International Journal of Economics, Business and Management Research

Vol. 7, No.10; 2023

ISSN: 2456-7760

Comparative Analysis of Track Access Charge (TAC) Calculation Using Full Costing and Pricing Methods for Cement Train in Java

Candy Alfan Hermawan[1], Djuminah[2]

[1]Sebelas Maret University, Faculty of Economics and Business,
Ir. Sutami Road, Surakarta57126, Indonesia

[2]Faculty of Economics and Business, Sebelas Maret University,
Ir. Sutami Road, Surakarta 57126, Indonesia

doi.org/10.51505/IJEBMR.2023.71006 URL: https://doi.org/10.51505/IJEBMR.2023.71006

Received: Aug 13, 2023 Accepted: Sep 20, 2023 Online Published: Oct 13, 2023

Abstract

Train operators that utilize state-owned railway infrastructure are obliged to pay a Track Access Charge (TAC). In Indonesia, the TAC formula employed is based on the full costing method. However, this TAC calculation formula does not currently accommodate the policies of multiple operators with varying types of train services and infrastructure. An alternative method for calculating TAC, known as the pricing method is available. In this research, TAC calculations were performed using both the full costing and pricing methods for freight trains in the Java region. From the TAC calculations using both methods, a comparison was made to determine the differences in the results, providing insights and references to the government in formulating policies and regulations related to the development of a relevant TAC formula for railway operators. The full costing method's TAC calculation is contingent on priority factors, while the pricing method's TAC calculation depends on axle load, axle count, unsprung mass, and train speed. Components of the pricing method's calculation directly influence the impact on railway infrastructure damage. In conclusion, the pricing method for TAC is considered fairer and more pertinent for all railway operators when making TAC payments to the government.

Keywords: track access charge, full costing method, pricing method, multi-operators

1. Introduction

In 2007, the government enacted Law Number 23 of 2007 concerning Railways, which allowed Regional Governments and private entities to participate in the development of railway services in Indonesia. This was evidenced by the emergence of new railway operators by private entities, including PT Jakarta Propertindo (JAKPRO), MRT Jakarta, and Servo Railway. However, the presence of these new railway operators has raised new challenges related to the Track Access Charge (TAC) for railway infrastructure usage, as the existing formula is less suitable for a multi-operator system in Indonesia.

According to the Regulation of the Minister of Transportation of the Republic of Indonesia Number 62 of 2013, TAC is the fee that must be paid by railway service providers for using

Vol. 7, No.10; 2023

ISSN: 2456-7760

railway infrastructure as railway operators. The TAC formula, as per the Government Regulation of the Republic of Indonesia Number 15 of 2016, has been simplified to TAC = Fp × IMO, where Fp (priority factor) is a constant with a maximum value of 0.75 determined by the Minister of Transportation. The term IMO (Infrastructure Maintenance and Operation) refers to the cost of maintenance and operation of state-owned railway infrastructure, which the government provides to PT KAI through an annual contract mechanism used to finance all maintenance and operational activities of the infrastructure to support the reliability and smooth operation of train journeys.

In practice, apart from the TAC calculation using the full costing method, there exists another method known as the pricing method. In a previous study, Jannah and Mutohar (2018) had already conducted research using both of these methods for container trains. In the present study, the focus has shifted to freight trains transporting cement, building upon the previous research. The cement freight train was selected based on the following considerations: 1) Cement freight volume is higher than that of container trains (as depicted in Figure 1), 2) Cement freight has more loading and unloading locations compared to container trains, 3) The research on cement freight trains was conducted in 2019 when an IMO contract had already been agreed upon between the government and PT KAI, 4) TAC payments to the government had been made based on the IMO costs provided to PT KAI according to the prevailing TAC calculation regulations at that time, 5) Cement freight trains were chosen as the sample, representing both loaded and empty cargo. Thus, it can be concluded that cement freight trains have distinct business processes compared to container trains.

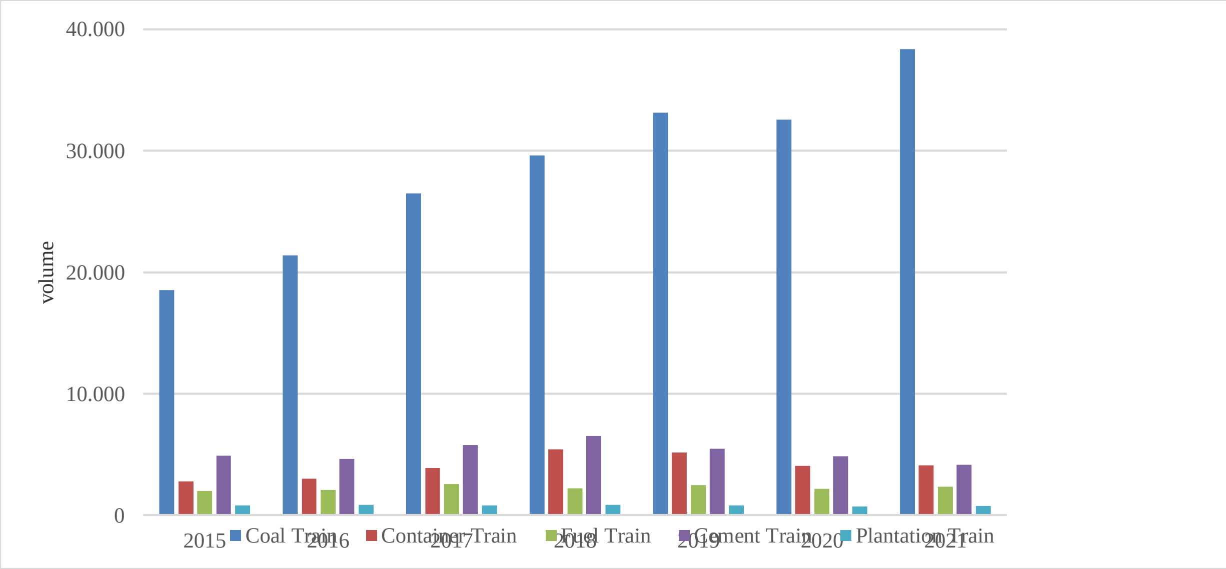

Figure 1. Comparison of Freight Train Volume in Java and Sumatera

Source: PT Kereta Api Indonesia (Persero)

Following the enactment of the Republic of Indonesia Law Number 23 of 2007 concerning Railways, the government embarked on a restructuring process, aiming to develop a comprehensive national transportation system. The administration of railways has demonstrated an increasingly vital role in supporting economic activities, notably through the involvement of Regional Governments and private entities to advance the national railway system. Another new policy introduced was the establishment of the TAC. This required railway operators, both public and private, utilizing railway infrastructure to pay the TAC.

This policy is governed by the Regulation of the President of the Republic of Indonesia Number 53 of 2012, as amended by Regulation of the President of the Republic of Indonesia Number 124 of 2015. It is important to note that the TAC scheme is intricately linked with the financing of Public Service Obligations (PSO) and Infrastructure Maintenance and Operation (IMO), as illustrated in Figure 2. In this context, the Ministry of Transportation, on behalf of the government, provides subsidies to the public for the services of economy-class railway (PSO) The fares for economy-class trains are determined by the government. The government is responsible to subsidize any difference between the fares set by the government and those set by PT KAI, ensuring that the prices of economy-class train tickets remain affordable for the public. Similarly, regarding Infrastructure Maintenance and Operation (IMO) costs, it falls upon the government to provide funding for the maintenance and operation of railway infrastructure. Currently, as a railway infrastructure operator has not been established, the Ministry of Transportation has assigned PT KAI the task of conducting maintenance and operation activities for state-owned railway infrastructure to ensure its reliability and the smooth operation of train journeys. In return for the IMO cost provided by the Ministry of Transportation, PT KAI is obligated to pay the TAC. According to the Government Regulation of the Republic of Indonesia Number 15 of 2016, the TAC paid by railway operators (PT KAI) constitutes Non-Tax State Revenue (PNBP) for the Ministry of Transportation. As stipulated in the Regulation of the Minister of Transportation of the Republic of Indonesia Number 17 of 2018, the TAC is one of the components that make up the operating costs used in calculating Public Service Obligation (PSO) tariffs.

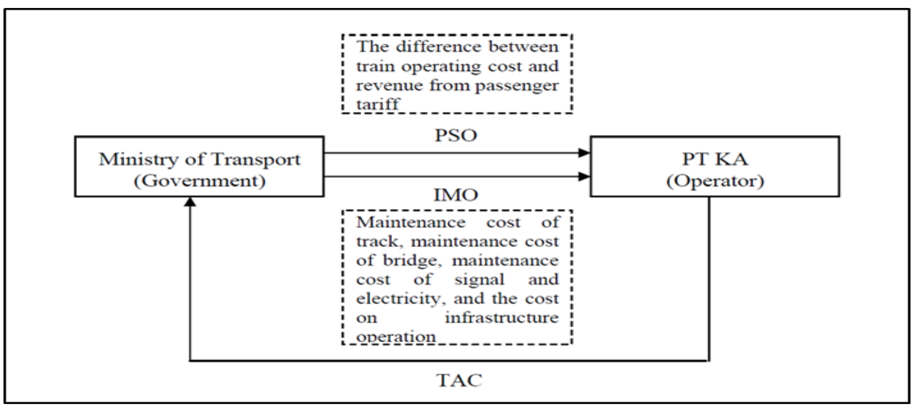

Figure 2. PSO, IMO, and TAC payment scheme in Indonesia
Source: Muthohar, Sumi, and Sutomo (2010)

The constant factor of priority (Fp), with a maximum value of 0.75 as stipulated by Government Regulation of the Republic of Indonesia Number 15 of 2016, applies to all types of railway services, including both passenger and freight transportation. According to Mayang and Mutohar (2016), the TAC formula based on the priority factor is less flexible for a multi-operator railway

Vol. 7, No.10; 2023

ISSN: 2456-7760

system. This is because the types of railway services and the loads carried by trains will always vary. Additionally, the presence of new railway operators with different types of rolling stock and railway infrastructure will result in varying degrees of infrastructure wear and tear.

The research objectives are as follows:

First, to determine the differences in TAC calculation results between the full costing method and the pricing method.

Second, to identify the tendency for TAC calculation results using the full costing method to be larger than the pricing method.

Third, to ascertain whether TAC calculation using the pricing method can provide fairer and more relevant results according to the type of railway service and infrastructure used compared to the full costing method.

Fourth, to explore whether the pricing method calculation can serve as an alternative TAC calculation method within the multi-operator system in Indonesia.

Theoretical benefits of this research are expected to provide insights and information regarding the comparative analysis of the calculation of Track Access Charge (TAC) for cement trains in Java between the full costing method and the pricing method. On a practical level, the research is anticipated to serve as a reference for the government, particularly the Ministry of Transportation, in formulating policies and regulations related to the calculation of Track Access Charge (TAC) within the multi-operator system in Indonesia.

2. Method

This research employed a quantitative descriptive method to compare the calculations of Track Access Charges (TAC) using the full costing and pricing methods for cement train transportation in Java. According to Yusuf (2017), quantitative descriptive research is conducted to provide answers to a research question, aiming to gain a broader understanding of a phenomenon using a quantitative approach. The data used in this study were secondary data from 2019. Data were obtained from PT KAI and the Directorate General of Railways (DJKA) under the Ministry of Transportation. They included information on the characteristics of railway infrastructure, train numbers, train configurations, travel distances, operational speeds, and railway infrastructure maintenance and operation (IMO) costs. The research location covered the railway routes used by cement trains in the Java region, including: Operational Region (hereafter, Daop) 1 Jakarta, Daop 3 Cirebon, Daop 4 Semarang, Daop 5 Purwokerto, Daop 6 Yogyakarta, Daop 8 Surabaya, and Daop 9 Jember. As per the railway travel graph, there are no cement train routes passing through Daop 2 Bandung and Daop 7 Madiun. From the obtained data, data analysis techniques were applied using the TAC calculation method, which includes:

2.1 Full Costing Method

The full costing method is a cost determination approach that takes into account all production costs (Ramdhani, et al., 2020). According to Iryanie and Handayani (2019), full costing is a method for determining the cost of goods produced by incorporating all production costs. Mulyadi (2014:17) defines full costing as a method for determining the cost of goods produced, which includes raw material costs, direct labor costs, and factory overhead costs, both variable and fixed. In conclusion, the full costing method can be understood as a cost allocation method that considers all costs used in production.

As mentioned by Jannah and Muthohar (2018), the calculation of TAC based on Government Regulation of the Republic of Indonesia Number 15 of 2016 employs the full costing method. This aligns with the statement by Sukmalalana and Oktaviani (2022) that the TAC calculation method adopts the full costing approach. Therefore, in its calculation, TAC allocates all the necessary costs for the maintenance of railway infrastructure, which include maintenance costs, operational costs, and depreciation of railway infrastructure.

The TAC formula is based on the Regulation of the Minister of Transportation of the Republic of Indonesia Number 122 of 2015, as amended by the Government Regulation of the Republic of Indonesia Number 15 of 2016, with the calculation formula as follows:

a. Component cost of railway infrastructure usage per operational region/regional division (hereafter, Daop/Divre)

$$IM_{Daop/Divre} = \frac{\text{Annual Total Railway Infrastructure Maintenance per Daop/Divre}}{\sum_{j=1}^{j=n} \text{Passing Tonnage}_j \text{ x Corridor Length Daop/Divre according to route}} \quad (1)$$

$$IO_{Daop/Divre} = \frac{\text{Annual Total Railway Infrastructure Operation per Daop/Divre}}{\sum_{j=1}^{j=n} \text{Passing Tonnage}_j \text{ x Corridor Length Daop/Divre according to route}} \quad (2)$$

$$ID_{Daop/Divre} = \frac{\text{Annual Total Railway Infrastructure Depreciation per Daop/Divre}}{\sum_{j=1}^{j=n} \text{Passing Tonnage}_j \text{ x Corridor Length Daop/Divre according to route}} \quad (3)$$

$$TAC_{Daop/Divre} = \frac{\text{Annual Total Track Access Charge per Daop/Divre}}{\sum_{j=1}^{n} \text{Passing Tonnage}_j \text{ x Corridor Length Daop/Divre according to route}} \quad (4)$$

b. Total cost of railway infrastructure usage (TAC) per Daop/Divre

$$TAC_{Daop/Divre} = IM_{Daop/Divre} + IO_{Daop/Divre} + ID_{Daop/Divre} \quad (5)$$

c. Total cost of railway infrastructure usage (TAC) per train number

$$TAC_{KA} = \left[GT_{KA} \text{ x } \sum_{i=1} KM_{KA} \text{ x } TAC_{Daop/Divre_i}\right] \text{ x } F_p \quad (6)$$

Description:

KA: Name of the calculated train for TAC

i:	Sequence of Daop/Divre traversed by the train; i = 1, 2, …, n
TAC_{KA}:	Cost of using railway infrastructure charged for one train journey (Rp)
GT_{KA}:	Weight of the train based on configuration plus cargo weight (GT/gross ton)
KM_{KA}:	Length of the train's track in Daop/Divre-i traversed (km)
$TAC_{Daop/Divre\,i}$:	Cost of using railway infrastructure per GTKM in Daop/Divre-i (Rp/GT-KM)
Fp:	Priority factor, with a maximum value of 0.75
$IM_{Daop/Divre}$:	Maintenance cost of railway infrastructure per Daop/Divre (Rp/GT-KM)
$IO_{Daop/Divre}$:	Operating cost of railway infrastructure per Daop/Divre (Rp/GT-KM)
$ID_{Daop/Divre}$:	Depreciation cost of railway infrastructure per Daop/Divre (Rp/GT-KM)
j:	Name of jth train passing through Daop/Divre, where j =1, 2, …, n
Passing tonnage$_j$:	Weight of train j based on configuration plus cargo weight passing through Daop/Divre (GT/gross ton)
Corridor length$_j$:	Length of train j's track in Daop/Divre according to service route (km)

2.2 Pricing Method

Pricing strategy is a method used to determine the price of products or services (Nisa, 2022). Pricing methods are a fundamental element in determining a company's profit and competitiveness in the market. Pricing methods require clear objectives, methods, and appropriate strategies to help select the right price that can maximize profits while considering market demand and consumer preferences. Pricing methods are a suitable solution for achieving price stability that can foster healthy competition.

According to Haksari (2022), cost-oriented pricing methods consist of three approaches, including: 1) Markup Pricing: This method involves increasing the price or adding a certain amount of cost to the total cost to arrive at the final price; 2) Cost-Plus Pricing: This pricing method calculates production costs and adds a fixed percentage. This method takes into account direct material costs, overhead costs, and labor costs. 3) Target-Returning Pricing: This pricing method calculates the price needed to achieve the desired profit.

In the TAC research conducted by Muthohar & Sumi (2010), the pricing method is defined as the method for calculating TAC developed based on tariff methods in the Mini-MARPAS model for variable usage charging methodology. Mini-MARPAS is a computer model developed in the late 1980s based on extensive research on railway track damage (Nash and Bryan, 2002). This method also considers the mode of transportation used and the type of track to calculate the impact on maintenance, asset lifespan, and data on maintenance activity costs to obtain the overall maintenance cost. The pricing method in the mini-MARPAS model has been modified with calculation methods based on the Indonesian railway system.

The modified formula for calculating TAC using the pricing method, adapted to the conditions of the railway system in Indonesia (Muthohar & Sumi, 2010), is elaborated as follows:

Vol. 7, No.10; 2023

ISSN: 2456-7760

a. Track Usage Charge (TUC) cost

1) Track EGTM

$$EGTM = K \times C_t \times A^{0,49} \times S^{0,64} \times USM^{0,19} GTM \quad (7)$$

$$K = \frac{\text{Average track maintenance cost per km per year}}{\sum EGTM_{annually}} \quad (8)$$

2) Structure EGTM

$$EGTM = L \times C_t \times A^{3,83} \times S^{1,52} GTM \quad (9)$$

$$L = \frac{\text{Average structure maintenance cost per km per year}}{\sum EGTM_{annually}} \quad (10)$$

b. Signal, Telecommunication, and Electricity usage (SUC) cost

$$SUC_{Daop/Divre} = \frac{\text{SUC maintenance cost per year per Daop/Divre}}{\sum \text{Corridor length per year per Daop/Divre}} \quad (11)$$

c. Infrastructure Operation (IO) cost

$$IO_{Daop/Divre} = \frac{\text{Infrastructure operating cost per year per Daop/Divre}}{\sum \text{Corridor length per year per Daop/Divre}} \quad (12)$$

d. Total TAC per Daop/Divre

$$TAC_{Daop} = TUC_{Daop} + SUC_{Daop} + IO_{Daop} \quad (13)$$

e. TAC calculation per train

$$TAC_{KA} = \sum_{i=1}^{n} \left(\left(TUC_{KA_i} + SUC_{Daop_i} + IO_{Daop_i} \right) \times KM_{KA_i} \right) \quad (14)$$

Where:

K: Variable parameter for track maintenance cost per km per year

L: Variable parameter for structure maintenance cost per km per year

C_t: 0.89 for locomotive-drawn vehicles; 1.00 for other vehicles

A: Axle load (ton)

S: Operating speed (km/h)

USM: Unsprung mass (kg/axle)

TAC_{KA}: Cost of using railway infrastructure charged for one train journey (Rp)

i: Sequence of Daop/Divre traversed by the train; i = 1, 2, …, n

KM_{KAi}: Length of the train's track in Daop/Divre-i traversed (km)

Vol. 7, No.10; 2023

ISSN: 2456-7760

According to Jannah & Muthohar (2018), the calculation of TAC using the full costing method and the pricing method shares similarities and differences in their components, which can be observed in Table 1.

Table 1. Comparison of similarities and differences in the components of TAC calculation between the full costing and pricing methods

Calculation Components	Full costing method	Pricing method
Train Characteristics:		
a. Train weight	√	√
b. Axle load	-	√
c. Axle count	-	√
d. Unsprung mass	-	√
Train name	√	√
Train configuration	√	√
Travel distance	√	√
Train speed	-	√
IMO costs	√	√

Source: Jannah & Muthohar (2018)

These two methods also differ in the IMO cost calculation. When calculating TAC using the full costing method, the Infrastructure Maintenance and Operation (IMO) costs, which consist of Infrastructure Maintenance (IM) and Infrastructure Operation (IO), are each divided by variables related to passing tonnage and corridor length. Meanwhile, when using the pricing method, the IMO costs are divided into three components: Track Usage Charge (TUC), Signal, Telecommunication, and Electricity Usage (SUC), and Infrastructure Operation (IO). Each of these components has its own calculation formula. In the TUC component, the calculation includes factors such as axle load, axle count, unsprung mass, and operational train speed. These four components are significant contributors to structural and track damage. On the other hand, the SUC and IO components are not determined by the four factors present in TUC and, therefore, do not have a direct impact on structural and track damage. The formulas for SUC and IO each divide their respective costs by the total corridor length per year.

3. Results & Discussion

PT KAI, as a railway operator, is obligated to pay the TAC for using state-owned railway tracks. This research focuses on calculating the TAC (Track Access Charge) value for the year 2019, considering that the implementation of the IMO (Infrastructure Maintenance and Operation) contract between the Ministry of Transportation and PT KAI has been running smoothly. The agreed-upon maintenance and operation work and their associated costs adhere to applicable regulations and are further stipulated in the IMO contract. Additionally, in the year 2019, there were no budget reductions as had occurred in previous years, specifically in 2017 and 2018. Therefore, based on the IMO fees received by PT KAI, the TAC calculation and payment to the government were conducted in accordance with the prevailing regulations using the full costing method.

Vol. 7, No.10; 2023

ISSN: 2456-7760

The IMO fees are received by PT KAI every quarter from the Ministry of Transportation. Before the IMO costs were paid, a verification process was conducted to ensure the alignment of documents between the realized reports and the program activities outlined in the IMO contract, including field inspections to assess the on-site activities. Following the payment of IMO by the Ministry of Transportation, PT KAI proceeded to pay the TAC. The formula for calculating TAC remains the same for each period based on Government Regulation of the Republic of Indonesia Number 15 of 2016. What distinguishes it is the calculation result, which is influenced by the weight of the infrastructure, the train formation, and the amount of IMO (Infrastructure Maintenance and Operation) costs for each quarter. The realization of IMO costs and the payments of TAC for cement trains in 2019 are detailed in Table 2.

Table 2. Realization of IMO Costs and TAC Payments for Cement Trains in 2019

Quarter	IM (Rp) (*1*)	IO (Rp) (*2*)	IMO (Rp) (*3*) = (*1*) + (*2*)	TAC (Rp)
First Quarter	85.647.354.222	93.251.678.219	178.899.032.441	8.673.753.722
Second Quarter	130.470.543.167	159.400.626.539	289.871.169.706	11.777.389.191
Third Quarter	81.895.326.784	97.403.851.240	179.299.178.024	11.532.100.366
Fourth Quarter	59.662.233.316	83.589.605.337	143.251.838.653	5.246.841.607

Source: PT Kereta Api Indonesia (Persero)

3.1 Quarter 1 of 2019

The results of TAC calculations for cement trains using the pricing and full costing methods for the fourth quarter of 2019 are shown in Table 3 and Figure 3.

Table 3. Comparison of TAC value between pricing and full costing methods during the first quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2725	PWT - AWN	78.628.194	43.357.191
2726	AWN - PWT	180.129.917	139.544.093
2727	PWT - AWN	81.730.437	44.927.357
2728	AWN - PWT	155.400.041	133.979.360
2729	SLO - KRL	115.954.854	175.166.100
2730	KRL - SLO	244.212.208	559.265.429
2733	SLO - KRL	1.322.929	1.701.662
2734	KRL - SLO	3.743.037	6.043.350
2735	LPN - KRL	86.317.211	86.514.750
2736	KRL - LPN	166.751.039	269.066.864
2701-2704-2705	NMO-KPB-SLO-BBN	48.080.674	126.595.218
2706-2703-2702	BBN-SLO-KPB-NMO	27.351.302	38.821.798
2707 - 2710	NMO-KPB-KLM	569.864.349	1.878.746.289
2709 - 2708	KLM-KPB-NMO	261.002.729	541.667.846
2711 - 2714	NMO-KPB-KLM	30.167.100	73.785.294
2711-2714-2755-2715	NMO-KPB-KLM-SDT-BW	1.002.065.375	1.928.531.446
2713 - 2712	KLM-KPB-NMO	8.854.900	17.988.906
2716-2756-2713-2712	BW-SDT-KLM-KPB-NMO	343.612.050	521.446.746
2730 - 2731	KRL-SLO-BBG	35.768.414	52.823.751
2732 - 2729	BBG-SLO-KRL	19.883.445	19.260.165
2738 - 2739	CNP-KYA-KRL	4.853.496	4.634.637
2740 - 2737	KRL-KYA-CNP	8.771.022	14.426.124
2742F - 2743F	CNP-KYA-KRL	36.425.224	80.729.724
2744F - 2741F	KRL-KYA-CNP	63.173.047	252.058.990
2747F	SLO - KRL	105.809.268	116.805.411
2748F	KRL - SLO	225.659.612	409.239.103
KP/11926-KP/11871/KP/11928	BBN-SLO-KPB-NMO	111.808.170	224.871.087
KP/12375	SMC - KPB	242.230	5.215.957

2724A - 2721e	BBN-SLO-AWN	52.658.580	49.064.569
2722C	AWN - SMC	18.479.573	32.788.409
2721H	SMC - AWN	8.110.020	9.857.078
KP/11867-KP/12120-KP/11869	NMO-KPB-SLO-BBN	273.418.755	769.080.096
KP/12408-KP/11867	NMO-KPB-SMC	10.246.561	33.455.251
KP/12559-KP/11928	SMC-KPB-NMO	4.570.986	12.293.673

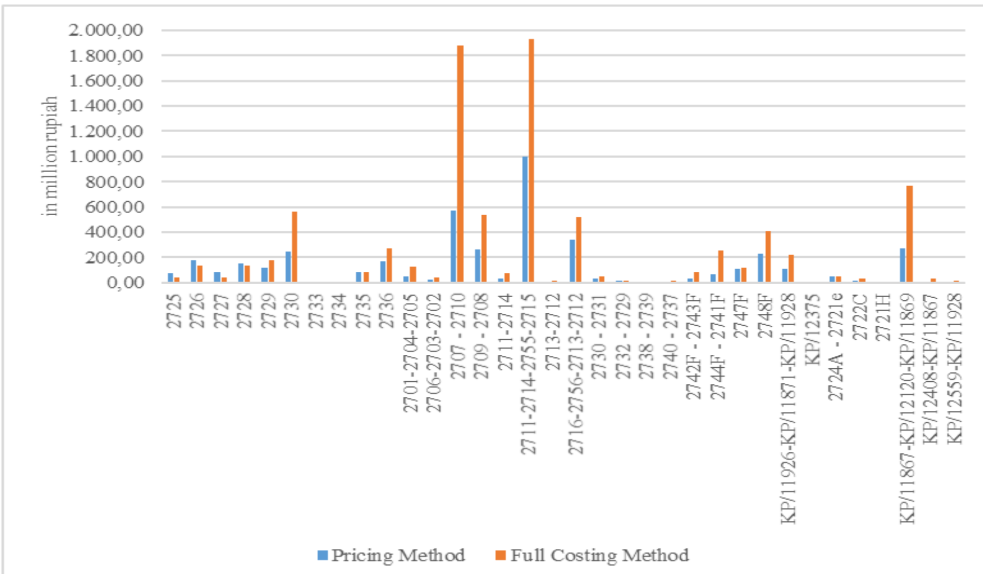

Figure 3. Comparison of TAC value between pricing and full costing methods during the first quarter of 2019

For the first quarter of 2019, the majority of TAC values calculated using the pricing method were lower than those calculated using the full costing method. Among the 34 cement trains operating during the first quarter, seven trains (21%) had TAC values calculated using the pricing method that exceeded the values calculated using the full costing method. These trains included: 1) KA 2725, 2) KA 2726, 3) KA 2727, 4) KA 2728, 5) KA 2732-2729, 6) KA 2738-2739, and 7) KA 2724A-2721e.

A further analysis was conducted on KA 2726 and KA 2728, which share the same route, to determine the reasons for the pricing method yielding higher TAC values compared to the full costing method. KA 2726 and KA 2728 are both loaded cement trains with the same route, Arjowinangun (Daop 3 Cirebon) to Purwokerto (Daop 5 Purwokerto). The pricing method for both of these trains resulted in higher TAC values than those obtained using the full costing method. For KA 2726, the TAC using the pricing method was Rp180,129,917, while the TAC using the full costing method was Rp139,544,093. For KA 2728, the TAC using the pricing method was Rp155,400,041, and the TAC using the full costing method was Rp133,979,360. A

Vol. 7, No.10; 2023

ISSN: 2456-7760

comparison of the TAC values using the pricing and full costing methods for KA 2726 and KA 2728 can be seen in Table 4.

Table 4. TAC values using the pricing and full costing methods for KA 2726 and KA 2728 during the first quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2726	AWN-PWT	180.129.917	139.544.093
2728	AWN-PWT	155.400.041	133.979.360

The differences in TAC values for KA 2726 and KA 2728 are due to variations in their frequencies and speeds. KA 2726 has 79 travel frequencies and operates at a speed of 60 km/h, while KA 2728 has 75 travel frequencies and operates at a speed of 50 km/h. The difference in travel frequency of the trains affects the passing tonnage. Both the full costing and pricing methods calculate TAC based on the total passing tonnage. However, in the pricing method calculations, the difference in values is more significant. This is because the operational speed difference between the two trains influences the Track Usage Charge (TUC) component. On the other hand, the full costing method does not consider the speed of the train in its calculations, resulting in less variation in TAC values. In the pricing method, the passing tonnage for KA 2726 is high, and its speed is relatively fast, leading to a higher TUC value. Conversely, for KA 2728, the passing tonnage and speed are lower, resulting in a lower TUC value. The results of the calculations for TUC, SUC, and IO for KA 2726 and KA 2728 can be seen in Table 5.

Table 5. TUC, SUC, and IO values for KA 2726 and KA 2728 during the first quarter of 2019

Train Number	Original Destination	Speed (km/h)	Freq.	TUC (1)	SUC (2)	IO (3)	TAC (1)+(2)+(3)
2726	AWN-PWT	60	79	180.091.893	10.607	27.418	180.129.917
2728	AWN-PWT	50	75	155.362.016	10.607	27.418	155.400.041

The calculations above indicate that the number of train frequencies is the basis for calculating axle load and the axle count. The difference in these two components affects the calculation of passing tonnage. The pricing method employs a more comprehensive set of components in its calculation formula compared to the full costing method. These components include axle load, axle count, operational speed, and unsprung mass. All four components in the pricing method calculation take into account the potential for railway infrastructure damage.

3.2 Quarter 2 of 2019

The results of TAC calculations for cement trains using the pricing and full costing methods for the second quarter of 2019 can be seen in Table 6 and Figure 4.

Table 6. Comparison of TAC value between pricing and full costing methods during the second quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2701-2704-2705	NMO-KPB-SLO-BBN	82.578.482	185.105.530
2706-2703-2702	BBN-SLO-KPB-NMO	46.119.218	55.348.433
2707 - 2710	NMO-KPB-KLM	1.043.323.599	2.664.321.962
2709 - 2708	KLM-KPB-NMO	471.214.488	763.326.427
2711-2714-2755-2715	NMO-KPB-KLM-SDT-BW	1.140.413.246	2.179.331.098
2716-2756-2713-2712	BW-SDT-KLM-KPB-NMO	510.734.912	581.646.237
2725	PWT - AWN	153.745.607	66.327.302
2726	AWN - PWT	343.532.713	207.162.023
2727	PWT - AWN	155.715.739	67.168.094
2728	AWN - PWT	296.859.438	207.162.023
2730 - 2731	KRL-SLO-BBG	31.345.730	25.043.778
2732 - 2729	BBG-SLO-KRL	17.350.735	10.085.705
2729	SLO - KRL	221.306.024	237.708.736
2730	KRL - SLO	372.490.123	611.789.810
2733	SLO - KRL	1.929.484	3.202.974
2734	KRL - SLO	5.476.325	5.061.354
2735	LPN - KRL	145.932.589	124.593.492
2736	KRL - LPN	296.864.851	385.482.536
2738 - 2739	CNP-KYA-KRL	3.823.040	2.795.000
2747F	SLO - KRL	210.143.371	150.135.286
2748F	KRL - SLO	231.994.967	404.952.054
KP/11926-KP/11871/KP/11928	BBN-SLO-KPB-NMO	168.653.856	395.934.042
2724A - 2721e	BBN-SLO-AWN	83.791.298	107.222.407
2722C	AWN - SMC	71.713.825	105.386.477
2721H	SMC - AWN	34.542.884	34.935.343
KP/11867-KP/12120-KP/11869	NMO-KPB-SLO-BBN	533.818.531	1.835.231.262
KP/12559-KP/11928	SMC-KPB-NMO	5.874.022	10.130.246
2722b - 2723a	AWN-SLO-BBN	175.471.606	350.799.560

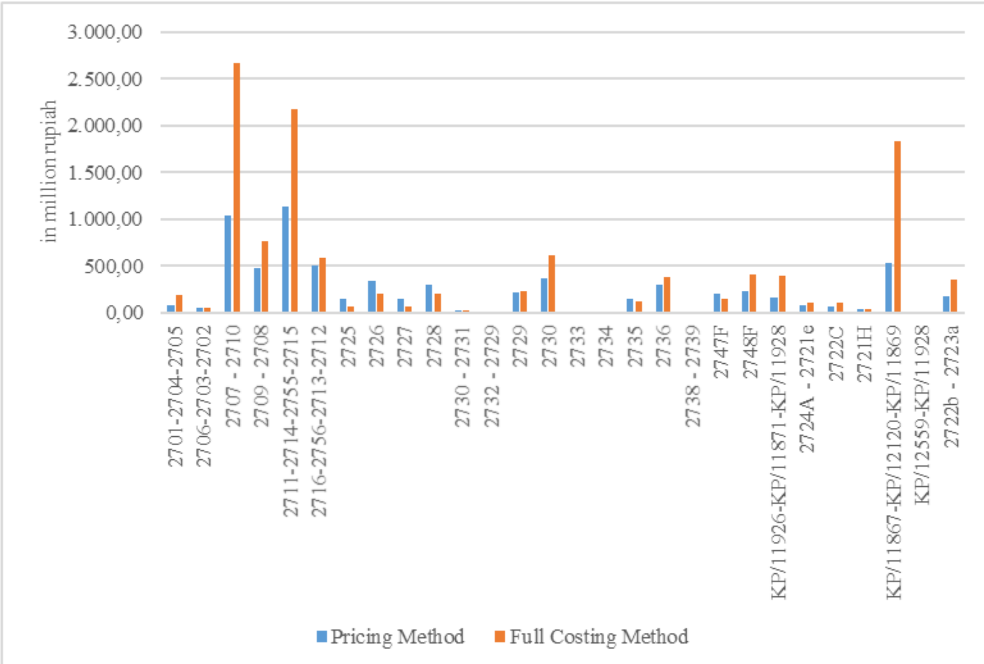

Figure 4. Comparison of TAC value between pricing and full costing methods during the second quarter of 2019

In the second quarter of 2019, the majority of TAC values calculated using the pricing method were lower than those calculated using the full costing method. Among the 28 cement trains operating during the second quarter, 10 trains (36%) had TAC values calculated using the pricing method that exceeded the values calculated using the full costing method. These trains include: 1) KA 2725, 2) KA 2726, 3) KA 2727, 4) KA 2728, 5) KA 2730-2731, 6) KA 2732-2729, 7) KA 2734, 8) KA 2735, 9) KA 2738-2739, and 10) KA 2747F.

Subsequent analysis was conducted on KA 2730-2731 and KA 2732-2729, which share the same route, to determine the reasons for the pricing method yielding higher TAC values compared to the full costing method. KA 2730-2731 travels between Karangtalun (Daop 5 Purwokerto) - Solo Balapan (Daop 6 Yogyakarta) - Brumbung (Daop 4 Semarang), while KA 2732-2729 has the opposite route, from Brumbung - Solo Balapan - Karangtalun (the reverse direction of KA 2730-2731). Both of these cement trains have the same train formation, frequency, and speed, consisting of 8 flatcars, 12 travel frequencies, and a speed of 30 km/h. The calculation results show that the TAC values using the pricing method for KA 2730-2731 and KA 2732-2729 were higher than those using the full costing method, as shown in Table 7.

Vol. 7, No.10; 2023

ISSN: 2456-7760

Table 7. TAC values using the pricing and full costing methods for KA 2730-2731 and KA 2732-2729 during the second quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2730 - 2731	KRL-SLO-BBG	31.345.730	25.043.778
2732 - 2729	BBG-SLO-KRL	17.350.735	10.085.705

The difference in TAC values for these two cement trains is due to the variation in their cargo weight, resulting in a difference in passing tonnage. Both the full costing and pricing methods are influenced by passing tonnage. KA 2732-2729 is an empty cargo train, resulting in a lower passing tonnage and, consequently, a lower TAC value. On the other hand, KA 2730-2731 is a loaded cargo train with a higher passing tonnage, leading to a higher TAC value. In the pricing method calculation, the TAC value is further broken down into TUC, SUC, and IO components. Passing tonnage only affects the TUC component. The TUC value for KA 2730-2731 is greater than that for KA 2732-2729 due to its higher passing tonnage. For the SUC and IO values for KA 2730-2731 and KA 2732-2729, the results are the same despite the difference in cargo weight, as the calculation of SUC and IO uses the total corridor length per year as the denominator. The detailed values for TUC, SUC, and IO for KA 2730-2731 and KA 2732-2729 can be seen in Table 8.

Table 8. TUC, SUC, and IO values for KA 2730-2731 and KA 2732-2729 during the second quarter of 2019

Train Number	Original Destination	Train Configuration	Speed (km/h)	TUC (1)	SUC (2)	IO (3)	TAC (1)+(2)+(3)
2730-2731 (empty train)	KRL-SLO-BBG	1 CC.206 - 8 GD.42	30	31.091.645	61.855	192.230	31.345.730
2732-2729 (loaded train)	BBG-SLO-KRL	1 CC.206 - 8 GD.42	30	17.096.649	61.855	192.230	17.350.735

The above calculation analysis demonstrates that the cargo weight of the train serves as the basis for calculating passing tonnage. Trains with loaded cargo have higher axle loads, contributing significantly to infrastructure damage. Therefore, it can be concluded that the axle load component affects the calculation of TAC using the pricing method.

Vol. 7, No.10; 2023

ISSN: 2456-7760

3.3 Quarter 3 of 2019

The results of TAC calculations for cement trains using the pricing and full costing methods for the third quarter of 2019 are shown in Table 9 and Figure 5.

Table 9. Comparison of TAC value between pricing and full costing methods during the third quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2725	PWT - AWN	106.281.218	140.566.246
2726	AWN - PWT	234.264.322	139.873.856
2727	PWT - AWN	106.281.218	139.873.856
2728	AWN - PWT	193.662.756	133.998.266
2729	SLO - KRL	174.110.377	549.656.540
2730	KRL - SLO	287.131.552	550.776.651
2733	SLO - KRL	7.563.982	37.135.576
2734	KRL - SLO	22.845.002	34.026.184
2735	LPN - KRL	123.413.111	319.627.329
2736	KRL - LPN	250.039.827	299.458.742
2701-2704-2705	NMO-KPB-SLO-BBN	407.883.809	803.971.723
2706-2703-2702	BBN-SLO-KPB-NMO	245.969.381	801.432.269
2707 - 2710	NMO-KPB-KLM	812.143.003	1.660.052.544
2709 - 2708	KLM-KPB-NMO	365.695.340	1.734.580.150
2711-2714-2755-2715	NMO-KPB-KLM-SDT-BW	859.265.854	1.594.918.735
2716-2756-2713-2712	BW-SDT-KLM-KPB-NMO	406.162.916	1.566.571.017
2738 - 2739	CNP-KYA-KRL	17.397.055	37.868.939
2747F	SLO - KRL	184.452.298	412.931.838
2748F	KRL - SLO	202.588.856	445.133.717
2724A - 2721e	BBN-SLO-AWN	60.593.505	38.840.911
2721H	SMC - AWN	37.626.167	90.805.280

Vol. 7, No.10; 2023

ISSN: 2456-7760

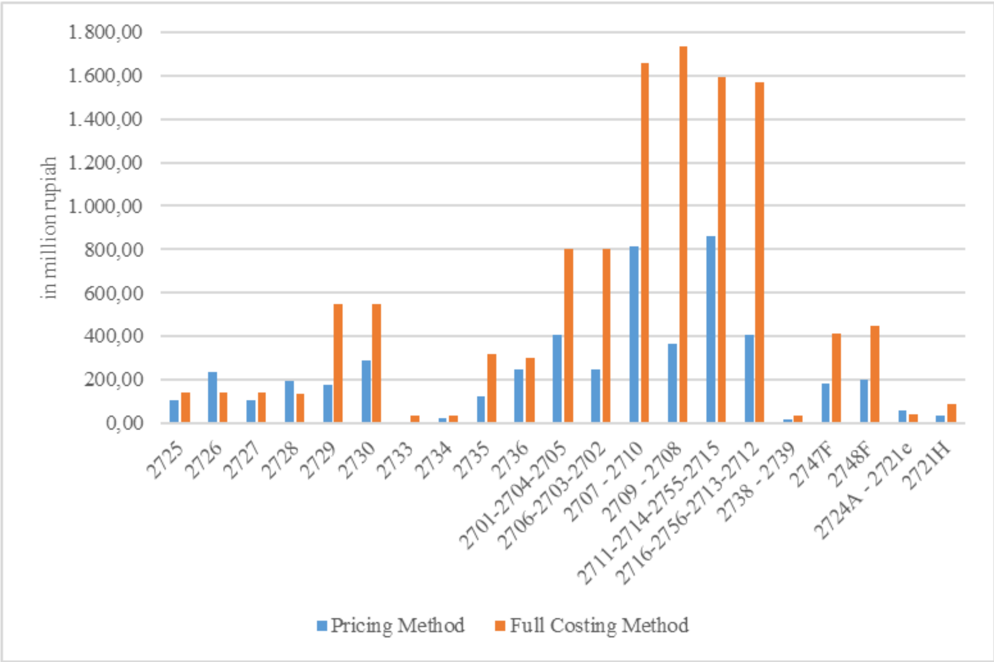

Figure 5. Comparison of TAC value between pricing and full costing methods during the third quarter of 2019

In the third quarter of 2019, the majority of TAC values calculated using the pricing method were lower than those using the full costing method. Out of 21 cement trains operating during the third quarter, three trains (14%) had higher TAC values using the pricing method compared to the full costing method. These three trains are: 1) KA 2726, 2) KA 2728, and 3) KA 2724A-2721e.

An analysis was conducted on KA 2726 and KA 2728, which share the same route, to determine the reasons for the pricing method yielding higher TAC values compared to the full costing method. KA 2726 and KA 2728 are cement trains with loaded cargo and share the same route, which is between Arjowinangun (Daop 3 Cirebon) and Purwokerto (Daop 5 Purwokerto). Both of these trains have the same train formation, consisting of 14 flatcars. The calculation results show that the TAC values using the pricing method for both KA 2726 and KA 2728 were higher than those using the full costing method. For KA 2726, the TAC value using the pricing method was Rp234, 264,322, while the TAC value using the full costing method was Rp139,873,856. For KA 2728, the TAC value using the pricing method was Rp193,662,756, and the TAC value using the full costing method was Rp133,998,266. A comparison of the TAC values for both methods for KA 2726 and KA 2728 can be seen in Table 10.

Table 10. TAC values using the pricing and full costing methods KA 2726 and KA 2728 during the third quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2726	AWN-PWT	234.264.322	139.873.856
2728	AWN-PWT	193.662.756	133.998.266

The difference in TAC values between KA 2726 and KA 2728 is due to differences in frequency and operational speed. KA 2726 operates with 92 travel frequencies at a speed of 60 km/h, while KA 2728 has 88 travel frequencies at a speed of 50 km/h. The difference in travel frequency affects the calculation of passing tonnage. Both the full costing and pricing methods for calculating TAC are influenced by passing tonnage. However, there is a more significant difference in values when using the pricing method. This is also influenced by the difference in speed between the two trains, resulting in variations in the TUC value when using the pricing method. The full costing method does not take into account the operational speed component in its calculation formula.

TAC calculation using the pricing method includes TUC, SUC, and IO components. Passing tonnage and train speed will affect the TUC component in the formula, but these two components are not considered in SUC and IO. In the pricing method, the passing tonnage and speed of KA 2726 are higher, resulting in a larger TUC value. Meanwhile, for KA 2728, the passing tonnage and speed are lower, leading to a smaller TUC value. The calculation results for TUC, SUC, and IO for KA 2726 and KA 2728 can be seen in Table 11.

Table 11. TUC, SUC, and IO values for KA 2726 and KA 2728during the third quarter of 2019

Train Number	Original Destination	Speed (km/h)	Freq.	TUC (1)	SUC (2)	IO (3)	TAC (1)+(2)+(3)
2726	AWN-PWT	60	92	234.229.666	8.546	26.111	234.264.322
2728	AWN-PWT	50	88	193.628.100	8.546	26.111	193.662.756

The analysis above shows that the frequency of train travel affects the axle load and the axle count. The difference in these two components affects the calculation of passing tonnage. Similarly, operational speed affects friction and wear on the railway tracks. The pricing method for TAC calculation uses a more comprehensive set of components in its formula compared to the full costing method. These components include axle load, axle count, unsprung mass, and operational speed. All four components in the pricing method factor in the likelihood of railway infrastructure damage.

3.4 Quarter 4 of 2019

The results of TAC calculations for cement trains using the pricing and full costing methods for the fourth quarter of 2019 can be seen in Table 12 and Figure 6.

Table 12. Comparison of TAC value between pricing and full costing methods during the fourth quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2725	PWT - AWN	45.359.434	88.569.128
2726	AWN - PWT	116.473.167	89.255.094
2727	PWT - AWN	45.359.434	89.107.686
2728	AWN - PWT	90.439.485	83.454.510
2729	SLO - KRL	66.196.384	309.447.964
2730	KRL - SLO	162.533.590	303.644.839
2733	SLO - KRL	10.066.166	105.741.007
2734	KRL - SLO	41.318.825	96.402.324
2735	LPN - KRL	45.954.159	166.792.468
2736	KRL - LPN	130.706.821	163.200.767
2701-2704-2705	NMO-KPB-SLO-BBN	215.229.939	652.940.338
2706-2703-2702	BBN-SLO-KPB-NMO	100.323.341	660.217.335
2707 - 2710	NMO-KPB-KLM	483.815.914	626.645.715
2709 - 2708	KLM-KPB-NMO	204.572.817	602.501.400
2711-2714-2755-2715	NMO-KPB-KLM-SDT-BW	429.004.037	584.492.948
2716-2756-2713-2712	BW-SDT-KLM-KPB-NMO	166.404.400	571.139.530
2738 - 2739	CNP-KYA-KRL	6.281.596	53.288.557

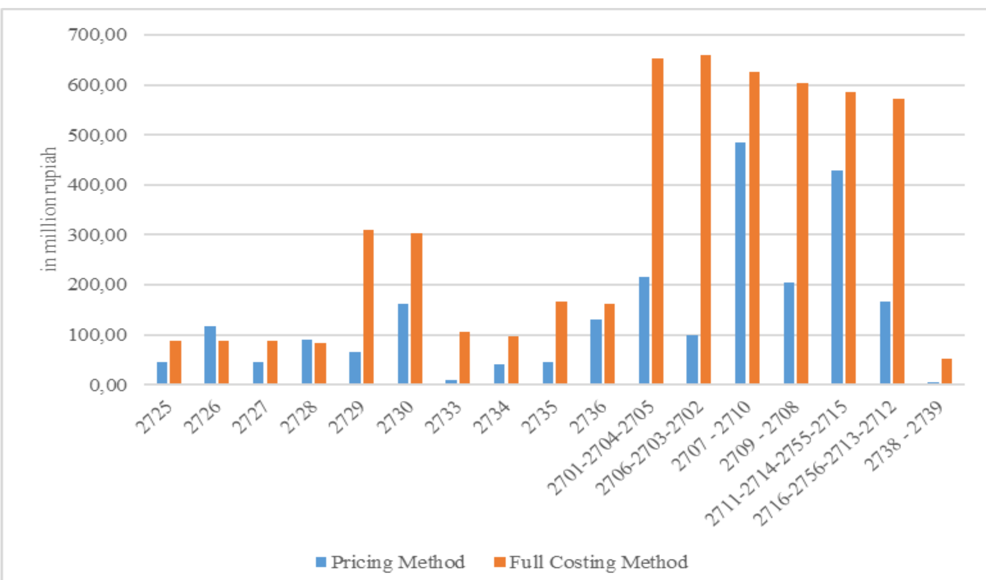

Figure 6. Comparison of TAC value between pricing and full costing methods during the fourth quarter of 2019

In the fourth quarter of 2019, the majority of TAC values calculated using the pricing method are lower than those using the full costing method. Out of 17 Cement trains, only two have TAC values using the pricing method higher than those using the full costing method. These two cement trains are KA 2726 and KA 2728, both with the Arjowinangun - Purwokerto route.

An analysis was conducted on KA 2726 and KA 2728, both of which are cement freight trains with the same configuration consisting of one locomotive of type CC.206 and a train set comprising 14 flatcars. The calculations revealed that the TAC using the pricing method for KA 2726 and KA 2728 resulted in higher values compared to the TAC calculated using the full costing method. The values of TAC for both methods for KA 2726 and KA 2728 can be found in Table 13.

Table 13. TAC values using the pricing and full costing methods KA 2726 and KA 2728 during the fourth quarter of 2019

Train Number	Original Destination	Pricing Method	Full Costing Method
2726	AWN-PWT	116.473.167	89.255.094
2728	AWN-PWT	90.439.485	83.454.510

The difference in TAC values for both cement trains appears to be accounted for by variations in frequency and operational speed. During the fourth quarter, KA 2726 had 61 trips with a speed of 60 km/h, while KA 2728 had 56 trips with a speed of 50 km/h, which is slower than KA 2726. The variance in trip frequency results in different axle load for each train, which, in turn, influences the calculation of passing tonnage. Both the full costing and pricing methods consider passing tonnage in their TAC calculations. However, Table 13 illustrates a significant difference in the TAC values between the pricing and full costing methods for these two trains. This difference is also due to the varying operational speeds of the two trains, which results in different values for TUC in the pricing method. Meanwhile, the full costing method does not factor in operational speed.

The calculation of TAC using the pricing method is broken down into three parts, which include TUC, SUC, and IO. Passing tonnage and speed affect the TUC formula. For KA 2726, a large passing tonnage and high-speed result in a large TUC value. Conversely, for KA 2728, a smaller passing tonnage and lower speed lead to a smaller TUC value. The values for SUC and IO for both KA 2726 and KA 2728 are the same because the calculation formula is identical. It involves the costs of signal, telecommunication, and electricity usage (SUC) and the costs of infrastructure operation (IO), divided by the total corridor length per year. The results of the calculations for TUC, SUC, and IO for KA 2726 and KA 2728 can be found in Table 14.

Table 14. TUC, SUC, and IO values for KA 2726 and KA 2728during the fourth quarter of 2019

Train Number	Original Destination	Speed (km/h)	Freq.	TUC (1)	SUC (2)	IO (3)	TAC (1)+(2)+(3)
2726	AWN-PWT	60	61	116.442.256	3.435	27.476	116.473.167
2728	AWN-PWT	50	56	90.408.575	3.435	27.476	90.439.485

Vol. 7, No.10; 2023

ISSN: 2456-7760

The analysis shows that the frequency of train journeys serves as the basis for calculating axle load and the axle count, both of which influence the calculation of passing tonnage. Trains with a higher frequency of travel result in a larger passing tonnage. Additionally, the operational speed of the train has a direct impact on the friction and wear of railway infrastructure. The components of axle load, axle count, and operational speed in the pricing-based Track Access Charge (TAC) are taken into account in assessing the potential for railway infrastructure damage.

4. Conclusions

Based on the discussion above, the following conclusions can be drawn:

First, there are instances where the Track Access Charge (TAC) calculated using the pricing method yields higher results compared to the full costing method. This is primarily attributed to factors such as the frequency of train journeys passing through a specific area during a given period, the weight of the load, and the operational speed of trains on the same route, even when traveling in opposite directions.

Second, the breakdown of Infrastructure Maintenance and Operation (IMO) costs differs between the full costing and pricing methods. In the full costing method, IMO costs are divided by the parameters of passing tonnage and corridor length. Meanwhile, in the pricing method, IMO costs are categorized into Track Usage Charge (TUC), Signal, Telecommunication, and Electricity Usage Charge (SUC), and Infrastructure Operation (IO). TUC calculations are influenced by factors such as axle load, the axle count, unsprung mass, and train operational speed. For the calculation of Signal, Telecommunication, and Electricity Usage Charge (SUC) and Infrastructure Operation (IO), each of them is directly divided by the total length of the corridor.

Third, when calculating TUC, the results consistently tend to be higher compared to both SUC and IO because the components involved in TUC calculations are influenced by all four of the aforementioned factors.

Fourth, the pricing-based TAC method takes into account the potential for infrastructure damage on railway lines, making it a more equitable and relevant alternative for operators to pay infrastructure usage fees (TAC) to the government in a multi-operator system in Indonesia.

References

Amirullah, Danu F. T., & Arbie. (2019). *Kajian Formulasi Track Acces Charge (TAC) atas Penggunaan Prasarana Perkeretaapian*. Jurnal Penelitian Transportasi Darat, (Vol. 21, No. 2, hlm. 131-144).

Badan Pusat Statistik Republik Indonesia. (2021). *Statistik Transportasi Darat*. Jakarta: Badan Pusat Statistik Republik Indonesia.

Berawi, M. A., Miraj, P., Berawi, A. R. B., Nahri, & Sumabrata, J. (2016). *Track Access Charge for Indonesian Railways Using Full Cost Method: Improving Industry Competitiveness*. MATEC Web of Conference, (No. 101. hlm 1-5).

Berawi, M. A., Miraj, P., Berawi, A. R. B., Susantono, B., Leviakangas, P., & Radiansyah, H. (2017). *Modeling Track Acces Charge to Enhance Railway Industry Performance*. AIP Conference Proceedings (hlm. 060001-1 – 06001-6).

Indriantoro, N., & Supomo, B. (2016). *Metodologi Penelitian Bisnis: Untuk Akuntansi dan Manajemen*. Yogyakarta: BPFE.

Jannah, A. N., & Muthohar, I. (2018). *Analisis Komparasi Perhitungan Track Acces Charges Antara Metode Full Costing dengan Metode Pricing pada Kereta Api Peti Kemas*. Prosiding Simposium Forum Studi Transportasi antar Perguruan Tinggi ke-21 Universitas Brawijaya, Malang 19-20 Oktober 2018, (hlm. 747-761).

Kementerian Hukum dan Hak Asasi Manusia Republik Indonesia. (2007). *Undang-undang Nomor 23 Tahun 2007*. Tentang Perkeretaapian.

Kementerian Perhubungan Republik Indonesia. (2012). *Peraturan Menteri Perhubungan Republik Indonesia Nomor PM. 67 Tahun 2012*. Tentang Pedoman Perhitungan Biaya Perawatan Dan Pengoperasian Prasarana Perkeretaapian Milik Negara.

Kementerian Perhubungan Republik Indonesia. (2013). *Peraturan Menteri Perhubungan Republik Indonesia Nomor PM. 62 Tahun 2013*. Tentang Pendoman Perhitungan Biaya Penggunaan Prasarana Perkeretaapian Milik Negara.

Kementerian Perhubungan Republik Indonesia. (2015). *Peraturan Menteri Perhubungan Republik Indonesia Nomor PM. 122 Tahun 2015*. Tentang Perubahan Atas Peraturan Menteri Perhubungan Nomor PM. 62 Tahun 2013 Tentang Pedoman Perhitungan Biaya Penggunaan Prasarana Perkeretaapian.

Kementerian Perhubungan Republik Indonesia. (2015). *Peraturan Menteri Perhubungan Republik Indonesia Nomor PM. 156 Tahun 2015*. Tentang Perubahan Atas Peraturan Menteri Perhubungan Nomor PM. 67 Tahun 2012Tentang Pedoman Perhitungan Biaya Perawatan Dan Pengoperasian Prasarana Perkeretaapian Milik Negara.

Kementerian Perhubungan Republik Indonesia. (2015). *Peraturan Direktur Jenderal Perkeretaapian Nomor: KU.203/SK.298/DJKA/12/15*. Tentang Komponen Biaya Yang Diperhitungkan Untuk Penerimaan Negara Bukan Pajak Yang Berasal Dari Penggunaan Prasarana Perkeretaapian Milik Negara.

Kementerian Sekretariat Negara Republik Indonesia. (2016). *Peraturan Pemerintah Republik Indonesia Nomor 15 Tahun 2016*. Tentang Jenis Dan Tarif Penerimaan Negara Bukan Pajak Yang Berlaku Pada Kementerian Perhubungan.

Kementerian Perhubungan Republik Indonesia. (2018). *Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 17 Tahun 2018*. Tentang Pedoman Tata Cara Perhitungan Dan Penetapan Tarif Angkutan Orang Dengan Kereta Api.

Kementerian Perhubungan Direktorat Jenderal Perkeretaapian. (2022). *Laporan Kinerja Instansi Pemerintah Direktorat Jenderal Perkeretaapian Tahun 2021*. Jakarta: Direktorat Jenderal Perkeretaapian.

Kuncoro, M., & Hardani, W. (2013). *Metode Riset untuk Bisnis dan Ekonomi*. Jakarta: Erlangga.

Mayang, S., & Muthohar, I. (2016). *Analysis on Railway Infrastructure Utilization Priority Faktor Variation on Track Acces Charges*. Journal of The Civil Engineering Forum (Vol.2, No. 2, hlm. 95-100).

Menteri/Sekretaris Negara Republik Indonesia. (1992). *Undang-undang Republik Indonesia Nomor 13 Tahun 1992*. Tentang Perkeretapaian.

Muthohar, I., Sumi, T., & Sutomo, H. (2010). *The Implementation and Impacts of PSO, IMO, and TAC Schemes on National Railways Reform in Indonesia*. Journal of the Eastern Asia Society for Transportation Studies, (Vol. 8, hlm. 261-270).

Muthohar, I., & Sumi, T. (2010). *Sustaining Political and Financial Allocation as a Sustainable Approach in Transport Policy Development: The Case of Indonesia's Railway during the Restructuring Process*. Journal of Sustainable Develpoment, (Vol. 3, No. 3).

Nash, C., & Matthews, B. (2002). *Competitive and Suistanable Growth (Growth) Programe*. Leeds: UNITE Partners.

Nisa. (2022). *Mengenal Apa Itu Pricing Strategy (Strategi Penetapan Harga) dan Cara Menentukannya*.

Presiden Republik Indonesia. (2012). *Peratura Presiden Republik Indonesia Nomor 53 Tahun 2012*. Tentang Kewajiban Pelayanan Publik Dan Subsidi Angkutan Perintis Bidang Perkeretaapian, Biaya Penggunaan Prasarana Perkeretaapian Milik Negara, Serta Perawatan dan Pengoperasian Prasarana Perkeretaapian Milik Negara.

Presiden Republik Indonesia. (2021). *Peratura Presiden Republik Indonesia Nomor 73 Tahun 2021*. Tentang Perubahan Kedua Atas Peraturan Presiden Nomor 53 Tahun 2012 Tentang Kewajiban Pelayanan Publik Dan Subsidi Angkutan Perintis Bidang Perkeretaapian, Biaya Penggunaan Prasarana Perkeretaapian Milik Negara, Serta Perawatan Dan Pengoperasian Prasarana Perkeretaapian Milik Negara.

PT Kereta Api Indonesia (Persero). (2019). *Grafik Perjalanan Kereta Api 2019*. Jakarta: PT Kereta Api Indonesia (Persero).

Putri, S. (2016). *Analisis Komparasi Perhitungan Biaya Prasarana Perkeretaapian Antara Metode Pembebanan Penuh (Full Costing) dan Metode Tarif (Pricing)*. Yogyakarta: Departemen Teknik Sipil dan Lingkungan Fakultas Teknik Universitas Gadjah Mada.

Radiansyah. H., Berawi, M. A., & Sumabrata, J. (2014). *Analisa Biaya Perhitungan Track Access Charge pada Perkeretaapian Indonesia dengan Metode Marginal Cost Plus Markup*. Depok: Departemen Teknik Sipil Fakultas Teknik Unibersitas Indonesia.

Ramdhani, D., Merinda, Hendrani, A., & Suheri. (2020). *Akuntansi Biaya (Konsep dan Implementasi di Industri Manufaktur*. Yogyakarta: CV Markumi.

Ramadhani, Oktavia. (2022). *9 Strategi Penetapan Harga yang Wajib Diketahui Bisnis*.

Sugiyono. (2013). *Metode Penelitian Kuantitaif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Sukmalalana, & Oktaviani, A. (2022). *Potensi dan Masalah Track Access Charge di Indonesia*. Jakarta: Tim Komisi V, Pusat Kajian Akuntabilitas Keuangan Negara.

Tika, M. P. (2006). *Budaya Organisasi dan Peningkatan Kinerja Perusahaan*. Jakarta: Bumi Aksara.

Tysara, Laudia. (2021). *7 Macam-Macam Metode Penelitian Kuantitatif dan Penjelasannya*.

Yusuf, A. M. (2017). *Metode Penelitian: Kuantitatif, Kualitatif dan Penelitian Gabungan*. Jakarta: Kencana.