

Analysis of Parking Management System at Hasanuddin University Hospital

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ABSTRACT

This study aims to analyze parking management at Hasanuddin University Hospital. This study's population consisted of all vehicles parked between 7:00 and 23:59 every weekday. Based on analyzing the parameters of the characteristics, it can be determined that the two- and four-wheeled vehicle peak hours occur between 09:00 and 11:00, with a total of 562 vehicles. The average duration on weekdays for both two and four-wheeled vehicles is not much different, which is more than 2 hours/vehicle. The highest average volume and parking turnover rate occur on Tuesday around 650 vehicles, which is 78 times in one day while four-wheeled vehicles are around 98 times a day. The maximum parking index value has above 190%, hence it is necessary to expand parking space availability. Based on determining that the average of 310 respondents rates parking management as a medium category. Parking management and paid parking more than 40% said they were satisfied, while 58% said the parking space capacity was not able to meet parking demand. Controlling illegal parking and the need for special regulations for parking is more than 74%. Furthermore, based on the results of questionnaire data from experts who were obtained using the AHP (Analytical Hierarchy Process) method, the alternative priority in meeting parking demand and parking management is the construction of a parking building in terms of technical and social criteria. Therefore, this study provides useful information for planners and policymakers to plan, design, and evaluate parking systems.

Keywords: Parking characteristics, hospital parking, off-street parking, Analytical Hierarchy Process (AHP)

1. INTRODUCTION

Nowadays most public facilities require efficient parking management, especially in areas with dense populations. A good parking management system reflects the extensive system and urban infrastructure. Security, practicality, and comfort are a few things that patrons of public facilities demand. Therefore, these public venues' activities will be disrupted if the parking system cannot meet these three conditions [1].

Parking is one of the most crucial components of the total highway transportation system [2,3]. The urban transportation system regularly encounters the problem of parking, which can contribute to congestion in crowded

sites such as hospitals [4]. Numerous institutions, including the Hasanuddin University Hospital in Makassar, are incapable of resolving the parking issue. Parking is one factor that influences the hospital's efficiency and productivity [5].

In addition to serving as a tool for enhancing the competency of medical education and the standard of research in the area of medical, Hasanuddin University Hospital (RSP Unhas) can also offer health services to the general population (PP Nomor 93 Tahun 2015).

The first hospital outside of Java to handle cases of cancer is RSP Unhas. With a significant contribution, RSP receives a sizable number of daily visitors [7]. The increase in RSP visits as

well as the location of the RSP next to a bank indicates the concentration of visitor activity in this area.

Currently, parking management at RSP is suboptimal, resulting in unorganized parking for visitors' vehicles, as well as those who park in no-parking zones. Limited parking space, increased demand for parking, parking users, and insufficient field management result in parking misuse, such as on-street parking, causing congestion that might disrupt hospital services, such as hindering emergency access.

In this regard, this study's objective is to analyze the parking lot's characteristics to establish the RSP Unhas parking requirements. As well as to inquire about the public's perception of parking management, followed by the perception of experts, in order to determine priorities for developing a parking system.

Many studies have been conducted on parking characteristics for parking demand analysis, including analysis of parking in several hospitals [4,5,8,9], analysis of parking demand in universities [10–13], and in the other public places (Parmar, Das, & Dave, 2020; Parmar, Das, Azad, et al., 2020; Putri et al., 2017; Zaenal et al., 2019; Tong et al., 2004). In this study, the parking analysis is based on parking characteristics that will be discussed, as and to find out public preferences, will develop a questionnaire and AHP method for selecting alternative priorities for parking development. This study is limited to off-street parking and does not analyze on-street parking which is one of the reasons for congestion in that area.

2. RESEARCH METHOD

This research is consist of three steps, namely data gathering via direct observation of the condition of the facility and the parking management system in use. This survey included

all vehicles parked at Hasanuddin University Hospital from 7:00 to 23:59. Observations of both two-wheeled and four-wheeled parking vehicles were undertaken Monday through Sunday. Based on observation, the existing parking space comprises around 230m² with 150 plots for two-wheeled vehicles and approximately 1500m² with 120 plots for four-wheeled vehicles.

The data gathered from parking will be used to examine several aspects of parking, including accumulation, duration, volume, turnover rate, and parking index.

The second stage involved distributing questionnaires to 310 respondents chosen using Slovin sampling, which is a sampling approach that offers each individual an equal chance of being a sample. With the target population, namely the average number of vehicle users throughout the survey period.

$$n = \frac{N}{1 + Ne^2}$$

n: Number of samples

N: Total population (Average parking lot users during the week)

e: error tolerance limit (error tolerance)

Safety, security, comfort, and environmental sustainability are the four primary metrics displayed. This questionnaire can provide the public's perspectives on the condition of the facilities and management systems they encounter.

The third stage is the Analytical Hierarchy Process (AHP), as Figure 1 describes the steps of AHP. Questionnaire survey to prioritize alternative parking management systems from experts in their fields. Expert Choice software based on the AHP approach was used to estimate the weight of the criterion. In this case, lower-level elements are compared according to their impact on the main elements above. Pairwise comparisons were made based on how one element dominated the other and

ratings were entered using the Saaty scale [18]. The value of the Random Index (RI) is related to the number of criteria used in the pairwise comparison matrix. If the consistency ratio (RC) is less or equal to 10% then it is stated that the comparison results are acceptable. The approach to the calculation of consistency ratio requirements is as follows:

$$\text{Consistency Ratio} = \frac{\text{Consistency Indeks}}{\text{Random Indeks}}$$

The formula to calculate the Consistency Index (CI):

$$\text{Consistency Indeks} = \frac{\lambda_{\max} - n}{n - 1}$$

Where;

λ : average of consistency vector

n: Number of Criteria

3. RESULT AND DISCUSSION

A. Analyze the parameters of the characteristics

1. parking accumulation

Based on data processing, the largest maximum accumulation of two-wheeled vehicles based on data processing occurred on Wednesday with a total of 299 vehicles/hour, The highest fluctuation in the use of the highest parking lot occurred at 09.00 – 10.00 as shown in Figure 2. During the survey period, the largest maximum accumulation of four-wheeled vehicle parking occurred on Tuesday with a total of 263 vehicles/hour, as determined by data processing. From 10:00 to 11:00, the biggest fluctuation in the use of the highest parking lot occurred, as shown in Figure 3.

2. Parking Volume

According to data processing, the overall average volume of parking for two-wheeled vehicles is around 3058, and for four-wheeled vehicles approximately 2798. The average volume was highest on Tuesday, May 17, 2022, with

approximately 650 two-wheeled vehicles and 651 four-wheeled vehicles, as in Table 1.

3. Parking Duration

The average parking duration determined from survey data is shown in Table 2. The longest average duration of two-wheeled vehicles is on Friday with a duration of more than 3 hours/vehicle. While on four-wheeled vehicles, namely on Thursdays with a duration of more than 2 hours. The average duration of parking for two-wheeled vehicles is longer in the parking lot because parking users are employees of the Hasanuddin University Hospital. The average duration on weekdays for both two- and four-wheeled vehicles is not much different, which is more than 2 hours/vehicle.

4. Parking Turnover

The highest parking turnover rate occurs on Tuesday which is around 78 times in one day with a percentage rate of 21.25% for two- and four-wheeled vehicles, the highest parking turnover rate on Tuesday is around 98 times a day and the percentage of turnover is 23.26%. The lowest turnover rate for both two-wheeled and four-wheeled vehicles is on Sunday with the percentage of change for two-wheeled vehicles is 6.06% and four-wheeled is 3.94%, as in Figure 4.

5. Parking Index

The maximum parking index value for two-wheelers has reached 199.33%, and the parking index for four-wheeled vehicles is 219.17%, as shown in Table 3. This means that parking facilities for both two-wheeled and four-wheeled vehicles have problems. Where parking requirements exceed normal capacity.

6. Parking Lot Requirement

Determining the need for parking space is by multiplying the parking lot existing, maximum accumulation, SRP area, and parking index. Based on calculations, it can be concluded that the parking lot cannot accommodate the number of two-

wheeled or four-wheeled vehicles. It can be seen from the comparison of the maximum accumulation of parking requirements of 894 m² from a parking area of 230 m² and 7205.21 m² from a parking area of 1500 m². The Calculation of parking space requirements is based on the Director General of Land Transportation, Ministry of Transportation 1996. Hence, public perception and alternative priorities are needed to deal with this problem.

B. Analysis of Public Preferences on Parking Management

Based on the distribution of 310 respondents' responses on the level of parking management at Hasanuddin University Hospital, it can be determined that the average respondent rates parking management as Medium. Figure 5, shows parking management and paid parking more than 40% said they were satisfied, while 58% said the parking space capacity was not able to meet parking demand. Controlling illegal parking and the need for special regulations for parking is more than 74%. Distribution of respondents based on the overall condition of the level of availability of parking infrastructure and parking management, as in Table 4.

C. Priority Determination of Parking Management System

Based on the results of questionnaire data from experts who were collected using the AHP (Analytical Hierarchy Process) method, the construction of a parking building selected by expert respondents had high technical criteria, but very low economic criteria. As for the results of improved management and electronic payment methods, which have almost the same value, the difference is only seen in social criteria, as shown in Figure 6. The inconsistency value is 0.04, which is acceptable.

4. CONCLUSIONS

The results reveal that Hasanuddin University Hospital's parking management needs improvement based on the factors. The maximum accumulation of two-wheeled and four-wheeled vehicles is around 260 vehicles/hour with a turnover rate of around 20%. According to the Director General of Land Transportation's 1996 estimation of parking requirements, parking needs are 894 m² from a parking area of 230 m² and 7205.21 m² from a parking area of 1500 m²,

This makes the parking lot very congested and causes vehicles to park outside the parking area. The distribution of respondents' ratings of the level of parking management at Hasanuddin University Hospital shows that, on average, 310 respondents gave the management of parking a Medium category, and 58% of respondents state the parking space capacity was not able to meet parking demand. Therefore, 74% of respondents stated that special regulations are needed for parking and controlling illegal parking. Furthermore, according to expert survey responses that were compiled using the AHP (Analytical Hierarchy Process) method, the construction of a parking structure should be given alternative priority in order to meet parking demand and manage to park, taking into account both technical and social factors.

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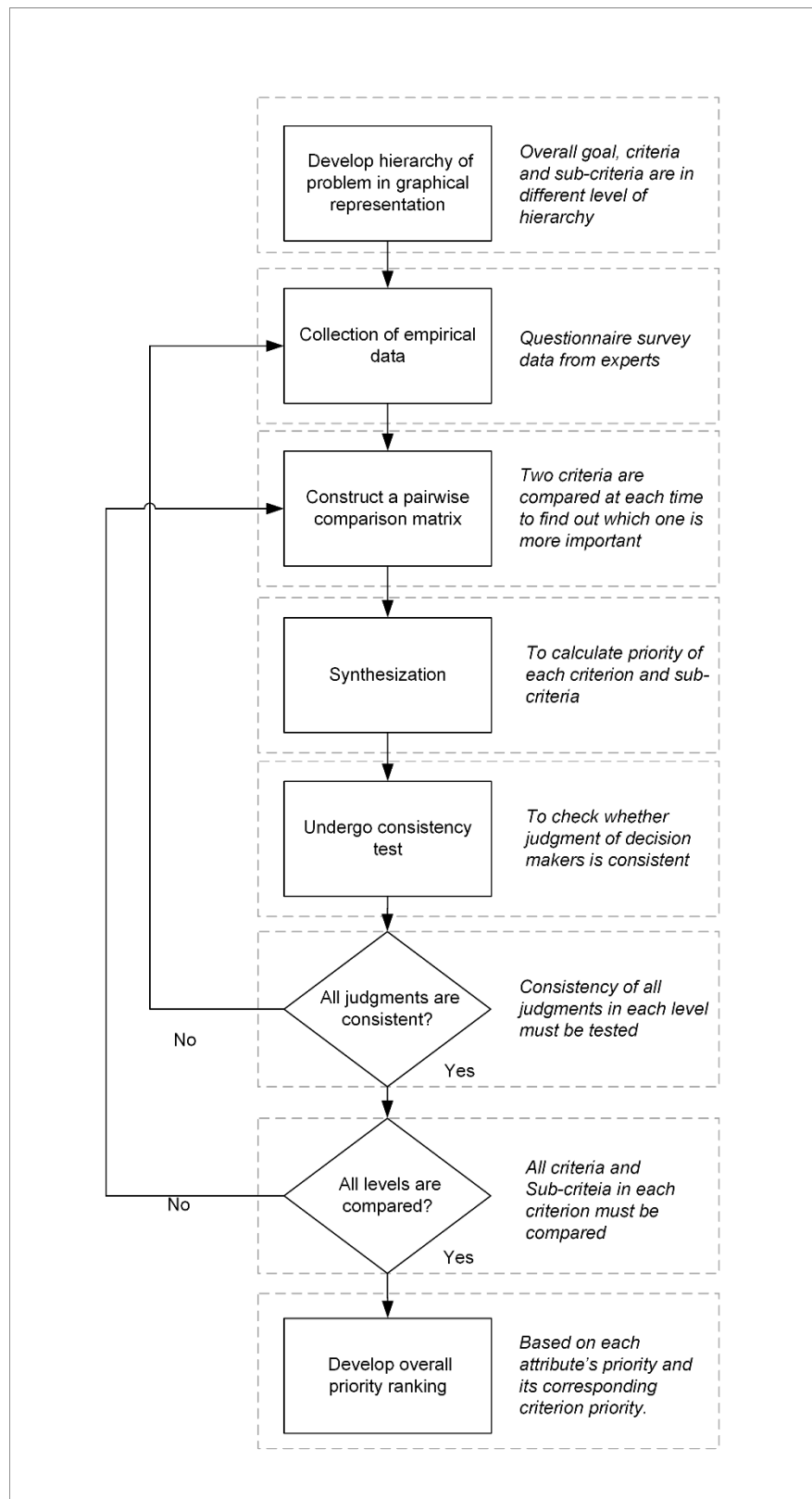


Figure 1. The flowchart of the analytic hierarchy process, adapted from [19]

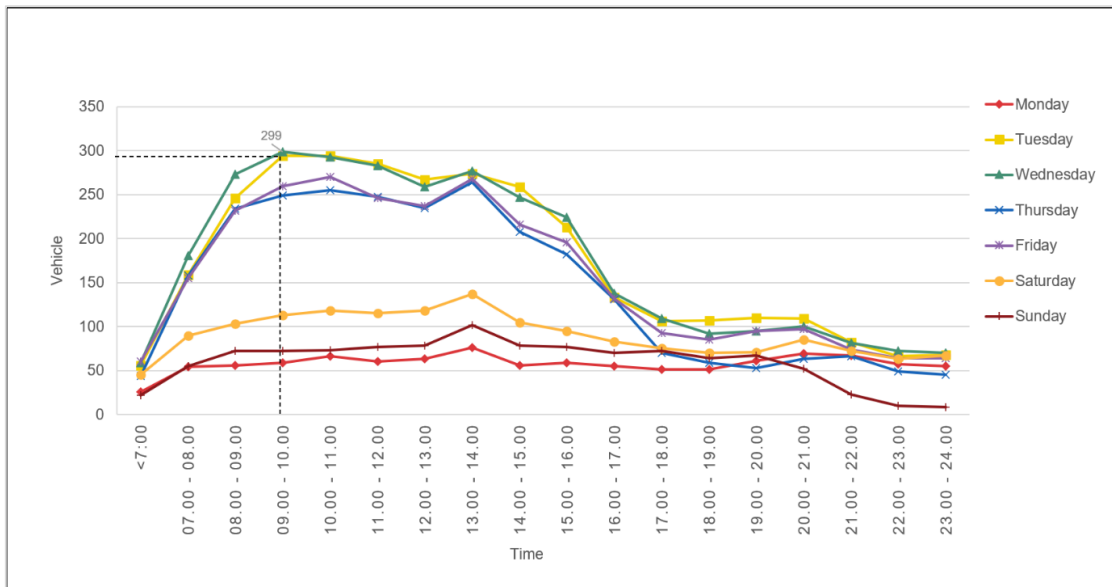


Figure 2. The maximum accumulation of two-wheeled vehicles

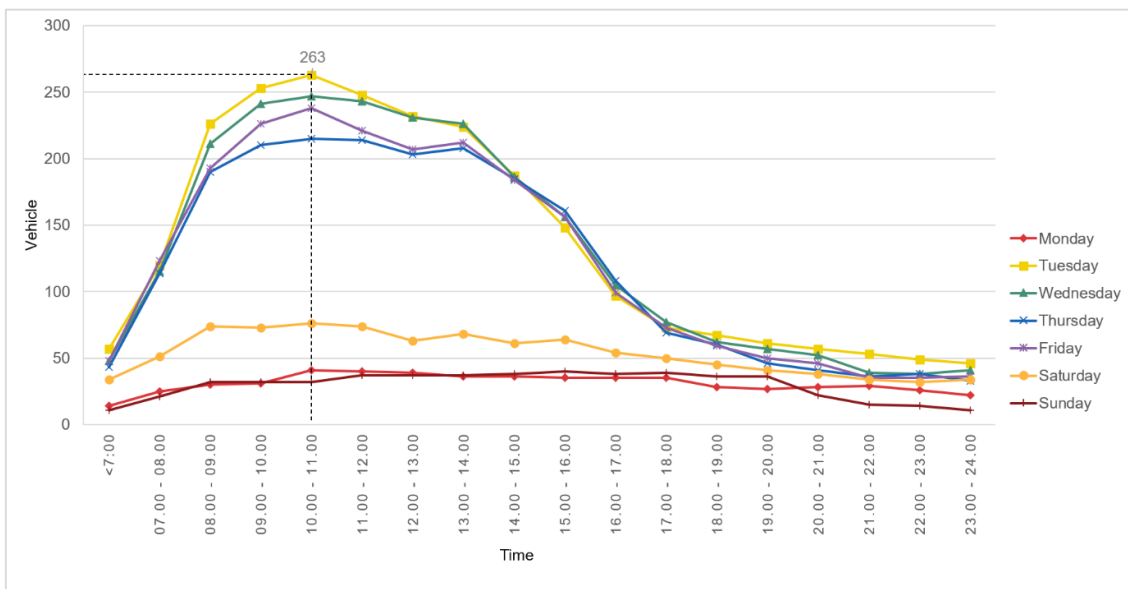


Figure 3. The maximum accumulation of four-wheeled vehicles

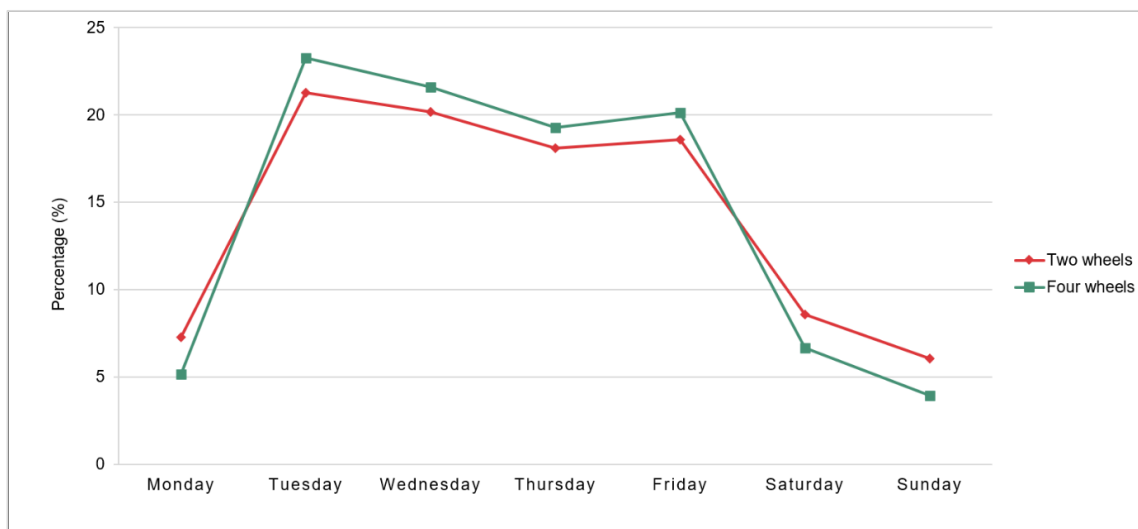


Figure 4. Parking turnover rate at Hasanuddin University Hospital

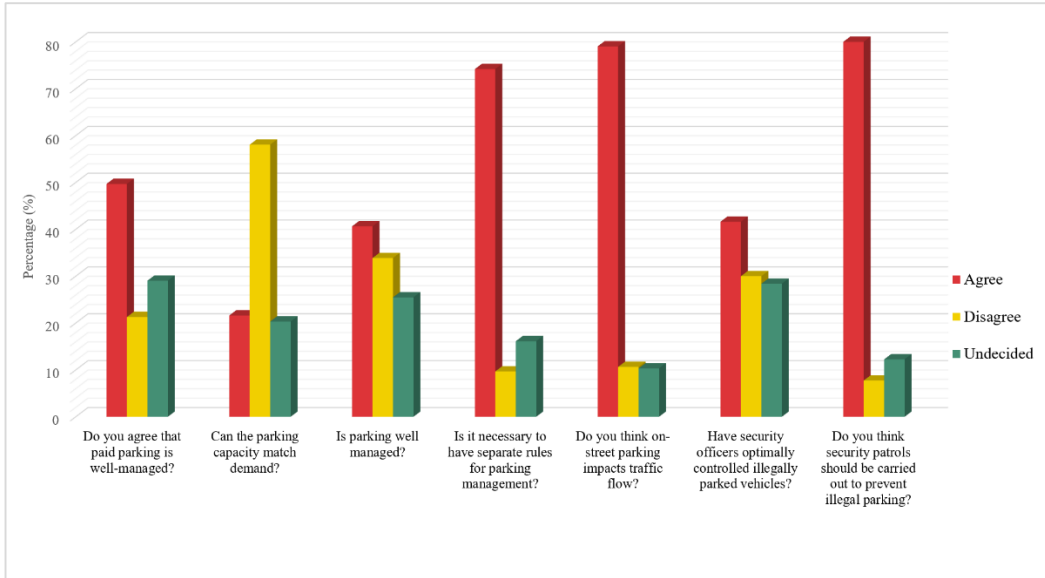


Figure 5. Satisfaction of respondents with parking management

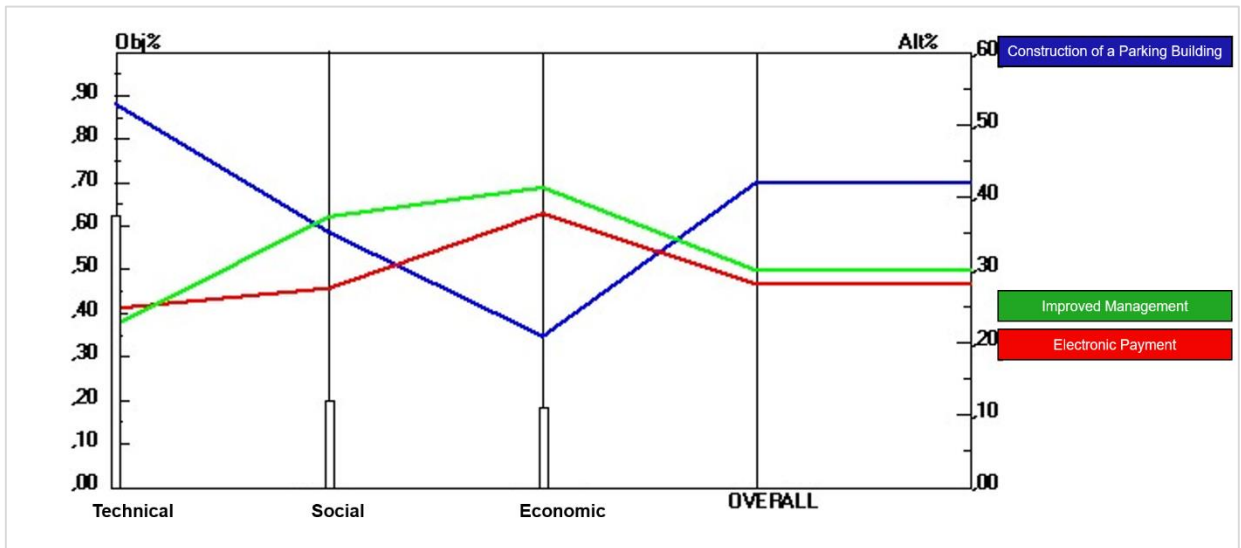


Figure 6. Performance sensitivity analysis of criteria With Respect to priority

Table 1. Daily average parking volume

Survey Period	Average Volume	
	Two wheels (Vehicle)	Four wheels (Vehicle)
Monday	223	144
Tuesday	650	651
Wednesday	617	605
Thursday	554	539
Friday	568	563
Saturday	262	186
Sunday	185	110
Total	3058	2799

Table 2. Daily average parking duration

Survey Period	Average Duration	
	Two wheels (Vehicle)	Four wheels (Vehicle)
Monday	1.97	1.68
Tuesday	2.87	2.18
Wednesday	2.95	2.32
Thursday	2.99	2.43
Friday	3.09	2.42
Saturday	3.02	2.36
Sunday	3.01	1.99

Table 3. Index of vehicle parking at Hasanuddin University Hospital

Day	Peak Hour		Parking Accumulation		Parking Index (%)	
	Two wheels (Vehicle)	Four wheels (Vehicle)	Two wheels (Vehicle)	Four wheels (Vehicle)	Two wheels (Vehicle)	Four wheels (Vehicle)
Monday	13:00 - 14:00	10:00 - 11:00	76	41	50.67	34.17
Tuesday	09:00 - 11:00	10:00 - 11:00	294	263	196.00	219.17
Wednesday	09:00 - 10:00	10:00 - 11:00	299	247	199.33	205.83
Thursday	13:00 - 14:00	10:00 - 11:00	264	215	176.00	179.17
Friday	10:00 - 11:00	10:00 - 11:00	270	238	180.00	198.33
Saturday	13:00 - 14:00	10:00 - 11:00	137	76	91.33	63.33
Sunday	13:00 - 14:00	15:00 - 16:00	102	40	68.00	33.33

Table 4. Analysis of public preferences on parking management

Indicator	Respondent Score					Total Score	Percentage (%)	Category
	Excellent (5)	Good (4)	Fair (3)	Poor (2)	Very Poor (1)			
Security	269	414	238	113	17	1051	67.78	Medium
Convenience	206	385	311	103	17	1022	65.94	Medium
Ease of Access	243	452	278	90	11	1074	69.28	High
Environmental Sustainability	196	443	299	105	8	1051	67.82	Medium