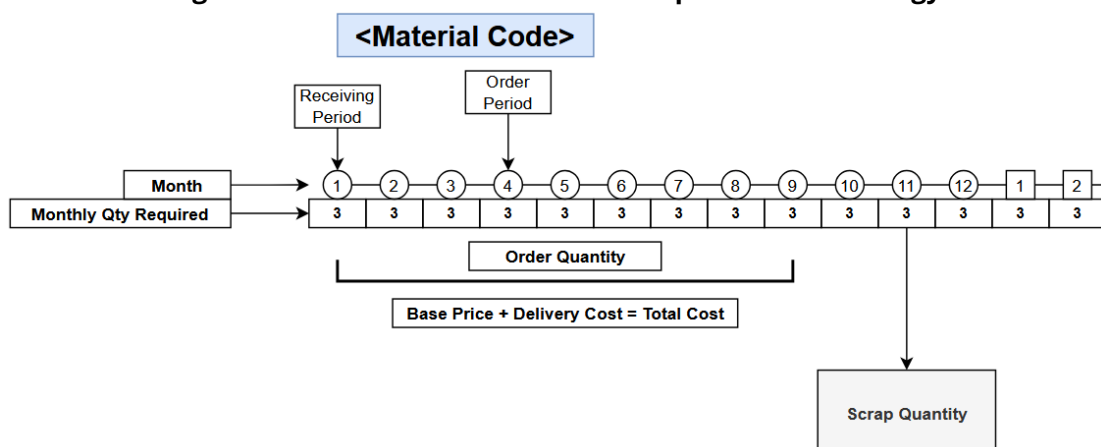


Table 6 illustrates the results of consumables' lost quantity and amount of money before and after the improvement strategy, where the amount of money lost due to expiration of consumables has been reduced up to 50%.

Table 6. Results of Consumables' Lost Quantity and Amount of Money Before and After Optimization

Material Code	MOQ	Without Optimization			With Optimization			Without Optimization		With Optimization		Before vs After (%)
		Order Qty 2024	Used Qty 2024	Scrap Qty 2024	Order Qty 2024	Used Qty 2024	Scrap Qty 2024	Lost Amount (USD)	Lost Amount LC (USD)	Order Amount (USD)	Lost Amount LC (USD)	
Mat-1	420.000.000	420.000.000	0	420.000.000	420.000.000	31.820	419.968.180	35.310,51	40.310,51	35.310,51	35.317,43	-12,39%
Mat-2	420.000.000	420.000.000	2.532	419.997.468	420.000.000	155.570	419.844.430	25.814,50	30.814,32	25.814,50	25.814,54	-16,23%
Mat-3	50.000	75.000	2.988	72.012	50.000	2.570	47.430	23.000,61	26.885,06	15.333,74	14.554,69	-45,86%
Mat-4	50.000	250.000	5.976	244.024	63.440	63.440	0	33.760,65	37.834,12	8.567,10	0,00	-100,00%
Mat-5	50	50	0	50	50	10	40	8.226,48	10.226,48	8.226,48	6.588,87	-35,57%
Mat-6	20	20	1	19	20	10	10	4.155,98	5.848,18	4.155,98	2.082,79	-64,39%
Mat-7	3.500.000	3.500.000	0	3.500.000	3.500.000	3.500	3.496.500	8.098,29	10.098,29	8.098,29	8.099,78	-19,79%
Mat-8	10	10	0	10	10	10	0	11.918,51	13.918,51	11.918,51	0,00	-100,00%
Mat-9	8.000	8.000	3.444	4.556	8.000	2.930	5.070	8.680,73	6.082,67	8.680,73	5.507,50	-9,46%
Mat-10	1.000	1.250	0	1.250	1.000	50	950	2.070,51	4.070,51	1.656,41	1.582,71	-61,12%
Mat-11	12.000	12.000	3.708	8.292	12.000	4.850	7.150	4.924,78	4.785,02	4.924,78	2.940,07	-38,56%
Mat-12	12.000	12.000	36	11.964	12.000	2.750	9.250	7.184,80	9.157,25	7.184,80	5.545,68	-39,44%
Mat-13	8.000	8.000	4.800	3.200	8.000	4.010	3.990	3.062,68	2.025,07	3.062,68	1.532,30	-24,33%
Mat-14	35.000	175.000	112.572	62.428	94.630	94.630	0	47.435,85	17.635,32	25.650,60	0,00	-100,00%
Mat-15	12	48	36	12	48	36	12	5.136,75	1.784,19	5.136,75	1.285,39	-27,96%
Total								228.781,63	221475,50	173.721,85	110851,74	-49,95%

(Source: Processed Data, 2025)

DISCUSSION

The implementation plan is aimed to reduce the quantity of lost consumables due to expiration. In a short term, this implementation plan is aimed to adjust the procurement quantity according to the required quantity to reduce the cost to procure these consumables. Additionally, defined procurement quantity based on required quantity would define monthly production target, triggering resource planning to follow the production target and increasing the utilization of these consumables.

Successful improvement strategy would standardize best practices and optimizing operations on a larger scale. Over time, by completing the production target and achieving on-time delivery, AE Company could enhance customer satisfaction and trust, which would increase business opportunities, leading to more orders and higher profits.

Future research opportunities could explore other types of materials within AE Company and creating consumables optimization based on the supplier to enhance AE Company procurement strategy.

CONCLUSION

Based on Kepner-Tregoe Analysis performed in this research, there are five root causes obtained and four alternative solution as an option for further decision-making analysis. These root causes and alternative solution also aligned with stakeholders' objectives and criteria to reach the goal of reducing expired consumables of AE Company.

By using Analytical Hierarchy Process (AHP) method, the results of decision-making analysis has concluded that the preferred criterion to consider when choosing an alternative solution is Schedule (50,5%), followed by Capacity (22,9%), Cost (18%), and Quality (8,5%). Schedule has the top ranking compared to other criteria, emphasizing the importance of on-time project completion. This prioritization reflects the stakeholders' goal to deliver projects within the specified time frame which will improve customer satisfaction.

Additionally, the results of decision-making using Analytical Hierarchy Process (AHP) has concluded that Optimization of Procurement Cycle and Quantity (46,15%) is the preferred alternative solution to reduce expired consumables at AE Company, followed by Simplify

Procurement SOP (20,83%), Implement Manpower Planning SOP (11,31%), Establishing Cross-Function Integration (11,13%), and Priority Based Budgeting (10,56%)

The implementation plan using modified Gantt chart has shown there are reduction on the possible financial loss due to expiration of consumables, which could be reduced up to 50%. However, there are improvements that can be done by AE Company, such as cooperation with more domestic vendors and implement other procurement strategy such as General Purchase Agreement (GPA) or Vendor Managed Inventory (VMI) to give AE Company flexibility during procurement with smaller quantities according to the actual consumption.

LIMITATION

This research will be conducted at AE Company's main site, focusing on Aerostructure Supply Chain. The objects studied on this study will be limited to the limited shelf-life consumables with shelf-life of 12 months. This research will be related to the procurement and usage of consumables, to determine efficient procurement quantity and cycle, leading to reduction of costs.

REFERENCES

- Brown, M. S. (2014). Transforming Unstructured Data into Useful Information. In *Big Data Mining and Analytics* (pp. 227–246). <https://doi.org/10.1201/b16666-14>
- Dettmer, H. W., 1997. *Goldratt's Theory of Constraints: A Systems Approach to Continuous Improvement*. ASQ Quality Press.
- Golany, B., & Kress, M. (1993). A multicriteria evaluation of methods for obtaining weights from ratio-scale matrices. *European Journal of Operational Research*, 69(2), 210–220. [https://doi.org/10.1016/0377-2217\(93\)90165-j](https://doi.org/10.1016/0377-2217(93)90165-j)
- Ivan, K. and Lucia, N., 2013. Selected aspects of the supply chain management in the aerospace industry. *INCAS BULLETIN*, [online] 5(1), pp.135–149. <https://doi.org/10.13111/2066-8201.2013.5.1.13>.
- Markopoulos, E., Refflinghaus, J., Roell, M. and Vanharanta, H., 2022. Understanding Situationality using the Kepner-Tregoe Method in the Company Democracy Model to increase Employee Engagement and Knowledge Contribution. *AHFE International*. <https://doi.org/10.54941/ahfe1001522>.
- Patel, M., & Patel, N., 2019. Exploring Research Methodology: Review article. Zenodo (CERN European Organization for Nuclear Research). <https://doi.org/10.5281/zenodo.3987854>
- Saaty, T.L., 1980. *The analytic hierarchy process: planning, priority setting, resource allocation*.
- Snyder, H., 2019. Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333–339. <https://doi.org/10.1016/j.jbusres.2019.07.039>
- Swarooprani, K., 2022. An study of research methodology. *International Journal of Scientific Research in Science Engineering and Technology*, 537–543. <https://doi.org/10.32628/ijsrset2293175>

- Walker, E. D., & Cox, J. F., 2006. Addressing ill-structured problems using Goldratt's thinking processes. *Management Decision*, 44(1), 137–154. <https://doi.org/10.1108/00251740610641517>
- Yadav, A., & Jayswal, S., 2013. Using geometric mean method of analytical hierarchy process for decision making in functional layout. *International Journal of Engineering Research And*, 2(10). <https://www.ijert.org/research/using-geometric-mean-method-of-analytical-hierarchy-process-for-decision-making-in-functional-layout-IJERTV2IS100143.pdf>