Evaluation of concretisation

by Evaluation Concretisation

Evaluation of concretization of local road in Padang city using the importance satisfaction analysis and customer satisfaction index methods

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Abstract. A road is the most critical infrastructure in economic development; therefore, it should be maintained at a certain level of service. In improving road quality, the satisfaction of road users can also be used as a reference to determine whether the road is still in good condition or if handling is needed to improve the comfort of the road users. This study aims to map the attributes that affect the satisfaction of local road users using the Importance Satisfaction Analysis and Customer Satisfaction Index methods, identify the main priority attributes that need to be improved, and assess the impact of concretization according to the community perceptions. The study found that road supporting facilities (road shoulder, drainage), the width of the road, smooth flow in and out of the road, prevention of stagnant water during the rainy season are the most priority attributes to be improved. The satisfaction index value is 67.22%, suggesting that overall, road users are satisfied with the existence of local road concretization in the city of Padang.

1 Introduction

The Major of Padang City has an excellent program in improving public needs, especially in residential areas. Public Works and Public Housing Agency has been instructed by the Major to evenly improve local roads in almost every residential and residential area that are densely populated by using road concrete programs since 2013. Ready Mix Concrete is chosen to pave the local road because the process is quite easy and can be done without heavy equipment compared to by using asphalt roads.

The rigid pavement is a road pavement with binding materials using Portland cement, reinforced concrete plates, or without reinforcement placed on the subgrade or without the bottom layer [3]. These concrete plates carry most of the traffic load. The advantages of cement concrete Pavement are: it is suitable for heavy traffic, more resistant to hot weather, and resistant to the influence of water. For local road/ concrete at residential area, rebate casting uses a K-225 concrete quality without reinforcement with a thickness of 15 cm.

According to (Director General of Highways, 2013), rigid Pavement can be a cheaper option for urban roads with limited access to very heavy vehicles. If the workspace is limited, the implementation of rigid pavement will be easier and faster to do than flexible pavement. From several opinions regarding rigid pavement (concrete), it can be concluded that road concretisation has advantages and disadvantages. However, concrete road pavement carried out on local urban roads is more effective and easier to work when it is compared to used asphalt. It is because housing/ local roads are generally narrow.

The local road concretisation aims to improve the quality and to increase the number of steady and durable roads in the residential in the context of regional development and fulfilling community needs. The question is, does the program has to satisfy the community needs? Are they (the community) happy with the road concretisation? Furthermore, will the concretisation trigger any disaster in the future, such as flooding or increasing the number of traffic accidents? These questions are important to evaluate the program. As far as the authors' knowledge, no study has been conducted to evaluate the satisfaction of the community regarding the concretisation, even though the program has been carried out since 2013. Therefore, authors are motivated to examine the essential attributes that significantly affect the satisfaction of users of concrete rebate roads and know the level of community satisfaction with the local road concretisation.

The objective of this study are: to map the attributes that affect user satisfaction based on the

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level of importance of the attributes as well as the level of community satisfaction with the Importance Satisfaction Analysis (ISA) method and the Customer Satisfaction Index (CSI); to know what attributes still need to be improved, so that the users' satisfaction of the community of road concrete users become higher; and to identify the impact of concretization according to community's perceptions. The object of the study was the residents who were living in the residential areas in the city of Padang, which received the road concretisation program between 2013 to 2017.

The attributes which expected to affect the satisfaction of the community were divided into four groups, including product (product), place/ location (place), process (process), and physical evidence (physical evidence). The attributes were examined to obtain the most important variables that affect peoples' satisfaction so that the authority could improve those variables. The Importance of Satisfaction Analysis (ISA) was used in this study to map the attributes and to spot the most important variables that should be maintained to enhance public satisfaction.

According to [6] Yosritzal et al., the Importance of Satisfaction Analysis (ISA) method is one of the evaluation tools in determining priorities for handling service attributes to improve customer satisfaction. The Importance Satisfaction Analysis (ISA) method is the extension of the Importance-Performance Analysis (IPA) method that is firstly introduced by Martilla and James (1977). The superiority of this ISA method can provide information items that needed to be improved for the users' satisfaction progress. The results are relatively easy to interpret. The scale is relatively easy to understand and to use, and the cost is relatively low.

Besides using the ISA method, this research also uses the Customer Satisfaction Index (CSI) method to determine the level of satisfaction of the user to the road concretisation as a whole. According to (Anggraini, 2015), the Customer Satisfaction Index (CSI) method is taken to determine the level of overall user satisfaction by looking at the importance of the attributes. The advantages of this CSI method include efficiency, easy to use, and straightforward. Also, it uses a scale that has a high enough sensitivity where users' satisfaction is determined by the user's perception toward product satisfaction for filling the expectations.

2 Material and methods

This research began with a preliminary survey to determine the concrete road conditions in the city of Padang and followed by several in-depth interviews to identify variables that affect the road user satisfaction. Secondary data about the road that had been paved with a concrete slab between 2013 to 2017 was collected from the Department of Housing and Settlements of the City of Padang Housing Area. The data was used to identify the samples. Primary data collection was carried out by distributing questionnaires to the residents who live and use the road before and after the concretisation work is done. The examined attributes used in this study are product, place, process, and physical evidence, which extracted, as shown in **Table 1**.

Table 1. Measurement Variables and Attributes

No.	DIMENSION (Attributes)	VARIABLE
1	*Product*	▪ The thickness of the pavement layer ▪ Quality of Road ▪ Road accessibility ▪ Supporting facilities and infrastructure (road shoulder, drainage)
2	*Place*	▪ Road width ▪ Ease of location ▪ The capacity of the road that is passed by the top-clock vehicle
3	*Process*	▪ The road casting with ready mix truck ▪ The presence or absence of road closure when casting road
4	*physical Evidence*	▪ Driving comfort (*rutting*) ▪ Road Safety (Road Hump) ▪ Vehicle noise ▪ Maintenance of concrete (28 days line closure) ▪ Impact on vehicle wheels ▪ The smoothness of road for vehicles in and out of the residence (when it disputes) ▪ Impact during the rainy season ▪ Impact during the dry season

There are 220 road concrete work packages done between 2013 to 2017. Twenty roads were randomly chosen as the sample for this study. Field observations were conducted to see the road conditions, road width, the thickness of castings, and road support. Then the questionnaire survey was carried out. Based on the Slovin equation, the number of samples for this study was 203 respondents.

The data were analysed using the Importance Satisfaction Analysis (ISA) method and the Customer Satisfaction Index (CSI). The first stages of data analysis using ISA are to determine the level

of suitability between the level of importance and the level of satisfaction of the attributes studied from the comparison of interest scores and satisfaction. The formula to check the suitability is shown in eq. 1

$$Tki = \frac{Xi}{Yi} x100\% \quad \text{......................(1)}$$

Where :
Tki is The level of compatibility of the Respondent-I; Xi is Performance Level Assessment (Satisfaction) Score; Yi is Road Concrete User Rating Score

The second stage is to calculate the average of each attribute with the eq. 2.

$$X = \frac{\Sigma Xi}{n} \ and \ Y = \frac{\Sigma Yi}{n} \quad \text{....................(2)}$$

Where :
X is Average Level of Satisfaction Assessment of attribute i;Y is Average Interest Rate Assessment of attribute i; n is Number of Data

Average (or median) Satisfaction Level

Fig.1 Importance Satisfaction Analysis Matrix (Graf et al., 1992)

The third stage is to calculate the average of each attribute of importance (Y) and Satisfaction (X), which will be used as the boundary in the Cartesian diagram with the eq. 3.

$$\bar{\bar{X}} = \frac{\Sigma Xi}{K} \ and \ \bar{\bar{Y}} = \frac{\Sigma Yi}{K} \quad \text{..................(3)}$$

Where:
X isTotal Attribute Satisfaction Level of attribute i;
Y is Total Attribute Average Interest of attribute i ;
K is Number of Questions Listed in the Questionnaire

The final stage of the ISA is the elaboration of each attribute in the Cartesian diagram, as shown in Fig 1.

After the ISA, the CSI was conducted. There are four steps in determining the customer satisfaction index, such as: determining mean importance score, establishing weight factor, determining to mean satisfaction score, and establishing.

Firstly, determining the Mean Importance Score (MIS) using eq. 4.

$$MIS_i = \frac{\sum_{i=1}^{n} Yi}{n} x \ 100 \ \% \quad \text{..................(4)}$$

Where:
n is Number of Data; Y_i is The importance value of the i-j attribute (which has been converted on a predetermined scale)
Secondly, establishing Weight Factor (WF) namely, weighted factors per attribute using eq.

$$WF_i - \frac{MIS_i}{\Sigma MIS} x \ 100 \ \% \quad \text{..................(5)}$$

Where:
MIS_i is MIS i-j attribute;MIS is The total number of MIS attributes
Thirdly, determining Mean Satisfaction Score (MSS) using eq. 6.

$$MSS = \frac{\sum_{i=1}^{n} Xi}{n} x \ 100 \ \% \quad \text{...............(6)}$$

Where:
n is Number of data; X_i is The performance value of the i-j attribute (which has been converted on a predetermined scale)

Finally, establishing Weight Score (WS), which is the multiplication between WF and MSS. Then specify CSI using eq. 7.

$$CSI = \frac{\sum_{i=1}^{n} WS_i}{HS} x \ 100 \ \% \quad \text{...............(7)}$$

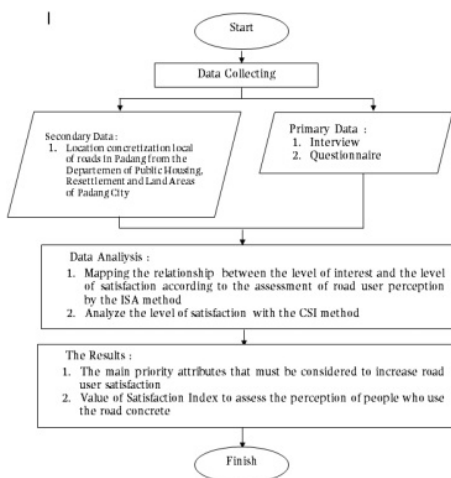The methodological framework of this study can be seen in Fig.2.

Fig.2 Methodological Framework

3 Result and discussion

Based on the field observation, it was found that the road sections vary in terms of the length and the width of the road section, the thickness of the pavement, and the presence of road shoulders. Therefore, the number of respondents is set to be proportionally distributed based on the length of the road sections. The list of the 20 road sections used as the samples and number of respondents for each section can be seen in Table 2.

Typical feature of the local road after concretisation program is in fig 3.

Fig.3. Manggis Street at Belimbing, Kuranji

Table 2. List of the Studied Road Sections

No.	Concrete Road Section	Road length	respond ents
1	Local Road at RT.05/RW.01 Bariang Indah III	737 m	5
2	Local Road at RT.04/RW.IV Ulak Karang Utara.	138 m	5
3	Jihad street at Kubu Dalam Parak Karakah	210 m	5
4	Local Road at RT.02/RW.06 Geri Permai Residence	226 m	5
5	Atlas II street at Ulak Karang	428 m	5
6	Local Road at RT.05/RW.03 Dadok Tunggul Hitam.	1.135 m	6
7	Local Road at Mutiara Putih Residence, Lubuk Gading Permai III Residence, Puri Lestari, Padang Sarai Permai Residence, Monang Indah Residence, Lubuk Sejahtera Lestari Residence.	6.644 m	48
8	Palembang Street at Ulak Karang Utara	502 m	5
9	Local Road at Mega Permai Residence.	1.286 m	20
10	Manggis street at RW 10, Kuranji	238 m	8
11	Local Road at Singgalang Residence, Batang Kabung	546 m	10
12	Local Road at Wisma indah IV Siteba, Pasir Putih Residence Tabing, Maransi, Pemda Sungai Lareh Residence	1.642 m	25
13	Local Road at RW. XIV Filano, Kubu Dalam Parak Karakah	226 m	7
14	Local Road at RT. 01/RW. 17, Anak Aie Koto Tangah	116 m	5
15	Banda Aceh Street at Ulak Karang	139 m	6
16	Local Road at Wisma Indah VII-Jundul IV Parupuk Tabing	351,1 m	8
17	Delima V street, RT. 005/RW.008 Belimbing, Kuranji	742 m	10
18	Local Road at Andalas and Parak Kopi	1.228 m	10
19	Local Road at Komplek Cendana Parupuk Tabing	570 m	5
20	Local Road behind PGSD, Lubuk Buaya	440 m	5
	Total		203

The level of conformity is the result of the comparison between the value of the level of satisfaction with the level of importance. Eq. 1 was used to calculate the level of conformity, and the level of suitability was used to see the ranking or ranking order of the attributes from the lowest to the highest. The result is shown in Table 3.

Table 3. Sequence of Attributes Based on Conformity

Priority	AtributeNumber	Atribute/Road Concrete Variable	Level of Conformity (%) (Tki)
1	4	Supporting facilities and infrastructure (road shoulder, drainage)	61,59
2	5	Road width	75,06
3	16	Impact during the rainy season	76,02
4	2	Quality of Road	79,42
5	1	The thickness of the pavement layer	83,55
6	3	Road accessibility	83,92
7	7	Volume-Capacity Ratio at the peak hour.	84,12
8	15	Smooth flow of vehicles in and out of the residential	84,22
9	6	Accessibility of the location	85,65
10	9	The road was closed during the concretisation work was running.	88,55
11	17	Prevention and reduction of dust during the dry season	88,63
12	8	Ready-mix concrete was used for the pavement	89,71
13	11	Installation of sleeping police to reduce vehicle speed	94,24
14	10	The surface of the pavement was rutted with a wire comb	94,64
15	12	Reduction of noise pollution	95,50
16	13	Roads were closed for 28 days during the concrete maintenance	96,24
17	14	Effect of the road pavement conditions toward tire wear (wheels)	96,75

In order to categorise the index level of satisfaction in the CSI, similar categorisation found in Syukri (2014) was used. The categorisation divides the CSI criteria based on the level of conformity, as shown in Table 4.

**Table 4** *Customer Satisfaction Index* Interpretation

Index level	Interpretation
x ≤ 64%	Very poor
64% < x ≤ 71%	Poor
71% < x ≤ 77%	Cause for concern
77% < x ≤ 80%	Borderline
80% < x ≤ 84%	Good
84% < x ≤ 87%	Very good
87% < x	excellent

Source: Syukri (2014)

Table 4 shows the level of suitability between the level of importance and the level of satisfaction in the attributes/variables of road concrete. The level of conformity shows the order of priority from the lowest to the highest as an effort to improve or repair the quality of the concrete road in the future by the related agency.

The data collected from the questionnaire were analysed using the Importance Satisfaction Analysis (ISA). Average Score of the Importance and the Satisfaction Level of Attributes of the Road Concrete seen in Table 5.

When the data were plotted to the Cartesian diagram of the ISA, the data spread in the four quadrants, as shown in Fig.4.
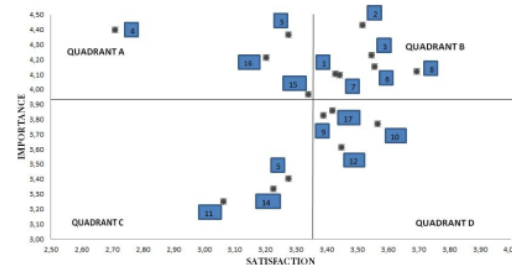
Fig.4 Plotted Data in a Diagram Cartesian

From the Cartesian diagram, it appears that the attributes are grouped into four quadrants as follows:
1. Quadrant A (*Main priority*)
The attributes include in this quadrant are attributes that are considered important, but the implementation has not been in line with the expectations. The attributes that exist are as follow:
- Supporting facilities and infrastructure (road shoulder, drainage) (4)
- Road width (5)
- Smooth flow of vehicles in and out of the residential (15)
Impact during the rainy season (16)

Table 5 Average Level of the Importance and the Satisfaction of the Road Concrete Attributes

No	Attribute/ Road Concrete Variable	Level of Importance (Y)	Level of Satisfaction (X)
1	Thickness of the pavement layer	4,10	3,43
2	Quality of Road	4,43	3,52
3	Road accessibility	4,23	3,55
4	Supporting facilities and infrastructure (road shoulder, drainage)	4,40	2,71
5	Road width	4,36	3,28
6	Accessibility of the location	4,15	3,56
7	Volume-Capacity Ratio at the peak hour.	4,09	3,44
8	Ready-mix concrete was used for the pavement	4,12	3,69
9	The road was closed during the concretisation work was running.	3,83	3,39
10	The surface of the pavement was rutted with a wire comb	3,77	3,57
11	Installation of a speed bump to reduce vehicle speed	3,25	3.06
12	Reduction of noise pollution	3,61	3,45
13	Roads were closed for 28 days during the concrete maintenance	3,40	3,28
14	Effect of the road pavement conditions toward tire wear (wheels)	3,33	3,23
15	Smooth flow of vehicles in and out of the residential	3,97	3,34
16	Impact during the rainy season	4,21	3,20
17	Prevention and reduction of dust during the dry season	3,86	3,42
	Total	**67,12**	**57,10**
	Average (X,Y)	**3,95**	**3,36**

2. Quadrant B (Maintain Performance)

The attributes included in this quadrant are attributes that are considered important by the respondent, and the performance/ satisfaction of the user is considered to be high. The attributes are:

- The thickness of the pavement layer (1)
- Quality of Road (2)
- Road accessibility (3)
- Accessibility of location (6)
- Volume-Capacity Ratio of the road at peak hour (7)
- Ready-mix concrete was used for the pavement (8)

Table 6 Calculation *Customer Satisfaction Index (CSI)*

No	Level Average Interests (MIS)	Importance Weigh Factor (WF)(%)	Level Average Satisfaction (MSS)	Weight Score (WS)
1	4,10	6,11	3,43	20,96
2	4,43	6,60	3,52	23,21
3	4,23	6,30	3,55	22,34
4	4,40	6,55	2,71	17,76
5	4,36	6,50	3,28	21,30
6	4,15	6,19	3,56	22,01
7	4,09	6,10	3,44	21,00
8	4,12	6,14	3,69	22,67
9	3,83	5,70	3,39	19,33
10	3,77	5,61	3,57	20,02
11	3,25	4,84	3,06	14,84
12	3,61	5,38	3,45	18,55
13	3,40	5,07	3,28	16,61
14	3,33	4,97	3,23	16,03
15	3,97	5,91	3,34	19,73
16	4,21	6,28	3,20	20,09
17	3,86	5,75	3,42	19,65
Tot	67,12	100		
Weighted Total				336,10
Customer Satisfaction Index (CSI)				67,22

3. Quadrant C (Low priority)

The attributes that are included in this C quadrant are attributes which considered as less important and also has less value of satisfaction. The attributes are:

- Installation of a speed bump to reduce vehicle speed (11)
- Roads were closed for 28 days during the concrete maintenance (13)
- Effect of the road pavement conditions toward tire wear (wheels) (14)

4. Quadrant D (Tends to be excessive)

The attributes include in D quadrant are attributes considered less important by road users, but the attributes are considered and implemented properly. The attributes included in this quadrant are:

- The road was closed during the concretisation work was running. (9)
- The surface of the pavement was rutted with a wire comb (10)
- Reduction of noise pollution (12)
- Prevention and reduction of dust during the dry season (17)

Finally, the data were analysed using the Customer Satisfaction Index (CSI) method to determine the level of satisfaction of the user to the road concretisation as a whole. The results are shown in Table 6.

It can be seen that the road user satisfaction index value is 67.22%, which means that the road user satisfaction level is in the range 0.66 - 0.80 or categorised as "satisfied" with the local road concretisation performance.

4 Conclusion

An exploration of the respondents' perception of the importance of the attributes of local road concretisation performance in Padang and how they satisfy the users has been conducted. The results show the attributes could be mapped in 4 quadrants, namely top priority, maintain performance, low priority, and tends to overdo.

1. Top Priority is an attribute that is considered important by concrete road users, but the implementation is not in line with the expectations. Furthermore, it is a top priority that needs to be considered and improved by the relevant agencies. These attributes include supporting facilities and infrastructure (road shoulder, drainage), road width, smooth flow of vehicles in and out of the residential, and lastly, the impact during the rainy season.

2. Maintain Performance is an attribute that has a relatively high level of importance with a relatively high level of user satisfaction so that managers need to maintain their performance. Attributes in the quadrant maintain this performance included: the thickness of the pavement layer, quality of the road, road accessibility, ease of location, the volume-capacity ratio at the peak, and the use of ready mix concrete for the pavement.

3. Low Priority is an attribute with a level of user satisfaction that is relatively below the average value of satisfaction, and the level of importance is also relatively lower than the average level of interest of the respondents. So, the priority is low. Attributes categorised into this quadrant include: installation of a speed bump to reduce vehicle speed, roads are closed 28 days for road treatment and maintenance, road pavement conditions against tire wear (wheels).

4. It tends to overdo. It is an attribute that the importance level is relatively low from the average level of importance of use and perceived by the user too excessive than relatively high level of satisfaction. Attributes that enter in this quadrant include: The road was closed during the concretisation work was running, the surface of the pavement was rutted with a wire comb, reduction of noise pollution, and prevention and reduction of dust during the dry season.

The calculation results using the Customer Satisfaction Index (CSI) method, it is obtained that the value of the respondents' satisfaction index is 67.22%, which means that overall the community feels "satisfied" with the road concretisation.

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