

Car Parking Practices and Challenges in Adama Town: The Case of Bedhatu Kebele



Hawetu Workineh Negeri

A Thesis Submitted to

The department of Architecture, Urban Planning and Design

School of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Urban
Planning and Design

Office of Graduate Studies

Adama Science and Technology University

June, 2021

Adama, Ethiopia

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Declaration and Recommendation

Declaration

I hereby declare that this Master Thesis entitled “Car Parking Practices and Challenges in Adama Town: The Case of Bedhatu Kebele” is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation

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I/we, the advisor(s) of this thesis, hereby certify that I/we have read the revised version of the thesis entitled “Car Parking Practices and Challenges in Adama Town: The Case of Bedhatu Kebele” prepared under my/our guidance by Hawetu Workineh (name of student) submitted in partial fulfilment of the requirements for the degree of Master of Science in Urban Planning and Design.

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APPROVAL PAGE OF M.SC. THESIS

I/we, the advisors of the thesis entitled “Car Parking Practices and Challenges in Adama Town: The Case of Bedhatu Kebele” and developed by (name of student) Hawetu Workineh, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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ACKNOWLEDGEMENTS

First and foremost, I would like to give all the praises to the Almighty God for giving me another day of life and I thank all who in one way or another contributed to the completion of this thesis.

I would like to express my deepest gratitude and great appreciation to my advisor *Professor Samson Kassahun* for his persistent guidance, caring, encouragement and patience, and for providing me with an excellent atmosphere in which to do and complete my thesis as he walked me through the whole processes of the thesis. He has really played a lions-share in bringing this thesis to come to an end.

My special thanks go to my colleagues for going through and editing my thesis with great care and professional commitment and for the encouragement and professional support they gave me during the data collection, transcription and analysis processes and reading through the final draft of my work.

I am very grateful to the respondents, interviewees and experts who made a remarkable contribution for the success of the data process. I want to extend my appreciation for their help and transparency during my research. They voluntarily gave me their time to fill the questionnaire, for the interview and focus group discussion while they had hectic schedules with their normal businesses.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	v
LIST OF FIGURE	3
LIST OF TABLES.....	4
LIST OF ABBREVIATION	4
<i>Abstracts</i>	5
1.1 INTRODUCTION	6
1.2 Background	7
1.3 Statement of the Problem	8
1.4 Research Objectives	9
1.5 Research Questions	9
1.6 Scope of the Study	9
1.7 Limitation of the study	10
1.8 Significance of the Study	10
1.9 Operational Definition of Terms	10
1.10 Organization of the study	11
2. LITERATURE REVIEW	12
2.1 Introduction	12
2.2 Overview of parking	12
2.3 Types of Parking	13
2.3.1 On-street parking:	13
2.3.2 Off-Street Parking Facilities	15
2.3.3 Parallel parking	16
2.4 Factors affecting parking lot design	17
2.5 Demands for car parking	17
2.6 Parameters	19
CHAPTER THREE	22
3. RESEARCH METHODOLOGY	22
3.1 Introduction	22
3.2 Research strategy	22
3.3 Research Design	22

3.4	Data Sources	22
3.5	Research Location	23
3.6	Sampling Method and Sample Size.....	24
3.7	Data Collection	25
3.7.1	Questionnaire.....	25
3.7.2	Interviews.....	26
3.7.3	Focus Group Discussion	26
3.8	Data Analysis.....	26
CHAPTER FOUR		28
4.	DATA PRESENTATION, ANALYSIS, AND DISCUSSION.....	28
4.1.	Result of Field Surveys in the studied areas	28
4.1.1	Personal information	28
4.1.2	General information of the respondents	24
4.2	Parking Issues and Challenges.....	24
4.2.1	Availability and sufficiency of car parking areas	24
4.2.2	The satisfaction of the respondents with the current parking situation.....	26
4.3	Demand for car parking spaces	28
4.4	Issues of parking parameters	34
4.4.1	Developing parking policies and pricing Systems.....	42
4.4.2	Modern approaches to parking management	43
4.4.3	The adequacy and efficiency of the current parking configuration	44
4.4.4	Networking.....	45
CHAPTER FIVE		46
5.	SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS	46
5.1	Summary of the Findings	46
5.2	Conclusion	49
5.3	Recommendations	51
References		53
Appendix		58
Questionnaire		58

LIST OF FIGURE

Figure 1 On-street parking (Source: Pictures from research site).....	14
Figure 2 Off-Street Parking (Source: Extracted from internet).....	15
Figure 3 Parallel Parking (Source: The Geometry of Perfect Parking by Simon R. Blackburn.....	16
Figure 4 Research Location (Source: Extracted from internet).	23
Figure 5 Study area location (Source: Pictures from research site).....	24
Figure 6 Gender of the participants (Source: Extracted from the questionnaire).....	28
Figure 7 Age Category of the participants (Source: Extracted from the questionnaire).....	29
Figure 8 Educational Status of the participants (Source: Extracted from the questionnaire).....	29
Figure 9 Study area location (Source: Adama City Structural plan (Bedhatu kebele plan).....	24
Figure 10 Percentage of why the drivers park at that specific place, (Source: Extracted from the questionnaire)	27
Figure 11 Study area location (Source: Pictures from research site).	28
Figure 12 Previous trend, (Source: Extracted from the questionnaire).....	29
Figure 13 Current trend, (Source: Extracted from the questionnaire)	29
Figure 14. Future trends, (Source: Extracted from the questionnaire).....	30
Figure 15 Car parking facility preferences, (Source: Extracted from the questionnaire).....	32
Figure 16 Public parking lot site selection trees in Boroujerd City (Source: Adapted from Asad, Y. 2015).....	33
Figure 17 Duration of parking place, (Source: Extracted from the questionnaire).....	34
Figure 18 Better ways of car parking management system: (Source: Extracted from the questionnaire)	40

LIST OF TABLES

Table 1 : Reasons for Parking	25
Table 2: Parking parameters	35

LIST OF ABBREVIATION

AHP.....	Analytical hierarchy process
CBD.....	Central Business District
FGD.....	Focus Group Discussion
GIS.....	Geographical Information System
GIZ	German Agency for International Cooperation (Gesellschaft für Internationale Zusammenarbeit)
GPS.....	Geographical Processing System
HOV.....	High-Occupancy Vehicle
ITE	Institute of Transportation Engineers
LED.....	Light Emitting Diode
LOS.....	Level of service
PRS.....	Parking Reservation System
SPSS	The Statistical Software program Software
UNESCO	United Nations Educational, Scientific, and Cultural Organization.
VMS.....	Variable message signs

Abstracts

This paper examines the car parking practices and challenges in urban cities of Adama with a view to provide effective suggestions to overcome the challenges. Due to high population growth increasing the number of vehicles and other related factors, the city cannot able to meet the ever-increasing demand for Car Parking place .The purpose of this study is to assess the car parking practices and challenges in Adama town: the case of kebele 07. The study was aimed showing the trend, the scarcity of car parking place, haw far the supply of the car parking spaces matched with the demands of the car parking spaces, how far the city drivers were satisfied with the car parking facilities and finally to recommend better ways car parking management systems. It also helps to determine to what extent car parking had effects on the city. The results of the study indicated that un-availability of car parking spaces was a major problem for traffic flow and development of the city. Besides, it was also learnt that car parking has major social, political and economic impact on the growth of the city. Finally, this study suggests that in order to reduce traffic congestions and delays at road intersections or junctions in the city such as on-street parking should be discouraged and adequate off-street parking facilities should be provided.

Keywords: *parking, challenges, practice, Adama*

CHAPTER ONE

1.1 INTRODUCTION

Adama city is a large city in central Ethiopia. From 2003 to 2006, it served as the capital of the Oromia region, before the capital was moved back to nearby Addis Ababa. It also is Aurora's first sister city since 1992 (established), chosen for its similarities in population, ethnic and religious diversity, geography and industry focus. It is a popular weekend destination for residents of Addis Ababa and hosts many governmental and non-governmental conferences.

Adama currently plays a great role in Ethiopia's financial, commercial, economic, and political development centre. In that role, it polarized its economic activities, which drew up the attention of the population of other provinces that saw there a job and lifestyle opportunity. The exponential population growth recorded in the last decades aggravated an increase in mobility, hence the number of vehicles circulating in the city. A vibrant community of nearly 500,000 people, Adama's landscape is brimming with educational, cultural, hospitality, and medical facilities. The city is also defined by its significant economic development potential, with investments being made in manufacturing, banking, agriculture, tourism, and especially wind energy production. Additionally, it serves as a critical transportation hub for the region, situated on the road that connects Ethiopia's capital city of Addis Ababa to the river city of Dire Dawa. Spread across nearly 30 square kilometers, Adama is located directly west of Ethiopia's Great Rift Valley, and approximately 90 kilometers southeast of Addis Ababa. The city enjoys close proximity to a number of different tourist destinations, such as Awash National Park, Lake Zewaye, Sof Omar Caves (soon to be a registered UNESCO site), and Dill Fekar Regional Park.

Residents of Adama are hospitable, friendly, and proud of their diverse, multi-cultural community. Citizens value historical traditions, family life, and cultural celebrations such as marriage. Adama is also committed to its international presence, and through partnering with Aurora Sister Cities International will seek to foster a sense of global cooperation and exchange. Meanwhile, I personally have observed that this lovely community has great challenge in fulfilling its daily plans due to traffic congestion. This motivated me to try the topic to propose alternatives for the traffic congestion.

This study intends to found out the challenges of traffic congestions and forwards alternative to the challenges. The design of the study is a mixed approach in which both quantitative and qualitative data were collected from both primary and secondary sources.

This chapter covers the area of the background of the study, statement of the problem, research question, research objectives, and scope of the research, and significance of the research. It also includes the operational definitions of terms, explanation of abbreviations.

1.2 Background

Parking today is regarded as a fundamental instrument when defining urban policies, due to its influence in urban mobility policies, in the dynamics associated with land use residential, commercial, and service areas, and by the involved parties' residents, workers, visitors, managing entities, etc. The civilization and industrialization of the world create migration of the population from rural areas to urban areas that cause concentration of population in cities. The result of civilization changes the living standard of people from, cave to house, rural area to urban area, and from animal transportation to car transportation. The car needs the space at the end of their destination that called parking area. The slowdown development and mismanagement of the available parking space create parking problem in the cities (Sofiène Abidi et al, 2015).

Parking is one of the comprehensive components in land use appearing in residential, shopping and industrial areas, and is related to all kinds of trips occurring in traveling, shopping and leisure trips (Mersden, 2006). The challenges of parking spaces seen in urban cities are claimed to be caused by urbanization, rapid increases of car dependence, high densities of the city and economic transition. Parking supply management, particularly pricing, could help shift auto dependence to more sustainable alternative modes and reduce congestion (Shoup, 2005).

From the international perspective, lack of parking supply, weak regulations and intergovernmental conflicts, and weak enforcement are the challenges observed. For instance, A recent survey conducted by Step & Mint (2011a) Limited based in Nigeria reported that, Cairo's public parking infrastructure could only accommodate 5.2 percent of its cars, Lagos 6.7 percent of its cars and Johannesburg had a ratio of 8 cars per public parking space.

In addition, based on the research by Chaniotakis, parking supply problems are twofold:- First, there is a general lack of parking spaces throughout African cities. Despite the rapid pace of construction in South Africa, Nigeria, and many more developing Africa countries, rising car consumption continuously outpaces it.

Secondly, the parking spaces that are supplied in most African cities are not necessarily used as efficiently as they could be. For example in Nigeria, public parking spaces that are available often do

not have time limits. Thus, a space in a high-demand area for parking may be taken by some individuals for most of the working hours. This is also tied to put into effect on fair use of space and fee collection issues.

Due to the increments of those sectors in the city, Parking facilities is going to become the basic issue, So getting parking facilities simply is the highest problem and difficult which leads the drivers spend more time for searching the vacant parking spots as it is shown in reality situation (Chaniotakis, 2014).

1.3 Statement of the Problem

The problem of traffic congestion in urban cities has been one of the very major stressing issues and one-third of this traffic congestion in the world is created by cars searching for parking spot due to the unbalancing of the parking demand and the availability of the space (Joseph Y.J et al, 2015). As study estimation shows that 14% of traffic density is created by searching for parking space and 50% of increase in congestion-related time loss on roads has been generated due to shortage of parking space (Brooke, 2015).

In this case the drivers to arrive a destination people may need to start their trip before their scheduled program and will be forced to spend more time on the roads. In addition, it has an economic impact on the country, and the government expending more money to adjusting this congestion problem due to the shortage of parking space.

Due to parking space shortage average traffic speed in the Adama city is very slow , inefficient parking space management due to that vehicles blocked the roads, idle the drivers by waiting the parking spot, illegal parking on the roads and that creates congestion on the roads. In addition, On-street parking service does not have standardized time interval to park their car in a parking lot and departure time and cars without parking lots are parked on roads or in residential area, which makes congestions of the road, even blocked passageways of an ambulance in this city. In this City, on-street parking service are the most used car parking services, due to shortage of parking facilities, the drivers' searching parking lot for long time and vehicles are consuming more fuel and emitting high amount of CO₂ to the environment. Therefore, this paper aims to examine the practices and challenges of car parking areas in Adama city. The following questions will be dealt with in order to assess the challenges.

1.4 Research Objectives

1.4.1 General objective

The general objective of the study was **to assess the practices and challenges of parking areas.**

1.4.2 Specific objective

The specific objectives of the study are as follows:

1.5.2.1 To assess the availability of parking areas in the study area.

1.5.2.2 To assess the demand for parking space available in the study area.

1.5.2.3 To assess the availability and efficiency of parking parameter.

1.5.2.4 To recommend the improvement of parking facilities in the study area.

1.5 Research Questions

The aim of the research was to assess the practices and challenges of parking spaces and also whether the parking space is sufficient, safe, and comfortable. A few questions were designed in order to find the solutions. Among the questions are:

1. Are the parking areas in Adama town available and sufficient?
2. How is the fluctuation of demand for parking spaces in the study area?
3. Are the parking parameters within reasonable limits?
4. What improvement of parking facilities can be made in the study area?

1.6 Scope of the Study

This study has dealt with the assessment of the existing parking facilities, practices, problems, strategies, and developing a possible solution to enhance the operation of car parking systems in Adama. The study area of the research is Adama town, particularly Bedhatu Kebele where large concentrations of vehicles are observed with a lack of reasonable parking facilities. This study has been limited to this Kebele because this location is more condensed in population than the other surrounding Kebeles. More car flows in the Kebele and also densely populated shops, groceries and other public service giving stations are located in this Kebele. Even though the scope of the research is limited to this specific location, the outcome of the study is envisaged to replicate to other congested places of the city as well to urban centers in the country

1.7 Limitation of the study

The unavailability of the subjects selected to take part in the study at planned contact time was observed as one of the limitations as they are always busy with their routine business activities. This was considered as one of the limitations as it may affect the quality of the data collected and also results in poor time management. However, in order to ease this limitation, proactive arrangements have been made with the participants and contacts have been made at their convenient time and place.

1.8 Significance of the Study

This study attempts to assess the current parking practice and challenges of Adama town. It is, therefore, hoped and expected to provide insights into the future development strategy of the town.

Accordingly, this study will contribute significant information on the following issues:

- It would provide insights in an attempt to revise and establish car parking strategic directions (if any) of the town.
- The results of this study forward recommendations to develop a car parking management system and show the opportunities in the formation of the parking industry so as to ease the traffic flow of the town.
- It throws some light for innovators for the importance of car parking investment.
- The findings would contribute information for the construction of car parking sites. It helps to stimulate further investigation in the area.

1.9 Operational Definition of Terms

- Traffic:-pedestrians or vehicles on roads.
- Fluctuation:-a wavering or unsteadiness.
- Congestion:-an excess of traffic or a high volume of traffic flow.
- Residents:-a person, animal, or plant living at a location or in an area.
- FDRE: Federal Democratic Republic of Ethiopia
- Community: the people living in one place or district including embassies and those who come for a short period stay.
- Parking Lot: an area, often paved, for parking a number of motor vehicles used to have parking-related services
- Parking is the act of stopping and disengaging a vehicle and leaving it unoccupied Traffic: the movement of vehicles, ships, persons, etc., in an area, along a street, through an air lane, over a water route, etc.

- Transport: the movement of people, animals, and goods from one location to another with the mode of transportation like air, rail, road, water, cable, etc
- Congestion: vehicles travel at slow speeds because there are more vehicles than the road can handle.
- Vehicular: the crime of causing the death of a human being due to illegal driving of an automobile, including growth negligence, drunk driving, traffic congestion, etc
- Metropolitan: a large city or urbanized area. Including adjacent suburbs and towns Opportunity: an exploitable set of circumstances with an uncertain outcome, require a commitment of resources and involving exposure to risk.
- Challenge: a call, invite or order to engage in any competition, as of skill, strength (someone to do something, especially to take part in the contest)

1.10 Organization of the study

The research has five parts. The first part is the introductory part which comprises the background of the study, statement of the problem, research questions, objective, significance, scope and organization of the research.

The second part deals with literature review on and or around overview of parking, types of Parking, factors affecting parking lot design, demands car parking, and Parameters of car parking management system.

The third part of the research comprised research strategy, research design, data sources, research locale, sampling method, data collection procedures, and data analysis mechanisms.

The fourth part of this material is composed of data presentation, analysis, and discussion of the data gathered in light of the previous research questions.

The fifth part presents the summary of the main results on the findings, draws the conclusion, recommendations and points out research insights based on the study. The final part presents appendices, references, and annexes that are the result of the questionnaire due to the long table.

CHAPTER-TWO

2. LITERATURE REVIEW

2.1 Introduction

This chapter discussed the general concept of parking, types of parking, the side effect of parking, strategies, and policies of parking, analysis of parking design factors, and optimization models of the parking problems in the literature are presented.

2.2 Overview of parking

Parking is an essential component in every car trip especially in the urban area context and plays a major role in the transport system since all vehicles require a parking location when they are not being used.

Parking areas in urban centers are becoming increasingly important, due both to the fact that almost every private car trip involves two parking acts and that cars spend over 80% of the week parked (RAC Foundation, 2004).

In many research, parking system has been studied regarding the following different factors which are mode of choice, location accessibility, and network performance due to congestion of traffic and parking location choices behaviors of drivers depend on the factors of access time to parking location, parking fees, walking distance to the final destination and several socio-economic characteristics of the driver (Adam J. Pel et al, 2016). In everyday life, everything that involves traveling by car will involve parking somewhere. No matter what the purpose of the trip is, be it leisure or business, still, someone will need a place where to leave the car. In every location and situation, there are different needs when it comes to parking (Litman 2006). It is defined as parking is a service where some operators in the system and provide parking services for the customers such as motor vehicles, passenger cars, and truck vehicles. The services were given based on an hourly, daily, or monthly basis. The service areas are parking garages, parking stations, and valet parking, and Car parks operated by councils are excluded from this industry (Report, 2014).

Although a car is parked – in a variety of places – for a large part of its life, little or no debate has focused on parking areas as hubs where transport converges. If parking areas are seen as transport hubs where the interchange between a variety of transit means takes place, (e.g. car/bus, car/underground, car/walking, etc.) – it can be argued that not much has been done for parking, despite the vital role that it plays (Kelly, 2006).

2.3 Types of Parking

There are three main types of parking spaces classified such as on street parking parallel parking, off-street parking, and private and Non-residential parking.

2.3.1 On-street parking:

The word explains itself: On-street parking means parking your vehicle on the street, anywhere on or along the curb of streets, in contrast, to parking it in a parking garage. On some streets, you can always park your vehicle on the street, but sometimes there are restrictions. Mostly these restrictions are presented on traffic signs. Sometimes you're only allowed to park on one side of the street, and sometimes you're not allowed to park your vehicle at all. There are also on-street parking situations where you need a parking permit to park (Peprah C, Oduro CY, Ocloo KA, 2014).

On-street parking service is a common feature in most developed cities around the world. On-street parking assists to improve the economic viability of commercial developments along transport corridors by providing easy and convenient access for customers, delivery vehicles, and employees of such developments. However, the provision of on-street parking along transport corridors could adversely impact the capacity as well as the achievable driving speeds of the adjacent road. Road safety is another key factor that needs to be considered when considering the provision of on-street parking along a transport corridor. The debate regarding the merits and drawbacks of on-street parking stems from a lack of research surrounding the subject over the last two to three decades (Shoup DC, 2006).

The utilization of on-street parking is considered to be a more efficient use of land as it limits the need for off-street parking and access points to properties adjacent to major arterial roads. This aspect of on-street parking also reduces costs for the businesses, maximizes land utilization, and creates a pedestrian-friendly environment for the community by delineating vehicles and land use. Extending from this concept it is believed to improve pedestrian safety by providing a barrier between the flowing traffic and the footpath as well as reducing the speed of vehicles traveling on the roadway. Although there are several benefits to providing on-street parking, there are some adverse impacts, particularly on traffic flow. On-street parking can impact road capacity in two ways. The reduction of the available lanes of a road to accommodate on-street parking is the primary factor that reduces road capacity. Additionally, on-street parking maneuvers can cause extensive delays, especially on heavily trafficked roads. This creates stop-start traffic flow behavior for the lanes adjacent to the parking lane, thus affecting the capacity of the road section (Wijayaratna, 2015).



Figure 1 On-street parking (Source: Pictures from research site)

On-street/curbside parking proves to be hazardous for through traffic and also one of the most influencing factors for the delay. A high number of on-street parking spaces along the major roads in urban areas affect the local traffic operations, especially when traffic is dense. Zu et al. (2014) suggested a solution to “division, construction, adjust & share” for parking management in the Wujiang district in China. Box (2004) studied the accidents caused due to curb parking, specially angled parking. The author stated that curb parking should be delimited for major roads in cities and showed that the number of accidents associated with angled parking is two to three times more than that is caused by parallel parking.

In most of the big cities in the world, illegal parking is also a common problem. In Greece, illegal parking in six different cities has been studied by Spiliopoulou and Antoniou (2012).

2.3.2 Off-Street Parking Facilities

Off-street parking is parking in the facility used in most of the urban centers, where they allot some space for parking nearer to the main roads and a shorter distance away from the main area of the traffic stream. Such parking is called off-street parking. These kinds of parking are operated by public agencies /private firms. Generally, off-street parking means parking vehicles anywhere on the streets like garages, private lots, and driveways. It can be on indoor and outdoor sites. A typical off-street parking facility is shown below (Shahi 2011).

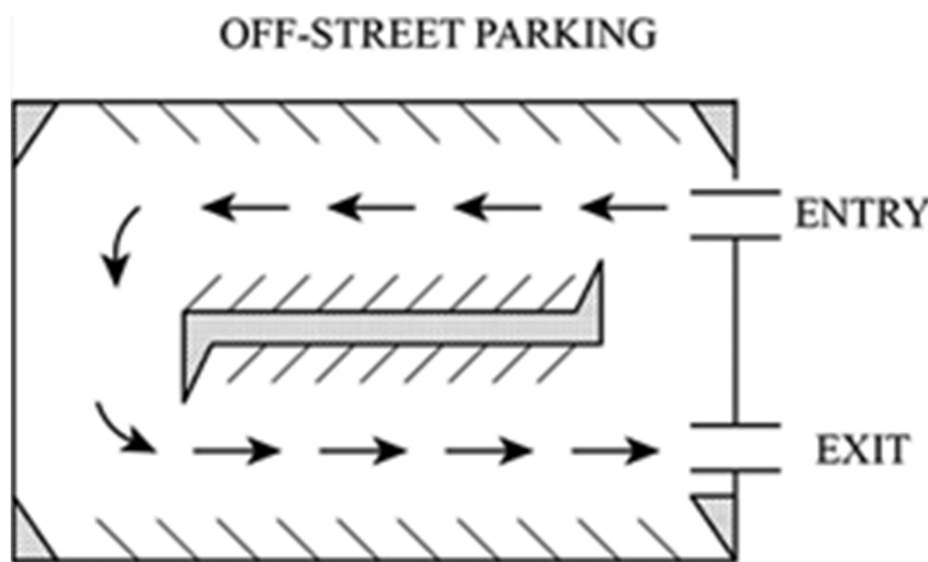


Figure 2 Off-Street Parking (Source: Extracted from internet)

There are different types of off-street parking: Surface car parks, Roof parks, Mechanical parks, and underground car parks. **There are some design considerations for off-street parking:** to create multiple small parking areas rather than a large area, reducing the extensive grade operations using topography design, Reduce the number of entry and exit. Make sure that the distance of at least 15 meters is provided for the proposed parking area entry and exit and to increase aesthetics in the design and in use for integrating planted islands. Some of the advantages of off-street parking are: it avoids the traffic rush at malls and specified places like a marketplace, public places, etc., there is no delay and congestion, it avoids confusion and create good visibility, it provides safety to vehicles and pedestrians, it provides convenient parking spaces (parking area orientation) and it should align with parking rows that are

perpendicular to the pedestrian crossing and also it creates a user within walking distance. (Wey, W.M., 2003).

Whereas some of the **disadvantages of off-street parking are: it lets the owners need to search for a greater distance to park the vehicles, the vehicle users have to walk for more distance after parking the vehicles and it is quite difficult to enforce** (Wey, W.M., 2003).

2.3.3 Parallel parking

Parallel parking involves parking the car in line with others and parallels to the curb. In such parking lots, all cars face in one direction with the front bumper facing the previous/front car's rear bumper. These parking lots are usually set on street sides where space is not enough allowing traffic to flow on smoothly. The vehicles are parked along the length of the road. Here there is no backward movement involved while parking or imparking the vehicle. Hence, it is the safest parking from the accident perspective. However, it consumes the maximum curb length and therefore only a minimum number of vehicles can be parked for a given curb length (Lin, Z., Li, Q., Liang, Y., & Cheng, D. 2012).

This method of parking produces the least obstruction to the on-going traffic on the road since the least road width is used.

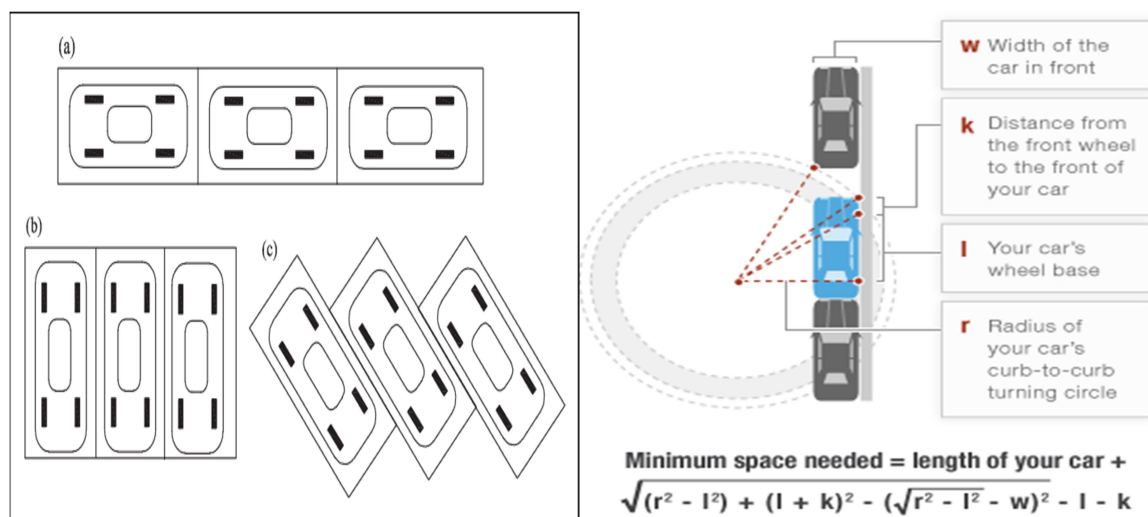


Figure 3 Parallel Parking (Source: The Geometry of Perfect Parking by Simon R. Blackburn

Credit: Alyson Hurt, NPR)

1. Your car's turning radius, r
2. The distance between the front and rear wheels,
3. The distance from your front wheel to the corner of the front bumper, k

4. The width of the car you're trying to park behind, w

“Parallel curbside parking is generally operated in the direction of traffic flow and under properly controlled conditions; it presents the least impediment to the orderly and regular flow of traffic along a road. While there is a substantial reduction of space available in a given length of a road compared to angle parking, it has the advantage of reducing the number of accidents occurring during parking and departure maneuvers. Parallel parking is the best system to adopt where street parking must be provided; street capacity must be kept to a maximum because it requires a lesser width of a roadway for parking and guiding (Lin, Z., Li, Q., Liang, Y., & Cheng, D. 2012). To provide orderly parking, it is desirable to line-mark areas with high demand and turnover (AACRA, 2003: PP 19-3).

2.4 Factors affecting parking lot design

Parking lot space is efficiently Utilized the result creates more parking capacity. In another hand, the shortage of the number of parking spaces created a challenge to utilize the parking areas more efficiently. Parking lots vary in design, size, and location. The capacity of any parking lot depends on the number of vehicles it services, which is a function of the parking angle inside the parking lot. The main factors affecting the design of the parking lot are the number of vehicles that need to be accommodated, the parking angle, the circulation system within the parking lot, and the expected vehicle size. When constructing any parking lot, the main objective is to provide the maximum capacity with a convenient and safe circulation. There are many problems associated with parking such as shortage of land in the city, strategy and police problems, inefficient usage of space, and management problems of the system (Akmal et al, 2014).

The existing parking lots should be managed efficiently before building new parking facilities. The parking stalls can be designed with different angles such as 45, 60, and 90. The angle of the parking stalls has a great impact on the capacity and the circulation of the parking lot. The 60 parking angle is the most common because of the easy entry and exit of vehicles from the parking facility. Also, the 60 parking angle has a reasonable traffic lane width. The 90 parking angle provides a reasonable number of parking spaces for a given area. But due to the difficulty of entering and leaving the parking stall, it's only recommended for all-day parking such as university or workplace parking garage (Akmal et al, 2014).

2.5 Demands for car parking

Parking demand in a particular area is generally influenced by the land use characteristics of that area. About 69 different land use classifications are available as indicated by the Institute of Transportation Engineers (ITE) (2010). Each statistics of land use characters more or less influence the parking generation for the particular building/area. It is necessary to estimate the

parking generation rate for all types of land uses at the preliminary stage to develop a demand estimation model for parking. The parking generation rate is the demand for the parking space generated from the given land use per unit area (Cheng et al., 2012).

Cheng et al. (2012) improved a parking generation rate model by considering several factors such as average turnover rate, parking lot occupancy, parking price impact coefficient, level of service of the parking facility, motor vehicle growth. In this study, the value of the level of service (LOS) was taken arbitrarily as 85% without considering the factors that are to be identified to define the LOS for a particular parking facility, hence, as an improvement over the past studies.

Parking is one of the most frequent activities that motorists do on a daily basis. Parking can be an issue when there is high demand for parking, and very low supply (e.g. a few parking spots) to fulfill the demand. This problem is particularly pressing in cities with high population density. Since 2009, the United States has become home to the second largest passenger vehicle market in the world after China. Every year on average, around 7.5 million vehicles were sold to customers in the last 20 years in United States. Around 70% of Americans prefer to drive to work (Manohar, B. 2019)

Al-Sahili and Hamadneh (2016) also studied the parking requirement for different land uses such as residential, hotel, office, and commercial/shopping to confine trips and parking associated with the specific land use. They used morning and evening peak period survey data for 11 different land uses to establish the relationship between parking demand generation with these land uses. Another simple way to forecast the parking demand is based on the parking accumulation profile for each unique parking activity for a given parking lot (Lau et al., 2005; Wong et al., 2000).

Past studies have shown that parking price seems to be one of the most influencing factors for parking demand for a particular parking lot and modal choice. Hensher and King (2001) examined the role of parking pricing in the generation of demand for parking at a specific parking lot. They used a stated preference data of private car users and public transit users to get samples of individual behavior varying with parking prices and hours of operation at various locations in the CBD area.

As explained in the previous sections, the mixed land use development in the urban area demands large spaces for parking. It is common that if the separate parking spaces are provided for different but adjoining land uses, there is a low utilization rate of the parking space. For

example, in a residential cum commercial area, the demand for residence parking is high during night time, whereas that for commercial land use is high during the day working hours. Hence, parking sharing policy will be helpful to supply optimal parking space based on demand. This type of study to forecast the demand in the CBD area based on shared parking has been done by Zheng et al. (2013) and stated that the model may avoid the overestimating of parking demand as forecasted by conventional approaches.

2.6 Parameters

Lack of effective parking management creates problems for everyone. Either improvement in the existing solutions requires significant financial commitments or they are difficult to implement due to their complex nature. Individual entities such as cities, firms, stadiums, and subways have their particular parking arrangements. However, there is no standard parking management skeleton. Each setting is different and what works for one organization may not work for another. Two motives are common among all who wish to provide a parking solution; first, they all strive to address their unique parking needs, and second, earn the most from investment in their parking facility. Due to the substantial investment and complexity involved in parking management, on the other hand, many institutions choose to outsource. These institutions are either unable or unwilling to deal with the challenges of operating and maintaining a parking facility (TRL,2010).

The planning and resources needed for setting up a parking facility vary significantly across organizations. It could be as simple as posting a person outside a gated lot, or it could be as complex as managing the vehicles of all commuters at an airport. The amount of resources, including parking space, is, of course, limited. Instead of searching for individual parking solutions, energies should be expensed on having a comprehensive view of the problem and identifying a standard solution that would apply to most parking systems (Maccubbin, R. P., & Hoel, L. A., 2000).

An effective parking strategy relies on either a specific type that meets the needs of a system or a combination thereof.

According to Maccubbin, et al, some of the parking management systems are:

1. Brick and Mortar Facility: The majority of institutions use these traditional parking facilities either by investing in large spaces of land or constructing large buildings to accommodate vehicles. This approach has been the tried and true approach. It addresses several parking management challenges effectively.
2. Preferential Parking: The use of this approach is to make the most of a given parking space. A good example would The Los Angeles Department of Transportation. They implement and enforce Preferential Parking Districts in residential areas where employees and customers of nearby businesses

and attractions regularly park for long periods making it difficult for residents to find parking. Preferential Parking Districts restrict parking for all motorists, but area residents and their guests are exempt from the special parking restrictions if they purchase and display Preferential Parking Permits.

Another example would include spaces reserved for people with two or more individuals in a vehicle, similar to an HOV carpool lane.

3. Price Discounts: This approach usually applies to carpools and or short-term parkers. This is desirable for change-mode parking facilities such as airports and subways, where commuters often park their vehicles before using public transportation services. Besides, carpool lanes on busy highways offer time-saving (Maccubbin, R. P., & Hoel, L. A., 2000).

4. Change-mode Parking Facility: This approach is perfect for institutions such as airports, subways, park-and-ride shuttle services. All of these institutions require the incumbents to locate a parking space promptly and continue commuting in a public vehicle.

5. Disincentives: On those who contribute to traffic congestions (illegal parking, parking near an expired meter), the state and local governments may impose citations. For example, a person is fined for traveling alone in a carpool lane that requires two or more passengers (Carrese, S., Gori, S., and Picano, T. 1997).

6. Satellite Parking: This approach is also known as remote parking or off-site parking. This approach is used when the place to park is far away. Usually, in this arrangement, a parking facility is shared with other entities or there are other incentives involved. Logan airport in Boston, for example, provides shuttle services to neighboring cities and towns.

7. Shared Parking: This is a popular approach to address a need for large space requirements with significantly reduced investment. Typical examples include universities, business parks, and privately-owned doctor's practices.

When parking management strategies are appropriately applied, they can effectively manage the number of parking spaces required in a particular situation and they provide a variety of undeniable economic, social, and environmental benefits. Each of these strategies, however, has its strengths and weaknesses to be discussed later (Carrese, S., Gori, S., and Picano, T. 1997).

Either parking pricing or information provision alone has been discussed intensively in the literature, but their relationships are not fully understood yet. Most of the parking studies are descriptive and provide qualitative guidelines for parking pricing in the steady-state context (e.g., Axhausen et al., 1994; Thompson and Richardson, 1998; Vianna et al., 2004; Shoup, 2005; Litman, 2011). However, real-time dynamic pricing in parking, one of the efficient economics tools to balance real-time supply and demand, has gained less attention.

This is partially due to the difficulty of acquiring real-time supply data (namely parking information) and possible objection from travelers for not being able to obtain such real-time information. However, cutting-edge sensing and information technology make it possible to obtain unprecedented information to overcome this difficulty. Equipped with parking sensors, modern parking lots or blocks can provide real-time usage of parking facilities.

The parking information, prices, and availability information, for instance, can be sent through smartphones and GPS receivers to travelers in real-time. We certainly expect sensing and information provided to help build more efficient parking pricing policies, as well as to resolve travelers' parking issues. Parking information provision has been implemented in the last two decades, but it alone is not working effectively as expected in many cases. In some cities, travelers are provided with parking information in the form of variable message signs (VMS) or traffic radio broadcasts. The real-time parking information is usually regarding the number of available spaces in certain parking lots or blocks. Although such general occupancy information in VMS may be used to optimize the parking reliability (Mei et al., 2012), both empirical studies and simulation show that the benefits of providing availability information alone may be marginal in congested network conditions (e.g., Asakura and Kashiwadani, 1994). This is essential because when the parking spaces are scarce, the information alone does not deviate travelers from cruising for parking (i.e. parking congestion), nor can it considerably change travelers' choices in departure time, routes, or traffic modes. This can certainly be improved by pricing. Therefore, it is essential to combine both dynamic pricing and sensing in parking management, and pricing and information provision jointly serve as efficient economic influence (Mei et al., 2012).

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter comprised the overall research approach and the design employed. Data sources, data gathering techniques, population, and sample and sampling frame have been briefly described. Besides, the data collection procedures and methods of the data analysis have been described and presented.

3.2 Research strategy

Both quantitative and qualitative research strategies were applied. The quantitative data collection through field measurements and their analysis were carried out. The quantitative and qualitative data collected through a survey questionnaire and interviews respectively were compiled and analyzed in an integrated manner. The mixed approach was adapted to the study to obtain data from relevant sources by using tools like field surveys, questionnaires, and interviews for triangulation purposes.

3.3 Research Design

Mouton (2001:56) described research design as an architectural design or blueprint of a research project and the execution of the design, the research process, or methodology as the construction process using methods and tools. The focus of the research design is on the type of study planned to reach specific outcomes. The process to follow and the methodology of the research is chosen to support the outcome and the significance of the results. Therefore, in all research, the underlying philosophical assumptions of the research, approach, strategy, research design, and methodology followed in the research need to be discussed. Accordingly, a mixed research approach under which survey research design was preferred and employed.

3.4 Data Sources

The study used data from both primary and secondary sources. Primary data is used to analyze social and environmental situations based on the challenge and opportunities for car parking. Besides, it is employed to understand the importance, satisfaction, scarcity, unfair use of road and building due to car parking through questionnaires and interviews. The secondary data relating to the challenges, opportunities, strategy, accident, motorization escalating and policy was gathered from the different organization's documents, reports, research, and standard literature.

3.5 Research Location

According to Neuman (2000), a site is the setting in which the research process takes place. To gain valuable data, I had to get as close as possible to the participants being studied. The longer researchers are staying on the site, the more they get to know their participants to get undeviating facts (Creswell, 2008). Accordingly, the research locales selected for this study is Oromia Regional State, Adama town, Mebrate Hail area.

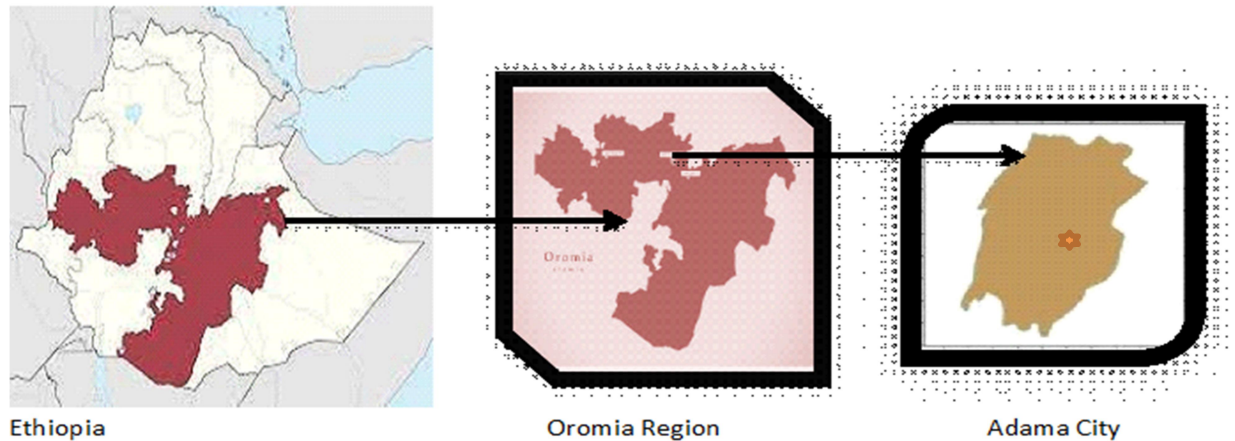


Figure 4 Research Location (Source: Extracted from internet).

This specific place has been selected based on prior observation to crosscheck the challenges of parking spaces in that surrounding. This specific name of the research site is called Arada Gebeya. The population of this Kebele 17,548. Among this population, more than 85% depend on trading. This kebele the most overcrowded trade area among the other Kebeles in Adama town. The town earns the largest revenue from this Kebele. As a result, the traffic is mostly congested as there are large numbers of cars moving in and out of this Kebele. The congested traffic is illustrated by the following Pictures.





Figure 5 Study area location (Source: Pictures from research site).

3.6 Sampling Method and Sample Size

The portion of the population that is studied is called a sample of the population; the elements making up this sample are those that are studied. The sample is the section of the wider population that has been engaged in the survey (Nworgu 1991:69). Sampling is the process of identifying who is to take part in the study from the population. The word ‘population’ is used to describe the target group, and while this may be the national population as a whole, it may also be a smaller group such as lone parents, or business members of a Chambers of Commerce in a particular location. Detailed consideration of sampling needs to be made to ensure the validity of your results.

The selection of the sample was based on simple random and convenient sampling methods. The drivers and the other participants such as shop and grocery owners and customers in that location were selected by using simple random sampling whereas the transportation officers such as traffic police officers were selected by using convenient sampling at their convenient time. This convenient sampling has been selected because it was difficult to get the officers easily. Accordingly, 105 drivers, shop and grocery owners and customers were selected by using simple random sampling and 05 transportation officers such as traffic police officers were selected by using convenient sampling.

3.7 Data Collection

Data collection is an integral part of any research effort. Just as important as it is to decide on research design and strategy, is the choice of specific data-collection methods in conducting the research (Maxwell, 2005:79). For data collection to be successful, the goal of the data-collection operation has been established. Once the purpose of the data gathering is known and understood, it is an indication of the format of the data-gathering operation and how the data should be analyzed. In design research, often classified as a problem-solving strategy, the first task is to set clear goals of what aspects of artifacts are investigated. Either the technical characteristics of an artifact are researched or the usefulness and impact of an artifact is the topic of the research.

Depending on the goal, artifact, and the research questions under investigation, appropriate data-collecting strategies and methods were selected and used. Maxwell (2005:23) distinguishes between quantitative and qualitative research and lists “intellectual” and “practical” goals for qualitative research. Intellectually the researcher should understand the total meaning, context, and process of the study, identify unforeseeable events, and use these events to generate new ideas and explain conclusions. Practically, researchers can share results, experiences, collaborate and help to improve existing practices. For this study, the following data collection tools were employed.

3.7.1 Questionnaire

According to Rogers et al. (2011:238), questionnaires are a well-established technique for collecting demographic data and the subject’s opinions. Questions in questionnaires should be unambiguous and set out to collect facts or information from human respondents as honestly as possible. Short, easy-to-answer questionnaires have a better chance of being answered. Questionnaires have closed and open questions and two of the advantages of using questionnaires are: reaching large numbers of respondents simultaneously and being more economic than interviews and observation. Disadvantages for researchers are not being in total control of the data-exchange process and not being able to probe particular responses (Rule et al., 2011:66).

This thesis survey was conducted by using self-completion questionnaires and was completed with the guidance of the researcher. This method was selected because there is a higher possibility for the candidate to respond to the survey and the researcher can ensure that the respondent has understood the questions and the purpose of the research.

3.7.2 Interviews

Interviews are suitable data-collection methods for gathering detailed information; flexible and complex situations when questions have to be adapted to suit different people; exploring feelings, beliefs, emotions, and experiences of people; and investigating sensitive social issues (Oates, 2006). Interviews are subjective and classified into four main types: open-ended or unstructured, semi-structured, structured, and group interviews. Unstructured interviews tend to generate a lot of rich exploratory data when participants are allowed to talk without much intervention from the researcher (Rogers et al., 2011:585). In semi-structured interviews, the researcher prepares open-ended and closed-ended theme questions but allows participants to share information, feelings, experiences, and emotions in conversation. Exploratory data is gathered (Oates, 2006; Rogers et al., 2011:585). Structured interviews consist of pre-determined, fixed, identical questions for every participant, usually with pre-coded answers. The goals of the interview session should be clear and well understood by participants (Oates, 2006:187; Rogers et al., 2011:299). In this study, a semi-structured interview was preferred and employed as the interviewee was free to raise everything they feel about the problem under study.

3.7.3 Focus Group Discussion

Group interviews or focus groups normally involve three to ten participants. According to Rogers et al. (2011:302), the group represents a sample of a target population. This method is used to get a collective view within a social context through interactive thought and discussion of a topic introduced by the researcher (Myers, 2009:125). A question raised or a comment made by the researcher joining a group of people triggers a conversation or brainstorming exercise regarding a specific topic. More than one viewpoint is raised, which may result in a discussion and it possible for the researcher to gather more data and gain more insight. According to Hevner and Chatterjee (2010:123), the reasons focus groups are appropriate for design research to include: flexibility for handling design topics and domains; direct interaction with participants and conversation about design issues; large amounts of rich data not only about the design itself but also to the situational use of an artifact in context; and building on other participants' comments. Under this section, the selected participants such as the transportation officers were grouped into several groups consisting of at least 6 participants for the focus group discussion purpose.

3.8 Data Analysis

The analysis of the data from the closed and open-ended questionnaire, semi-structured interview and focus group discussion (FGD) was compiled, integrated, and analyzed.

More specifically, the data obtained through questionnaires were analyzed using the Statistical Software programme (SPSS v22.0) Software. The analysis of the data from the questionnaire is carried out using descriptive statistics. These are mainly frequency counts and percentages. The consequence of data from the field survey was described quantitatively by calculating the availability of car parking space, the demand for car parking spaces, and parking parameters efficiency of the studied areas. The results of the open-ended questionnaire and interview were described qualitatively and the findings are summarized. The gathered information was presented in the form of a chart, graph, and tables to ensure a clear presentation and better understanding. Thus, the organized data in the form of tables, figures, indices, graphs, and maps have been analyzed and interpreted all together as mentioned above.

The analyzing processes clarify the problems and the results of the analysis help to formulate recommendations for possible use by policymakers.

Some of the other software employed in this study was:

1. MS EXCEL: the purpose of this thesis is to draw pie charts, histograms, and to calculate Drivers' questionnaire response data.
2. MINITAB: To draw the Pareto diagrams to prioritize the main car parking problems in Adama city based on the drivers' questionnaire response.
3. LINGO 17 Software: used to solve the LP model and it can also solve more than 300 hundred variables and constraints.
4. GIS and AUTOCAD software will be used as an analysis tool for the design of car parking of the selected site.

CHAPTER FOUR

4. DATA PRESENTATION, ANALYSIS, AND DISCUSSION

This chapter deals with analyzing and presenting the data collected during field surveys, through questionnaires and interviews regarding car parking practices and challenges at the selected area in Adama city. The analysis of the study was structured and conducted to answer the research questions by addressing the objective of the research. In this chapter; the response rate, the demographic information of the respondents, findings of the survey, and analysis with detailed interpretations and discussions were explicitly presented.

4.1. Result of Field Surveys in the studied areas

As indicated in chapter three above, the parking survey was conducted from May 15 to June 15, 2020. The questionnaires have been developed and distributed to the subjects selected. These subjects were supposed to use the selected place in the selected study area. The subjects were instructed to fill the questionnaires and return the filled questionnaire in a week. Similarly, the interviews have been conducted with the subjects who were volunteers to take part in the interview. Five interview sessions have been done with different subjects. Moreover, volunteer subjects have been organized to sit for the FGD to acquire deep information about the issues covered through both the questionnaires and interview sessions for the matter of triangulating the findings.

4.1.1 Personal information

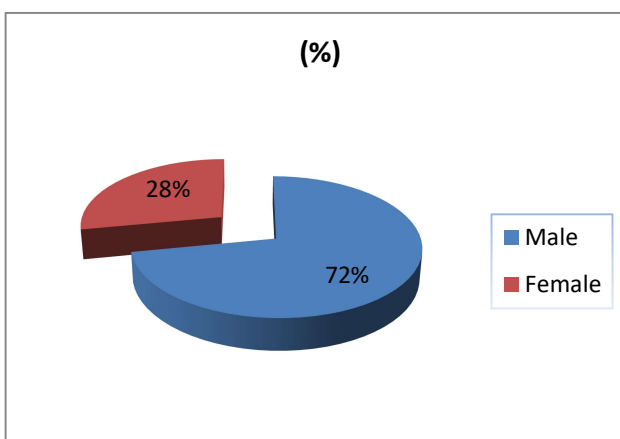


Figure 6 Gender of the participants (Source: Extracted from the questionnaire)

The above figure (figure 6) indicates that 28% of the participants were female drivers and 72% of them were male drivers.

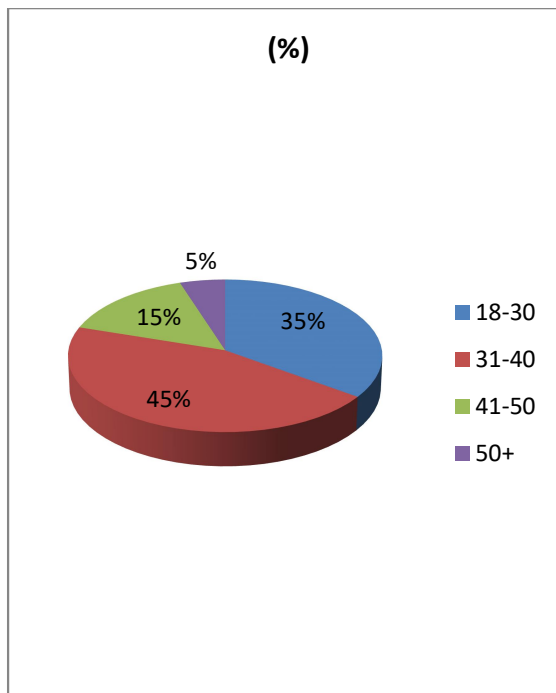


Figure 7 Age Category of the participants (Source: Extracted from the questionnaire)

The above figure (Figure 7) indicates that 45% of the participants were found in the age category of 31-40, 35% of the participants were found in 18-30 age categories, 15% of them were found 41-50 age categories and the rest of the 5% of them are above 50.

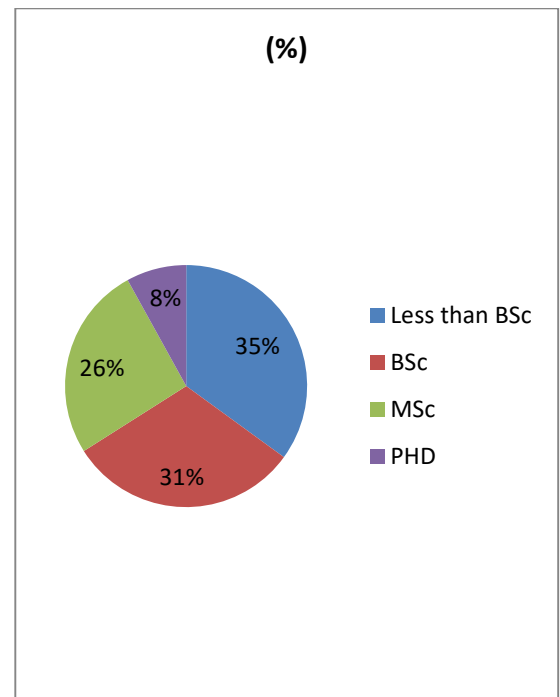


Figure 8 Educational Status of the participants (Source: Extracted from the questionnaire)

The above figure (Figure 8) indicates that 35% of the drivers who participated in the study have certificates or less. 31% of them are graduates of any bachelor's degrees, 26% of them were MSc holders and the rest 8% of them are Ph.D. holders.

4.1.2 General information of the respondents

From the survey data, 85% of the participants were drivers, and the rest 15% of them were other parts of the community such as transport officers. 100 % of the driver participants lived here in Adama for 1 to 12 years. 15% of the drivers resided in Adama for about 1-4 years, 52% of the drivers lived in Adama for about 5-8years, 17% of the drivers lived in Adama for about 9-12 years and 16% of them lived in Adama for about 13 or so years.

21% of the sample drivers drove cars for two years, 49% of them drove a car for 4 years, and 12% of them for 6 years and 18% of them drove a car for 8 years. Almost 85% of the sample drivers drove loading (truck) cars and the rest 15% of them drove automobiles. These findings indicated that the sample participants were believed to have rich information to answer the questions under study sufficiently.

4.2 Parking Issues and Challenges

4.2.1 Availability and sufficiency of car parking areas

The availability and sufficiency of car parking in the study areas as shown

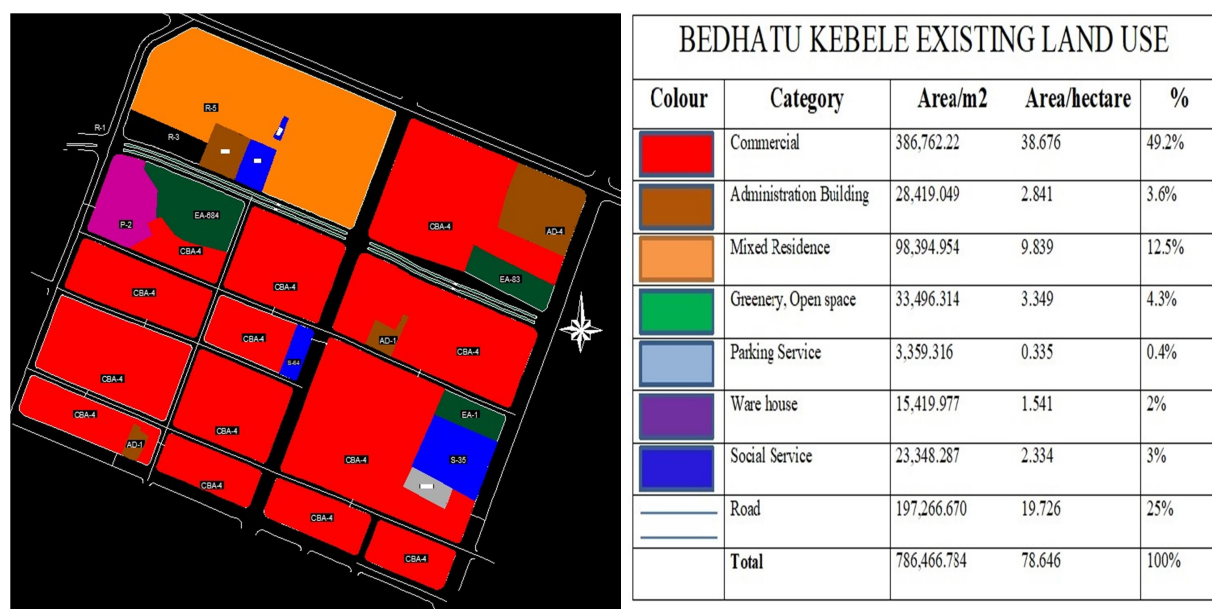


Figure 9 Study area location (Source: Adama City Structural plan (Bedhatu kebele plan))

The finding on the availability and sufficiency of the car parking spaces in the selected area are analyzed and presented as follows.

Almost 100% of the sample subjects responded that they usually park in the selected area most often. Findings on why the drivers' park is presented as follows.

	Items	N=110	Percentage (%)
1	Work or work-related		65%
2	Non- Work/Non-Business		5%
4	Business (Proximity to the business area)		16%
4	Entertainment (dining, museums, etc)		3%
5	Shopping		7
6	Visiting family or friends		1
7	Drop /load passengers		0
8	Medical/ dental appointment		3
9	First time to be here		0
10	Others_____		Not Any.

Table 1: Why do Parkers Park? (Source: Extracted from the questionnaire)

From the above table (Table 1), it was indicated that 65% of the drivers park in that specific area for work or work-related purposes. 16% of the park because the area is close to their business area. 7% of them shop in that specific area for shopping. 5% of the park for non-business and or non-work-related purposes and finally 3% of the park there for entertainment purposes.

Generally, it can be seen from this finding that most of the respondents who took part in this study responded that they park in that specific parking space for work or work-related purposes. In concomitant to this, the data from qualitative sources also indicated that the drivers parking at

the study area park for work and or work-related purposes. The respondents also added that as a result of the scarcity of parking spaces, they couldn't be successful with their daily activities as they oftentimes fail to find the parking spaces.

According to Litman, in everyday life, everything that involves traveling by car will involve parking somewhere. No matter what the purpose of the trip is, be it leisure or business, still, someone will need a place where to leave the car. In every location and situation, there are different needs when it comes to parking (Litman 2006). Parking coordinates land use and transportation in urban areas, and it is also one of the most important assets, bringing revenues to cities

In many research, parking system has been studied regarding the following different factors which are mode of choice, location accessibility, and network performance due to congestion of traffic and parking location choices behaviors of drivers depend on the factors of access time to parking location, parking fees, walking distance to the final destination and several socio-economic characteristics of the driver (Adam J. Pel et al, 2016). These studies reflected that for the finding above indicated that the drivers/businessmen or women residing and or doing business around the study area, to be successful with their daily routine activities, there has to be location accessibility, good network performances, good parking managements which to the contrary is lacking in the study area as indicated in this current study.

4.2.2 The satisfaction of the respondents with the current parking situation

80% of the respondents are not happy with current parking situations in the study area due to a lack of sufficient parking spaces, inconvenient parking options, and inefficient parking configurations. All of the respondents provided negative answers.

Causes for the dissatisfaction of the respondents on the current parking situation

As shown (Figure 8) below, 67% of the drivers mentioned a lack of sufficient parking spaces as reasons for the inconveniences with the current parking situation. 15% of them mentioned inadequate pricing methods as reasons for the inconveniences with the current parking situation. 10% of them mentioned inappropriate parking arrangements as reasons for the inconvenience.

5% of them mentioned there are inadequate pricing methods and 3% of them mentioned inadequate loading and unloading spaces as a reason for inconveniences with the current parking situation. This finding indicated that most of the participants are not happy because of the lack of sufficient parking spaces and inconvenient parking options indicating that the street is mostly occupied by cars and also other convenient parking options are not available in the areas.

Similarly, from the other sources of data; from the interview and FGD, the participants mentioned that there are scarcities of parking spaces, there are parking space arrangements, and inconvenient parking options. They added that as a result of the scarcity of car parking spaces, parking congestion usually happens in the area.

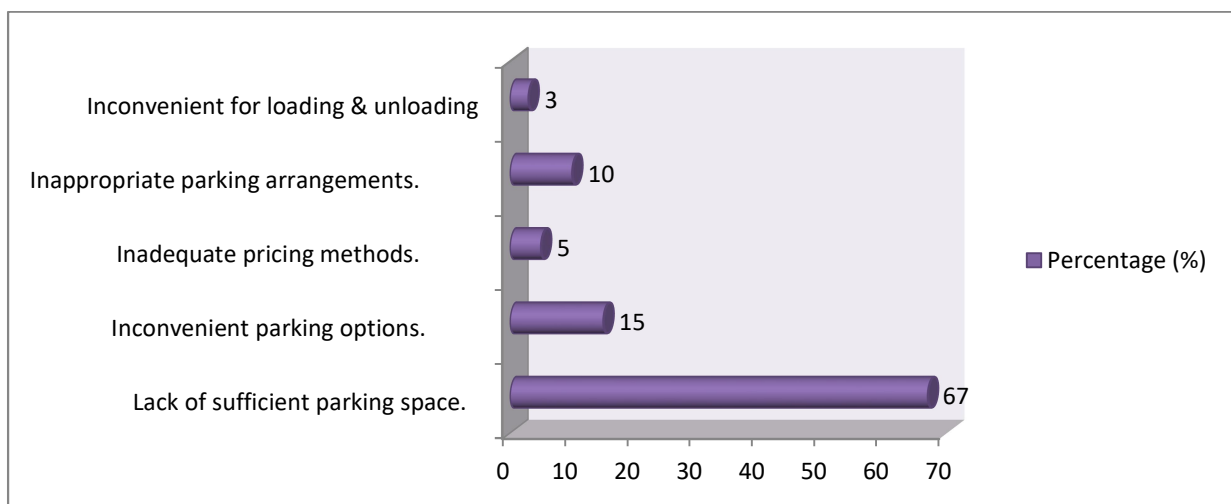


Figure 10 Percentage of why the drivers park at that specific place, (Source: Extracted from the questionnaire)

Literature underlines that the best way to approach an arduous dilemma, such as traffic congestion, is to first understand the origin of the problem. According to Downs (2006), traffic congestion is a worldwide problem with four primary causes: 1. Congestion exists because societies organize economies so most people will work during the same hours each day. 2. Rising incomes intensify congestion by permitting more households to purchase vehicles and buy homes-mainly in suburban areas. 3. Population growth. When urban growth is accompanied by rising prosperity, more households buy more cars, and roads become more congested. 4.

Incidents and accidents. Result from high volumes of traffic generated by the first three causes. Overall, Downs' believes that traffic congestion results from economic growth.

Congestion is frequently employed in the road traffic context, both by technicians and by the public at large. It is usually understood as meaning a situation in which there are a large number of vehicles circulating, all of which are moving forward slowly and irregularly. These definitions are subjective, however, and are not sufficiently precise.

Generally, this study both from the quantitative and qualitative data indicated that car parking spaces are scarce and as a result of the scarcity of car parking spaces, traffic congestion usually happens in the area.

4.3 Demand for car parking spaces

Parking demand refers to the number of vehicles whose driver desired to park at a specific location of the study area. It is usually expressed in the number of vehicles. There are two types of parking demands; the latent demand, and revealed demand. Revealed demand refers to the actual observation of vehicles in the parking facilities during the study period. While latent demand considers even those vehicles intending to park but due to limited spaces have to be turned away. The latent demand case was selected for this survey. That means parkers who didn't get space but desired to park are counted in the course of survey time.



Figure 11 Study area location (Source: Pictures from research site).

In this study, the question was forwarded to the respondents to assess how the car parking spaces demand increased in the past, in the current situation in the future changed. The analysis is presented as follows.

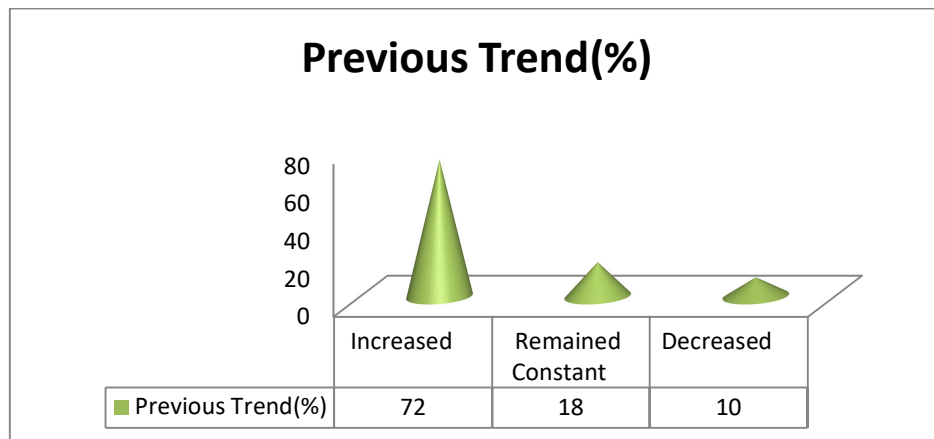


Figure 12 Previous trend, (Source: Extracted from the questionnaire)

To assess the total parking demand and supply of the study area, a parking usage survey has been conducted both on the on-street and off-street parking spaces. Accordingly, as indicated in the above figure (Figure 10), 72% of the respondents mentioned that the demand for car parking in the previous five years has been increasing. 18% of the respondents mentioned that the demand in the last five years has remained constant. Whereas, 10% of the respondents mentioned that the demand in the previous five has decreased.

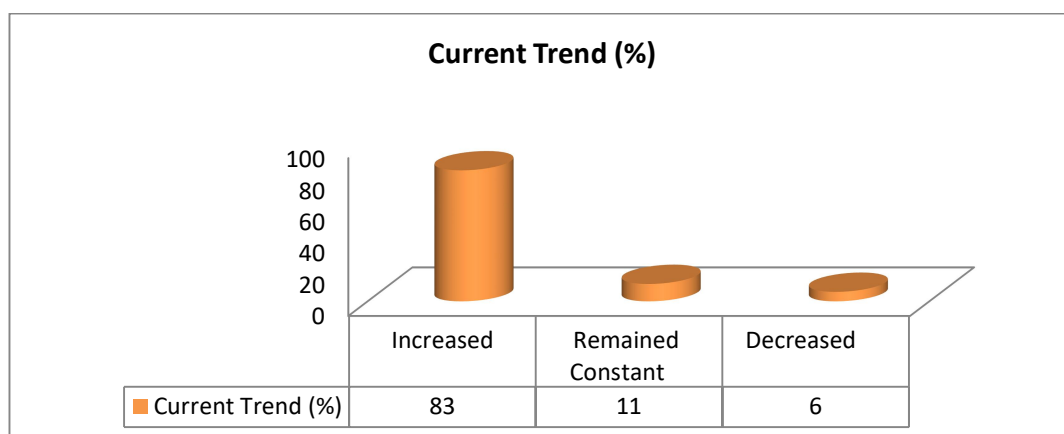


Figure 13 Current trend, (Source: Extracted from the questionnaire)

It was indicated in the above figure (Figure11) that the demand for car parking spaces is also increasing in the current situation; 83% of the respondents responded that the demand for car parking spaces is increasing. 11% of them responded that the demand for car parking space is currently constant. Only 6% of them mentioned that the demand for car parking space is decreasing.

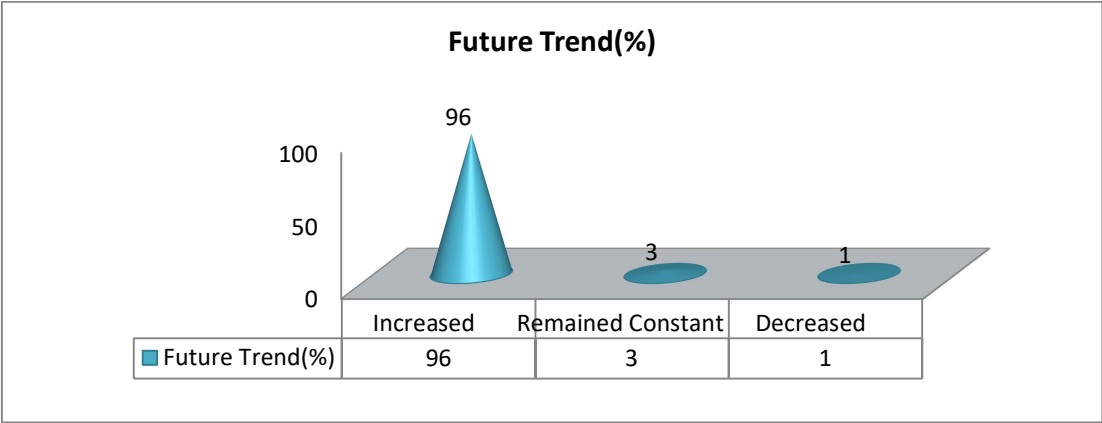


Figure 14. Future trends, (Source: Extracted from the questionnaire)

The above figure (figure 12) also indicates that the demand for car parking space over the next five years most like increases alarmingly. 96% of the respondents mentioned that over the next five years, the demand for car parking spaces most likely increases. 3% of them mentioned that the car parking space over the next five years most likely remains constant and only 1% of them mentioned that the demand for car parking space over the next five years will decrease.

Data from other sources such as interviews and focus group discussions also indicated that the demand for car parking spaces is increasing at an alarming rate. When comparing the demands of the past, current,, and future trends of the demand of the car parking spaces, the respondent who took part in the interview and FGD indicated that relatively the demand is increasing as the numbers of the vehicles are increasing. It was also added by these respondents that the demand and supply of the car parking space don’t relate.

There are factors that determine parking demands. Researches have shown that parking price seems to be one of the most influencing factors for parking demand for a particular parking lot and modal choice. Hensher and King (2001) examined the role of parking pricing in the generation of demand for parking at a specific parking lot. They used a stated preference data of private car users and public transit users to get samples of individual behavior varying with parking prices and hours of operation at various locations in different areas (McGuinness and McNeil, 1991).

Some other findings on parking demand were attained based on the analysis of the parking utilization indices namely its utilization (occupancy rate), accumulation as well as the duration of the facility itself. Utilization here refers to the occupancy of the designated spaces within the facility and is calculated as the number of spaces occupied over the total number of spaces available (Papacostas, C.S., Prevedouros, P.D., 2001).

Accumulation relates to the number of vehicles parked at a given time while duration explains the total hours that the vehicles being parked at the facility. It is divided into short-term parking, mid-term parking, and long-term parking (Papacostas, C.S., Prevedouros, P.D., 2001).

The high percentage of long-term parkers indicates that there is a demand for the park and ride facilities especially among the trip makers from a suburban area. This is shown by the demand for long-term parking at Seremban station which is higher as compared to Shah Alam station. Besides, the study conducted at the park and ride facility in San Francisco Bay Area at California by Shirgaokar and Deakin, (2005), found that from the surveys conducted at Caltrans owned park and ride lots in the region, 19 lots were at or approaching capacity that is 80% or more full, 13 lots at or over capacity where all spaces are taken and cars parked on shoulders. Moreover, 11 lots were heavily used and another 19 lots were underused where they had less than 50% occupancy at midday.

Generally, this study indicated that the demand for parking spaces is determined by why the parkers park in that specific parking area; this means some park for a business, some park for shopping, and some park for entertaining. Therefore, in order to satisfy the needs of all, parking

spaces have to be available, there have to be fair parking prices, and the parking management schemes have to be there to attract and or satisfy the car parking demands.

All of the respondents mentioned that there are no adequate parking spaces in this city especially in the study area which matches the increasing demand? Responses to the question “What type of car parking facilities do you recommend?” are analyzed and presented as follows.

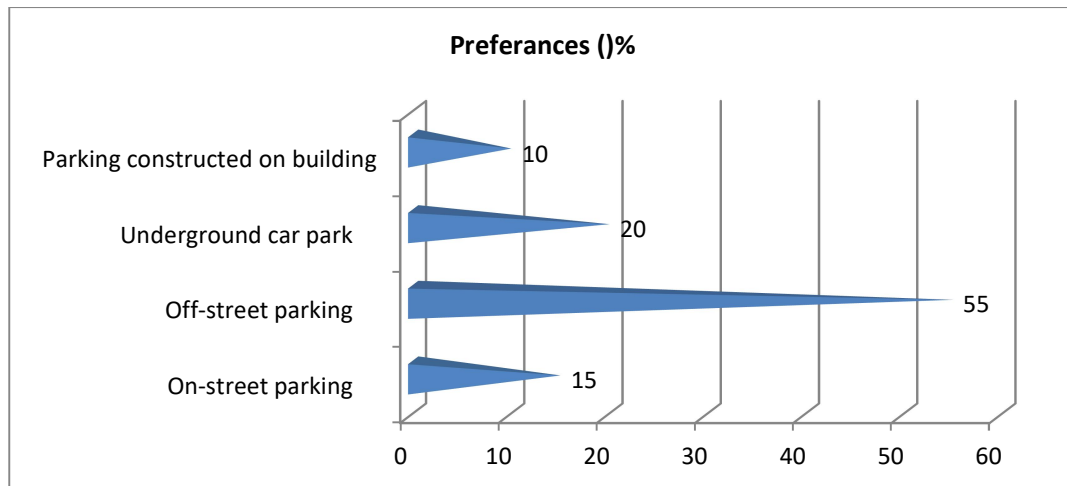


Figure 15 Car parking facility preferences, (Source: Extracted from the questionnaire)

The above figure (Figure 13) indicates that 55% of the respondents have stated that they prefer off-street parking spaces, 20% of them stated that they prefer underground car parking spaces, 15% of them mentioned that they prefer on-street parking spaces and only 10% of the respondents preferred the parking spaces constructed on buildings. The selection of sites for the larger, centralized parking facility is a complex undertaking. Similarly, the design of a parking garage requires the application of specialized knowledge and at the same time, parking space site selection aims at assigning available space commensurate with demand. In general, the selection of parking site selection criteria should be done following the satisfaction of both clients and constructors

The lack of public spaces urges local authorities to consider more innovative measures while creating more parking spaces. More expensive alternatives for on-street parking like garage parking and mechanical and automated parking facilities (automated garages or car stackers) have to be considered. This can enhance the opportunities to provide parking both below and

above ground level, creating a more efficient use of on-street parking space. These measures can also be integrated into new building plans. Most important is the reduction in the nuisance (noise, visual & environmental pollution) caused by the heavy flow of traffic searching for parking. The suitability of these alternatives depends on the layout of an area because automated garages usually provide a large number of parking spaces; these are suitable for high density mixed-use areas. Generally, site selection for parking put in summary in the following figure.

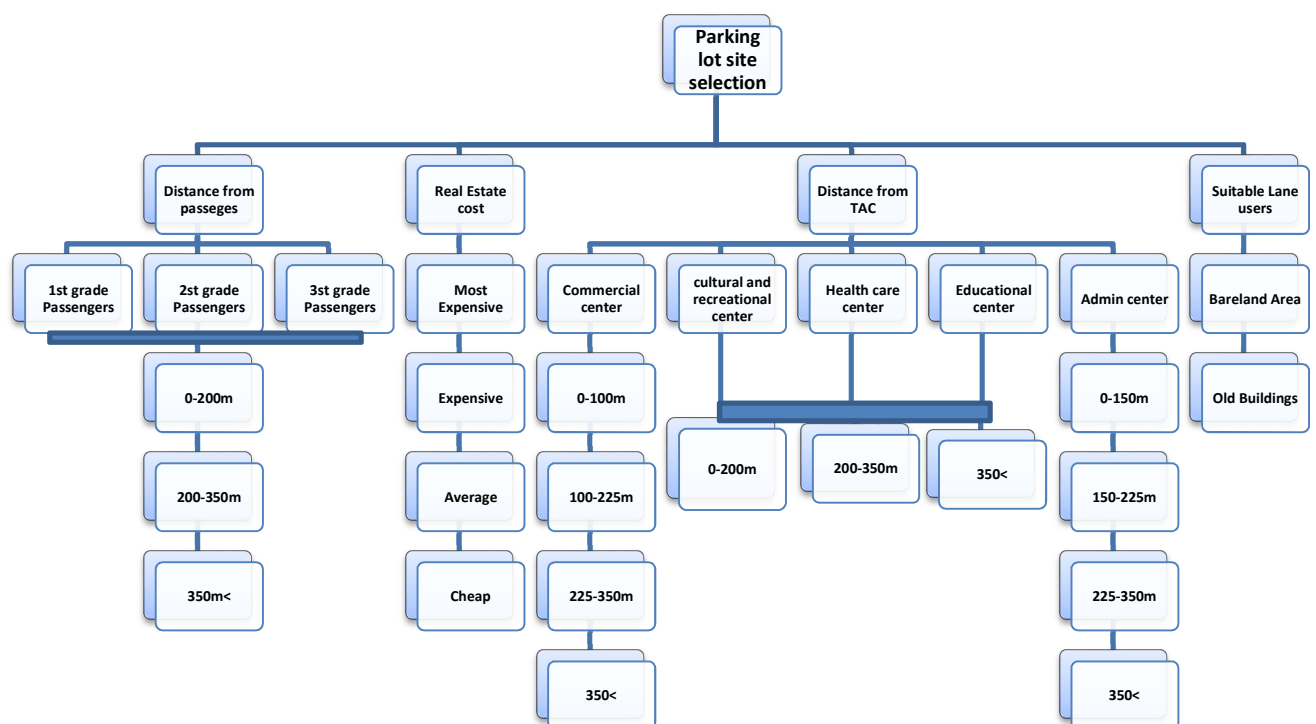


Figure 16 Public parking lot site selection trees in Boroujerd City (Source: Adapted from Asad, Y. 2015)

The potential for mixed-use of parking facilities depends on the amount of mixed-use development in the area. This concept cannot be successful in the case of single-use areas having only one user group. Increasing mixed-use development can add a significant contribution to better utilization of parking facilities but this can only be achieved through a planned long-term strategy. The current single-use lay-out in many areas is not likely to change in future, despite spatial policies directed at increasing mixed-use development, this type of development in new residential areas is limited (Snellen et al., 2005)

The evidence on the impact of parking (and other demand restraint) policies on business location decisions is weak. Integrated transport demand management strategies at a site and city level can do much to offset the impacts of reduced spaces or increased charges. A key factor in demonstrating the success of a 9 strategy to business would appear to be an improvement in the accessibility of the workforce (and potential workforce) to the site of employment.

4.4 Issues of parking parameters

Parking is regarded as an integral part of the urban transportation system, and the increase in the number of vehicles had caused problems with parking in major cities (Mathew, T. and Kirshana, K., 2006). Under this section, parking parameters with a specific focus on time limits, notices in and around the parking areas, and related issues were covered. The question on the duration of the parking place was analyzed and put as follows.

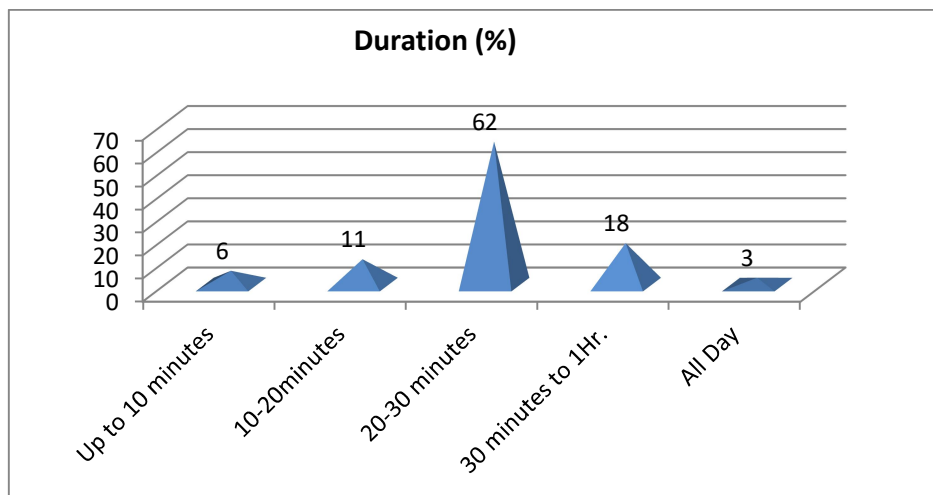


Figure 17 Duration of parking place, (Source: Extracted from the questionnaire)

As indicated in the above figure (Figure 15), 62% of the respondents stated that they stay 20-30 minutes in the parking lot. 18% of them stated that they stay in the parking lot for 30 minutes to 1hour. 11% of them stated that they stay in the parking lot for 10-20minutes. 6% of them stated that they stay in the parking lot for up to 10 minutes and only 3% of them stay in the parking lot all day. Of course, there are very few theoretical parking models that consider parking cruising time, but it is a key component in parking management and design. Time restrictions are a common policy measure was the periods during which stopping, standing, or parking are limited.

These policies are typically in effect during peak traffic periods and apply to passenger vehicles and commercial vehicles alike.

In big cities, common time restrictions are in place both for parking and for the by-passers. The goal of such a policy is to ease the traffic congestion and also separate commercial vehicles and passenger vehicles in urban areas temporally instead of spatially. These kinds of moves are also meant to designate curbside parking for freight vehicles in the morning and create better parking opportunities for passenger vehicles later in the day (Zalewski et al., 2011).

Off-peak delivery is another time restriction that has received increased attention recently. Under an off-peak delivery policy, commercial vehicles are encouraged to make deliveries overnight instead of during the day. This policy has two main benefits: commercial vehicles can complete tours much more quickly due to spending less time stuck in traffic, and commercial vehicles are able to find adequate parking facilities much more easily. Even if commercial vehicles park illegally immediately in front of an establishment while making a delivery, the impact is dramatically reduced due to the reduction in overall traffic levels during the overnight period.

The responses to the question on the nature of the parking spaces in the study are is compiles and presented as follows.

No.	Items	YES Frequency (%)	NO Frequency (%)
1	Are there time limits to stay in the parking?	25	75
2	Are there penalties if you stay in the parking more than the limit?	39	61
3	Is these limit controls set either manually or electronically?	15	85
4	Are the drivers notified of the speed limits on the spot	10	90

Table 2: Parking parameters; (Source: Extracted from the questionnaire)

The above table (Table 2) comprises the analysis of the question that asks about the nature of the parking they used. As was indicated in the table, 75% of the respondents stated that the parking they used doesn't have a time limit; only 25% of them said that the parking has a time limit. This finding indicates that most drivers can stay in the parking as long as they want to do so. In a similar way, 39% of the respondents responded that parking penalizes those who stay in the parking for a longer time. 61% of them stated that the parking doesn't penalize the drivers who stay in the parking for a longer time. 85% of the respondents mentioned that the parking they usually use doesn't have either manually or electronically set time limits, whereas only 15% mentioned that the parking they usually use has a time limit to stay in the parking. 90% of the respondents mentioned that the drivers are not notified of other traffic laws such as speed limit in and around that parking and only 10% of them mentioned that the speed limit notices are in place in and around the parking places they usually use. It can be deduced from these findings that the parking spaces are not to the standard; no time limit, no penalties on those who stay in the parking for a longer time, no speed limit documents, and no traffic laws notices.

Question on the advantages of the presence of parking parameters is compiled, enriched with theories, and presented as follows.

Parking systems are an essential attribute in different walks of our lives. Parking assistance/parameters are smart enough to regulate traffic at any point in time in residencies, offices, shopping malls, hospitals, and other public places. With the transformation of parking technologies, there are integrated parking equipment and software that offer the best solutions to parking-related complications.

With advanced parking parameters, it is completely appropriate, comfortable, and adjustable to regulate the entry and exit of vehicles in the parking facility. The authorities can smoothly enhance their parking system and manage free-flowing vehicles, throughout the day.

Advantages of parking parameters as compiled from the FGD session:

- ❖ The main important benefit of parking parameters is its advanced technology. It follows the latest technologies and concepts to assure profitable outcomes.

- ❖ For parking authorities and vehicle owners, parking parameter resources are flexible enough to operate and manage.
- ❖ The design and implementation of parking parameters are very easy to supervise and manage. This system can be easily handled by the staff members because of its well-organized structure.
- ❖ The adaptation of a valid parking system depends on the type of area and technologies. With the emergence of a wide range of technologies and devices, we can customize their usage based on the needs and requirements of the parking spaces. Example: Residential complexes and buildings are types of clustered settlements; hence the vehicular flow is limited whereas places like hospitals have a fluctuating number of vehicles either entering or leaving the parking areas. Therefore according to the settlement, the exact type of management system is installed in the applicable parking areas.
- ❖ Maintenance of a complete parking system was a hectic job but these days due to innovation and technology it has become a matter of a few seconds before an issue gets resolved. Local maintenance service staffs work 24*7 and can be accessed to operate and maintain the whole parking system. If any kind of defect is encountered in the technologies, it is immediately taken care of and resolved or else the best solution is provided to regulate the normal parking for the smooth working of the system.
- ❖ Another unique advantage of the parking parameters varies in their cost. It is a cost-effective technique for monitoring and managing parking areas. With less manpower, a large sum of money is saved. Moreover, it saves manual labor and energy.
- ❖ The parking parameter saves a lot of deal on time. Vehicles can move at a faster speed and traffic can be managed in a better way. It is a strategic way to handle the frequency of vehicles in the parking lot.
- ❖ It is well secured with tech-savvy security provisions. The vehicle users are well assured on grounds of security and privacy. Their vehicles park in a safe location and are equally well secured. The systems prohibit unauthorized entry or exit and are suitable for single and multiple entry points. With such a system, places like shopping malls, hospitals and hotels can manage their entire parking system.

- ❖ Parking parameters use integrated applications and software that can be combined with other applications of the parking spaces, for better results. It creates space for third-party software, without any interruption. The system is all the more designed in a manner to make the parking experience unique and attractive.
- ❖ Thus, concluding, the best parking parameters offer unique facilities, benefits, and advantages. It saves cost, time, and energy. The modern parking lots use well-improvised technologies and equipment, for smooth regulation and operation. Overall, it requires lower maintenance and services and ensures efficient functioning and coordination within the parking space.

According to the responses of the participants who took part in the questionnaire, interview, and FGDs, regarding parking policies and pricing systems, there are Poor Street parking management systems and pricing in the city. The pricing is subjective; it depends on the free wills of the mostly illegal park controllers. Detail studies have not been carried out on price differentiation depending on different cities in Ethiopia. There is good progress in big cities such as Addis Ababa where there is practical progress in developing different parking management systems such as pricing systems for smart parking. Developing Clear Parking policies and pricing systems policy will be designed in the future. This current study investigated better ways of parking management systems as recommended by the respondents.

The following figure (Figure 15) comprises better ways of car parking space management systems. The finding was narrated as follows: the respondents were asked to rate the nature of the parking spaces they want to have by using a Likert scale. It can be seen from the table that 47% of the respondents stated that having parking guiding systems is very important. 37% of them said that the presence of parking guiding systems is important. 12% of them said that the presence or absence of parking guiding systems doesn't influence parking management, 4% of them responded that the presence of parking guiding doesn't have importance and, none of them said that the presence of parking guide is not important at all. It could be concluded from this finding that 84% of the respondent recommended that the presence of a parking guide in establishing fair parking space management.

51% of the respondents responded that parking space reservation systems are very important to have to ease parking space management. 38% of them responded that the parking reservation

systems are important to help the users of the park around the study area. 8% of them responded that they neither recommend nor reject the parking guiding systems. 2% of them mentioned that these parking guiding systems are not important and only 1% mentioned that the parking guiding systems are not important at all. It can be concluded from this item that 89% of the respondents recommended the presence of the parking guide to ease parking space management.

67% of the respondents responded that providing information for clients is very important. 22% of them mentioned that providing information for clients is important. 10% of them mentioned that providing information for the clients neither important nor unimportant, 1% of them said that providing information for the clients is not important and none of them mentioned that providing information for the clients is not important at all. For this item, it can be concluded that 89 % of the respondents recommended that provision of information for the clients increases the effectiveness of the parking management system.

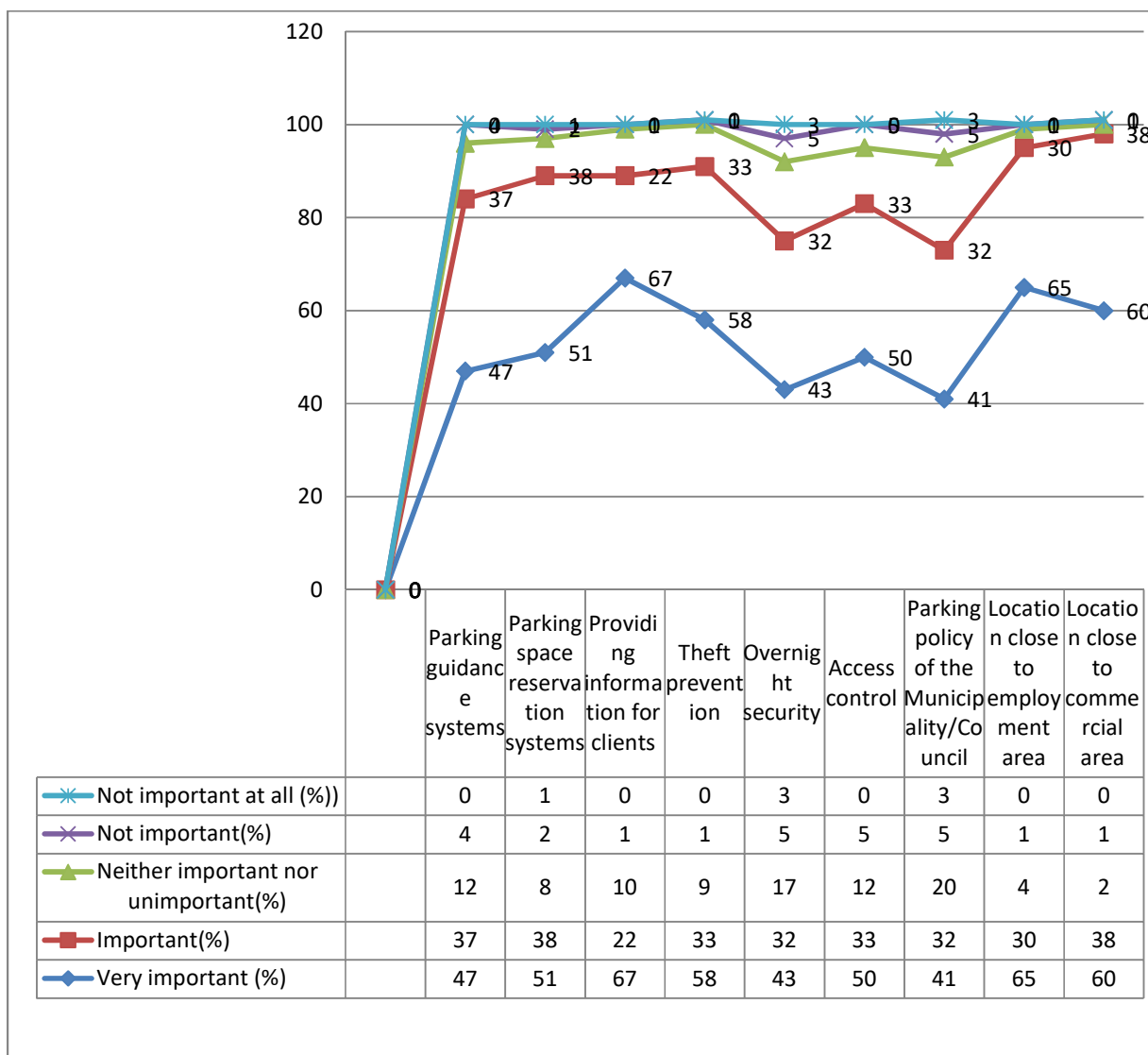


Figure 18 Better ways of car parking management system: (Source: Extracted from the questionnaire)

58% of the respondents recommended theft prevention mechanisms around the parking space is very important. 33% of them said that theft prevention mechanisms are important. 9% of them said that theft prevention mechanisms around the car parking spaces are neither important nor unimportant. 1% of them said that theft prevention mechanisms are not important and none of them said that theft prevention mechanisms are not important at all.

43% of the respondents mentioned that overnight security is very important. 32% of them mentioned that overnight security is important. 17% said overnight security is neither important

nor unimportant. 5% mentioned that overnight security is not important and only 3% of them mentioned that overnight security is not important at all. For this item, it can be concluded that 75% of the respondents mentioned that overnight security is important in the parking space.

50% of the respondents responded that access control is very important. 33% of them mentioned that access control is important. 12% of them mentioned that access control is neither important nor unimportant. 5% of them mentioned that access control is not important and none of them mentioned that access control is not important at all. It can be concluded for this item that 83% of these respondents recommended access control in parking spaces.

41% of the respondents responded that the parking policy of the municipality/council is very important to manage the parking spaces, 32% of them stated that the parking policy of the municipality/council is important. 20% of them said that the parking policy of the municipality/council is neither important nor unimportant. 5% of them said the parking policy of the municipality/council is not important and only 3% of the respondents responded that the parking policy of the municipality/council is not important at all. It can be concluded from this item 73% of the respondents recommended the parking policy of the municipality/council for the parking space be effectively and efficiently managed.

65% of the respondents responded that locating the parking space close to the employment area is very important. 30% of them responded that locating the parking space close to the employment area is important. 4% of them mentioned that locating the parking space close to the employment area is neither important nor unimportant. 1% of them added that locating the parking space close to the employment area is not important and none of them said locating the parking space close to the employment area is not important at all. It can be concluded for this item that 95% of the respondent mentioned that locating the parking lot close to the employment area is important.

60% of the respondents mentioned that locating the parking space close to the commercial area is very important. 38% of them responded that locating the parking space close to the commercial area is important. 2% of them responded that locating the parking space close to the commercial area is neither important nor unimportant. 1% of them mentioned that locating the parking space close to the commercial area is not important and none of them mentioned that locating the

parking space close to the commercial area is not important at all. It can be concluded for this item that locating the parking space close to the commercial area is an idea to make the parking lot effective and efficient.

Even though the application of parking pricing and supply restrictions is “the most widely accepted and readily accepted method” of limiting car use (IHT, 2005, p20) it is a topic that has received comparatively little study upon which to ground the development of policies for the future. There are several theoretical reasons why the pursuit of research into parking management systems and road space rationing is more appealing than that of parking pricing and supply management.

Parking management system (parameters) can be used to influence a wider range of trip characteristics than parking policies can such as “trip length, time of driving, the route followed and vehicle used” and can, therefore, more adequately be used to tackle the full range of externalities (Verhoef, Nijkamp, and Rietveld 1995:142).

However, despite these disadvantages Verhoef et al. (Ibid.) note that, under the right conditions, parking policies can be used to tackle congestion effectively, a finding supported by a more recent theoretical exploration (Calthrop, Proost, and van Dender, 2000). In most circumstances, however, the ‘right conditions’, where everyone pays the true cost for their parking, do not exist (Shoup, 2005a; IHT, 2005). Parking policy is at best an opaque balance between a revenue-raising activity for local authorities and easing parking challenges for the customers.

The following parking management systems were forwarded from the respondents.

4.4.1 Developing parking policies and pricing Systems

Many cities encounter parking problems with rapid urbanization and an increase in the number of vehicles. The parking demand in city centers frequently exceeds the supply, and parking spaces are usually distributed unevenly, leading to overcrowding of popular parking lots (Kotb, A.O.; Shen, Y.; Huang, Y., 2017). Drivers need to compete for limited popular parking spaces, and those losing ones will have to cruise around, thereby increasing the travel time and is inconvenient for drivers. On the one hand, government agencies may consider building additional parking lots to address this current dilemma. However, this task is difficult to implement and

sustain because of the limitations in capital and land resources (Rogers, J.; Emerine, D.; Haas, P.; Jackson, D.; Kauffmann, P.; Rybeck, R.; Westrom, R. Estimating Parking, 2016)

On the other hand, many parking management instruments are acknowledged to mitigate parking problems, in which parking pricing is an effective strategy. Parking pricing may change drivers' parking choices and lead to improved parking distribution and resource utilization. Parking pricing has elicited extensive attention in the literature. Related research is divided into two categories, namely, the impact of parking price rates on parking demand and the study of parking charging methods. The first category of research focuses on the sensitivity of users to parking charges. Wilson (1992) used a multinomial logit model to assess the effects of employer-paid parking on the mode choice and parking demand of downtown Los Angeles commuters. Thresholds of parking fare increase are found to change an already chosen parking location or to shift to another mode from private cars (Wilson, RW, 1992: 133-145).

In addition to the research on parking price, parking reservation systems (PRSs) have been rapidly developed with the development of information and mobile Internet technologies. The original intention of the PRS concept in the field of intelligent transportation is to assure users of parking space and avoid scrambling for parking spaces by making an advance reservation. PRS reduces traffic congestion, optimizes the utilization of parking resources, maximizes parking revenue, and reduces user time consumption. Therefore, PRS is preferred as a new method to alleviate urban parking problems. The reservation of some parking spaces is allowed in the reservation system. With these advantages, parking reservations are considered in the parking pricing strategy.

4.4.2 Modern approaches to parking management

Concerning modern technologies to parking systems, the responses of the interview and FGD participants focused on technologies of parking and collecting fees which are not so significant that is Parking Meters are not installed and the system of collecting fees is manual issuing receipt. Currently, the development of smart parking elsewhere like Addis Ababa that includes both Building parking and Surface parking need to be extended to other cities such as Adama

4.4.3 The adequacy and efficiency of the current parking configuration

Regarding adequacy and efficiency of current parking configurations, the respondents responded that the number of vehicles in Adama is increasing from time to time and correspondingly the demand for parking spaces is increasing.

In view of the above, parking places are not enough to accommodate the existing vehicles and most of the buildings with designated parking spaces are not efficiently serving their purposes, and instead, they are used for other business intentions resulting in drivers parking their cars on streets exacerbating the problems of traffic operations. This action consequently leads to illegal parking such as double parking which narrows road carriageways creating discomfort to pedestrians.

Evaluation of the parking system and its characteristics at the strategic level of planning, it is important to evaluate the existing parking facilities to develop the level of service to make a better plan and operation.

Different theories explain that several approaches have been established in the past to evaluate the existing parking system performance (LOS) considering different parking characteristics. At an earlier stage, Yu and Lincoln (1973) investigated various parking variables which are significant to assess the parking service level and can measure the individual parking efficiency. Saaty and Vargas (1979) have developed an analytical hierarchy process (AHP) which has been widely used for analytical planning. The AHP approach has been used by several authors to evaluate the parking system using predefined characteristics (Das and Ahmed, 2018; Sun et al., 2015). Kay and Smith (2000) introduced a categorized level of service approach which is mainly focused on how easy it is to find parking space considering traffic flow conditions. Smith and Butcher (2008) developed the level of service of the parking facility as a measure of walking distance to the destination from parking for performance evaluation. The fuzzy model for the evaluation of parking system performance has been used by Dong and Wang (2009). Three aspects of customer satisfaction point J. Traffic Transp. Eng. (Engl. Ed.) 2020; 7 (1): 111e124 117 of view, namely safety, convenience, and efficiency, have been considered based on expert's objective evaluation without conducting practical survey and analysis. They found a positive relationship between customer satisfaction and the service level of the parking area.

The key factors they considered for the evaluation of LOS were space utilization and the number of legal and illegal parking as well as the availability of parking shades, accessible walking routes, and accessible transit stations. This method can also be applied to other land uses by considering respective metrics and some required adjustments.

4.4.4 Networking

Networking protocols are key to pass information from sensors to smart parking systems otherwise it would be chaotic to connect to every sensor in place for retrieving its data. In smart parking solutions, there are two types of network protocols (one for users and one for sensors). In some cases, sensors and users might use the same protocol. However, user protocols consume more power and require having Internet connectivity. On the other hand, most sensor protocols do not connect directly to the Internet, they have to pass through a gateway sometimes (i.e., LoRa, ZigBee, and NB-IoT). This gateway is in charge of translating a Wireless IoT protocol to a TCP/IP based. The deployment of a smart parking solution demands a network architecture infrastructure able to support hundreds of thousands of devices connected transmitting every certain time. This topology must consider short-range and long-range communications for connecting sensors to gateways and then to software solutions. These network implementations have to focus on deploying wireless IoT protocols and mesh networks to cover wider spaces and allow sensors to transmit even if the gateway node fails. Networking in smart parking has to be aligned with low energy consumption, minimum delay, and reliable throughput. There are initiatives in place to improve networking for smart parking, as described in. The usage of several communication solutions has been proposed over the reviewed research papers. In this context, the solutions were classified into two major categories as shown in Figure 3. First of all, the “sensor network” category describes network architecture and protocols applied to sensor communication. Then, the “User Network” category describes protocols used to send useful information to the end-user. This classification was based on and the noticeable trend in the use of wireless network technologies for sensor communication. Finally, the “Vehicle Network” category was not considered, due to the lack of research papers containing information about those networks; therefore, that category was discarded

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Summary of the Findings

Based on the discussions presented in the previous chapter, the findings are summarized as follows: The results obtained from the field surveys, Focus Group Discussion, and observations indicate that most of the drivers in the study indicated that they usually park at the study area for work or work-related reasons and also since they have business in that vicinity.

In addition, the results of the study through questionnaires and interviews indicated that most of the respondents are not happy with current parking facilities in the studied areas due to lack of sufficient parking spaces, inconvenient parking options, and inefficient parking configurations. This means that the existing available parking spaces were occupied and there were no alternative convenient parking places in the study areas. Lack of adequate parking spaces can cause street congestion since the existing parking spaces would be occupied by car users and so other car users double park narrowing the carriageways, especially during the peak resulting in crowded streets.

Reasons for using street parking are because of lack of sufficient off-parking places and vehicle users want to park their cars closer to their destinations. The results of the quantitative survey, FGD, and the observation indicated that the drivers use street parking because of the lack of sufficient off-street parking spaces. It was also found that most of the respondents spent more time in the parking lot.

Besides, there are difficulties of finding parking places during weekdays and Saturdays during the morning and at afternoon hours are common resulting in losses of resources in terms of productive time, energy, and fuel while looking for parking places. This study also indicated that car parking spaces are scarce and as a result of the scarcity of car parking spaces, traffic congestion usually happens in the area.

In another way, the literature presented under chapter two and the findings of the current study also indicated that as a result of the scarce parking spaces causes traffic congestion; congestion exists because societies organize economies so most people will work during the same hours each day, the rising of the economic status of the community also intensifies congestion by permitting more households to purchase vehicles and buy homes-mainly in suburban areas and as a result, when urban growth is accompanied by rising prosperity, more households buy more cars, and roads become more congested.

Concerning parking parameters, it was indicated in the finding that the respondents stay in the parking lot for about 20 minutes to 1hour. This indicated that as the car stays in the parking lot, the other drivers could not get a parking place and hence they park on-street which in-turn results in traffic congestion. Of course, there are very few theoretical parking models that consider parking cruising time, but it is a key component in parking management and design. Time restrictions are a common policy measure was the periods during which stopping, standing, or parking are limited. These policies are typically in effect during peak traffic periods and apply to passenger vehicles and commercial vehicles alike.

The study also indicated plenty of advantages of well-managed parking facilities such as its usage to advance technology, design, and implementation of parking parameters become very easy to supervise and manage, parking parameters resources are flexible enough to operate and manage, with the emergence of a wide range of technologies and devices, we can customize their usage based on the needs and requirements of the parking spaces, maintenance of a complete parking system was a hectic job but these days due to innovation and technology of parking facilities, it has become a matter of few seconds before an issue gets resolved and also it improves the cost. Besides, it is well secured with tech-savvy security provisions and also the parking parameters save a lot of deals on time.

According to the data findings presented in chapter five, the respondents recommended the following parking management systems to improve the scarcity of the availability and the poor management of the car parking space in the study place.

- Developing parking policies and pricing Systems

- The adequacy and efficiency of the current parking configuration
- Developing modern approaches to parking management
- Networking

With advanced parking parameters, it is completely appropriate, comfortable, and adjustable to regulate the entry and exit of vehicles in the parking facility. The authorities can smoothly enhance their parking system and manage free-flowing vehicles, throughout the day.

The result of this study also revealed that there is a Poor Street parking management system, and no detailed investigation is developed regarding the pricing system on-street parking and also lack of installed modern technology to collect parking fees. Furthermore, parking places are not enough to accommodate the existing cars and those designated for parking facilities under buildings are not serving their purposes and instead are used for other business intentions. Because of this, most drivers' use in-street parking resulting in illegal parking such as double parking narrowing road carriageways, and inconvenience to pedestrian's movements.

In summary, the main problems with regards to car parking spaces in the study area are Lack of sufficient parking places; Loss of resources i.e. time, energy, fuel while looking for parking places; Lack of sufficient off-street parking places resulting in in-street parking; Blocking personal business/commercial centers by parking in front of their shops / offices; Risk of security and theft of vehicle parts during street parking; Parking on restricted areas due to lack of parking space; Road congestions due to double parking; and Accidents during car maneuvers

5.2 Conclusion

Parking has been and will continue to be something that affects everybody in the society ranging from street dwellers, short-term visitors, as well as traffic and law officers. Meanwhile, the monitoring methods have proved to be porous and therefore a need for improvements has become necessary not only at present moment but also in the future.

This study has found that using the proposed improved methods of parking management system there will be a range of benefits from increased revenues to improved security as well as customer satisfaction. The proper collaboration between management bodies and other stakeholders, as well as the advanced control systems using simple and reliable technologies, will drive monitoring stresses out of our way. By deploying systems that are more effective than the existing ones, vehicles violating rules will be easily detected through the automatic detection of parked vehicles as well as the societal responsibility.

Demand-side measures also have a place Measures that act on demand are intended to persuade a significant proportion of travelers to switch from cars to high occupancy modes of transportation or travel by non-motorized means during hours of peak traffic, or to change the times of their travel. These measures are either viewed less favorably by motorists or are downright unpopular since they run counter to people's strong desire to travel on their own. They tend to be supported, however, by public transit users, who form the majority in most cities in the region. It is clear that such measures do have a role to play in easing congestion. Some measures are regulatory in nature and impose restrictions.

Others provide economic rewards or disincentives to encourage behaviors that mitigate congestion. Both types should be considered in order to achieve a better overall result, in view of the fact that economic measures may not be totally effective and regulatory measures are vulnerable if enforcement is weak. Important achievements can be made by rationalizing parking, since the availability and cost of parking affects accessibility by car.

Permanent or daytime parking bans on major arteries, charging fees to park on other streets, regulating paid parking on private lots, regulating the free parking provided by institutions and companies to the public or their employees, economic incentives to discourage driving to work, intermediary parking linked to public transit—all are potentially useful measures if applied in the

appropriate context to an appropriate degree. Some can also generate revenues for the government. In any case, care should be taken when imposing highly restrictive requirements that drive away businesses and residents, or else certain areas of the city might experience depression. Thus, there should be a comprehensive parking policy that is consistent with urban development and sustainability.

In general, respondents perceive parking policy to be sometimes systematic and sometimes by chance but rather by chance. This implies that parking policy should be more systematic based on measures that have proven their efficiency and aligned with the whole urban and national traffic policy. This would allow the parking policy to be much more goal-oriented and efficient in the future.

5.3 Recommendations

In order to reduce the parking problems, the parking management requires changing current policy development, zoning, and design patterns and it should not only dependent on Micro and Small Enterprise duty. To accomplish this, the public officials, planners, and the public are required to establish the techniques depending on the parking problems. Then provide solutions after being familiar with existing parking techniques implemented in the city to the benefits of the society after understanding the whole system. It is important to establish an institution that relates the other fields such as transportation management associated with parking activities to improve the enforcement and addressing different opportunities obtained when car parking place developed.

The proposed solutions are not rigid and they can change depending on the circumstances and the time of applications, and therefore the doors should stay open to welcome more ideas with similar aims.

As car ownership is growing, the demand for parking will also grow. Most of the cities in Europe and developing countries such as Ethiopia are already suffering from the issues that already have been outlined in the materials. This means that it is always important to learn from the mistakes/experience of other places as well as to update the methods in use by measuring their efficiency. Parking spaces in big cities such as Adama especially the time-limited parking spaces which oblige to a use parking disc need more attention.

Introduction of sensors for detecting the presence/movement of a vehicle at a particular space can start on these lots to eliminate the tiring job of wardens. This can go hand in hand with the erection of surveillance systems in those places with the aim also of improving safety. Legislative bodies should give local authorities and the public power to exercise the enforcement more contrary to the present moment where the society/public has little to contribute to efficient parking. This could be done mainly through direct reporting of the offenses.

Parking should also be more expensive for on-street parking than off-street parking to encourage people to use the latter. Park and ride facilities can be introduced, but this will work better where

there is a shortage of central parking (which is not the case in Adama Town) but our case is about monitoring the parking lots to arrive at the efficient use of them.

Traffic congestion in large cities is worsening so fast that the authorities urgently need to devise an appropriate approach to the adaptation of urban transport systems, including both public transit and cars, at the times and places with the heaviest congestion. The strong adverse effects of congestion in both the immediate and long terms require multidisciplinary efforts to keep it in check since there is no possibility of eliminating it altogether. This raises the challenge of designing policies and measures that will help moderate and control congestion. The problem is complex, and the most appropriate solutions will not be found easily. All indications are that a combination of actions should be tried with respect to both transport supply and demand, in terms of rationalizing the use of the public motorways. In the context of cities in developing regions, although local conditions must always be taken into consideration, the most advisable approach seems to be to undertake the following measures:

- Redesigning intersections
- Improving marking and signposting
- Rationalizing on-street parking
- Staggering schedules
- Coordinating traffic lights
- Introducing reversible-flow lanes on some streets
- Implementing segregated bus lanes, accompanied by a restructuring of public transit routes

It should also be recognized that basing mobility primarily on car driving is not sustainable in the long run, though it is not necessary to think of prohibiting cars. They have many applications that facilitate urban life, such as pursuing social activities, shopping, or traveling to distant locations. Taking advantage of this product of development is not objectionable if the inherent costs are paid. Using the car every day to commute to work or school in areas of heavy traffic, on the other hand, will inevitably generate congestion and pollution, as well as other major detriments to society. Individual transportation has its place, but it should not be exaggerated. Therefore, a better balance between owning and using cars should be attained.

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Appendix

Questionnaire

Adama Science and Technology University

School of Civil Engineering

Department of Architecture and Urban Planning

MSc Thesis Questionnaire

Dear Respondents, My name is Hawetu Workineh, a post graduate student at Department of Architectural and Urban Planning, Adama Science and Technology University. Currently, I am conducting research on " **Practicing and Challenges on Car Parking**". The successful completion of the study will qualify me for the degree of the Masters of Science in Urban Planning. The main objective of the study is to understand the current parking problems in Adama City and forward possible solutions for consideration by pertinent policy makers of Adama City Administration. For successful completion of this study, your cooperation in filling this questionnaire is extremely valuable. Therefore, you are cordially asked to objectively fill the attached questionnaire by providing genuine information and frank opinion. The researcher also wants to assure you that the data to be collected from you will be used for this academic purpose only; and it's confidentially will be strictly kept. For any additional information, explanation and comments, you can leave your message through the following address:

Phone number: _____

Email: _____

Thank you in advance,

Hawetu Workineh

Part 0

General Information: Data collector name _____

Name of supervisor: _____

Duration of interview: _____

Date of Data Collection: _____ -

PART I: PERSONAL INFORMATION

Instruction: Please put an “X” mark in the shape provided

1. Sex: Female ☐ Male ☐
2. Age in years: 18-30 ☐ 31-40 ☐ 41-50 ☐ 50+ ☐
3. Educational background
Certificate ☐ BA/BSC ☐ PhD ☐ Diploma ☐ MA/MSc ☐
Other specify _____

PART II: GENERAL INFORMATION

Instruction: Please put an “X” mark in the shape provided

4. Do you live in Adama? Yes ☐ No ☐
Yes (If yes, please proceed to question #5)
No (If No, please proceed to question #6)
5. For how long have you lived in Adama?
A. 1-4 ☐ B. 5-8 ☐ C. 9-12 ☐ D. 13+ ☐
6. Are you a driver?
A. Yes ☐ B. No ☐
Yes (If yes, please proceed to question #7)
No (If No, please proceed to question #8)
7. How many years of driving experiences do you have?

A. 2 ☒ B. 4 ☒ C. 6 ☒ D. 8 ☒

8. What type of car you mostly have been driving?

A. Automobile ☒ B. Truck ☒ C. Construction Machineries D. Bajaj ☒

PART THREE: PARKING ISSUES AND CHALLENGES

The following questions are designed to answer the basic question “the availability and sufficiency of car parking areas. Therefore, the respondents are kindly requested to give answers to the questions accordingly.

BQ1.1. Do you usually park in this town? YES ☒ NO ☒

BQ1.2 If your answer for the above question is “YES”, which of the following best describes why you park your car at this location today?

	Items	Tick as much as you want to
1	Work or work-related	
2	Non- Work/Non-Business	
4	Business (Proximity to my business area)	
4	Entertainment (dining, museums, etc)	
5	Shopping	
6	Visiting family or friends	
7	Drop /load passengers	
8	Medical/ Dental appointment	
9	First time to be here	
10	Others _____	Mention if any

BQ1.3 Are you happy with the current parking situation(availability of parking space) in the city in general?

YES ☒ NO ☒

BQ1.4 If your answer for question No. BQ1.3 is ‘No’; please specify the reason by ticking one or more of the following:

	Items	Tick as much as you want to
1	Lack of sufficient parking space.	
2	Inconvenient parking options.	
3	Inadequate pricing methods.	
4	Inappropriate parking arrangements.	
5	Inconvenient for loading & unloading	
6	Others _____	Mention if any

BQ1.5. How do you describe in your own words the availability of car parking spaces in Adama city?

BQ2.1: The following questions are designed to answer the basic question on “**demand for car parking spaces in Adama city**?” Therefore, these questions investigate how demand for car parking has changed/may change in Adama city. Please tick the relevant boxes below to indicate how.

BQ2.1.1 Previous trend: During the past five years demand for car parking has

	Increased	
	Remained constant	
	Decreased	

BQ2.1.2 Current trend: At the present time demand for car parking is

	Increasing	
	Constant	
	Decreasing	

BQ2.1.3. Future trends: Over the next five years demand for car parking is likely to

	Increase	
	Remain constant	
	Decrease	

BQ2.2. Do you think there are adequate parking spaces in this city that matches the increasing demand?

YES ☒

NO ☐

BQ2.3. If your answer for question BQ1.4 is ‘No’; what type of car parking facilities do you recommend? Please tick one box, which best describes the type of parking facility you recommend.

	Items	Tick the one you prefer
1	On-street parking	
2	Off-street parking	
4	Underground car park	
4	Parking constructed on building	
5	Any Other	Mention if any

The following questions are designed to answer the basic question on the “**parking parameters?**” Therefore, the respondents are kindly requested to give answers to the questions accordingly.

BQ3.1 When you park in this city, on average how long do you spend? (Please tick in one of the following boxes)

Up to 10 minutes ☒

10 – 20 minutes ☐

20 to 30 minutes ☐

30 minutes to an hour ☐

All-day (Note: These may be are shop owners in that area) ☐

BQ3.2 Tick any of the following based on your stay in the park.

	Items	YES	NO
1	Are there time limits to stay in the parking?	☐	☐
2	Are there penalties if you stay in the parking more than the limit?	☐	☐
3	Are this limit controls set either manually or electronically?	☐	☐
4	Are the drivers notified the speed limits on the spot	☐	☐

BQ3.3 what are the advantages of the presence of these parameters?

BQ3.4 What are the challenges of these parameters?

BQ4.1 The following questions are designed to answer the basic question on participants' suggestions on better ways of car parking management system.

Which of the following do you suggest for safe and better parking spaces in Adama city? Please indicate the level of importance you attach to each of the factors listed below (tick one box per row).

	Items	Very important	Important	Neither important nor unimportant	Not important	Not important at all	Remark
1	Parking guidance systems						
2	Parking space reservation systems						
4	Providing information for clients						
4	Theft prevention						
5	Overnight security						
6	Access control						
7	Parking policy of the Municipality/Council						
8	Location close to employment area						
9	Location close to commercial area						
10	Other factors (Mention if any)						

BQ4.2 What are your final suggestions to improve parking service in Adama city?
