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Queue Management Assessment of Public Transport Users in Vehicle Stations: A case of Tepi Town

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Abstract

Managing the queue in the vehicle sanctuary is essential for every public transport users. There are a large number of people making queues in Tepi town vehicle sanctuary every day. The central goal of this study is to scan the queue management assessment system in vehicle sanctuary public transport users. The data were gathered from both primary and secondary sources. Identifying potential queuing factors, properly managing those factors, and improving the poor discipline of vehicle sanctuary officers and other stakeholders can reduce public transportation users' waiting time, reduce their stress while waiting in line, and improve the security, satisfaction, and safety of public transportation users and other participants.

Keywords: *Public transport, Queue management, Safety of transport, Vehicle sanctuary*

1. Introduction

Public transportation plays an essential role in different countries around the world (Shrestha et al., 2017). Transportation is the most crucial component of community activities; it plays a critical part in the everyday movement of people and commodities, and its importance may be seen from a variety of perspectives, including economic, social, political, security, and environmental protection (Levkoe, 2006). Transportation impacts human civilization, and it is also a key component of society. Advances in transportation change the manner of life and the way society is controlled, so transportation affects human civilization, and it is also a major component of society (Thahir et al., n.d.).

As a result, public transit is critical in both developed and developing world cities (Richardson et al., 2002). Providing a cheap option for urban commuters helps to minimize dependency on private car ownership (Salau, 2015a).

The study of the movement of people, things, or information through a line is known as queuing theory (Green, 2006). A queuing system removes time-wasting distractions that accumulate throughout the day, manages customers, and frees up resources for other duties by allowing more customers to be seen (Forsyth, 2013). Customers, who are happier, are usually less stressed, that allows employees to be more focused on efficiency (Wright et al., 2007). Waiting in a queue means forming or joining a row of people waiting one behind the other (Moran, 2010). Queuing or waiting in line for services is an unpleasant but necessary part of life (Mann, 1969). The study of such encounters is where the queuing theory began and has expanded to a significant extent (Hasenfeld et al., 1987). Human queuing phenomena are numerous, and those linked with public transportation services are frequently observed daily (Wang et al., 2014).

While providing real-time information has the potential to minimize travel uncertainty, its effects are dependent on the underlying service's reliability, the prediction scheme's performance, and the scheme's perceived credibility (Cats & Gkioulou, 2017). Different sorts of randomness have an impact on the reliability of public transportation (El-Geneidy et al., 2014). Randomness can arise from a variety of sources, including random events such as accidents or protests, as well as systematic uncertainty relating to service supply, such as dwell time or transit time between successive stations (Soza-Parra et al., 2021).

According to the aforementioned author's explanation, in addition to these sources of unpredictability, consumers are also subjected to an additional source of uncertainty when a public vehicle is not instantly accessible to avoid a lengthy wait (Rathor & Saxena, 2020). Even with perfect regularity, consumers in a frequency-based system (without timetables) remain uncertain about the arrival time of the following truck (Pozo Montaño, 2015). In the case of urban public transportation, problems develop as people gradually shift from using public transportation to using private vehicles to carry out their duties (Syahlendra, 2021).

Examining current and predicted socioeconomic data in a community is a critical first step in estimating current and future transportation needs (Toole et al., 2015). Key socioeconomic elements that contribute to understanding the city's travel habits are population size, the number of houses, and employment (Salau, 2015b).

The quality of services is determined by several parameters, differently perceived by users and operators: on the one hand, users want to be satisfied by the service offered (e.g., in terms of frequency, travel time, and cost); on the other, operators aim at increasing the ridership with the

lowest possible cost (Inturri et al., 2021). Both issues should be satisfied to achieve a good quality of the system and affect public transport use and effectiveness (Inturri et al., 2021). The quality of public transportation services can be measured from the user's perspective, in terms of the gap between expected and perceived quality, and from the service provider's perspective, in terms of the gap between the targeted and provided service (Inturri et al., 2021). Based on AHP, data queues can be prioritized in a systematic manner by setting up hierarchies, contrasting weight measures, and then making decisions (Saaty, 2004). AHP enables quick response to emergencies and timely handling of urgent cases (Li, et al., 2016). Since there are queuing problems in every vehicle sanctuary, yet no more researches were conducted on it. In addition, there were no AHP based queue factors prioritization that can affect public transport users before.

1.1. Objectives

The study aims to investigate the queue management assessment of vehicle sanctuary public transport users. It also aims to identify the causes of the queue and reduce the stress of waiting inline.

2. Methods

2.1. The Study Area's Description

Tepi is a town in the Southwest Ethiopian Region known for its coffee and spice cultivation. Addis Ababa lies 621 kilometers south of the town. The town is located at 7°12′N 35°27′E and has an average elevation of 1,097 meters above sea level (Mekonnen et al., 2020). The land is covered in beautiful green trees (Saphores & Li, 2012).

2.2. Nature and Source of Data

The information was gathered from both primary and secondary sources. The primary data were gathered from the car sanctuary's location using techniques such as surveys, observation, personal interviews, and questionnaires. Secondary data were gathered from a company, institution, or government agency, as well as publicly available resources such as books, manuals, and research papers. The study populations were the stakeholders of the public transport users (I.e., the whole population that uses public transport, like passengers, drivers, traffic policemen, and vehicle sanctuary officers. The goal of this analysis was to answer the research questions and achieve the study objectives, which were backed up by the findings. The quantitative and qualitative types of analysis methodologies were used in this type of applied research. A quantitative and qualitative method suggested that the conclusion of the research was dependent on the manipulation of this

knowledge. Finally, using tables, figures, charts, and graphs, the gathered information was organized, analyzed, and presented.

2.3. Sampling Size and Techniques

A total of 200 samples were purposefully selected from the vehicle sanctuary's public transportation users for the qualitative analysis. The snowball sampling technique, in a manner of characters that are hard-to-reach important information, was also being used. The first step in the data collection was the identification of various queue factors affecting public transport users and conducting a pilot study to shortlist the queue factors. After the pilot study was done, the questionnaire were designed and circulated for data collection. Data collection was done through direct visits, interviews, and by circulating the questionnaire to the public transport users.

Figure 1 the research methodology flow chart

Figure 1, shows the methodology flowchart of the research that follows the above steps.

2.4. Data Analysis and Presentation

Data analysis is a technique for transferring order structure to a large amount of information. 'What the result means that' was indicated in this section as a possible outcome of the findings. Qualitative data analysis can be defined as a search for general generalizations about links between different types of data. Words, concepts, terms, symbols, and other symbols were utilized to create a framework for conveying the essence of what the information revealed in this method, whereas quantitative methods were used procedures and techniques to investigate knowledge numerically. The data were then organized, evaluated, and presented using tables, figures, charts, and graphs. Finally, the conclusions of the analysis were drawn along with suggestions to support those findings.

2.5. AHP calculation

First, the criteria must be examined in pairs to assess their relative weight and importance in relation to the overall objective. The relative importance of the first criteria categories was determined in the second step of the evaluation.

3. Results and discussion

3.1. Causes of the queue in vehicle sanctuary

While shortlisting the queue factors that can affect public transport users, conducting the pilot study and questionnaires were designed and circulated for data collection. After circulating the design questionnaires, we get the following responses (pairwise matrices) for prioritizing and the following queue factors see **table 1**.

Table 1 the pairwise comparison of questionnaire responses

Factors causing queue	PA	DR	TCI	TSO	NAV	QR	VSEEL	TP
Transport cost increment (TCI)	1	½	1/2.5	3	2.5	2	3	3.5
Drivers (DR)	2	1	½	4	3.5	3	4	4.5
Passengers (PA)	2.5	2	1	5	4.5	4	5	5.5
Quality of road (QR)	1/3	1/4	1/5	1	1/2	1/2.5	1.6	2.3
Number of available vehicles (NAV)	1/2.5	1/3.5	1/4.5	2	1	1/2	2	2.8
Transport service officers (TSO)	1/2	1/3	1/4	2.5	2	1	2.5	3.3
Transport policy (TP)	1/3	1/4	1/5	1/1.6	1/2	1/2.5	1	1.5
Vehicle sanctuary exit and entrance location (VSEEL)	1/3.5	1/4.5	1/5.5	1/2.3	1/2.8	1/3.3	1/1.5	1

A perfectly consistent decision-maker should always get CI=0, although little amounts of inconsistency are acceptable. If the consistency ratio (CR) is less than 0.1, AHP should provide a reliable result with tolerable inconsistencies.

3.1.1. Structure of the Hierarchy

Decompose the problem of decision-making into a set of criteria.

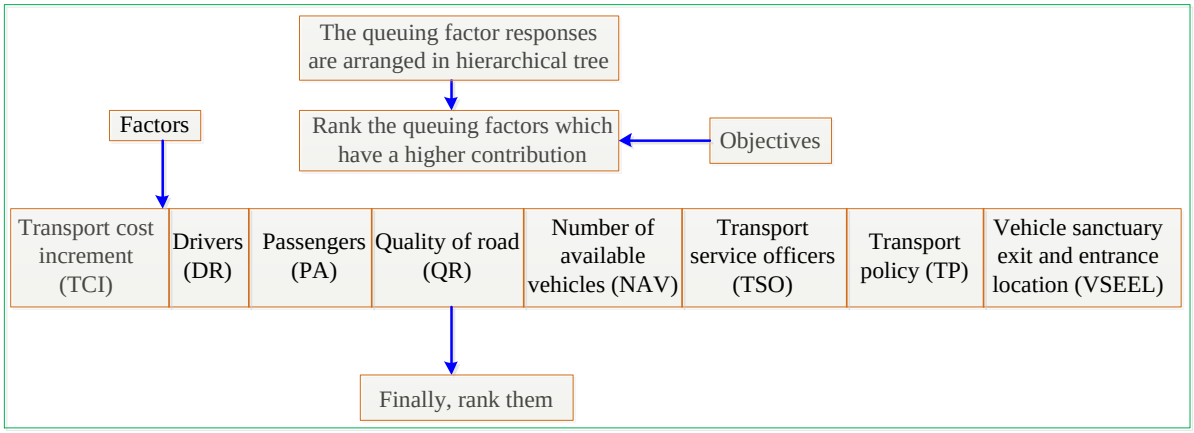

Figure 2 the hierarchy structure

We acquire the following result after evaluating responses (pairwise comparison matrices) as given in **Table 2**, following the steps listed in **Figure 2**, and checking consistency.

Table 2 AHP priority rank of queue factors based on questionnaire response

Queue factors	Eigenvector	Rank
Passengers (PA)	0.31	1
Drivers (DR)	0.22	2
Transport cost increment (TCI)	0.15	3
Transport service officers (TSO)	0.10	4
Number of available vehicles (NAV)	0.08	5
Quality of road (QR)	0.06	6
Vehicle sanctuary exit and entrance location (VSEEL)	0.04	7
Transport policy (TP)	0.04	8

From **Table 2**, among the 8 queuing factors, passengers take the first, and transport policy takes the last consideration.

3.2. The stress of waiting inline

To get a satisfactory level of service, the average wait time should be between 5 and 10 minutes, with a maximum of 20 minutes (Mammo, 2010). Based on this, three questions were addressed to customers of public transport users and the responses were analyzed as follows.

Table 3 response to the amount of waiting time

Response on amount of waiting time	Minimum waiting time		Maximum waiting time		Average waiting time	
	Respondents		Respondents		Respondents	
	Frequency	%	Frequency	%	Frequency	%
10-20 minutes	5	2.5	0	0	2.5	1.25
20-30 minutes	10	5	8	4	9	4.5
30-45 minutes	25	12.5	17	8.5	21	10.5
45-60 minutes	30	15	30	15	30	15
More than 60 minutes	130	65	145	72.5	137.5	68.75
Total	200	100	200	100	200	100

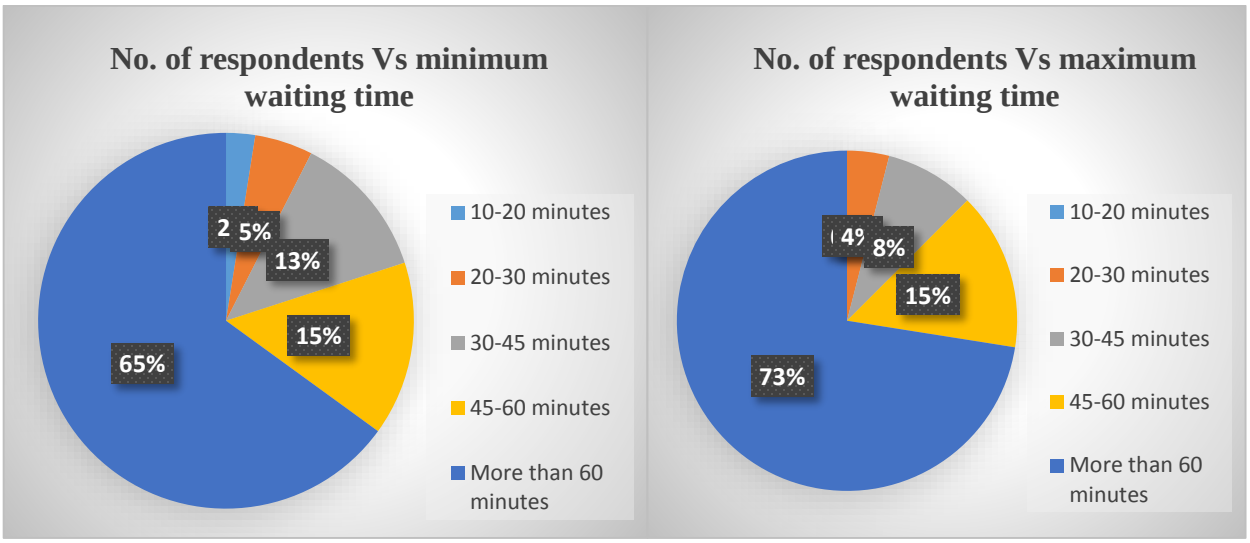

Figure 3 No. of respondents vs. minimum and maximum waiting time

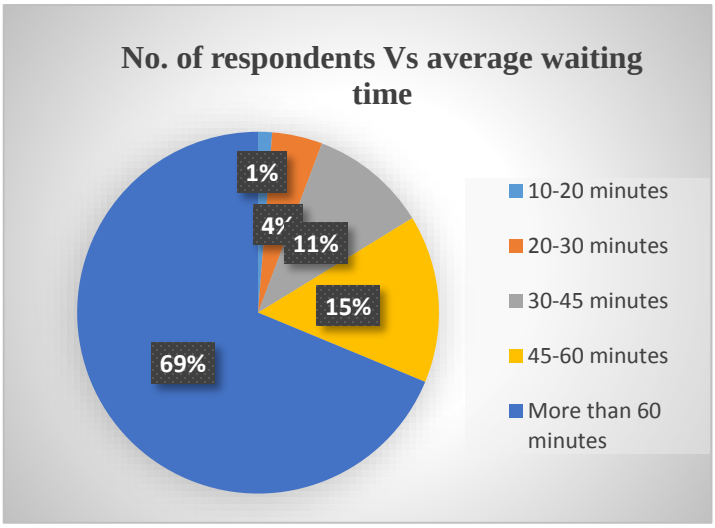

Figure 4 No. of respondents vs. average waiting time

From **Table 3**, the maximum and minimum waiting time is more than 60 minutes and between 10-20 minutes (which covers 73% and 2% which is stated in **Figure 3**) respectively. From **Figure 4**, the average waiting time between 10-20 minutes covers 1% and more than 60 minutes cover the higher percentage (i.e., 69%).

3.3. Service delivery waiting time and Customer Satisfaction

Passengers can be retained for a long time if service providers give dependable service. Passengers were happy with the scheduled service, customers were asked about the reliability of serving vehicles and the following result is found.

Table 4 response on availability of sufficient number and on-time arrival of vehicles

Response	Sufficient number of vehicles availability Respondents		On-time arrival of vehicles Respondents	
	Frequency	Percent	Frequency	Percent
Highly dissatisfied	95	47.5	109	54.5
Dissatisfied	52	26	45	22.5
Average	25	12.5	25	12.5
Satisfied	20	10	16	8
Highly satisfied	8	4	5	2.5
Total	200	100	200	100

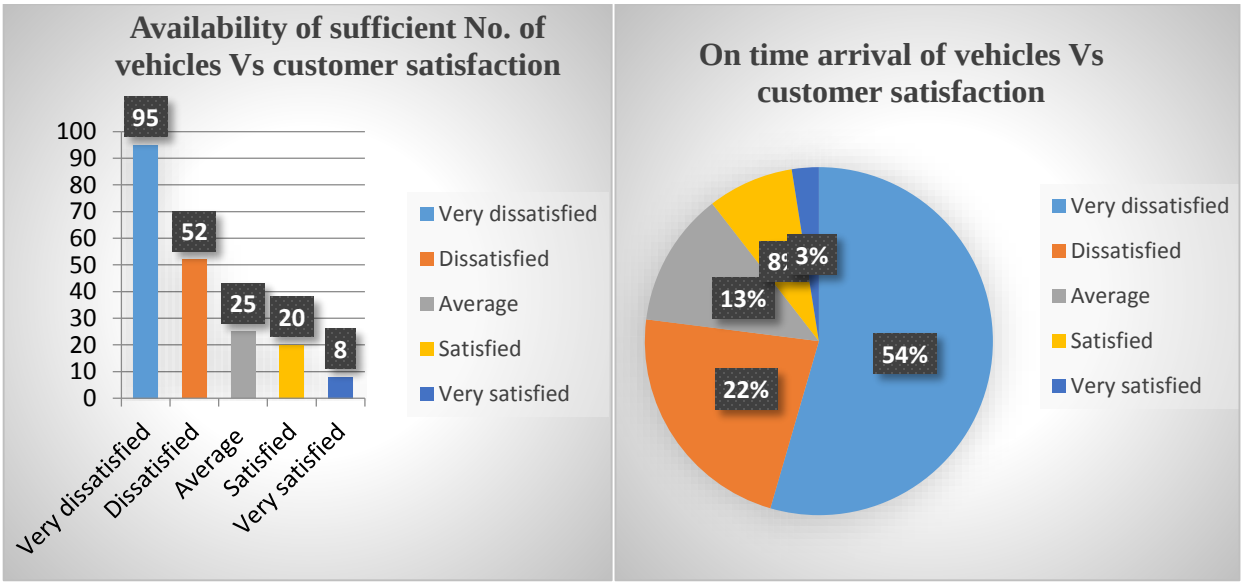

Figure 5 availability of sufficient No. and on-time arrival of vehicles vs. customer satisfaction

Table 4 denotes that concerning the availability of a sufficient number of vehicles, nearly 73.5% of the respondents are not satisfied (47.5% are highly dissatisfied and 26% are dissatisfied). On the contrary, virtually 14% of the respondents are satisfied (4% are highly satisfied and 10% are satisfied) with the availability of a sufficient number of vehicles. Whereas, 12.5% of the respondents reacted that their level of satisfaction concerning the availability of vehicles is average.

From **Figure 5**, regarding the on-time arrival of vehicles, 54% of the respondents are highly dissatisfied and 22.5% are dissatisfied. Conversely, 11% of the respondents are satisfied (i.e., 8% are satisfied and 3% are highly satisfied). 13% of the respondents are neither satisfied nor

dissatisfied with the on-time arrival of vehicles. Most of the respondents justified that long waiting time is one of the major discouraging factors. 77% explained that vehicles do not arrive on time, which implies they have to wait a long time to access the service, and there is no clear timetable, as a result, they are not sure about the exact arrival time of vehicles, and they have recommended the provision of a sufficient number of vehicles helps to improve the length of waiting time.

The results obtained from the survey as indicated in **Figure 4**, there can be evidence that passengers must wait an extended period to use the service. (For example, 15% of the respondents reacted that they wait a minimum of 30-45 minutes, 15% wait for from 45-60 minutes, and more than 69% wait for vehicles for more than 60 minutes). According to the officials of vehicle sanctuary, the service life of most vehicles has expired, and there is a high mechanical breakdown of vehicles because of the road condition.

As a result, most of the time vehicles are in the garage to be maintained and the frequency of service in every route is declining, consequently, the waiting time is increasing. From this, we can infer that the service is not reliable and a persistent endeavor is required to improve its reliability. Moreover, providing a sufficient number of vehicles for service can contribute a higher role to the queuing problem. Therefore, proper management of the on-time arrival of vehicles can save waiting time for public transport users that waiting in line.

3.4. Safety of transport system and customer satisfaction concerning Travel Expenditure

Passenger safety is thought to be primarily affected by poor driving standards and poor vehicle conditions. Customers were asked a series of questions to assess their level of satisfaction with safety. Customers were asked about their level of satisfaction concerning the fare of the service and the following results were found.

Table 5 *responses to the fare of the service and transport cost increment*

Response	Fare of the service Respondents		Transportation fare increment Respondents	
	Frequency	Percent	Frequency	Percent
Very low	17	8.5	0	0
Low	20	10	0	0
Medium	140	70	15	7.5
High	15	7.5	48	24
Very high	8	4	137	68.5
Total	200	100	200	100

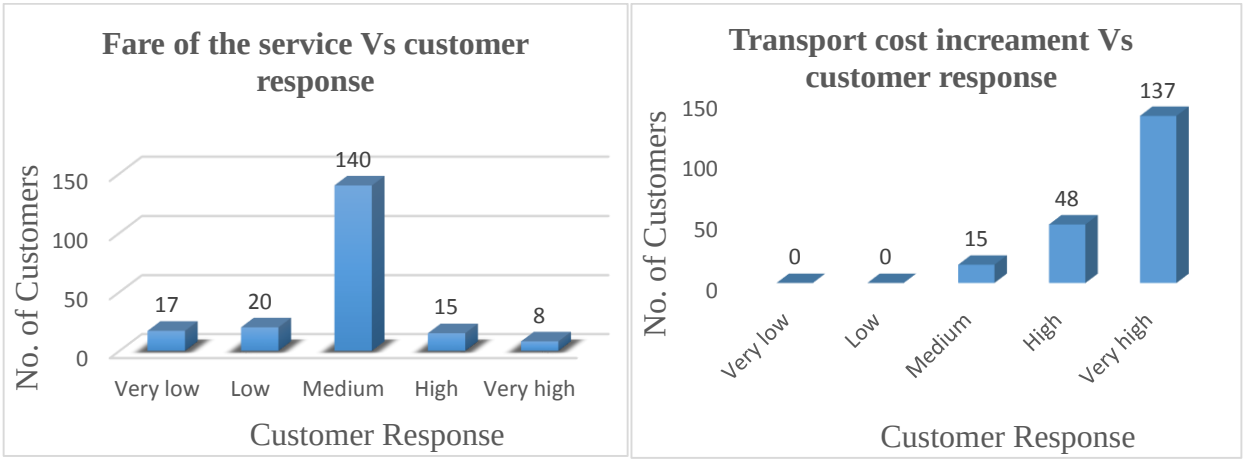

Figure 6 fare of the service and transport cost increment vs. customer response

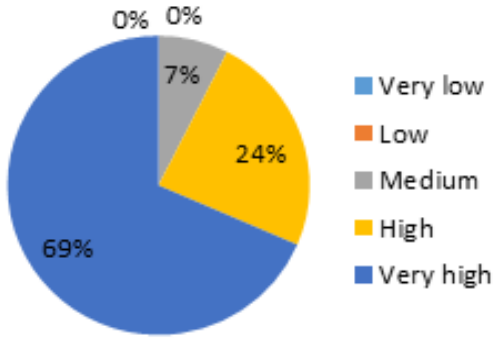

Figure 7 transport cost increment vs. customer response

The results obtained from the survey as indicated in **Table 5 and Figure 6**, shows that 140 respondents said the fare of the service is medium while 137 respondents said the transportation fare increment is very high. Moreover, **Figure 7** shows that 93% of respondents said that the transportation fare increment is exaggerated (i.e., 24% of the respondents reacted that the transportation fare increment is high and 69% of the respondents said that the transportation fare increment is very high).

Therefore, this leads to the disagreement between public transport users, vehicle sanctuary officers, drivers, and other stakeholders and contributes to a higher contribution of queuing. Confidentially, proper management of the transportation fare increment solves this queuing problem.

3.4.1. Availability of Information

Availability of information enables passengers to identify the vehicle within a particular service in a particular direction. Passengers will be more satisfied if they have accurate and up-to-date

information, and it may also encourage them to use the service. Almost all public transport users say that no one gives accurate information and they tend to make queues and waste time.

3.4.2. Security of Customers in the Process of Service Delivery

Passengers are frequently targeted for pickpocketing and lose their wallets and properties as a result of long queues, poor car sanctuary officer discipline, and other factors. Questions were forwarded to customers to measure the security problem occurrence and their level of satisfaction with their level of security.

Table 6 response to security problem occurrence and level of security satisfaction

Security problems	Customer response about their occurrence Respondents		Response	Level of satisfaction with the level of security Respondents	
	Frequency	Percent		Frequency	Percent
Item theft	50	25	Very low	140	70
Dacoity	20	10	Low	45	22.5
Beat up	15	7.5	Medium	15	7.5
Insulting	90	45	High	0	0
Dropping	13	6.5	Very high	0	0
Secured	12	6	Total	200	100
Total	200	100			

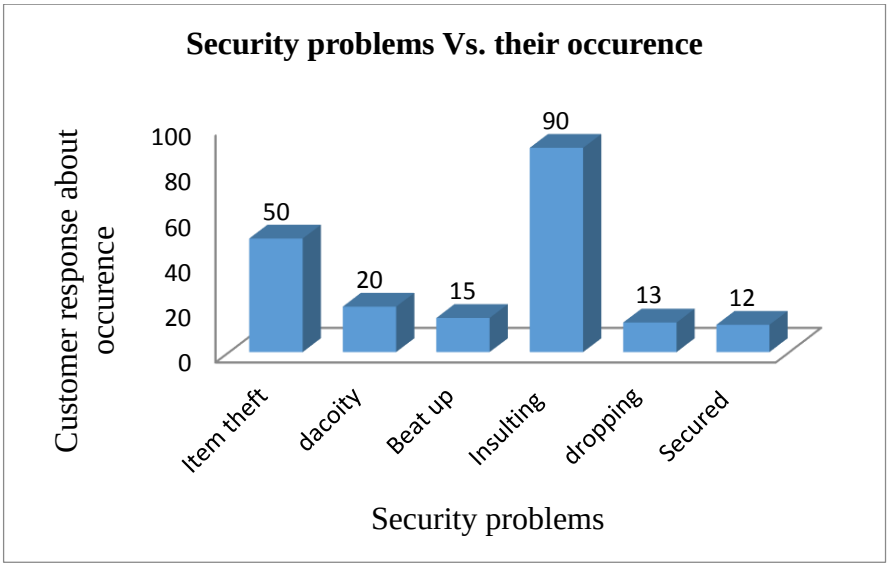

Figure 8 security problems vs. their occurrence

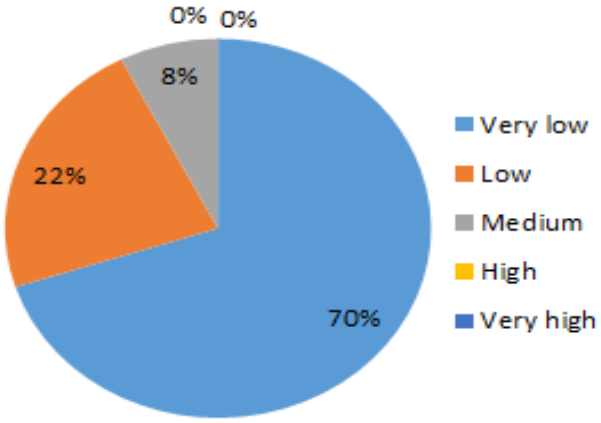

Figure 9 the percentage of Level of satisfaction with the level of security

The results obtained from the survey as indicated in **Table 6 and Figure 8**, show that all five listed problems occurred and among those, insulting and item theft cover the higher percentage (i.e., insulting 45% and item theft 25%, total 70%). Moreover, **Figure 9** shows that 92% of respondents said that the level of satisfaction with the security level is not kept (i.e., 22% of the respondents reacted that the level of satisfaction with the security level is low and 70% of the respondents said that the level of satisfaction about the security level is very low). Therefore, the proper management of queuing and improvement of the poor discipline of vehicle sanctuary officers, and other stakeholders, can increase the level of security, satisfaction, and safety of public transport users and other stakeholders.

4. Conclusions

This study outlines the key findings, considers the objectives, and success in achieving them. There are also recommendations for further work. The major goal of this research is to raise awareness about assessment queue management by identifying the main contributing variables and determining how to manage them. Questionnaires were designed, distributed, and conducted interviews for a total of 200 public transport users of Tepi vehicle sanctuary. Among queuing factors, passengers play a major role while transport policy plays the least contribution to queue formation. According to 69% of the respondents, there is a higher rate of delay (i.e., more than 60 minutes) that increases the stress of the public transport users waiting in line. As per 77% of respondents, an on-time arrival of vehicles is also one factor in the formation of queuing and that public transport users wait long to access service delivery. Moreover, there is no clear timetable and information, so they are not sure about the exact arrival of vehicles.

About 93% of the respondents stated that the higher transportation fare increment can cause queuing and 92% of respondents define that the security level problem is also one of the factors that can be informed for queuing formation.

5. Recommendations

Based on the analysis obtained from the assessment of queuing management, the following recommendations are presented.

- For future study, more research should be conducted on all essential parameters of the queuing factors of all other (many) vehicle sanctuary services.
- It is better to develop the queuing management model using queuing management software.
- Revise the fare level and transport cost increment rate properly.

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