Analysis on Railway Infrastructure Utilization Priority Factor Variation on Track Access Charges

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ABSTRACT

Railway is one of the available transportation modes in Indonesia, in Java and Sumatera, which is used for carrying the passengers and freights. People choose to use railway because it is a fast transportation mode and has its own track which averts from the traffic jam. In Presidential Regulation Republic of Indonesia No. 53 in 2012, it is explained that every railway operator which use railways infrastructure have to pay Track Access Charges (*TAC*) to Government. The rules of the calculation of *TAC* which have to be paid by PT.KAI is explained in Regulation of Transport Minister No. 62 in 2013 about The Rule of Calculation Rail Infrastructure Charges State Owned. In Regulation of Transport Minister No. 62 in 2013, there is priority factor which has same value for every service type of the train (*Fp*=1). Actually, every service type of railway has different priority and gives different damages for infrastructure based on the speed. This research intended for analyzing the influence of priority factor to *TAC*. Quantitative description method is a method which is used in this research. The objects of the research are Executive, Business, and Economic class of passenger train in Java. The calculation of *TAC* based on Regulation of Transport Minister No. 62 in 2013 with the variations in priority factor (*Fp*). It suggested with two ways calculation which oriented on railway travel time. Then, the best *Fp* is chosen which represented the real condition where the train with higher priority has to pay *TAC* higher than that of others. The result of this research, with *Fp*=1 average, *TAC* for Economic class is 68.00 IDR/GT/km, for Executive class is 30.00 IDR/GT/km, while for Business class is 28.00 IDR/GT/km. There are two ways to calculate *Fp*. The first way generates *Fp*= 1.39 for Executive class and gives 42.00 IDR/GT/km for the average *TAC*, while *Fp*=1.21 for Business class and generates 34.00 IDR/GT/km for average *TAC*. The second way generates *Fp*=3.00 for Executive class and it gives 91.00 IDR/GT/km while for Business class it generates *Fp*=2.00 and it gives 56.00 IDR/GT/km. the calculation of *TAC* with second way is more represents the real condition, where Executive class has higher priority and speed than the other classes, so it also has to pay higher *TAC*.

Keywords: Railway, *TAC*, infrastructure utilization priority factor,

1 INTRODUCTION

In general, transportation is the act of moving item or human from one location to another. Various transportation modes could be chosen to reach the destination location, such as private vehicle (motorcycle or car), bus, or railway train. Railway train is one of the available transportation modes in Indonesia, in Java and Sumatera, which is used to transport passenger and freight. The railway is the mode transportation that has separate lane so it could avert from the traffic jam and has higher speed than car or bus, thus making the travel time shorter. Railway has a higher transport capacity and a cleaner type of transportation when compared with other land transportation. The matter that exists in people is whether the tariff that charged to the passenger is proportional with the given service. As for sure, each railway services have different service level, as in time of the travel and also the comfort inside the train.

The Indonesian Railways (PT. KAI) as the organizer of railway system also become burdened with the responsibility of conducting maintenance and operation, as well as promoting the passenger train and freight train. The type of service that the PT. KAI offer for passenger train is Argo subclass, Executive class, Business class, Economy class with AC, Economy class (no AC), local train and commuter line. As for freight train, the services offered are general cargo train (Parcel and Parcel ONS), special cargo train (logistic train, container train, petroleum train, Java coal train, cement train, fertilizer train, clinker train, pulp train, CPO train), and *Babaranjang* train (coal train with long coach series).

Every railway system organizer that uses railway infrastructure is required to pay utilization cost to the Railway Infrastructure Organizer Business Entity based on Presidential Decree About Obligations of Public Service And Pioneer Transport Subsidies, Railway Infrastructure Usage Fees as State Property, and Maintenance and Operation of Railway Infrastructure Owned by State (Presidential Decree, 2012), the aforementioned fee is the Track Access Charge (*TAC*). Furthermore, *TAC* or railway infrastructure utilization fee is the fee that required to be paid by railway system organizer for using the railway infrastructure that operated by the railway infrastructure organizer (Regulation of Ministry of Transportation, 2013). The calculation of *TAC* required to be paid by PT. KAI is explained in Regulation of Transport Minister Number 62 The year 2013, also explained the IMO (Infrastructure Maintenance and Operation) calculation that the government needs to provide as the railway infrastructure organization to PT. KAI. IMO is the fund that PT. KAI gets from state for having cared and operated the infrastructure such as rail, signal system, telecommunication equipment, and electricity system, which are state property (Presidential Decree, 2012). The number of *TAC* should not exceed IMO, for it would make the railway tariff more expensive and unaffordable to the people; also would turn into the people losing interest to choose railway, which means a decline for railway system.

The policy on *TAC* pricing scale needs to be thought as thorough as possible, in order to make the railway could compete with another transportation mode. For example, private vehicle is not required to pay road utilization fee, yet on the contrary, railway as a mass transportation mode is burdened with high infrastructure utilization fee. The calculation of IMO and *TAC* are helpful to calculate the scale of PSO (Public Service Obligation) or subsidy the government will give as the railway infrastructure organizer to PT. KAI. This regulation will then simplify the regulation making for Railway Multi-operator (Indonesian Republic, 2007).

As mentioned earlier, railway has several different services type, which each type has different priority and will also result in different service level, including the travel time. The factor priority for entire railway was equated (*Fp*=1), with the consideration that the maintenance cost presently incurred is equal for all service types (Regulation of Ministry of Transportation, 2013). Because each railway service types would give different burden to railway infrastructure and different service class, then the calculation for factor priority of each railway service types was conducted, whereas the result could be used to improve the calculation of *TAC* scale. Therefore this research was conducted in order to discover the factor priority value of railway infrastructure utilization to *TAC* scale for different types of railway service.

2 METHODOLOGY AND ANALYSIS

The research method used was quantitative descriptive research method, because the data available was in form of numbers, data analysis was conducted after the data were collected, and have deductive nature. The main purpose of this methodology is to explain an issue, yet generated a generalization. The measured part in this research is actually a small portion of the population, also known as “data”. Data is factual example from reality that could be predicted to reality level by applying certain quantitative method.

To investigate the effect of infrastructure utilization priority factor to *TAC* scale, then the calculation was done to several types of railway service. The calculation was not conducted to the entire railway in Indonesia, but only on the Executive railway, Business railway, and Economy railway. These three railway service types were calculated based on formula (Regulation of Ministry of Transportation, 2013), whereas it was set to be valued 1 (one) using the assumption that the maintenance cost presently incurred is equal for all service types. For the entire railway service types, it was one (*Fp*=1). The infrastructure utilization priority factor (*Fp*) was calculated based on the priority level that covers service class and/or load weight (Regulation of Ministry of Transportation, 2013). Second calculation was to compare the *Fp* value of each railway service, and then compared the result with the first calculation. The calculation formula of *TAC* (Regulation of Ministry of Transportation, 2013) is as follows:

$$IM_{Daop/Divre} = \frac{\sum_{i=n} Maintenance\ Budget\ per\ Daop\ or\ Divre}{\sum_{i=1} (Passing\ Tonnage_i \times Corridor\ length_i)} \quad (1)$$

$$IO_{Daop/Divre} = \frac{\sum_{i=n} Operational\ Budget\ per\ Daop\ or\ Divre}{\sum_{i=1} (Passing\ Tonnage_i \times Corridor\ length_i)} \quad (2)$$

$$TAC_{Daop/Divre} = \frac{\sum_{i=n} Usage\ Budget\ per\ Daop\ or\ Divre}{\sum_{i=1} (Passing\ Tonnage_i \times Corridor\ length_i)} \quad (3)$$

where $TAC_{Daop/Divre}$ is ratio between usage budget of infrastructure and GTKM for each Daop/Divre (IDR/GT-KM), $IM_{Daop/Divre}$ is ratio between maintenance budget of infrastructure and GTKM for each Daop/Divre (IDR/GT-KM), $IO_{Daop/Divre}$ is ratio

between operational budget of infrastructure and GTKM for each Daop/Divre (IDR/GT-KM).

Table 1. *TAC* value of each Operation Area

Operation Area	Total IMO per Operation Area (IDR)	Tonnage-Km of Operation Area (Million GTKM)	Operation Area *TAC*
I (Jakarta)	423, 957,149,473	31,495.90	13.46
II (Bandung)	128,988,833,046	1,934.43	66.69
III(Cirebon)	97,176,848,948	5,425.18	17.91
IV(Semarang)	115,225,058,343	8,758.85	13.16
V (Purwokerto)	102,379,488,581	2,823.85	36.26
VI (Yogyakarta)	97,820,852,823	2,727.18	35.87
VII (Madiun)	90,206,257,071	1,262.43	71.45
VIII (Surabaya)	155,790,782,683	2,669.22	58.37
IX (Jember)	81,537,932,944	374.25	223.13

$$TAC_{total} = \sum_{i=1}^{i=n} TAC_{KAi} \quad (4)$$

$$TAC_{KA} = \left[GT_{KA} \times \sum_{i=1}^{i=n} KM_{KAi} \times TAC_{Daop/Divre} \right] \times Fp \quad (5)$$

Results of basic *TAC* (Table 1) was used to TAC_{KA} calculation, by using formula as in equation 5. The tonnage of each railway (GT_{KA}) was obtained by adding up the entire railway and locomotive in one stamformation or train series. Other data needed to get TAC_{KA} value was the mileage of each Operation Area, whereas each train has different mileage on its Operation Area which based on each relation. Table 2 shows the calculation result of TAC_{total} for each railway service types that was calculated according to Equation 4, with *Fp* value in Equation 5 is 1.

Table 2. Comparison on *TAC* per year with *Fp*=1 on Executive class, Business class, and Economy class Railways

Railway service type	Service frequency	*TAC* railway/day (IDR)	*TAC* railway/year (IDR)
Executive	34	194,135,415	70,859,426,561
Business	14	106,143,874	38,742,514,124
Economy	40	495,150,193	180,729,820,571

The *TAC* (IDR/GT/km) for each railway is the cost that operator must spend because of the infrastructure utilization for each tonnage and passing track. From the calculation result, the average *TAC* for Executive class railway is IDR 30.00 for every GT/km, as for average *TAC* for Business class railway is IDR 28.00 for every GT/KM, and average *TAC* for Economy class railway for every GT/KM is IDR 68.00 (Table 3).

Table 3. *TAC* value for each railway KA (IDR/GT/km) with *Fp*=1

Statistical parameter	*TAC*(IDR/gt/km)		
	Executive class	Business class	Economy class
Average	30.00	28.00	68.00
Maximum	52.00	53.00	195.00
Minimum	15.00	15.00	15.00

With service priority factor value that was equated for all the railway service type (*Fp*=1), *TAC* on Economy railway became higher than Business and Executive class. However, the speed of Executive and Business railways was higher, this means the destructive force on the infrastructure it passes is larger, and which it supposed to be given a higher *TAC*. Every railway services have different characteristic, but the *TAC* calculation explained that the infrastructure utilization priority factor on each railway is one or be equated. This condition has not represented the existing difference on each railway service, so then it needs a different infrastructure utilization priority factor for each railway service ($Fp \neq 1$).

Other data that was needed in the calculation of the *TAC* with infrastructure utilization priority factor that isn't equal one are the total railway travel time, running time, and also stay time. The travel time, track length, and train schedule also could be discovered from Railway Travel Graph 2013.

Service factor is the infrastructure utilization priority factor (*Fp*) that was included in the calculation, in order to give certain priority to each railway based on its service type. Every railway service type gives different service, thus it needs a value that could differ each service, which later could affect the infrastructure utilization cost, or also known as *TAC* (Mayang, 2014).

Priority factor is a function of *f*1 and *f*2 (Equation 6), in which *Fp* resulted from the multiplication of *f*1 and *f*2 (Equation 7). The *f*1 value was the average of all *f*1 for each railway service type (Equation 8). The *f*1 KA value was resulted from comparing travel time of each railway service type, based on the same distance (Equation 9). The calculation of *f*2KA (Equation 10) was the comparison of railway's stay time with running time. The *f*2 value was the average of all *f*2 for each railway service type (Equation 11).

$$Fp = f(f1; f2) \quad (6)$$

$$Fp = f1 \times f2 \quad (7)$$

$$f1 = \frac{\sum_{i=1}^{n} f1_{KA}}{n} \quad (8)$$

$$f1_{KA} = f(t; d) \quad (9)$$

$$f2 = \frac{\sum_{i=1}^{n} f2_{KA}}{n} \quad (10)$$

$$f1_{KA} = ST / RT \quad (11)$$

where *ST* is staying time (minutes), *RT* is railway running time (minutes), *t* is time travel with same distance (minutes), *d* is travel distance (km).

Value standardization on service factor (*Fp*) was used to give reference to service factor value that was resulted from calculations of each railway service type, so that comparison could be conducted between service factor of each different railway service system, which then would be used for calculation of infrastructure utilization cost (*TAC*). The method of the service factor value standardization was with making a reference by assigning service factor value of one (*Fp*=1) to one type of railway service, which was the Economy class railway service.

Economy class railway service became the standard because of the basic level of service it has. With consideration that the travel time of Argo railway, Executive railway, Business railway and Economy (with AC) railway would be shorter than the Economy (no AC) railway; therefore the *Fp* value of Executive railway, Business railway, and Economy (with AC) railway would be higher than the Economy (no AC) railway. The standardization method on each railway service type could be seen in Equation 12.

$$fi = \frac{f_{economy}}{f_x} \quad (12)$$

Where *fi* is value of *f1* or *f*2, $f_{economy}$ is value of *f1* or *f*2 for economic railway, f_x value of *f1* or *f2* for argo, executive, business, and AC economic railway.

The result of calculation of infrastructure utilization priority factor with standardization of each railway service types is shown in Table 4 and Table 5. In the *Fp* calculation, there were two alternatives for the calculation; the Alternative 1 is by using *f*1 value alone, while in Alternative 2 both *f*1 and *f*2 was used.

Table 4. Calculation Result of *f*1 value

Railway Service Type	*f*1 (minute)	Comparison *f*1
Executive	507.66	1.39
Business	585.21	1.21
Economy	707.42	1.00

Table 5. Calculation Result of *f*2 value

Railway Service Type	*f*2	Comparison *f*2 value
Executive	0.047	4.32
Business	0.117	1.72
Economy	0.202	1.00

Table 6. Railway *TAC* with influence of Utilization Priority Factor (*Fp*) Alternative 1

Railway Service Type	Service Frequency	*TAC* per year (IDR)	*TAC* (IDR/GT/km)
Executive	34	98,494,602,920	42.00
Business	14	46,878,442,090	34.00
Economy	40	180,729,820,571	68.00

From Table 6, it could be seen that the *TAC* of Economy class railway is still higher than the Executive or Business class railway. As mentioned before on the *TAC* calculation of *Fp*=1 (Regulation of Ministry of Transportation, 2013), this condition is not compatible with the actual reality on the field, wherein railway with higher speed and priority is the one who should pay higher *TAC*. Therefore, *f*2 need to be included as the second alternative in the *Fp* calculation.

The *Fp* calculation with Alternative 2 was by multiplying *f*1 value, which already standardized on each railway service types; the result which could be seen in Table 6. The *f*2 was included in the *Fp* calculation because not all railway service types was considered, or it could be said that the *f*1 is a generalized calculation and does not cover the entire railway service types, such as Economy (with AC) class or the local railway, therefore another factor is needed, ones that cover the entire railway service types.

From Table 7, it could be seen that the really high *Fp* value on Executive railway was caused by its *f*2 value that was higher than the *f*2 value of Business railway and Economy railway. The amount of stay time in Economy railway was used as reference for the *f*2 value calculation, in which the Economy railway has longer stay time in every station, and more frequency of

stopping; therefore the *f*2 value was much higher for Executive railway.

Table 7. Infrastructure utilization priority factor value (*Fp*) for each railway service type

Railway Service Type	Infrastructure utilization priority factor value (*Fp*) (*Fp* = *f*1 x *f*2)
Executive	6.02
Business	2.08
Economy	1.00

This could explain that the maximum *Fp* value of Executive railway could reach 6, which means that it has flexibility in its application. The *Fp* value equal 6 could not be applied directly, but gradually. The higher *Fp* value is, the higher *TAC* would be, therefore in the application the ability to pay and willingness to pay of the people should be concerned. In the present time, from the calculation result of *Fp* value of Business railway and Economy railway, it could generate the Executive railway *Fp* value of 3.00, and this could gradually increase until it reaches the value appropriate the initial calculation (Table 7). Therefore, it resulted in the recommended new *Fp* value for each railway service type, as could be seen in Table 8. After the new *Fp* value was acquired, the next step is to carry out the *TAC* calculation for each railway. The *Fp* was inserted into the *TAC* calculation based on Alternative 2, which is *Fp* resulted from multiplication of *f*1 and *f*2. Average *TAC* for each GT/km on Executive railway became IDR 91.00, whereas *TAC* of Business railway was IDR 56.00 for each GT/km, and *TAC* of Economy railway was IDR 68.00 for each GT/km (Table 9). From Table 10, it could be seen that the *TAC* on Executive railway became higher, compared to *TAC* on Business Railway and Economy Railway, after the influence of *Fp* with Alternative 2 in the *Fp* calculation, whereas *Fp* was the result of multiplying *f*1 with *f*2. This result could represent better the real condition on the field, in which the main priority does give to the Executive railway; therefore the calculation of *TAC* was more precise with formula (Regulation of Ministry of Transportation, 2013) with *Fp* influence from *Fp* calculation on Alternative 2.

Table 8. Infrastructure utilization priority factor value (*Fp*) Alternative 2 that is recommended for each railway service type

Railway Service Type	Infrastructure utilization priority factor value (*Fp*)
Executive	3.00
Business	2.00
Economy	1.00

Table 9. Railway *TAC* with influence of Utilization Priority Factor (*Fp*) Alternative 2

Railway Service Type	Service Frequency	*TAC* per year (IDR)	*TAC* (IDR/GT/ km)
Executive	34	212,578,279,684	91
Business	14	77,485,028,248	56
Economy	40	180,729,820,571	68

Table 10. Comparison of *TAC* value with variation on infrastructure utilization priority factor of each railway service type

Railway Service Type	*TAC* with *Fp*=1 (IDR/GT/km)	*TAC* with influence *Fp* (IDR/GT/km)	
		Alternative 1 *Fp*= *f*1	Alternative 2 *Fp*= *f*1x *f*2
Executive	30.00	42.00	91.00
Business	28.00	34.00	56.00
Economy	68.00	68.00	68.00

3 CONCLUSIONS

From the analysis and discussion above, it could be concluded that the calculated *TAC* based on Regulation of Transport Minister Numb. 62 Year 2013, with equated *Fp* for all type of railway service (*Fp*=1), the *TAC* number resulted are IDR 70,859,426,561 in one year for Executive railway; IDR 38,742,514,124 for one year in total for Business railway *TAC*; and IDR 180,729,820,571 for one year in total for Economy railway. The *TAC* calculation with infrastructure utilization priority factor of one is considered still could not represent the differences that exist in each railway service types. It is known that the Executive railway has the higher priority to pass the rail track compared to other railway service type, which made it has shorter travel time. Therefore, the calculation formula for *TAC* in Regulation of Transport Minister Numb. 62 Year 2013 should include different *Fp* values for each railway according to its service types.

There are two alternatives to calculate the utilization priority factor (*Fp*). In the Alternative 1, the *Fp* for Executive railway was 1.39; 1.21 for Business railway; and 1.00 for Economy railway. With these *Fp* numbers in Alternative 1, *TAC* for Executive railway is IDR 98,494,602,920,00 per year, *TAC* for Business railway for a year is IDR 46,878,442,090,00, while the *TAC* for Economy railway did not change, for it became the reference in the standardization. As for Alternative 2, the *Fp* value for the Executive railway was 3.00; and for Business railway was 2.00. With the *Fp* calculation in Alternative 2, *TAC* for Executive railway in one year is IDR 212,578,279,684 and *TAC* for Business railway in one year is IDR 77,485,028,248.

The variation in *Fp* value affected the *TAC* value for each railway service types. For Executive railway, average *TAC* per GT/km was IDR 30.00 with *Fp*=1, and increased to IDR 42.00 per GT/km with influence from *Fp* Alternative 1, then increased again to IDR 91.00 after influence from *Fp* Alternative 2. For Business railway, the number was IDR 28.00 per GT/km before *Fp* influence, then increased to IDR 34.00 with influence from *Fp* Alternative 1 and IDR 56.00 after influence from *Fp* Alternative 2. Whereas for Economy railway that became their reference in *Fp* value standardization, the *Fp* value did not change, which was 1.00; and the *TAC* value for every GT/km was IDR 68.00.

As the *Fp* value increases, the *TAC* that PT. KAI have to pay to the railway infrastructure organizer also became higher. The *TAC* calculation with *Fp* Alternative 2 has resulted in higher *TAC* on Executive railway, and this is considered to be quite fair, as the high speed of Executive railway inflict larger damage on the infrastructure, which they made the utilization cost or *TAC* spent must be higher than for the other railway passenger. This result could represent better the real condition in the field, in which the main priority gives to the Executive railway, which made the Executive railway's travel time is shorter than another railway passenger.

REFERENCES

Indonesian Republic, 2007. *Constitution on Railways No. 23 Year 2007*.

Mayang, S., 2014. *Analisis Pengaruh Variasi Faktor Prioritas Penggunaan Prasarana Perkeretaapian Terhadap Track Access Charges (TAC) [Priority Factor Analysis on Track Acess Charges of Railway]*, Yogyakarta: Universitas Gadjah Mada.

Presidential Decree, 2012. *Obligations of Public Service and Pioneer Transport Subsidies in Railways, Railway Infrastructure Usage Fees State Property, and Maintenance and Operation of Railway Infrastructure State Owned No.53 Year 2012*.

Regulation of Ministry of Transportation, 2013. *Guide on Estimation of Railways Infrastructures Utilization Fee State Owned No.62 Year 2013*.