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TRAFFIC ACCIDENT COST ANALYSIS BASED ON ACCIDENT VICTIMS USING GROSS OUTPUT METHOD IN KARAWANG REGENCY

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Abstract. Traffic accidents tend to increase and are still a major problem in road transportation in Indonesia. A traffic accident is an incident on the road that is unexpected and unintentional involving a vehicle with or without other road users, resulting in human casualties and/or property loss. This loss of property or material is then referred to as the cost of a traffic accident. This research was conducted to determine the percentage change in the number of accidents, the cost of traffic accidents in Karawang Regency. The method used in calculating the amount of traffic accident costs is by using the gross output (human capital) method. Data on accident victims in the state of Death, serious injury, Minor injury and material losses in 2016, 2017, 2018, 2019, and 2020 were obtained from Korlantas Polres Karawang. The number of traffic accidents in 2016 was 540 accidents. In 2017, there were 534 accidents. In 2018, there were 630 accidents. In 2019, there were 817 accidents and in 2020 there were 728 accidents. The results of the analysis showed that the largest increase in the number of accidents was in 2019, which increased by 29.68% from 2018 and the largest reduction in the number of accidents was in 2020, which decreased by 10.89% from 2019. The cost of traffic accident victims using the Gross Output method shows that 2019 was the year with the largest cost of traffic accident victims with the largest cost of Rp. 189.115.338.860,06 where the average cost of accident victims per month was the highest in 2019 which was Rp. 15.759.611.571,67/month and 2016 was the year with the lowest cost of traffic accident victims at a cost of Rp. 135,804,470,051.69 where the average monthly cost of accident victims was the lowest, which was Rp. 11,317,039,170.97 / month.

INTRODUCTION

Road traffic and transport is a unified system consisting of traffic, road transport, traffic and transport network, traffic and road transport infrastructure, vehicles, drivers, road users, and their management. Traffic is the movement of vehicles and people in the road traffic room. Negligence in driving and lack of attention to vehicle maintenance due to poor road conditions can result in accidents in traffic. Traffic accidents are very complex cases that are influenced by many factors, especially traffic volume in addition to construction conditions and road geometry. This is because the accident seems to have had very different causes (Persaud dan Mucsi, 1995). A Traffic accident, based on constitution (Traffic Regulation) no. 22 of 2009, is an incident on the road that is unexpected and unintentional involving a vehicle with or without other road users, resulting in human casualties and/or property loss. This loss of property or material is then referred to as the cost of a traffic accident.

Traffic accident costs are costs incurred as a result of a traffic accident. These costs include the cost of treating the victim, the cost of property loss, the cost of handling traffic accidents, and the cost of the loss of the victim's productivity. Traffic accidents also have an impact on increasing poverty, because they cause maintenance costs, loss of productivity, loss of breadwinner in the family which cause trauma, stress and prolonged suffering.

The problem faced in Karawang Regency is the number of traffic accidents which tends to increase from year to year with a fairly high number of accidents. Therefore, traffic accidents on the highway must require serious attention in handling in order to reduce the number of accident victims and material losses caused. By knowing the nominal amount of the accident cost, it is hoped that it can give an idea to the public how much the cost is being due to an accident. In addition, it can also provide benefits in an effort to reduce the occurrence of traffic accidents. Thus, the parties involved in the accident handling program, including the road user community, have become more attentive

and concerned about preventing and reducing traffic accidents. This research uses the Gross output (Human Capital) method in calculating the cost of traffic accidents. The calculation using the Gross output Method includes the calculation of the present value of the victim's future income which is calculated using with and without principle. So, if the victim does not have an accident, the victim should be able to make some money and if the victim has an accident, he will lose as much income as if he did not become a victim of an accident (Sugiyanto, 2010). The purpose of this study was to determine the magnitude of the increase in accidents, the cost of accidents every year in Karawang Regency using the Gross output Method Pd. T-02-2005-B.

LITERATURE REVIEW

Traffic

According to constitution no. 22 of 2009, traffic is defined as the movement of vehicles and people in the Road Traffic Room, while what is meant by the Road Traffic Room is the infrastructure intended for the movement of vehicles, people, and/or goods in the form of roads and supporting facilities. Meanwhile, according to WJS Poerwadarminta, the definition of traffic is: "Traffic is walking back and forth, back and forth, regarding travel, as well as regarding transportation between one place and another (by shipping, air, land, and so on)." Traffic is defined as "pedestrians, ridden, or herded animals, vehicles stress and other conveyances either singly or together while using any highway for the purpose of traffic".

In traffic, there are 3 (three) component systems which include humans, vehicles and roads that interact with each other in the movement of vehicles. Traffic as part of the transportation system must develop its potential and role to realize security, safety, order and smooth traffic and road transportation. Without traffic, you can imagine how difficult it is for us to get to work or do work related to using the highway. There is not a single job that does not escape the use of traffic. Road traffic and transportation need to be carried out in a sustainable manner and continuously improved in order to provide wider coverage and services to the community by paying maximum attention to the public interest and the capabilities/needs of the community, environmental sustainability, coordination between central and regional authorities as well as elements of sector agencies, and between related elements and the creation of security and public order in the settlement of traffic and road transportation, as well as in the context of realizing a reliable and integrated national transportation system.

Traffic Order and Safety

According to constitution No. 22 of 2009 concerning road traffic and transportation regarding traffic procedures in articles 105 and 106. Article number 105 reads:

Everyone who uses the mandatory road:

- a. Behave in an orderly manner; and/or
- b. Preventing things that can hinder, endanger the security and safety of traffic and road transportation, or that can cause road damage.

Article number 106 reads:

- (1). Everyone who drives a motorized vehicle on the road must drive his vehicle fairly and with full concentration.
- (2). Everyone who drives a motorized vehicle on the road must prioritize the safety of pedestrians and cyclists.
- (3). Everyone who drives a motorized vehicle on the road must comply with the provisions on technical requirements and roadworthiness
- (4). Everyone who drives a motorized vehicle on the road must comply with the provisions:
 - a. Command sign or prohibition sign;
 - b. Road markings;
 - c. Traffic signaling device;
 - d. Traffic movement;
 - e. Stop and park;
 - f. Alerts with sound and light;
 - g. Maximum or minimum speed; and/or
 - h. Procedures for towing and attaching with other vehicles.

- (5). When a motorized vehicle is inspected on the road, every person driving a motorized vehicle is required to show:
 - a. Vehicle registration certificate or motor vehicle trial certificate;
 - b. Driver's license;
 - c. Proof of passing periodic tests; and/or
 - d. Other valid proof.
- (6). Everyone who drives a motorized vehicle with four or more wheels on the road and the passenger sitting beside it must wear a seat belt.
- (7). Everyone who drives a four-wheeled or more motorized vehicle that is not equipped with houses on the road and the passenger sitting beside it must wear a safety belt and wear a helmet that meets Indonesian national standards..
- (8). Everyone who drives a motorcycle and a motorcycle passenger is required to wear a helmet that meets Indonesian national standards.
- (9). Everyone who drives a motorcycle without a side carriage is prohibited from carrying more than 1 (one) passenger.

Traffic Accident

Traffic accidents according to the Law of the Republic of Indonesia Article 1 No. 22 of 2009 is an incident on the highway that is unexpected and unintentional involving a vehicle with or without other road users, resulting in human casualties and/or property loss. Traffic accidents are classified into 4 classes, namely:

- a. fatal accident;
an incident on the road that is unexpected and unintentionally involves a vehicle with or without other road users resulting in the victim's death.
- b. serious accident;
an incident on the road that is unexpected and unintentional involving a vehicle with or without other road users resulting in serious injuries.
- c. minor accident;
an incident on the road that is unexpected and unintentional involving a vehicle with or without other service users resulting in minor injuries.
- d. accidents with property loss.
an incident on the road that is unexpected and unintentional involving a vehicle with or without other road users, resulting in property loss.

Classification of Accident Victims Article 93 of Government Regulation no. 43 of 1993 concerning Road Traffic and Infrastructure, classifies accident victims as follows:

- a. Fatal Accident/Died;
Death victim or death victim is a victim who is confirmed to have died as a result of a traffic accident within 30 days of the accident..
- b. Serious Injury Accident;
Seriously injured victims are victims who due to their injuries suffer from permanent disability or must be treated for more than 30 days after the accident. What is meant by permanent disability is when a limb is lost or cannot be used at all and cannot be healed/recovered forever.
- c. Minor Injury Accident.
Minor injuries are the condition of the victim experiencing injuries that are not life-threatening and/or do not require further assistance/treatment at the hospital.

Cost of Traffic Accident

Traffic accident costs are costs incurred as a result of a traffic accident, these costs include: victim treatment costs, property loss costs, traffic accident handling costs, and victim productivity losses.

The Gross Output Method

The Gross Output method is a method for analyzing accident costs by calculating the reduction in the value of all lost resources from all parties due to accidents. This method is often used to analyze the cost of accidents in developing countries such as Indonesia (Balitbang PU, 2003).

The method of calculating the unit cost of traffic accidents with the approach, The Gross Output or Human Capital, consists of two main costs, namely:

- 1) costs calculated due to direct losses (direct cost);
- 2) costs calculated as loss or loss of income of traffic accident victims (indirect cost).

Direct losses consist of 3 cost components, namely:

- 1) the cost of repairing and replacing damaged vehicles and or materials;
- 2) hospital treatment costs for the treatment of victims;
- 3) accident handling and administration costs.

The cost of repairing and replacing damaged vehicles and or materials can be obtained through a survey on vehicle repair costs due to traffic accidents at vehicle repair shops (workshops). The fee is collected for repairs of the vehicles involved in each accident class (fatal, heavy, light, material loss).

The cost of treating the victim can be obtained through the information contained in the hospital's medical record. To find out the category of the victim, it is necessary to record the length of the victim's treatment in the hospital. Besides that, information is also needed about the length of rest time needed from being treated to being able to carry out activities or work again to calculate lost productive time..

Accident handling and administration costs can be obtained through interviews or data collection at the local police force. These costs include::

- handling fees at the crime scene (TKP);
- crime scene processing costs;
- case investigation fees, and
- research costs for traffic accidents.

Information on these costs is collected for each accident class (fatal, serious, minor, material loss). The lost productivity value experienced by traffic accident victims is calculated based on the length of time the accident victim cannot produce and the average income level of the community (productivity value). For dead victims, the length of time not in production is assumed based on the difference between the average life expectancy (BPS) and the average age for victims of death due to accidents (POLRI). While the value of productivity can be calculated based on GRDP per capita (BPS).

The unit cost of traffic accident victims (BSKO_j) is the cost needed to treat traffic accident victims for each level of the victim category, while T₀ is the base year for calculating costs, namely 2003. The unit cost of traffic accident victims in 2003, BSKO_j (T₀), can be taken from Table 1.

Table 1. Cost of Traffic Accident Victims (BSKO_j (T₀))

No.	Victim Category	Victim Unit Cost (Rp/victim)
1.	Dead Victim	119.016.000
2.	Serious Injury Victim	5.826.000
3.	Minor Injury Victim	1.045.000

The unit cost of traffic accident victims for a certain year (T_n) can be calculated using the following equation:

$$BSKO_j(T_n) = BSKO_j(T_0) \times (1 + g)^t \dots\dots\dots (1)$$

With the understanding:

BSKO_j (T_n) = unit cost of traffic accident victims in year n for each category of victims, in rupiah/victim

BSKO_j (T₀) = unit cost of traffic accident victims in 2003 for each category of victims, in rupiah/victim, see Table 1.

g = inflation rate of accident unit cost, (in default value g = 11%)

T_n = year of calculation of victim cost

T₀ = base year for calculating victim costs (in 2003)

t = difference in calculation year (Tn – T0)
j = victim category

The amount of the cost of traffic accident victims is calculated in year n using the following equation:

$$BBKO(T_n) = \sum_{j=1}^m (JKO_j \times BSKO_j(T_n)) \dots\dots\dots (2)$$

With the understanding:

BBKO = the amount of the cost of a traffic accident victim in a road section or intersection or area, in rupiah/year.

JKOj = Number of victims of traffic accidents for each category of victims, in victims/year.

BSKOj (Tn) = unit cost of traffic accident victims in year n for each category of victims, in rupiah/victim

j = victim category

RESEARCH METHOD

Research Data

The data used in this study only uses secondary data, in the form of:

1. Accident data for 2016 – 2020 from the Police Resort Authority of Karawang Regency

Data Analysis Procedure

1. Determine the accident data based on the year of occurrence in Karawang Regency, then determine the year of calculation (Tn);
2. Determine the difference in the calculation year (t);
3. Collect data on traffic accidents and victims from the local police;
4. Compilation of accident victim data according to the categories of dead victims, serious injuries, and minor injuries;
5. Calculate the unit cost of victims in year n for each category of victims using formula 1 and table 1;
6. Calculate the cost of the victim using formula 2.

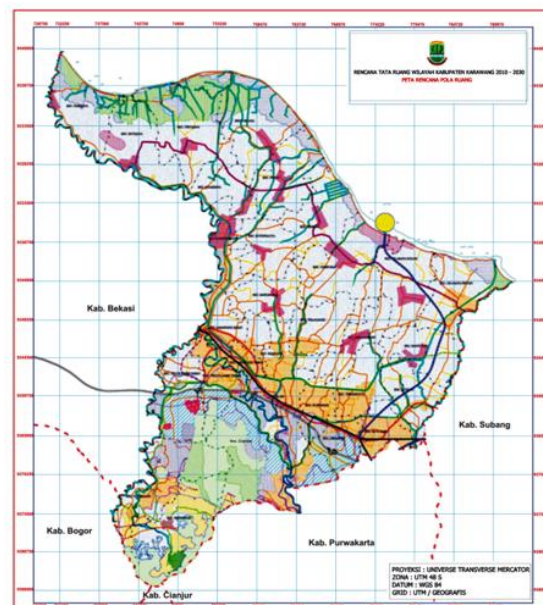


Figure.1. Road Network at Karawang Regency

RESULTS AND DISCUSSION

Accident Data in Karawang Regency

Traffic accident data obtained from the Police Resort Authority Karawang Regency. The list of recapitulation of traffic accidents in Karawang Regency during January 2016 to December 2020, can be seen in table 2.

Tabel 2. Data Recapitulation of Accident Rates in the Karawang Regency Region 2016 – 2020

Month	Number of Traffic Accidents					Accident Victim Dies					Accident Victims Seriously Injured					Accident Victims Minor Injured				
	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
January	48	53	63	51	75	18	37	30	19	24	14	14	7	5	4	50	33	79	55	78
February	48	35	44	52	64	24	12	18	17	16	19	4	3	4	8	23	29	40	64	53
March	38	27	48	56	83	21	16	21	26	23	18	4	12	3	6	24	26	64	55	74
April	32	42	54	61	46	22	23	24	26	11	18	7	13	4	5	4	37	54	54	48
May	44	41	53	60	43	20	21	23	32	18	13	9	10	2	8	21	28	52	56	39
June	45	35	28	71	67	5	23	17	31	18	22	9	6	2	6	32	18	29	68	70
July	53	76	54	99	63	41	38	25	24	9	13	13	9	1	9	28	72	60	91	56
August	54	45	54	95	67	45	24	16	23	24	20	9	3	2	9	9	42	66	96	56
September	57	48	53	73	76	36	24	29	21	21	10	12	7	4	14	31	42	41	65	66
October	44	55	66	69	54	18	28	19	22	17	9	7	8	4	4	33	45	66	61	55
November	23	40	52	74	55	10	18	19	23	20	7	5	7	7	3	15	30	63	63	60
December	54	37	61	56	35	22	26	25	26	19	22	3	3	11	2	47	23	64	46	24
Amount	540	534	630	817	728	282	290	266	290	220	185	96	88	49	78	317	425	678	774	679

Based on table 2, the highest number of traffic accidents was in 2019 with the number of traffic accidents amounting to 817 incidents with 290 deaths, 49 seriously injured and 774 minor injuries.

Comparison of Traffic Accidents in Each Year

Table 2 shows the number of traffic accidents each year. To see changes in the number of traffic accidents can be seen in table 3 and figure 1.

Table 3. Changes in the Number of Traffic Accidents in Karawang Regency

Year	Number of Traffic Accident	Percentage Change in Number of Accidents
2016	540	0,00%
2017	534	-1,11%
2018	630	17,98%
2019	817	29,68%
2020	728	-10,89%

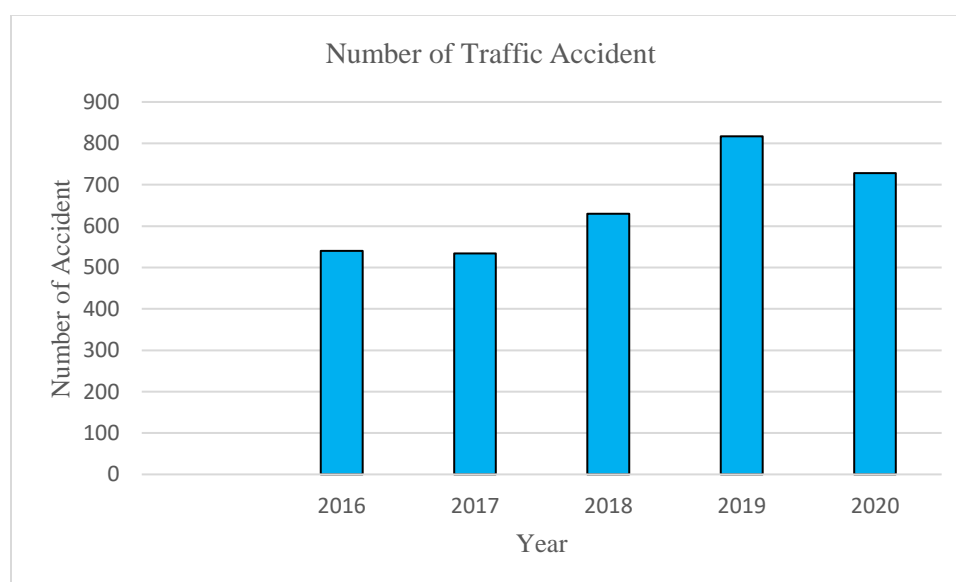


Figure 1. Changes in the Number of Traffic Accidents in Karawang Regency

Based on table 3 and figure 1, the results show that the highest percentage increase in the number of traffic accidents was in 2019 at 29.68% and the lowest percentage decrease in the number of traffic accidents was in 2020 at -10.89%.

Accident Victim Cost Based on The Gross Output Method

The calculation of the unit cost of traffic accident victims (BSKO_j (Tn)) for each year is calculated using the formula (1):

Calculation of BSKO_j (Tn) 2016

Dead Victim

$$\text{BSKO}_j (\text{T2016}) = 119.016.000 \times (1 + 0.11)^{13} = \text{Rp } 462.172.471,83 / \text{Victim}$$

Serious Injury Victim

$$\text{BSKO}_j (\text{T2016}) = 5.826.000 \times (1 + 0.11)^{13} = \text{Rp } 22.623.990,23 / \text{Victim}$$

Minor Injury Victim

$$\text{BSKO}_j (\text{T2016}) = 1.045.000 \times (1 + 0.11)^{13} = \text{Rp } 4.058.027,77 / \text{Victim}$$

Based on the calculation of BSKOj (T2016) it was obtained for the dead victim of Rp. 462,172,471.83 / Victim, Seriously Injured of Rp. 22,623,990.23 / Victim and Minor Injury of Rp. 4,058,027.77 / Victim. With the same calculation method, the value of BSKOj (Tn) in 2017, 2018, 2019, and 2020. The values of BSKOj (Tn) in each year can be seen in table 4.

Table 4. BSKOj Value (Tn) in 2016 – 2020

Year	BSKOj (Tn) (Rp/Victim)					
		Dead Victim		Serious Injury Victim		Minor Injury Victim
2016	Rp	462.172.471,83	Rp	22.623.990,23	Rp	4.058.027,77
2017	Rp	513.011.443,73	Rp	25.112.629,15	Rp	4.504.410,82
2018	Rp	569.442.702,54	Rp	27.875.018,36	Rp	4.999.896,02
2019	Rp	632.081.399,82	Rp	30.941.270,38	Rp	5.549.884,58
2020	Rp	701.610.353,80	Rp	34.344.810,12	Rp	6.160.371,88

Based on table 4 for the unit cost (BSKOj) for each year, it can be calculated the amount of the cost of traffic accident victims in year n using formula (2) and the accident rate data in Table 2. An example of the calculation in January 2016 is as follows:

Cost of Traffic Accident Victims in January 2016

BBKOj January (T2016)

$$= \Sigma [(18 \times \text{Rp. } 462.172.471,83 \text{ (T2016)}) + (14 \times \text{Rp. } 22.623.990,23 \text{ (T2016)}) + (50 \times \text{Rp. } 4.058.027,77 \text{ (T2016)})]$$

$$= \Sigma (\text{Rp } 8.319.104.492,97 + \text{Rp } 316.735.863,18 + \text{Rp } 202.901.388,50)$$

$$= \text{Rp } 8.838.741.744,65$$

In the same way to look for BBKOj every month and year, the total cost for traffic accident victims in Karawang Regency from 2016 to 2020 can be seen in Table 5.

Table 5. Total Accident Costs From Each Month/Year

Month	Total Accident Cost									
	2016		2017		2018		2019		2020	
January	Rp	8.838.741.744,65	Rp	19.481.645.783,48	Rp	17.673.397.990,04	Rp	12.469.496.600,28	Rp	17.456.536.738,46
February	Rp	11.615.329.776,99	Rp	6.387.215.755,32	Rp	10.533.589.541,48	Rp	11.224.341.491,45	Rp	11.827.023.851,50
March	Rp	10.210.246.399,04	Rp	8.425.748.297,78	Rp	12.612.790.318,71	Rp	16.832.183.858,29	Rp	16.798.974.517,38
April	Rp	10.591.258.315,47	Rp	12.141.714.810,44	Rp	14.298.994.484,55	Rp	16.857.575.244,09	Rp	8.185.135.792,71
May	Rp	9.622.779.892,76	Rp	11.125.377.483,86	Rp	13.635.926.934,90	Rp	20.599.280.871,43	Rp	13.143.999.352,78
June	Rp	2.938.447.032,80	Rp	12.106.356.263,08	Rp	9.992.773.037,85	Rp	20.033.798.086,53	Rp	13.266.281.260,83
July	Rp	19.356.807.995,62	Rp	20.145.216.620,22	Rp	14.786.936.489,75	Rp	15.705.934.362,66	Rp	6.968.577.300,63
August	Rp	21.286.763.286,91	Rp	12.727.473.566,60	Rp	9.524.701.432,79	Rp	15.132.543.656,10	Rp	17.492.732.607,69
September	Rp	16.990.247.749,09	Rp	12.802.811.454,06	Rp	16.913.959.238,92	Rp	13.758.216.975,32	Rp	15.621.229.315,69
October	Rp	8.656.635.321,43	Rp	14.742.807.315,71	Rp	11.372.404.632,22	Rp	14.368.098.836,84	Rp	12.403.575.708,58
November	Rp	4.840.963.066,46	Rp	9.494.901.457,70	Rp	11.329.529.925,81	Rp	15.104.103.816,95	Rp	14.504.863.819,28
December	Rp	10.856.249.470,49	Rp	13.517.236.873,49	Rp	14.639.685.963,66	Rp	17.029.765.060,13	Rp	13.547.135.267,66
Amount	Rp	135.804.470.051,69	Rp	153.098.505.681,75	Rp	157.314.689.990,68	Rp	189.115.338.860,06	Rp	161.216.065.533,19
Average	Rp	11.317.039.170,97	Rp	12.758.208.806,81	Rp	13.109.557.499,22	Rp	15.759.611.571,67	Rp	13.434.672.127,77

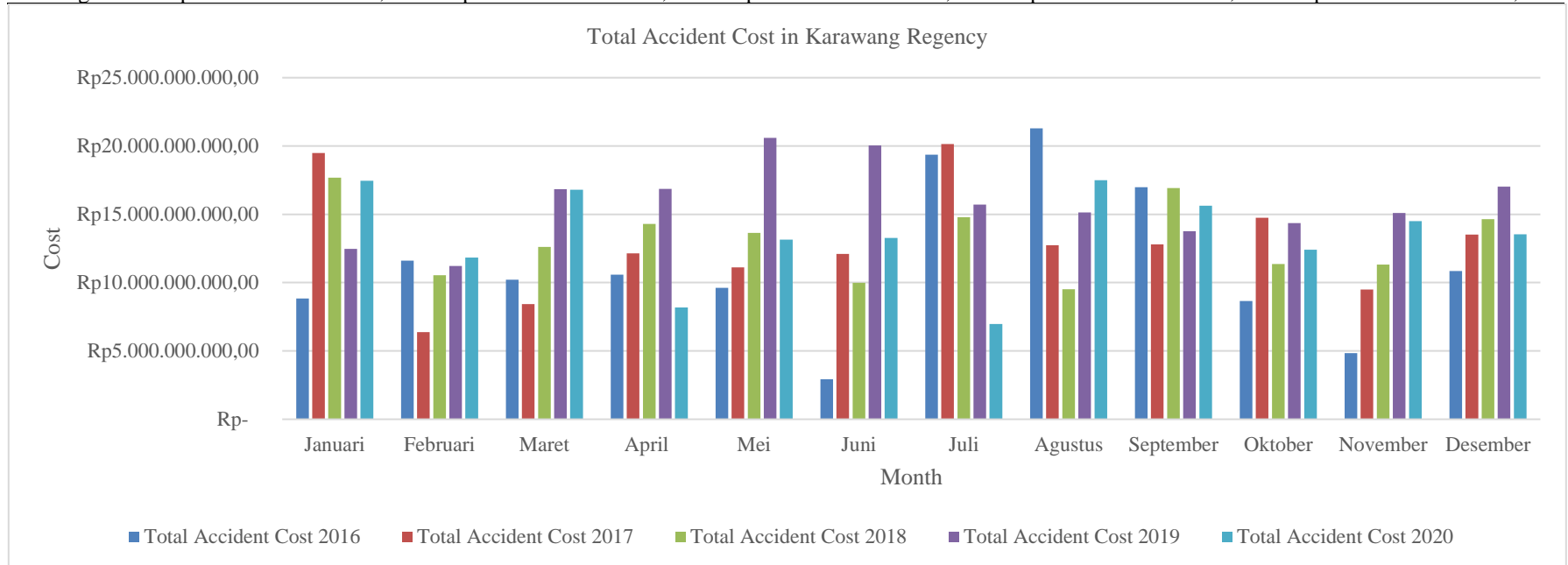


Figure 2. Total Accident Costs From Each Month/Year

Based on table 5 and figure 2, it is found that in 2019 the cost of the largest traffic accident victim with the largest BBKO was Rp. 189,115,338,860.06 where the average cost of accident victims per month was the highest, which was Rp. 15,759,611,571.67/month and it was found that in 2016 the smallest cost of traffic accident victims with the largest BBKO was Rp. 135,804,470,051.69 where the average cost of accident victims per month was Rp. 11,317,039,170.97 / month.

CONCLUSION

In the Karawang Regency area, the rate of traffic accidents continues to increase every year except from 2019 to 2020 the number of total cost accident is decrease because at the time the area due impact of pandemic covid19. This can make the loss of accident costs even greater, based on the calculation of accident costs using The Gross Output method, the total cost of accident victims (BBKO) in the Karawang district in 2016 - 2020 is obtained:

1. 2016 = Rp 135.804.470.051,69
2. 2017 = Rp 153.098.505.681,75
3. 2018 = Rp 157.314.689.990,68
4. 2019 = Rp 189.115.338.860,06
5. 2020 = Rp 161.216.065.533,19

So the need for handling so that traffic accidents can continue to decrease by checking the feasibility of the vehicle, road conditions and the condition of the driver himself.

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