Analysis of the Pedestrian System In Jayapura City (A Case Study of Pedestrian Line on Percetakan Street)

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Abstract: *Pedestrian line on Percetakan Street in Jayapura city still need to get handling to pedestrian performance. This study aims to analyze the characteristics of pedestrian traffic, to know the condition of pedestrian infrastructure and analyzing the pedestrian performance. This study uses qualitative descriptive method, Customer Satisfaction Index (CSI), Importance Performance Analysis (IPA) and service quality. The results showed that pedestrian traffic characteristic in segment 1 was average of 52 people/ hour, Segment 2 was on average 70 people/hour, and segment 3 was on average 82 people/hour. The condition of pedestrian facilities and equipment has not met the standard. Performance of pedestrian line according to CSI Customer Satisfaction Index at segment 1 CSI = 73.54%, segment 2 CSI = 68.44%. And segment 3 CSI = 59.35%. In the Importance Performance Analysis (IPA) diagram of the worst segment 3 indicator. Priority of handling of pedestrian performance indicated by service quality with lowest indicator value must be completed soon.*
Keywords: *Pedestrian, Performance, Jayapura City*

I.   INTRODUCTION

Pedestrian line is a container or space for pedestrian activities, and to provide services the pedestrians, so as to improve the smoothness, security, and comfort for pedestrians. But sometimes pedestrian is forgotten in urban design, pedestrian line is designed incidentally without thinking of the norms and standard that exist, so that the pedestrian is not yet provide comfort for its users. For example, a pedestrian lane filled with street vendors does not mean that the street vendor must be removed; The height of the pavement is not the same so difficult for pedestrians up and down, and so forth. Whereas pedestrian line has the main function of accommodating all the activities of pedestrians. Factors supporting elements that can affect the comfort of pedestrian among others: the physical state, sitting group, vegetation or shade trees, lighting, directions and others. This happens is on Percetakan Negara Street Jayapura City as the center of urban activity and one of the city icons [1].

Characteristics of the region as a central government, service and souvenir sales center of Papua [1], making the area of Percetakan Street in Jayapura City have a high traffic pull, both vehicles and pedestrians. The average increase of the population is 1.16% per year, so Jayapura is one of the cities with a high density of 293 souls/km² [2], this is in line with the economic growth rate is good. In 2015 the economic condition of Jayapura City is measured through the average economic growth rate of 8.43% and the average growth rate per year of Gross Regional Domestic Product (GRDP) of 19.02% [2]. Autonomous population growth and economic triggered private vehicle ownership levels, by 2016 showing a growth rate of vehicles 6.64% and an increase by 2015 by 12.38%. The largest increase was dominated by the number of private car and motorcycle ownership [3]. However, the growth is not in line with the development of infrastructure network, the growth is not followed by the improvement of road quality.

In the year 2015 approximately 24.99% of national roads and 11.87% of urban roads are in light and heavy damage condition [4]. This condition resulted in potential congestion in Jayapura city which is quite high especially in urban areas. This directly impacts the quality of urban pedestrian. Based on the description of the problem, it is necessary to conduct research on urban pedestrian systems of Jayapura City in order to create an effective and efficient urban pedestrian.

II.   METHODOLOGY

This research is descriptive and qualitative are a case study by conducting surveys, questionnaires and field observations. The analysis used is; Customer Satisfaction Index (CSI), Importance Performance Analysis (IPA) and service quality.
The location of the research as shown in Figure 1.

Figure 1. Research Sites

III. RESULTS AND DISCUSSION

3.1 Characteristics of Pedestrian Traffic

Traffic conditions of pedestrian in segment 1, segment 2, and segment 3 on Percetakan Street Jayapura City can be seen in Table 1, using the Pedestrian Volume Formula:

$$Q = \frac{N}{T}$$

Notes: Q = pedestrian flow (human/m/minute)

N = number of passers by (human/m)

T = observation time (minutes)

Table 1. Pedestrian traffic conditions

Segment 1		Time(T=Minute)	Monday (N=human)	Wednesday (N=human)	Saturday (N=human)	Total (N=human)
Duration of observation	06:00-08:00	120	41	39	36	116
	11:00-13.00	120	36	31	32	99
	16:00-18:00	120	37	32	28	97
Total T and N		360	114	102	96	312
Total Human/Minute (Q=N/T)			0.3	0.3	0.3	0.9
Average human/hour (Qx60 Minute)			**19**	**17**	**16**	**52**
Segment 2		**Time (T=Minute)**	**Monday (N=Human)**	**Wednesday(N= Human)**	**Saturday (N=Human)**	**Total (N=Human)**
Duration of observation	06:00-08:00	120	41	36	38	115
	11:00-13.00	120	38	44	67	149
	16:00-18:00	120	52	49	56	157
Total T and N		360	131	129	161	421
Total human/minute (Q=N/T)			0.4	0.4	0.4	1.2
Average human/hour (Qx60 minute)			**22**	**22**	**27**	**70**
Segment 3		Time (T=Minute)	Monday (N=org)	Wednesday (N=org)	Saturday (N=org)	Total (N=org)
Duration of observation	06:00-08:00	120	57	47	56	160
	11:00-13.00	120	30	35	31	96
	16:00-18:00	120	77	78	81	236
Total T and N		360	164	160	168	492
Total human/minute (Q=N/T)			0.5	0.4	0.5	1.4
Average human/hour (Qx60 Minute)			**27**	**27**	**28**	**82**

Source: Survey Results, 2017

Based on the calculation of pedestrian traffic volumes of the three segments referred to segment 1 on holiday pedestrian traffic volume decreased because this segment is dominated by offices. In the second segment, pedestrian traffic conditions are relatively constant on weekdays and increased on holidays. In the third segment, pedestrian traffic tends to be very tight both on working days and on holidays. The average number of third-segment pedestrian movements during 3 days of observation shows the smallest pedestrian traffic is segment 1 that is 52 people/hour, followed by segment 2 of 70 people/hour, and the highest or solid is segment 3 i.e. 82 people/hour. Segment 3 dominates number of pedestrians due to the presence of a market for indigenous Papuan traders who are busy every day. The density of the number of pedestrians in each segment is strongly influenced by land use, segment activity, and pedestrian infrastructure availability in this case the pedestrian width. Walking traffic presentation in 3 segments can be seen in Figure 2.
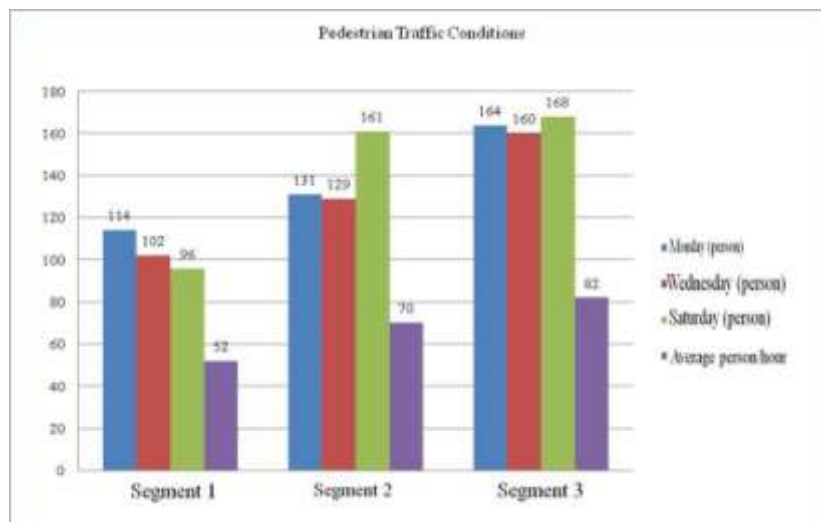

Figure 2. Pedestrian traffic conditions

3.2. Condition of infrastructure
Percetakan Street Jayapura City, segment 1 pedestrian area with a width of 1.5 m has not met the standard. In addition, there are other uses on pedestrian line such as the presence of trees, power lines and billboards that reduce the width of the pedestrian line so as not to function optimally. While one side of the road on Percetakan Street has no pedestrian line, and used for vehicle parking, but already available lights and zebra cross with good condition. In the segment 2 width of the pedestrian line of 1.8 m, the standard pedestrian width of the road is still minimal where the ideal width of the pedestrian line is 3-4 m. This is because part of the land has been confiscated by the road and land use passing the building border line, so there is no space for widening the sidewalk. While the 3 segment pedestrian line of Percetakan Street is used to sell it so as to generate clutter, according to the observation of wide pedestrian line vary between 1.8 m to 2.8 m while the standard should be 4 meters.

3.3. Performance of pedestrian line with Customer Satisfaction Index (CSI) methods
This method calculated service as a whole in accordance with the indicator of pedestrian line service on Percetakan Street. The result of calculation of CSI (Customer Satisfaction Index) pedestrian in segment 1, segment 2, segment 3 pedestrian line of Percetakan Street seen in Table 2.
Customer Satisfaction Index (CSI) segment 1

Table 2. Calculation of customer satisfaction index segment 1

No.	Pedestrian Service Attribute on Percetakan Street segment 1	Expectation (I)	Performance (P)	Score (S) = IXP
	Pedestrian Security			
1	Traffic accident	4.43	4.43	19.58
2	Theft	4.53	4.43	20.02
3	Barriers to street vendors, parking and beggars	4.40	4.35	19.14
4	Pedestrian Accidents	4.38	4.43	19.36
	Pedestrian pleasure			
5	Number of visits in the area	3.93	3.95	15.50
6	Duration of each visit in the area	4.25	4.18	17.74
7	Attractive power of the region	4.23	4.10	17.32
8	Availability of Facilities	4.30	3.95	16.99

No.		Expectation	Performance	Score
	Pedestrian convenience			
9	Protect from heat	4.35	2.25	9.79
10	Shielded from the rain	4.20	1.48	6.20
11	Disturb By vehicle	3.75	3.75	14.06
12	Disturb by dust/smoke smell of vehicles	4.18	3.75	15.66
	Pedestrian facilities			
13	Movement of Walker	4.45	4.03	17.91
14	Congestion Walking	4.25	4.23	17.96
15	Availability of Traffic Signals	4.35	1.58	6.85
16	Movement/shift of Transportation Mode	3.95	3.95	15.60
Total		**67.90**		**249.68**

Source: Results of data processing, 2017

CSI= $\frac{249.68}{5 \times 67.90}$ x 100% = 73.54 %

The CSI value obtained is 73.54%, it depicts pedestrians on segment 1 on Pedestrian Street segment quite satisfied with the performance of the pedestrian, but is still not maximal overall.

Customer Satisfaction Index (CSI) segment 2

Table 3. Calculation customer satisfaction index of segment 2

No.	Pedestrian Service Attribute on Percetakan Street of segment 2	Expectation(I)	Performance (P)	Score (S) = IXP
	Pedestrian Security			
1	Traffic accident	4.38	4.25	18.59
2	Theft	4.43	4.60	20.36
3	Barriers to street vendors, parking and beggars	3.55	2.95	10.47
4	Crash Accidents	4.38	4.38	19.14
	Pedestrian pleasure			
5	Number of visits in the area	3.93	3.95	15.50
6	Duration of each visit in the area	4.03	4.00	16.10
7	Attractive power of the region	4.00	3.95	15.80
8	Availability of facilities	3.75	3.63	13.59
	Pedestrian convenience			
9	Protect from heat	3.83	2.48	9.47
10	Protect from the rain	3.98	1.88	7.45
11	Disturb by vehicle	2.93	2.93	8.56
12	Disturb by dust/smoke smell of vehicles	3.20	3.20	10.24
	Pedestrian facilities			
13	Pedestrian movement	3.58	3.25	11.62
14	Pedestrian congestion	3.68	2.95	10.84
15	Availability of traffic signals	3.75	1.93	7.22
16	Movement/shift of transportation modes	3.68	3.78	13.87
	Total	**61.03**		**208.83**

Source: Result of Data Processing, 2017

CSI= $\frac{208.83}{5 \times 61.03}$ x 100% = 68.44 %

The CSI value obtained is 68.44%, lower than the 1st segment. It depicts pedestrians on 2 segment of Percetakan Street segment quite satisfied with pedestrian performance, but pedestrian performance in segment 2 should be improved.

Customer Satisfaction Index (CSI) segment 3

Tabel 4. Calculation Customer Satisfaction Index Segment 3

No.	Pedestrian Service Attribute on Percetakan Street of segment 3	Expectation (I)	Performance (P)	Score (S) = IXP
	Pedestrian Security			
1	Traffic Accident	4.05	3.78	15.29
2	Theft	4.10	4.15	17.02
3	Barriers to street vendors, parking and beggars	4.13	2.05	8.46
4	Pedestrian Accident	3.80	3.28	12.45
	Pedestrian pleasure			
5	Number of visits in the area	4.23	4.10	17.32
6	Duration of each visit in the area	4.00	4.00	16.00
7	Attractive power of the region	4.20	4.20	17.64
8	Availability of facilities	4.10	3.65	14.97
	Pedestrian convenience			
9	Protect from heat	4.33	2.38	10.27

10	Protect from rain	4.38	2.08	9.08
11	Disturb by Vehicles	4.35	1.98	8.59
12	Disturb by dust/smoke smell of vehicles	4.23	2.20	9.30
	Pedestrian Facilities			
13	Pedestrian movement	4.23	2.25	9.51
14	Pedestrian congestion	4.20	2.00	8.40
15	Availability of traffic signals	4.08	1.93	7.84
16	Movement/shift transportation modes	3.93	3.73	14.62
	Total	**66.30**		**196.74**

 Source: Result of Data Processing, 2017

CSI= $\dfrac{196.74}{5 \times 66.30}$ x 100% = 59.35 %

The CSI value obtained in segment 3 is 59.35%, the CSI value in segment 3 is the lowest of the three segments. It depicts pedestrians in the 3 segment of Percetakan Street segment not yet satisfied with the performance of the pedestrian line, besides this indicates the problem in segment 3 which is related to the pedestrian line quite a lot.

3.4. Performance of pedestrian line with Importance Performance Analysis (IPA)

This analysis relates between the importances of an attribute of a particular object to the reality/performance perceived by the user. Importance Performance Analysis is an analysis using diagrams by plotting the average data item in the Importance Performance Analysis diagram. In the results indicated by the Importance Performance diagram, the attributes that enter the first quadrant are the main priority, i.e. the attributes whose service is not satisfactory, the attribute that entered the quadrant I is considered by the customer has a relatively high expectation level, but is considered to have a relatively low performance so it must be done immediately Improvements for attribute performance in quadrant I increases. Attribute entered into the second quadrant is considered good so it must be maintained service/performance, which means the user is satisfied with the service. These attributes must be maintained because it is an advantage that already exists. Attributes enter into quadrant III low priority, which means the customer is not too concerned with the service. This attribute has a relatively low level of expectation and the perceived level of perceived user performance is also relatively low. Attributes that enter the quadrant IV is considered the customer has a relatively low interest level but gives a relatively high level of satisfaction can be concluded the user is satisfied with the performance of the item. Pedestrian line of Percetakan Street segment is presented in the form of tables and diagrams IPA. The table used is the table average items, can be seen in Table 5.

Importance Performance Analysis (IPA) segment 1

Table 5. Average level of expectations and performance of pedestrian Segment 1

No.	Pedestrian Service Attribute on Percetakan Street of segment 1	Expectation (I)	Performance (P)
	Pedestrian Security		
1	Traffic Accident	4.43	4.43
2	Theft	4.53	4.43
3	Barriers to street vendors, parking and beggars	4.40	4.35
4	Pedestrian Accident	4.38	4.43
	Pedestrian pleasure		
5	Number of visits in the area	3.93	3.95
6	Duration of each visit in the area	4.25	4.18
7	Attractive power of the region	4.23	4.10
8	Availability of facilities	4.30	3.95
	Pedestrian convenience		
9	Protect from heat	4.35	2.25
10	Protect from rain	4.20	1.48
11	Disturb by Vehicles	3.75	3.75
12	Disturb by dust/smoke smell of vehicles	4.18	3.75
	Pedestrian facilities		
13	Pedestrian movement	4.45	4.03
14	Pedestrian congestion	4.25	4.23
15	Availability of traffic signals	4.35	1.58
16	Movement/shift transportation modes	3.95	3.95
	Total	**67.90**	**58.80**
	Average	**Y= 4.24**	**X= 3.68**

Source: Results of data processing, 2017

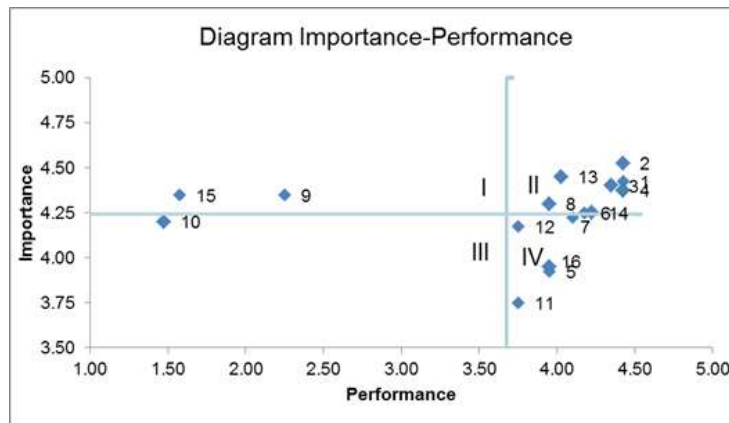These data are then incorporated into the following Importance Performance diagram (see in Figure 3).

Figure 3. Importance Performance Segment 1

Importance Performance Analysis (IPA) segment 2

Table 6. Average level of expectations and performance of pedestrian segment 2

No.	Pedestrian Service Attribute on Percetakan Street (Segment 2)	Expectation (I)	Performance (P)
	Pedestrian Securities		
1	Traffic Accident	4.38	4.25
2	Theft	4.43	4.60
3	Barriers to street vendors, parking and beggars	3.55	2.95
4	Pedestrian Accident	4.38	4.38
	Pedestrian pleasure		
5	Number of visits in the area	3.93	3.95
6	Duration of each visit in the area	4.03	4.00
7	Attractive power of the region	4.00	3.95
8	Availability of facilities	3.75	3.63
	Pedestrian convenience		
9	Protect from heat	3.83	2.48
10	Protect from rain	3.98	1.88
11	Disturb by vehicles	2.93	2.93
12	Disturb by dust/smoke smell of vehicles	3.20	3.20
	Pedestrian facilities		
13	Pedestrian movement	3.58	3.25
14	Pedestrian congestion	3.68	2.95
15	Availability of traffic signals	3.75	1.93
16	Movement/shift transportation modes	3.68	3.78
	Total	**61.03**	**54.08**
	Average	**Y= 3.81**	**X= 3.38**

Source: Result of Data Processing, 2017

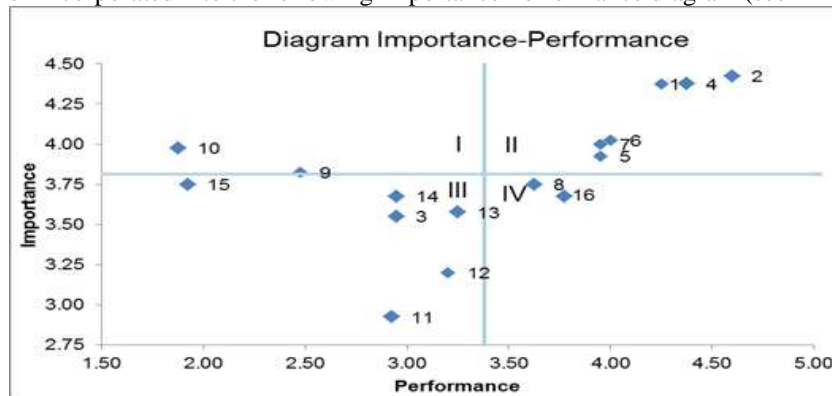These data are then incorporated into the following Importance Performance diagram (see in Figure 3).

Figure 4. Importance Performance Segment 2

Importance Performance Analysis (IPA) segment 3

Table 7. Average level of expectations and performance of pedestrian Segment 3

No.	Pedestrian Service Attribute on Percetakan Street (segment 3)	Expectation (I)	Performance (P)
	Pedestrian Securities		
1	Traffic Accident	4.05	3.78
2	Theft	4.10	4.15
3	Barriers to street vendors, parking and beggars	4.13	2.05
4	Pedestrian Accident	3.80	3.28
	Pedestrian Pleasure		
5	Number of visits in the area	4.23	4.10
6	Duration of each visit In the area	4.00	4.00
7	Attractive power of the region	4.20	4.20
8	Availability of facilities	4.10	3.65
	Pedestrian convenience		
9	Protect from heat	4.33	2.38
10	Protect from rain	4.38	2.08
11	Disturb by vehicles	4.35	1.98
12	Disturb by dust/smoke smell of vehicles	4.23	2.20
	Pedestrian facilities		
13	Pedestrian movement	4.23	2.25
14	Pedestrian congestion	4.20	2.00
15	Availability of traffic signals	4.08	1.93
16	Movement/shift transportation Modes	3.93	3.73
	Total	**66.30**	**47.73**
	Average	**Y= 4.14**	**X= 2.98**

Source: Results of data processing, 2017

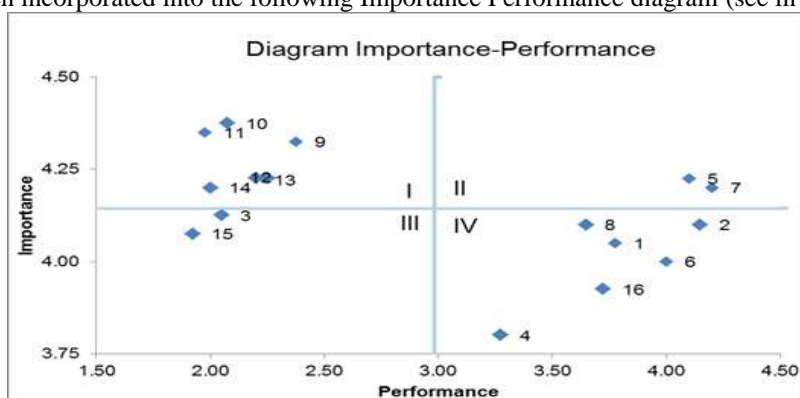These data are then incorporated into the following Importance Performance diagram (see in Figure 5).

Figure 5. Importance Performance Segment 3

3.5 Performance of pedestrian line with service quality

To know how the perception and expectations of customers to the services provided. The calculation of service quality is done by calculating the difference between perception/performance and customer expectation, calculation with negative value is considered the worst, while the value of 0 and positive is considered good. The calculation of service quality scores on the three segments is shown as follows (results with red backgrounds are attributes/indicators that have not been well-performing).

Service Quality Segment 1

Tabel 8. Score the pedestrian service quality of segment 1

No.	Pedestrian Service Attribute on Percetakan Street (segment 1)	Performance (P)	Expectation (I)	Score (S) = P-I
	Pedestrian Security			
1	Traffic Accident	4.43	4.43	0.00
2	Theft	4.43	4.53	-0.10
3	Barriers to street vendors Parking and beggars	4.35	4.40	-0.05
4	Pedestrian Accident	4.43	4.38	0.05
	Pedestrian pleasure			
5	Number of visits in the area	3.95	3.93	0.03
6	Duration of each visit In the area	4.18	4.25	-0.08
7	Attractive power of the region	4.10	4.23	-0.13
8	Availability of facilities	3.95	4.30	-0.35

No.	Pedestrian convenience			
9	Protect from heat	2.25	4.35	-2.10
10	Protect from rain	1.48	4.20	-2.73
11	Disturb by vehicles	3.75	3.75	0.00
12	Disturb by dust/smoke smell of vehicles	3.75	4.18	-0.43
	Pedestrian facilities			
13	Pedestrian movement	4.03	4.45	-0.43
14	Pedestiran congestion	4.23	4.25	-0.03
15	Availability of traffic signals	1.58	4.35	-2.78
16	Movement/shift transportation modes	3.95	3.95	0.00

Source: Result of data processing, 2017

Service Quality Segment 2

Table 9. Score the service quality of pedestrian segment 2

No.	Pedestrian Service Attribute on Percetakan Street (segment 2)	Performance (P)	Expectation (I)	Score (S) = P-I
	Pedestrian Security			
1	**Traffic Accident**	4.25	4.38	-0.13
2	Theft	4.60	4.43	0.18
3	Barriers to street vendors Parking and beggars	2.95	3.55	-0.60
4	Pedestrian Accident	4.38	4.38	0.00
	Pedestrian pleasure			
5	Number of visits in the area	3.95	3.93	0.03
6	Duration of each visit In the area	4.00	4.03	-0.03
7	Attractive power of the region	3.95	4.00	-0.05
8	Availability of facilities	3.63	3.75	-0.13
	Pedestrian convenience			
9	Protect from heat	2.48	3.83	-1.35
10	Protect from rain	1.88	3.98	-2.10
11	Disturb by vehicles	2.93	2.93	0.00
12	Disturb by dust/smoke smell of vehicles	3.20	3.20	0.00
	Pedestrian facilities			
13	Pedestrian movement	3.25	3.58	-0.33
14	Pedestrian congestion	2.95	3.68	-0.73
15	Availability of traffic signals	1.93	3.75	-1.83
16	Movement/shift transportation modes	3.78	3.68	0.10

Source: Results of data processing, 2017

Service Quality Segment 3

Tabel 10. Score of the service quality of pedestrian segment 3

No.	Pedestrian Service Attribute on Percetakan Street	Performance (P)	Expectation (I)	Score (S) = P-I
	Pedestrian Security			
1	Traffic accident	3.78	4.05	-0.28
2	Theft	4.15	4.10	0.05
3	Barriers to street vendors Parking and beggars	2.05	4.13	-2.08
4	Pedestrian Accident	3.28	3.80	-0.53
	Pedestrian pleasure			
5	Number of visits in the area	4.10	4.23	-0.13
6	Duration of each visit In the area	4.00	4.00	0.00
7	Attractive power of the region	4.20	4.20	0.00
8	Availability of facilities	3.65	4.10	-0.45
	Pedestrian convenience			
9	Protect from heat	2.38	4.33	-1.95
10	Protect from rain	2.08	4.38	-2.30
11	Disturb by vehicles	1.98	4.35	-2.38
12	Disturb by dust/smoke smell of vehicles	2.20	4.23	-2.03
	Pedestrian facilities			
13	**Pedestrian m**ovement	2.25	4.23	-1.98
14	**Pedestrian** congestion	2.00	4.20	-2.20
15	Availability of traffic signals	1.93	4.08	-2.15
16	Movement/shift transportation modes	3.73	3.93	-0.20

Source: Results of data processing, 2017

Result of recapitulation of service quality pedestrian score on Percetakan Street Jayapura city showed unsatisfying attribute on segment 1 there were 11 attributes, segment 2 there were 10 attributes, and the most is segment 3 that is 13 attribute, attribute with lowest value considered urgent to be finished soon. Attributes that are not satisfactory and are found in all segments are attribute no 3 (Barrier Street, Parking and Beggars), 8

(availability of facilities), 9 (protected from heat), 10 (protected from rain), 13 (pedestrian movement) 14 (pedestrian accident), and 15 (availability of traffic signs).

IV.   CONCLUSION

The average characteristic of pedestrian traffic on Percetakan Street Jayapura City segment, on segment 1 is 52 human/hour segments 2 is 70 human/hour and segment 3 is 82 human/hour.

The condition of pedestrian facilities and facilities on Percetakan Street Jayapura City still has not fulfilled the standard such as pedestrian width, traffic signs, and not yet friendly to people with disabilities. In addition to other uses above pedestrian such as the presence of trees, electricity poles and billboards that reduce the width of the pedestrian so it does not work optimally.

The level of user satisfaction on the performance of pedestrian line with the method of Customer Satisfaction Index (CSI) in segment 1 CSI = 73.54%, segment 2 CSI = 68.44%, and Segment 3 CSI = 59.35%, which means good enough, but no CSI value beyond 80% so it still needs improvement especially in segment 3 which CSI value is very low.

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