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FULL TIME EQUIVALENT - BASED WORKFORCE ANALYSIS OF HEAD TRUCK OPERATORS AT AMBON CONTAINER TERMINAL

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ABSTRAK

Terminal Petikemas Ambon memiliki peran penting dalam mendukung kelancaran aktivitas bongkar muat petikemas. Kinerja operasional terminal dipengaruhi oleh tingkat pemanfaatan tenaga kerja, khususnya operator Head Truck yang bertugas memindahkan petikemas antara dermaga dan container yard. Penelitian ini bertujuan menganalisis beban kerja operator Head Truck menggunakan metode Full Time Equivalent (FTE). Data diperoleh melalui observasi langsung, pengukuran waktu kerja dengan stopwatch time study, penilaian kinerja menggunakan metode Westinghouse, serta perhitungan waktu normal, waktu baku, dan waktu kerja efektif. Hasil penelitian menunjukkan total nilai FTE sebesar 17,82 dengan rata-rata FTE 0,74, yang mengindikasikan seluruh operator berada pada kategori underload. Hasil simulasi menunjukkan kebutuhan tenaga kerja optimal berkisar antara 17–18 operator, lebih rendah dibandingkan jumlah operator saat ini sebanyak 24 orang. Temuan ini menunjukkan perlunya optimalisasi pemanfaatan tenaga kerja dan pengurangan aktivitas menunggu untuk meningkatkan efisiensi operasional terminal.

Kata Kunci: *Beban Kerja, Full Time Equivalent, Head Truck, Tenaga Kerja, Terminal Petikemas.*

ABSTRACT

Ambon Container Terminal plays an important role in supporting container loading and unloading operations. Terminal performance is influenced by workforce utilization, particularly Head Truck operators responsible for transporting containers between the quay and the container yard. This study aims to analyze the workload of Head Truck operators using the Full Time Equivalent (FTE) method. Data were collected through direct observation, stopwatch time study, Westinghouse performance rating, and calculations of normal time, standard time, and effective working time. The results showed a total FTE value of 17.82 with an average FTE of 0.74, indicating that all operators were classified as underload. Simulation results suggested that the optimal workforce requirement ranged from 17 to 18 operators, lower than the current workforce of 24 operators. These findings highlight the need to optimize workforce utilization and reduce waiting activities to improve terminal operational efficiency.

Keywords: Key Words*: Workload, Full Time Equivalent, Head Truck, Workforce Utilization, Container Terminal.*

1. INTRODUCTION

Container terminals are critical logistics infrastructures that support the smooth flow of goods through container loading and unloading activities. The performance of a container terminal is determined not only by the capacity of its facilities and equipment but also by the effective utilization of human resources involved in operational activities Nizrina et al., 2024; Mazloumi dan van Hassel, 2021; Santoso et al., 2025). One of the key personnel in the loading and unloading process is the Head Truck operator, who is responsible for transporting containers between the quay and the container yard (Mathias et al., 2024).

The efficiency of container movement is highly dependent on the performance of Head Truck operators. An imbalance between workforce size and actual workload can lead to various operational issues. Insufficient staffing may result in worker fatigue, service delays, and reduced productivity. Conversely, excessive staffing can lead to low workforce utilization and increased operational costs (Imayanti et al., 2024; Lubis et al., 2025; Xie et al., 2024).

Ambon Container Terminal currently employs 24 Head Truck operators working across three shifts. Terminal operations involve container transportation activities within a container yard covering approximately 3.5 hectares. Although the number of operators is relatively large, it remains unclear whether the existing workforce matches the actual workload in the field. Therefore, an objective workload assessment is necessary to evaluate the level of workforce utilization.

One of the most widely used methods for workload assessment is the Full Time Equivalent (FTE) method. FTE is a quantitative workload measurement approach that evaluates workforce utilization by comparing the amount of work required to perform a job with the effective working time available to employees. The method converts workload into an equivalent number of full-time workers needed to complete a given task within a specified period. As a result, FTE provides an objective measure of staffing adequacy and workforce utilization. Based on commonly accepted classification criteria, FTE values below 1.00 indicate underload conditions, values between 1.00 and 1.28 indicate a normal workload condition, and values above 1.28 indicate overload conditions. Due to its ability to quantify workload and workforce requirements systematically, the FTE method has been widely applied in manufacturing, service, logistics, and transportation sectors to support workforce planning, resource allocation, and operational improvement (Utomo et al., 2025; Basuki et al., 2025).

Previous studies have demonstrated the effectiveness of the Full Time Equivalent (FTE) method in evaluating workforce requirements across various industrial sectors. However, studies focusing on workforce utilization in container terminal operations, particularly those involving Head Truck operators in archipelagic regions, remain limited. The operational characteristics of container terminals differ from those of many other industries because workforce performance is highly influenced by the interaction between transportation equipment, container handling facilities, and terminal traffic conditions. Therefore, this study aims to assess the workload of Head Truck operators at Ambon Container Terminal using the Full Time Equivalent (FTE) method. The main contribution of this research is the provision of empirical evidence regarding workforce utilization in container handling operations and the identification of workload conditions that may affect operational efficiency. In addition, the study demonstrates the applicability of the FTE method in evaluating workforce performance within container terminal environments. The findings are expected to support management decision-making related to workforce allocation, utilization, and operational improvement (Taufan et al., 2023; Kurniawan et al., 2022; Mazitah et al., 2023).

2. METHODS

This study employed a quantitative approach using work measurement techniques to evaluate the workload of Head Truck operators at Ambon Container Terminal. Data were collected through direct observation, company documentation, and stopwatch time study of operational activities. The research involved 24 Head Truck operators working in three operational shifts. Observations focused on container transportation activities between the quay and the container yard, including loading, unloading, and travel movements within the terminal area.

The workload analysis was conducted using the Full Time Equivalent (FTE) method. The research procedure began with measuring cycle time for each work activity through repeated observations. Subsequently, operator performance was assessed using the Westinghouse Rating System, which considers skill, effort, working conditions, and consistency. The obtained rating factors were used to calculate normal time. Allowances were then determined to account for personal needs, fatigue, and unavoidable delays, enabling the calculation of standard time for each activity.

Effective working time was calculated based on the total available working hours after deducting allowance factors for each shift. Finally, the FTE value was determined by comparing the total workload with the effective working time available. The resulting FTE values were classified into three categories: underload (0.00–0.99), normal (1.00–1.28), and overload (>1.28). The analysis results were used to evaluate the workload level and workforce utilization of Head Truck operators at Ambon Container Terminal.

In this study, the Full Time Equivalent (FTE) value was calculated by comparing the total workload required to perform operational activities with the effective working time available to each operator. The workload was represented by the standard time obtained from work measurement procedures, while the effective working time was determined after considering allowances for personal needs, fatigue, and unavoidable delays. The resulting FTE values were then classified into underload, normal, and overload categories to evaluate the extent to which the available workforce capacity was utilized in terminal operations.

3. RESULT AND DISCUSSION

a. Work Measurement Results

Work measurements were conducted on all Head Truck operators involved in container handling activities at Ambon Container Terminal. The observed work elements consisted of container loading at the quay, loaded travel to the container yard, loading and unloading activities at the container yard, and empty travel back to the quay. Time measurements were performed repeatedly using a stopwatch time study method to obtain representative cycle times for each work activity.

Table 1. Workstation Description

Workstation	Symbol
Port Wharf (Loading Container to Container Yard Transport)	K1
Loaded Trip to Container Yard (CY)	K2
Container Yard (Loading/Unloading Operations at CY)	K3
Empty Return Trip to Wharf	K4
Container Yard (Loading/Unloading Operations at CY)	K5
Loaded Trip to Wharf	K6

The observation results indicated variations in cycle times among operators and workstations. These differences were influenced by operational conditions, travel distances, equipment availability, and traffic conditions within the terminal area. In general, loaded travel and container handling activities at the container yard required a relatively longer duration than other work elements, indicating their significant contribution to the total working time.

Table 2. Average Work Measurement Results

Operator	Total Calculation for the 10th Day							
	K1	K2	K3	K4	K5	K6	K7	K8
1	340	213	278	157	272	209	348	166
2	345	214	281	159	275	210	351	167
3	346	220	284	159	276	211	354	168
4	346	217	282	159	274	210	352	167
5	343	214	280	158	273	210	351	167
6	344	220	281	161	274	211	352	168
7	341	217	280	158	274	210	351	168
8	349	221	290	164	282	215	360	171
9	360	224	293	165	286	219	367	174
10	360	223	294	166	286	219	366	175
11	358	224	294	165	285	219	366	175
12	358	224	292	168	285	219	365	175
13	353	222	289	164	282	216	361	173
14	355	225	286	163	280	215	360	171
15	353	223	289	163	280	215	359	172
16	350	222	285	163	278	214	356	170
17	352	223	286	160	277	212	356	169
18	343	218	281	159	271	207	351	166
19	341	219	279	157	272	207	350	167
20	339	214	272	156	267	204	345	164
21	342	218	277	156	271	207	350	166
22	344	217	279	158	271	207	351	166
23	341	221	280	158	272	207	350	167
24	339	221	276	159	269	206	347	166

b. Allowance Determination

Allowances were determined to account for personal needs, fatigue, and unavoidable delays experienced during work activities. The allowance assessment considered several factors, including physical effort, working posture, movement patterns, lighting conditions, temperature, atmospheric conditions, workplace environment, and unavoidable interruptions.

Table 3. Allowance Factors for Head Truck Operators

Allowance	Shift		
	Morning Shift	Afternoon Shift	Night Shift
Energy Expended	4%	4%	4%
Work Attitude	2%	2%	2%
Work Movement	2%	2%	2%
Indoor Lighting	1%	1%	2%
Temperature Conditions	2%	3%	2%
Atmospheric Conditions	1%	1%	1%
Environmental Conditions	1%	1%	2%
Complementary	1%	1%	1%
Total	**14%**	**15%**	**16%**

The results showed that the allowance values differed across shifts. The morning shift received an allowance of 14%, while the afternoon and night shifts received allowances of 15% and 16%, respectively. The higher allowance values for later shifts reflected the increased physical and environmental demands experienced by operators.

c. Cycle Time Analysis

Cycle time represents the average time required to complete a work cycle from start to finish. Based on the observation results, cycle times varied among operators due to differences in operational circumstances during the observation period.

The following is the cycle time calculation for Operator 1 at the first workstation:

$$Cycle\ Time = \frac{\sum x_i}{N} \tag{1}$$

$$Cycle\ Time = \frac{340}{10}$$

$$\text{Cycle Time} = 34.00$$

where:

$$\frac{\sum x_i}{N} = \text{Total observed time} \tag{2}$$

N = Number of observations

Based on the cycle time calculations obtained for each operator, the results were subsequently presented in graphical form to illustrate the differences in operator working times during the morning, afternoon, and night shifts, as shown in the following figure.

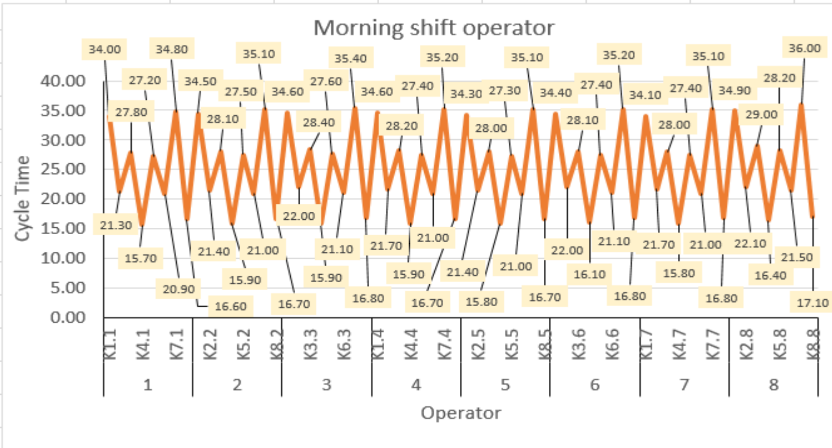

Figure 1. Cycle Time of Morning Shift Operators

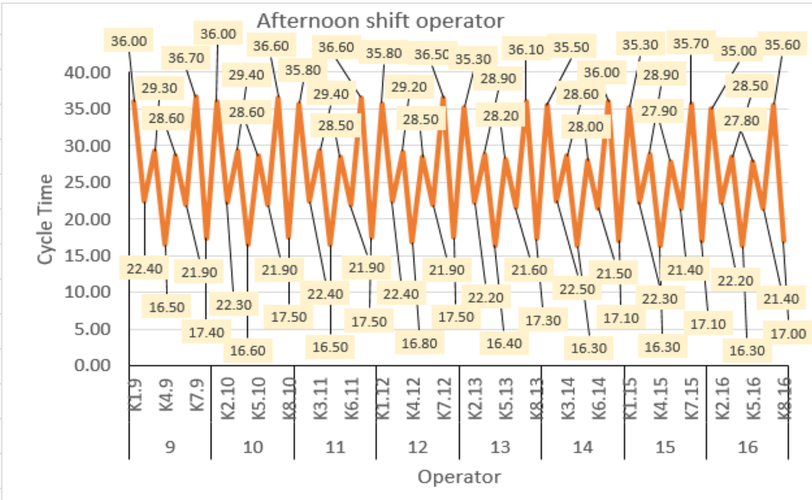

Figure 2. Cycle Time of Afternoon Shift Operators

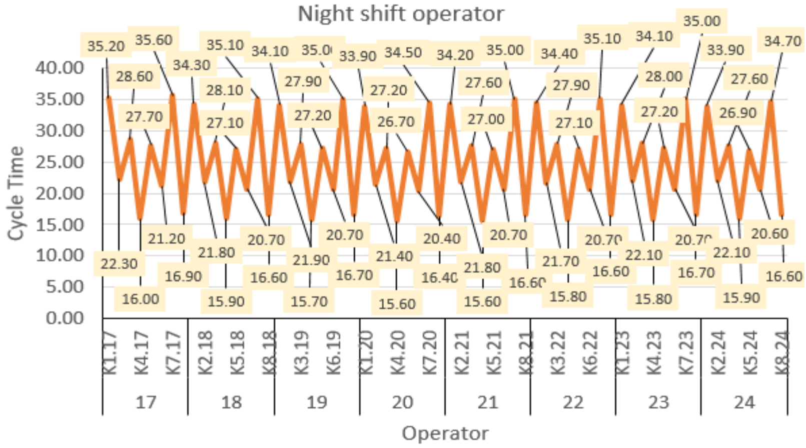

Figure 3. Cycle Time of Night Shift Operators

The cycle time analysis revealed that operational delays and waiting periods contributed significantly to variations in work duration. Activities involving container transportation between the quay and the container yard accounted for a substantial portion of the overall cycle time.

d. Normal Time Analysis

Normal time was calculated by multiplying the observed cycle time by the performance rating obtained through the Westinghouse Rating System. The performance evaluation considered operator skill, effort, working conditions, and consistency during task execution. Normal time is calculated using the following formula:

$$WN = WS \times RT \quad (3)$$

Substituting the observed values:

$WN = 34.00 \times 1.13$

$WN = 38.420$

where:

WN = Normal Time

WS = Observed Working Time

RT = Rating Factor

Based on the normal time calculations obtained for each operator, the results were subsequently presented in graphical form to illustrate differences in operator working times across the morning, afternoon, and night shifts, as shown in the following figure.

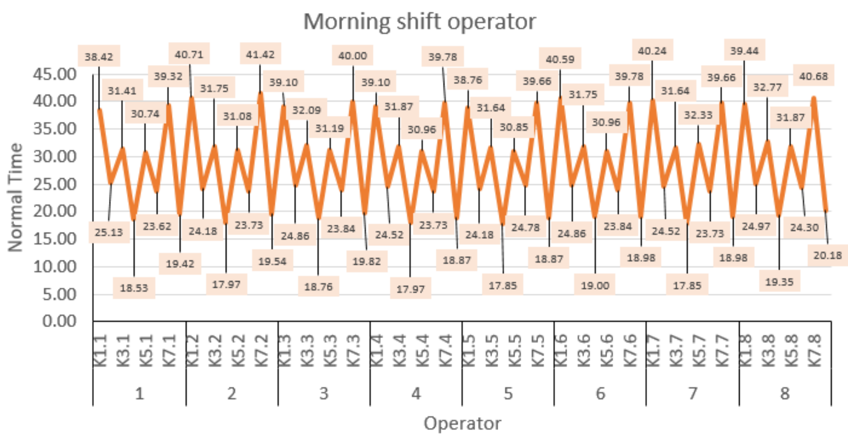

Figure 4. Normal Time of Morning Shift Operators

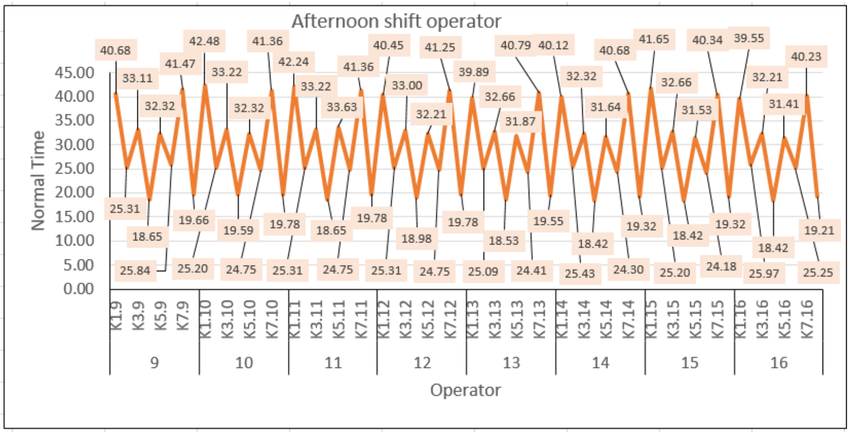

Figure 5. Normal Time of Afternoon Shift Operators

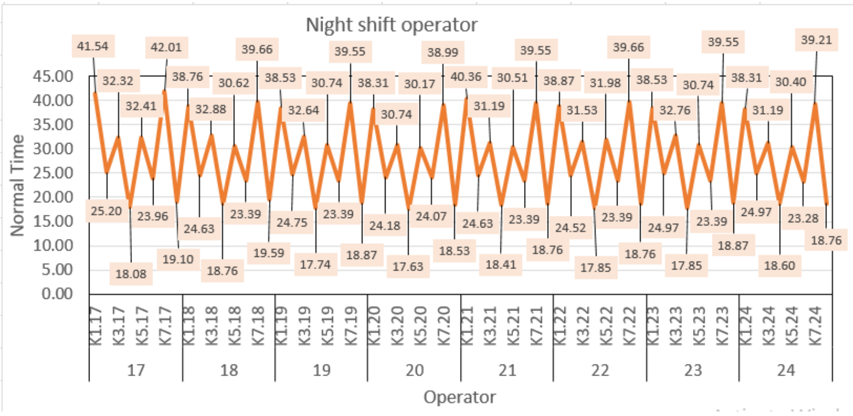

Figure 6. Normal Time of Night Shift Operators

e. Standard Time Analysis

Standard time was subsequently determined by incorporating allowance factors into the normal time calculations. The resulting standard times reflected the actual time required by operators to perform their tasks under normal working conditions while accounting for fatigue and unavoidable interruptions. The analysis indicated relatively consistent standard times among operators, suggesting that the work procedures and operating conditions were generally standardized throughout the terminal.

The standard time can be calculated using the following formula:

$$ST = NT + (NT \times A) \tag{4}$$

where:

- **ST** = Standard Time
- **NT** = Normal Time
- **A** = Allowance Factor

Substituting the calculated values:

$$ST = 38.420 + (38.420 \times 0.14)$$
$$ST = 38.420 + 5.38$$
$$ST = 43.80$$

Based on the standard time calculations obtained for each operator, the results were subsequently presented in graphical form to illustrate the differences in operator working times across each shift. The comparison of standard times for the morning, afternoon, and night shifts is shown in the following figure.

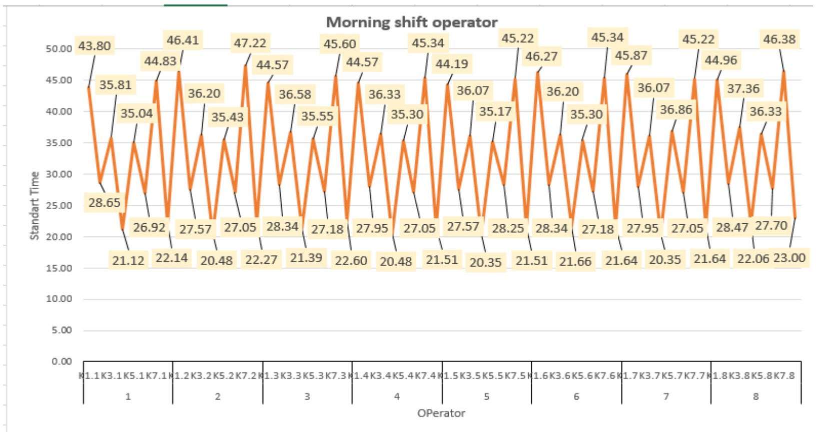

Figure 7. Standard Time of Morning Shift Operators

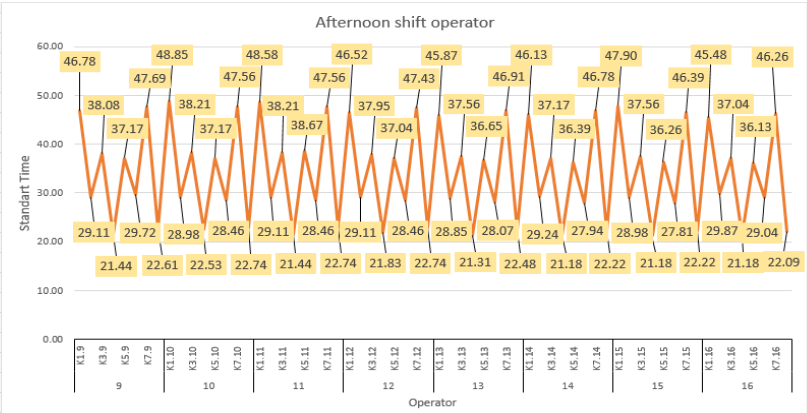

Figure 8. Standard Time of Afternoon Shift Operators

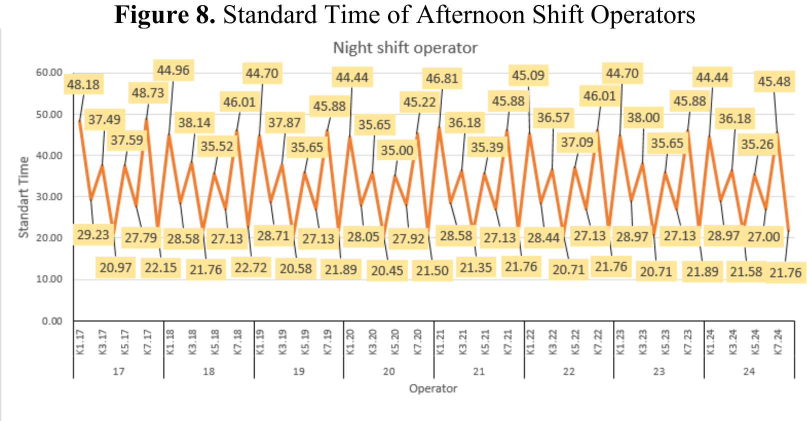

Figure 9. Standard Time of Night Shift Operators

f. Effective Working Time

The company applies a working schedule of seven hours per shift, equivalent to 420 minutes per day. Effective working time was obtained by subtracting allowance values from the total available working time.

Full-Time Equivalent (FTE) was obtained by dividing the standard time by the effective working time, as shown in the following equation:

$$FTE = \frac{\text{Standard Time}}{\text{Effective Working Time}} \tag{5}$$

where:

- FTE = Full-Time Equivalent

- Standard Time = Standard working time required to complete a task
- Effective Working Time = Actual available working time after considering allowances and non-productive activities

The calculations showed that the effective working times were 361.2 minutes for the morning shift, 357 minutes for the afternoon shift, and 352.8 minutes for the night shift. These values served as the basis for calculating the Full Time Equivalent (FTE) index.

Based on the FTE calculations for each operator, the results were subsequently presented in graphical form to illustrate the differences in workload levels across the morning, afternoon, and night shifts, as shown in the Table 4.

Table 4. Effective Working Time Calculation

Operator	FTE Index								$\sum FTE$
	K1	K2	K3	K4	K5	K6	K7	K8	
1	0,12	0,08	0,10	0,06	0,10	0,07	0,12	0,06	0,72
2	0,13	0,08	0,10	0,06	0,10	0,07	0,13	0,06	0,73
3	0,12	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,72
4	0,12	0,08	0,10	0,06	0,10	0,07	0,13	0,06	0,72
5	0,12	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,72
6	0,13	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,73
7	0,13	0,08	0,10	0,06	0,10	0,07	0,13	0,06	0,72
8	0,12	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,74
9	0,13	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,76
10	0,14	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,77
11	0,14	0,08	0,11	0,06	0,11	0,08	0,13	0,06	0,77
12	0,13	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,76
13	0,13	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,75
14	0,13	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,75
15	0,13	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,75
16	0,13	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,75
17	0,14	0,08	0,11	0,06	0,11	0,08	0,14	0,06	0,77
18	0,13	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,75
19	0,13	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,74
20	0,13	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,73
21	0,13	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,75
22	0,13	0,08	0,10	0,06	0,11	0,08	0,13	0,06	0,74
23	0,13	0,08	0,11	0,06	0,10	0,08	0,13	0,06	0,75
24	0,13	0,08	0,10	0,06	0,10	0,08	0,13	0,06	0,74
Total Indeks FTE									17,81
Rata-rata Indeks FTE									0,74

g. Full Time Equivalent (FTE) Analysis

The workload of Head Truck operators was evaluated using the Full Time Equivalent (FTE) method. The results showed that the total FTE value for all operators was 17.82, with an average FTE value of 0.74.

Based on the FTE index summary table, all operators have FTE values ranging from 0.72 to 0.77. Therefore, all operators are classified as being in an underload condition, which indicates that: 1) the workload is lower than the effective working capacity, and 2) the number of operators exceeds the actual labor requirement.

The average FTE was calculated as follows:

$$\text{Total FTE of 24 operators} = 17.81$$

$$n = 24 \text{ operators}$$

$$\text{Average FTE} = \frac{17.81}{24}$$

$$\text{Average FTE} = 0.74$$

The average FTE value of 0.74 indicates that the workload assigned to the 24 operators is below the standard workload level (FTE < 1.0). This result suggests that the current workforce exceeds the actual operational requirement, indicating an overstaffing condition and the need for workforce reduction.

Based on the total FTE value of 17.81, the optimal workforce requirement can be estimated using the following formula:

$$\text{Optimal Number of Operators} = \frac{\text{Total FTE}}{\text{Target FTE per Operator}} \tag{6}$$

Assuming the target workload is 1.0 FTE per operator, the optimal number of operators is calculated as:

$$\text{Optimal Number of Operators} = \frac{17.81}{1.0}$$

$$\text{Optimal Number of Operators} \approx 18 \text{ operators}$$

Therefore, the operation requires approximately 18 operators to achieve a balanced workload distribution. Compared with the current workforce of 24 operators, this indicates a surplus of 6 operators.

To determine the most appropriate number of head truck operators, an FTE simulation was conducted. The simulation results are presented in the following table.

Table 5. FTE Calculation Results

Number of Operators	FTE Simulation	Optimal Number of Operators	Status
24	17,82/24	0,74	*Underload*
23	17,82/23	0,77	*Underload*
22	17,82/22	0,81	*Underload*
21	17,82/21	0,85	*Underload*
20	17,82/20	0,89	*Underload*
19	17,82/19	0,94	*Underload*
18	17,82/18	0,99	*Underload*
17	17,82/17	1,05	Normal
16	17,82/16	1,11	Normal
15	17,82/15	1,19	Normal
14	17,82/14	1,27	Normal
13	17,82/13	1,37	*Overload*
12	17,82/12	1,49	*Overload*

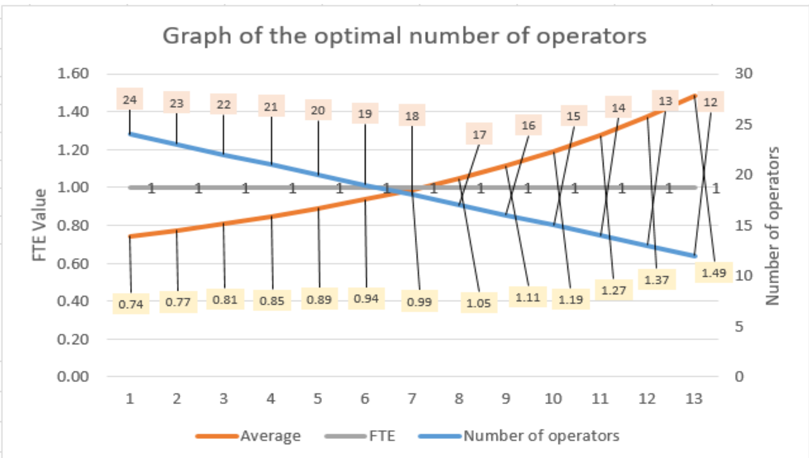

Figure 10. Distribution of FTE Values among Operators

h. Discussion

The average FTE value of 0.74 indicates that the workload assigned to Head Truck operators is lower than their effective working capacity. According to the FTE classification, this condition falls within the underload category, suggesting that workforce utilization at Ambon Container Terminal has not yet reached an optimal level.

The underload condition observed in this study does not necessarily imply poor operator performance. Instead, it reflects an imbalance between available workforce capacity and actual operational workload. Container terminal operations involve strong interdependencies among equipment, transportation units, and handling activities. Consequently, operator productivity is highly influenced by the overall operational system rather than individual performance alone (Sitompul, 2023; Cho et al., 2023).

Field observations revealed that a considerable amount of working time was spent on waiting activities. These waiting periods occurred when operators had to wait for quay crane operations, container yard handling processes, or access to congested terminal routes. Such non-value-added activities reduced the effective utilization of operator working time and contributed to the relatively low FTE values (Garmouch et al, 2025; Nurcahyo et al., 2020).

The findings are consistent with previous workload studies that reported underutilization of labor resources when operational delays and idle times were prevalent (Purnama and Haryanto, 2026; Badshah et al., 2024; Giotopoulos et al., 2024). Therefore, efforts to improve operational efficiency should focus on reducing waiting times, improving coordination between handling equipment and transportation units, and optimizing workflow within the terminal. These improvements could increase workforce productivity without requiring additional labor resources. These results are in line with the findings of Sundari et al. (2024), who highlighted the importance of integrating workflow strategies with effective resource management practices to enhance operational efficiency and support the achievement of sustainable competitive advantage.

From a managerial perspective, the results provide valuable information for evaluating workforce utilization and identifying opportunities to improve operational performance (Tessema et al., 2025). The FTE method proved to be an effective tool for assessing workload conditions and supporting workforce management decisions in container terminal operations.

4. CONCLUSION

This study evaluated the workload of Head Truck operators at Ambon Container Terminal using the Full Time Equivalent (FTE) method. The results showed that the total FTE value was 17.82, with an average FTE value of 0.74. Based on the FTE classification, all operators were categorized as underload, indicating that the available workforce capacity exceeded the actual workload requirements.

The findings suggest that the current utilization of Head Truck operators has not yet reached an optimal level. FTE simulation results indicated that a workforce of approximately 17–18 operators would be sufficient to achieve a balanced workload, compared with the current workforce of 24 operators. This finding implies that there is potential for workforce optimization while maintaining operational performance.

Therefore, efforts to improve operational efficiency should focus on optimizing workforce utilization, reducing non-value-added activities, and improving coordination within container handling operations. Future studies may further investigate operational bottlenecks and their effects on workforce productivity and overall terminal performance.

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