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Workload Analysis on the Apron Movement Control (AMC) Unit at Sentani Jayapura International Airport Using the Workload Analysis Method

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Abstract

This paper analyzes the workload of Apron Movement Control (AMC) personnel at Sentani International Airport in Jayapura, where increased flight frequency and limited resources have led to excessive workload. A work sample was taken from 12 personnel across 3 teams and 2 shifts. Data were processed through productivity percentages, performance assessments, and allowance calculations using the Workload Analysis Method. The results show that the average workload is 144.04%. This figure exceeds the ideal standard, indicating the risk of fatigue and decreased productivity. To improve operational efficiency and safety, recommendations are to add personnel, redistribute tasks, and revise work shifts.

Keywords: *Apron Movement Control (AMC), workload, Workload Analysis Method*

Introduction

In an era of globalization and rapid economic growth, air transportation plays a crucial role in supporting the mobility of people and the rapid and efficient distribution of goods. Indonesia, as the world's largest archipelagic nation with over 17,000 islands, relies heavily on air transportation as a key link between regions, particularly remote and border areas. One such region is Papua, where Sentani International Airport in Jayapura serves as the main air mobility gateway in Eastern Indonesia.

Sentani International Airport –as shown in Figure 1– is one of the busiest airports in Papua, serving a variety of regular and irregular domestic flights, including charter and cargo flights. As passenger numbers and flight frequencies increase annually, the airport's operational complexity also increases. Data from PT. Angkasa Pura Indonesia shows a 5% increase in air traffic and a 20% increase in passenger numbers in the January–July 2024 period compared to the same period the previous year. This puts significant pressure on personnel on the ground, particularly the Apron Movement Control (AMC) unit, which plays a central role in managing aircraft movement on the apron.

Source: https://www.oysteinlundandersen.com/sentani-airport/

Source: https://www.milestothewild.com/tag/jayapura/

Figure 1. Sentani International Airport

According to the Director General of Civil Aviation Regulation Number KP 038 of 2017 concerning Apron Management Services, the Apron Movement Control Unit (AMC) is responsible for managing and supervising aircraft movements on the apron during landing, parking, and takeoff, including coordination with air navigation operators [1]. Furthermore, AMC personnel at Sentani Airport must also manage the operation of facilities such as aircraft bridges, plot aircraft parking, and input and update data through systems such as ATV, Siopskom, and Chronos [2] [3] [4] [5] [6]. These tasks not only require high precision and accuracy, but also require optimal work capacity and adequate supporting resources.

Unfortunately, limited personnel and facilities, such as the lack of a comprehensive CCTV-based surveillance system, mean that much of the work remains manual. This situation has the potential to lead to excessive workload, which in the long term can impact individual performance, service quality, and even operational safety in the airport airside area. An unbalanced workload can trigger physical and mental fatigue, increase the likelihood of human error, and reduce the effectiveness of decision-making in critical situations.

This study aims to analyze the workload of Apron Movement Control personnel at Sentani International Airport in Jayapura using the Workload Analysis method. It is hoped that this study can provide an empirical picture of actual conditions in the field and offer relevant recommendations for airport management in an effort to improve work efficiency, service quality, and operational safety in the apron area.

Research Methods

The Workload Analysis Method is one approach that can be used to systematically measure workload [7]. Using techniques such as work sampling, this analysis allows for the evaluation of the proportion of productive and unproductive time and takes into account various factors that influence performance, such as performance ratings and allowances. The results of this analysis can be used as a basis for strategic decisions, such as adding personnel, restructuring work schedules, or optimizing operational tasks in the field.

Performance ratings are conducted to normalize observed work time, taking into account variations in work pace, skill level, environment, and other fluctuating factors. This assessment uses the Westinghouse method, which evaluates four factors to determine the reasonableness or unreasonableness of work performance.

Allowance time aims to provide employee with rest periods to meet personal needs, recover from fatigue, and accommodate factors beyond their control.

Results and Discussion

The data collection technique was carried out through field observations by calculating the percentage of productive and non-productive operators in carrying out their work [8]. Observations were carried out directly using work sampling on the workload analysis method for 12 AMC personnel. Data collection was carried out for 5 working days with a total of 77 observations per day, so there were a total of 385 observations. Observations were carried out from 08.00 to 12.00 Eastern Indonesian Time (WIT). From 12.00 – 13.00 WIT is the shift change time. Observations then continued from 13.00 to 16.00 WIT. A recapitulation of the data obtained is presented in Table 1.

Based on the data in Table 1, a summary of the results of observations of officer activity over a five-day period is presented. The table shows the percentage of productive and non-productive employee activity obtained from the Apron Movement Control officer's activity observation schedule during the observation period.

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Table 1. Recapitulation of productive and non-productive percentages

Shift	Employee	Work	Idle	% productive	% non-productive
1	1	349	36	90.65	9.35
	2	362	23	94.03	5.97
	3	353	32	91.69	8.31
	4	345	40	89.61	10.39
2	1	349	36	90.65	9.35
	2	352	33	91.43	8.57
	3	352	33	91.43	8.57
	4	356	29	92.47	7.53
3	1	346	39	89.87	10.13
	2	358	27	92.99	7.01
	3	359	26	93.25	6.75
	4	364	21	94.55	5.45

Table 2 shows a summary of allowance factors. This table shows the amount of allowance received by Apron Movement Control officers. The allowance value can be calculated using the International Labor Organization (ILO) table, but must be adjusted based on the conditions of the AMC unit officers while performing their work.

Table 2. Recapitulation of allowance factors

Allowance factor	%
Constant allowance	5
Variable allowance	2
Energy expended	0
Noise level	5
Mental stress	4
Monotony	4
Boredom	0
Attention level	5
Atmospheric conditions	7
Light factor	0
Total	32

Table 3 provides the Westinghouse factor scores, while Table 4 shows the summary of the rating factor assessments for each individual employee. The resulting rating factor score is the total of the Westinghouse factor scores plus 1.

To determine the workload experienced by each Apron Movement Control member, it is necessary to know their performance evaluation and tolerance. Based on Table 4, the performance evaluation can be calculated by adding the factors that influence a person's performance speed and adding a value of 1. This value of 1 represents the external factor. To determine this rating factor, the Westinghouse method is used to direct the research towards four factors: skill, effort, working conditions, and consistency.

The summary of data adequacy test is listed in Table 5. Based on the data in the table, the results of the data sufficiency calculation show that if N > N', the data is deemed sufficient, no additional data is required, and the study can proceed.

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Table 3. Westinghouse factor

Shift	Employee	Skill	Effort	Working conditions	Consistency	Total
1	1	0.08	0.02	0.03	0.03	0.16
	2	0.08	0.02	0.03	0.03	0.16
	3	0.08	0.05	0.03	0.03	0.19
	4	0.08	0.05	0.03	0.03	0.19
2	1	0.08	0.02	0.03	0.03	0.16
	2	0.08	0.02	0.03	0.03	0.16
	3	0.08	0.05	0.03	0.03	0.19
	4	0.08	0.05	0.03	0.03	0.19
3	1	0.08	0.05	0.03	0.03	0.19
	2	0.08	0.05	0.03	0.03	0.19
	3	0.08	0.05	0.03	0.03	0.19
	4	0.08	0.05	0.03	0.03	0.19

Table 4. Rating factor

Shift	Employee	Westinghouse factor	Rating factor
1	1	0.16	1.16
	2	0.16	1.16
	3	0.19	1.19
	4	0.19	1.19
2	1	0.16	1.16
	2	0.16	1.16
	3	0.19	1.19
	4	0.19	1.19
3	1	0.19	1.19
	2	0.19	1.19
	3	0.19	1.19
	4	0.19	1.19

Table 5. Summary of data adequacy test

Shift	Employee	Total observations (N)	(N’)	Data sufficiency
1	1	385	135.6	Cukup
	2	385	113.2	Cukup
	3	385	116.1	Cukup
	4	385	124.5	Cukup
2	1	385	135.6	Cukup
	2	385	130.5	Cukup
	3	385	128.8	Cukup
	4	385	124.5	Cukup
3	1	346	145.6	Cukup
	2	358	125.3	Cukup
	3	359	117.2	Cukup
	4	364	108.7	Cukup

Table 6 shows a summary of the results of the data uniformity test, which was conducted in this study with a 95% confidence level. This is because the researcher used a 95% confidence level for the measurement results and a precision level that indicates a maximum deviation of 5%. Therefore, it

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can be concluded that all observation data are uniform because they fall between the upper and lower control limits.

Table 6. Summary of data uniformity test results

Shift	Employee	Proportion (P)	BKA	BKB	Description
1	1	0.9065	0.9362	0.8768	uniform
	2	0.9403	0.9645	0.9161	uniform
	3	0.9169	0.9445	0.8889	uniform
	4	0.8961	0.9271	0.8651	uniform
2	1	0.9065	0.9362	0.8768	uniform
	2	0.9143	0.9425	0.8861	uniform
	3	0.9143	0.9425	0.8861	uniform
	4	0.9247	0.9513	0.8981	uniform
3	1	0.8987	0.9295	0.8679	uniform
	2	0.9199	0.9559	0.9039	uniform
	3	0.9325	0.9581	0.9069	uniform
	4	0.9455	0.9686	0.9224	uniform

Standard Time Calculation

To calculate the standard time, several steps must be completed first. The steps are as follows:

a. *Calculating Productive Working Hours (PWH)*. The calculation of productive working hours for one employee is as follows:

$$PWH = Productive\ Percentage \times Total\ Working\ Time \quad (1)$$

Total working time = 8 hours/day × 5 days × 60 minutes = 2,400 minutes
As example, for Employee 1 shift 1, PWH = 0.9065 × 2,400 = 2,175.6 minutes

b. *Calculating Cycle Time (Ws)*. The calculation of productive working hours for one employee is as follows:

$$Ws = PWH / (Number\ of\ Observations) \quad (2)$$

As example, for Employee 1 shift 1, *Ws* = 2,175.6/385 = 5.65 minutes

c. *Calculating Normal Time (Wn)*. The calculation of productive working hours for one employee is as follows:

$$Wn = Ws \times Rating\ Factor \quad (3)$$

As example, for Employee 1 shift 1, *Wn* = 5.56 × 1.16 = 6.55 minutes

d. *Calculating Standard Time.* The calculation of productive working hours for one employee is as follows:

$$W_b = W_n \frac{100}{100 \times allowance} \quad (4)$$

As example, for Employee 1 shift 1, *Wb* = 6.55 x (100/68) = 6.55 x 1.4796 = 9.6 minutes

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Table 7. Summary of standard time calculations

Shift	Employee	Productive Working Hours (PWH)	Ws (minutes)	Wn (minutes)	Wb (minutes)
1	1	2175.6	5.65	6.55	9.63
	2	2256.72	5.86	6.80	9.99
	3	2200.56	5.71	6.79	9.99
	4	2150.64	5.59	6.65	9.77
2	1	2175.6	5.65	6.55	9.63
	2	2194.32	5.70	6.61	9.71
	3	2194.32	5.70	6.78	9.97
	4	2219.28	5.76	6.85	10.07
3	1	2156.88	5.60	6.66	9.80
	2	2231.76	5.80	6.90	10.14
	3	2238.00	5.81	6.91	10.16
	4	2269.20	5.90	7.02	10.31

The workload calculation is influenced by the rating factor and allowance. It is considered normal and does not require repetition if the workload value is in the range of 70% to 100%. The workload calculation for one officer is as follows:

$$Workload = \%P \times (1 + rating\ factor) \times (1 + allowance) \quad (5)$$

As example, for Employee 1 shift 1, the *workload* = 0.9065 × (1 + 0.16) × (1 + 0.32) = 0.9065 × 1.16 × 1.32 = 138.77%.

Table 8. Summary of workload calculation results

Shift	Employee	Workload (%)
1	1	138.77
	2	143.91
	3	145.45
	4	142.04
2	1	138.77
	2	140.00
	3	145.02
	4	146.67
3	1	142.5
	2	147.53
	3	147.94
	4	149.93

Table 9. Summary of optimal number of employee calculation

Initial number of employee (people)	Initial workload (%)	Proposed number of employee (people)	Proposed workload (%)	Total employee (people)
12	144.04	6	96.03	18

Based on the analysis, it can be seen that the total workload experienced by Apron Movement Control officers is 144.04%, which is too high. Therefore, to reduce the workload, it is proposed to add six employee, bringing the total to 18, reducing the proposed workload to 96.03% of the normal standard.

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Conclusion

The workload faced by officers still far exceeds the ideal work standard. The average workload for all personnel reached 144.04%, meaning each officer must handle tasks exceeding their normal capacity. This indicates a workload overload that has the potential to cause fatigue, decreased concentration, and the risk of human error, which can compromise operational safety on the apron.

The high productivity levels, ranging from 89.61% to 94.55% of working time, do not necessarily reflect ideal conditions, as they must consider various allowance factors and additional pressures from the work environment. Data adequacy and uniformity tests have also proven that the observation results are valid and representative enough to serve as a basis for decision-making.

Recommendations. For Sentani International Airport in Jayapura, specifically the Apron Movement Control unit, it is recommended to increase the number of personnel to minimize the risk of excessive workload and maintain health and productivity. Furthermore, regular evaluations of the work environment and supporting facilities are needed, as well as ongoing training to improve the skills and preparedness of personnel to face operational challenges on the apron. By implementing these recommendations, it is hoped that AMC personnel performance will be optimized, and occupational safety and comfort can be guaranteed in accordance with applicable standards.

Further research is expected to expand the workload analysis by considering additional variables, such as stress levels, ergonomic factors, and the influence of the latest technology on apron operations. Furthermore, research can expand the scope of observations by involving a larger sample or conducting comparisons with other airports to obtain a more comprehensive picture of AMC personnel workload optimization. Research can also integrate qualitative methods to understand personnel perceptions and expectations of the work environment, allowing for the formulation of more holistic and sustainable solutions.

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