Addis Ababa University

College of Business and Economics School of Commerce

Impact of Smart Parking Developments as a Strategy for addressing Parking Space Supply Problems: the case of Megenagna and Markato Smart Parkings.

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Statement of Declaration

Declaration

This thesis is a result of my independent research work on the topic entitled "Impact of Smart Parking Developments as a Strategy for addressing Parking Space Supply Problems: the case of Megenagna and Markato Smart Parkings, in partial fulfillment of the requirements for the degree of master of arts in logistics and supply chain management, Addis Ababa University school of commerce. This work has not been presented for a degree to any other university. All references also duly acknowledged.

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School of Graduate Studies

This is to Certify that the thesis prepared by *(Tesfaye Getachew Hailegabriel)*, entitled: *(Impact of Smart Parking Developments as a Strategy for addressing Parking Space Supply Problems: the case of Megenagna and Markato Smart Parkings.)* Submitted in partial fulfillment of the requirements for the degree of Degree of Master of Arts (*Logistics and Supply Chain Management)* complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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TABLE OF CONTENTS:

Contents **Page**

LIST OF TABLES

Tables Page

LIST OF FIGURES

Figures Page

ACRONYMS

SP: Smart Parking

MSP: Megenagna Smart Parking

MAMSP: Markato Anwar Mesgid Smart Parking

CBD: Central Business District

THC: Trade Hub Center

AATMA: Addis Ababa Traffic Management Agency

AATB: Addis Ababa Transport Bureau

AATP: Addis Ababa Traffic Police

GDP: Gross Domestics Products

PPP: Private Public Partnerships

GHG: Green House Gas

CSA: Central Statistics Agency

IoT: Internet of Things

VMS: Variable Message Signs

GPS: Global Positioning System

TDM: Transport Demand Management

ABSTRACT

Addis Ababa has recently been afflicted by a series of infrastructure and utility problems. The city government implemented the Smart Parking spaceSupply system to address the parking problem, which comprises the construction of multistory parking garages in two locations within densely developed and crowded districts. The performance of the Smart Parking for the surrounding development has been analyzed using both quantitative and qualitative data collection study methods. The study gathered data using a variety of methods, including semi-structured and open-ended surveys, interviews, observation, and mapping using a readily available base map. After that, the data was processed and presented in an Excel spreadsheet. The effectiveness of the present smart parking supply was assessed, and the data of the respondents was analyzed using a data triangulation study design approach. Using the Scott M. Smith technique, the researcher picked 122 respondents purposely: 14 for a neighboring Smart Parking buildings blocks, 101 for SP users (Automobile drivers) on the chosen two sites, and 6 for government expertise, such as offices like (AATMA), (AATB), and (AATP). After triangulating and analyzing the data, the research indicated a supply imbalance in the current smart parking space supply based on demand for parking spaces in surrounding buildings. Dissatisfaction among drivers with the automated steel structure parking system, as well as a lack of attention and poor integration with key government agencies and stakeholders, are all significant hurdles for the new SP development. As a result, its overall effects on city parking supply demand appear to be negligible, based on current MSP and MAMSP space supply around the CBD and THC based on empirical real city traffic volume evidence. It is also recommended that, the needs of clearwritten car parking supply developments strategy and policy which will align with theobjectives of significant parking facility supplies based on supply demand. The study will also help and encourage forfurther investigation to other researchers.

Keywords*: Smart Parking, Supply demand, and congestion.*

CHAPTER ONE

1. INTRODUCTION

This chapter presents background of the study, statement of the problem, research question, research objectives, significance of the study, scope of the study, limitation of the study, definition of terms, and organization of the study.

1.1 Background of the Study

Transportation has long been considered a key variable in urban economic development. In the recent past, the incidence of Vehicle acquisition has been more common in recent years, with cars being parked for longer periods of time as owners pursue various socioeconomic goals. This draws attention that the parking space supply of vehicles is a vital component within the urban transportation system which cannot be overlooked (Rooshihanet al., 2019). Urban economic daily activities and movements have a direct relationship. Adequate transport system network is needed to facilitate greater choice of the peripheral areas if urban transport provided by the state. Because of most city socio-economic activities concentrated in the center, mobility problems are created, such as increasing car usage and trips to the central business districts (CBD) and trade hub centers (THC), this in turn leads to high demand for parking space supply, urban environmental problem (pollution, noise), and in-abilities to handle these problems results in congestion (Cameron &Krynauw, 2003).

Parking space supply will, therefore, remain a fundamental constituent of the urban development on the account of the role that it plays in the containments of traffic and congestion (Aswathy& Prince, 2018). Although parking is perceived as an indispensable part of the trip making in the urban areas, in most urbanized cities, increasing car ownership and inadequate supply of parking space have led to land use conflicts (Adams et al., 2014). As such, the provision of adequate car parking spaces supply is currently emerging as a topical issue in the districts of urban areas. This situation has occurred as a result of the rapid increase in demand for automobile ownership, which has outstripped parking supplies; in this case a difficulty can be traced to failed land use planning initiatives, (Ibrahim, 2017).

As a result, a gap between supply and demand must be solved to ensure that the supply of parking spaces spots does not have a negative impact on the urban land use structure of cities, (Wang, et al., 2013).

Vehicles Parking Services provides a linkage between transportation and land use management Msigwa, (2013). Finding a vacant parking space in a downtown area or a crowded city is difficult in most develop and developing countries. Moreover, finding vacant parking spaces supply around citytransit squares, shopping complexes, commercial buildings, market places, hospitals, hotels, airports, etc..., is an equally challenging task. The growing number of car sales around the world and the requirement to park them appropriately has propelled the global, parking space supply industry, market to new heights which found that around 30% of city traffic is caused by drivers trying to find a parking spot (Jun Xiao et al., 2018).

The primary objective of this research is to obtain a better understanding on the city smart parking space supply demand problems and closely to investigate their impacts on solving Addis Ababa's parking supply demand shortage. Therefore the researcher purposely selected MarkatoAnwar Mesgid Smart Parking (MAMSP) and MegenagnaSmart Parking (MSP) automated steel structures that were started a few years ago with collaboration between the city's various parking skilled technological stakeholders and specialists from China. These types of Smart parking is already being developed in China to alleviate parking supply problems, and this new kinds of parking technology was introduced to Addis Ababa as a solution to the city's major parking space supply problems.(TPMO, 2018).

The city recently also completed a construction of a parking space supply1,400 car parking structure beneath Meskel Square by a special initiative of Prime Minster Abiy Ahmed (PhD). The revised master plan for Addis Ababa City also proposes sites for the construction of 60 new additional parking space supply spots; and begins the implementation as a pilot project in Yeka sub city around shollagebya, a new modern type of smart parking facility (2B+G+5) building was under construction that will be use as a new parking spotsupply and can hold 1000 cars at a time having with full parking facilities. Therefore, theAddis Ababa Traffic Management Agency (AATMA) and Addis Ababa Transport Beauros (AATB) turned their

approach towards a better and more sustainable traffic management through modern parking spots supplydevelopments, that has been proved for cities as an important enabler in the efficient management of parking space supply and the parking sector has seen a growing uptake of technology in most developed countries, (Oluwoye, 2000).

1.2. Statement of the Problem

Recently in most parts of Addis Ababa City Streets, vehicles parking problem is not a new phenomenon. It has an economic cost on the productivity of the cities' communities and the overall country economy. Despite the city lower car ownership levels, lack of vehicles parking space supply and the city traffic flow congestion becoming more serious problems in a day to day activities of all commuters and drivers in all parts of the City, particularly, in the morning and evening which is commonly known to us peak hour's recurrent traffic congestion were the major source for the problems and caused by the following rationales:Rodrigue et al. (2006).

Primarily, parking problems are an outcome of insufficient infrastructure, lack of sufficient parking spaces supply around CBD, THC and integrated traffic flow management systems, because of the city doesn't have clear parking strategy and policy revised, and limited optional standard secondary roads, so the problem becomes serious in most parts of the city.

Secondly; Insufficient capacity of the roads to cope up with the existing high traffic volume at pick hours, resulted a recurrent congestion in most streets of the city; and

Thirdly; Illegal on-street parking habit, due to the result of there is no enough well developed off-street parking roads, are the major problems that lead to vehicles traffic congestion.

In addition, congested slums houses along the roads and poor land use management leads to long travel time or delay to reach destination that affect government workers, business user's time productivity, and any emergency cases affect by increasing fuel consumption-wastage, impact on the economic activity of the city and over all the country GDP are the main impacts of vehicles congestion which wasn't still prevail.

In Ethiopia dedicated parking delivery is not common; especially smart parking space supply was a new phenomenon to the country or the city, so as long as on the capable of a researcher referring materials on these issue, there has not been much research / article wrote on this particular topics; So it creates a great knowledge gap on this particular case matter, (Manaye, 2019) analyzed the current parking system and finding of optimal parking location by considering parking site selection criteria and using Analytical Hierarchy Process method. The space optimization model considers different constraints and the thesis data extracted concluded that 90 degree parking saves more spaces to supply. On the other hand,(Mikyas, 2011).found that open spaces developments for city public facilities especially for parking spaces supply concluded that low attitude was given by the city council to open spaces preservations and developments to appropriate purpose

So to fill the above gaps between optimization of parking spaces and open space developments for public usethe researcher motivates to do this thesis research paper on the city smart parking spots efficient space supply and to look their impacton the city parking space shortagessupply alleviation. Hence the researcher of this paper has its own rationale in order to fill these gaps by shown the real problems by data triangulation design approach.

1.3. Research Questions

1. How can evaluate the current smart parking supply demand gaps?

2. Howmuch satisfied smart parking service delivery?

3. How muchclosely give support government staffs insmart parkings service delivery?

1.4. Objectives of the Study

1.4.1. General Objective

The general objective of this study is to assess the Impact of Smart Parking Developments as a Strategy for addressing Parking Space Supply Problems: the case of Megenagna and Markato Smart Parkings.

1.4.2. Specific Objectives

The specific objectives of the study are:

1.To assess the buildings blocks smart parking supply demand gaps,

2. To evaluate smart parking service by customers satisfactions,
3. To investigate the contribution of expertise on smart parking service delivery.

1.5. Significance of the Study

It is believed that the significance of this study wasto add to some extent the existing academic knowledge of the researcher on developing a skill of thesis paper writing based on existing or practical society/community problems which were helps in the future carrier to pave the way for the researcher and interested stakeholders by facilitating data's and other contemporary hot and new issues of the city. This research overall will build scientific and academic knowledge which can provides an opportunities for university researchers and others for further educational and skill carrier improvements. In addition to this, a city administration of Addis Ababa can also use the best findings of graduate'sstudents papersas inputs for policy formulation and designing a strategy to implement/make a decision based on true/real ground existing information's/facts.

1.6. Scope of the Study

The scope of this study is limited to Smart Parking space supply service efficiency in Addis Ababa, and their service contributions whether considered as one of the city parking space supply problems mitigation strategy; particularly in the case study of the newly functioned smart parking spots located in Yeka sub city at Adwa Avenue, called MSP found adjacent to Zefmesh Mall in which considered to be one of the transport corridors intersections and the other study area is also located in Addis Ketema sub city MAMSP one of the THC in the country's and the continents' which is the most congested areas visited by different modes of vehicles entering together.

1.7. Limitation of the Study

The real limitation of the researcher were the study focus only on two parking spots due to lack of other same types of automated smart parkingin the city and information's/data's from the government offices like AddisAbaba traffic management and AddisAbaba transport beauros difficultto got valuable data's because of repeatedly restructuring the offices and experienced staffs resignations and the likes.

1.8. Definition of Terms

Parking: is to bring (a vehicle that one is driving) to a halt and leave it temporarily in a typical a special well managed car parking areas or by the side of the road.

Supply: is a fundamental economic concept that describes the total amount of a Specific good or service that is available to consumers/customers. (By Will Kenton updated June 29. 2021)

Smart parking: is a parking strategy that combines technology and human innovation in an effort to use as few resources as possible-such as fuel, time and space- to achieve faster, easier and denser parking of vehicles for the majority of time they remain idle.

Smart parking is also a vehicle parking system that aid drivers to identify empty parking lots supply (by Pcmag, 2014).

Parking management: is a process in which parking area is provided, controlled, regulated, or restricted, and in transportation real parking policies aim at improving environmental quality and accessibility (by Corpus Christi Metropolitan Planning Organization, 2009).

Smart Parking Management: is a way that aimed at making better use of available parking space supply including favored parking or price discounts.

Traffic: It is total aggregation of things, such as pedestrians or vehicles on a particular area or locality during a specified period of time.

Congestion: is a condition in which the number of vehicles attempting to use a roadway at any time exceeds the ability of the roadway to carry.

Delay: (vehicle-hours and person-hours): delay is a manner in which journeys are taking long time than what would have been in a normally occurrences.

Land-use planning: It is a planning carried to identify the optimum uses of land, serve as a basis for the adoption of land use controls. Land use planning (zoning) determines what parts of urban areas will be used for particular purpose, such as residential, commercial area, terminal, and also parking areas has a great role in emphasis on transportation route planning.

Road capacity: it as it is a maximum volume of traffic, like vehicles, passengers and others accommodated within a specific time that measured quantitatively and independent or fixed irrespective of the fluctuating of traffic volume (demand) to this view, defined by (Mathew & Krishna 2007).

Internet of Things (IoT): refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data, adding sensors to a level of digital intelligence enabling to communicate real-time data without involving a human being.(by Steve Ranger, on February 3, 2020)

Likertscale: showing respondents' agreement or disagreement.

1.9. Organization of the Study

The organization of this research thesis paper and the arrangement and management of the researcher graduate final thesis documents contains as usual any standard thesis had. Obviously / usually organized as follows: Chapter One: elaborate shortly the overall Introduction part with short and precise words; follows Chapter Two: which contains in depth Review of related Literature; merged to Chapter Three: Methodology part that had described of the study area and research type/design; goes through widely to Chapter Four: contains data analysis, interpretation and discussion, and finally; wind up by Chapter Five by putting Summary, Conclusion and Recommendation based on the data analysis result.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

This chapter presents a brief critical reviewing of related literature that deals with particularly vehicles parking space supply issues which are relevant to the development of the city parking spaces; and Although try to increase an understanding of the existing research and debates relevant to smart parking theories, concepts and conceptual frameworks related to the topics, and to dig in deep through academic knowledge in the form of a particular issue as a case. Conducting appropriate related literature review was help to understand this particular understudy topic. The main reason of this chapter wasto acquire a critical knowledge, important concepts and practices, research methods, and describing techniques that would be use in investigations this particular smart parking supply demand. This literature review helps to the researcher to get scientific knowledge of how research findings had been presented based onscientific methods on parkingindustry.

2.1 Review of Theories and Conceptual Studies

2.1.1 Concepts of Parking

Parking is an essential component of the transportation system. Vehicles must park at every destination. A typical automobile uses several parking spaces each day. Parking convenience affects the ease of reaching destinations and therefore affects overall accessibility. Parking space supply is required to store vehicles when they are not in use. All motor vehicle trips terminate eventually at some form of parking space spot supply facility so that drivers can go about their business, Vehicle is parked in a variety of places for a large part of its life; little or no debate has focused on parking space supply areas as hubs where transport converges. If parking areas are in fact 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 supply, despite the vital role that it plays. So urban car parks and especially those open to the public, play a fundamental role in encouraging, regulating, restricting access to the city or town in or near to which they are located. These reasons are of a social, financial and policy nature. (Kelly, 2006).

The Federal Democratic Republic of Ethiopia (FDRE) Ministry of Transport (August, 2011) has prepared transport policy for Addis Ababa city. In order to be a competent city on the regional, continental and international levels, the FDRE outlined eleven key policy issues and implementation strategies. Under these policies, expansion of transport infrastructure is included and it further elaborate that : "car parking facilities shall be built by private, government and public private partnership in the city center and in areas with high traffic volume and land supply shall be given special attention by the city administration".

The practical situation of the Addis Ababa city is showing that, all cars use the left and/or right side of the major road for parking and the central part is left to the passage, unless otherwise restricted. The poorly functioning traffic system has resulted in high level of congestion particularly at peak hours. Besides, at some road sides, there is a facility for car wash and street vendor's which has a serious problem for the purpose of the road, the waste water affects the road durability plus congestion & accidents respectively. Therefore Parking is identified as one of the key "infrastructural" challenges stated (Transport Policy manual book of Addis Ababa, August 2011.).

2.1.2 Types of Parking

Vehicles parking can be categorized into four main groups:

A. On-street Parking: As its name suggests a parking space on the public road,

B. Off -street parking: parking outside some distance away from the public road,

C. Surface Car Parking; and

D. Multi-Storey Parking**,**(Wijayaratna, et al 2015).

A. On-street parking

On street parking means the vehicles are parked on the sides of the street itself. This will be usually controlled by government agencies itself. Common types of on-street parking are as listed below. This classification is based on the angle in which the vehicles are parked with respect to the road alignment (Wijayaratna, 2015).

I. Parallel parking: The vehicles are parked along the length of the road. Here there is no backward movement involved while parking or un-parking 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. This method of parking produces least obstruction to the on-going traffic on the road since least road width is used.

II. 30 °degree parking: In thirty degree parking, the vehicles are parked at 30° with respect to the road alignment. In this case, more vehicles can be parked compared to parallel parking.

III. 45° degree parking: As the angle of parking increases, more number of vehicles can be parked. Hence compared to parallel parking and thirty degree parking, more number of vehicles can be accommodated in this type of parking.

IV. 60° degree parking: The vehicles are parked at 60° degree to the direction of road. More number of vehicles can be accommodated in this parking type.

V. 90° degree (Right angle) parking: In right angle parking or 90° degree parking, the vehicles are parked perpendicular to the direction of the road. Although it consumes maximum width curb length required is very little, in this type of parking, the vehicles need complex maneuvering and this may cause severe accidents. This arrangement causes obstruction to the road traffic particularly if the road width is less. However, it can accommodate maximum number of parking space supply to vehicles for a given curb length.

B. Off-street parking

In many urban centers, some areas are exclusively allotted for parking which will be at some distance away from the main stream of traffic. Such a parking is referred to as off-street parking. They may be operated by either public agencies or private firms or most of times by public private partnership (PPP); (Paul A., 2010).

I. Public off-street: A car park not on the public road, in which any member of the public can park their car, subject to complying with any regulations (e.g. maximum stay (in

hours), or paying a fee). This kind of car park may be owned and/or operated by the public and/or private sector.

II. Private non-residential off-street: This is car parking that is associated with a particular building or land use - parking for a shopping center, or an office-building. Only people who are connected with that building or land use should, in theory, be able to use the parking, and the land- owner has control over this use (within legal constraints in the member state concerned).

III. Private residential parking off-street parking: associated with houses or flats. In theory, only the residents of these houses or flats should be able to use the parking.

IV. Surface parking and Multi-story parking are also categorized in off-street parking.

C. Surface Car Parking

Most parking facilities are surface car parks, mainly because of the ease with which they can be quickly and economically designed and constructed when suitable sites become available. Surface car parks have no ramps, stairs, lifts, structural columns or roofs; consequently, they are more space supply efficient, driver sightlines are normally clearer, users feel more secure when walking to/from their cars, there are no ventilation or tall vehicle problems, and more generous layout dimensions can often be used, as compared with multi-storey structures. The safe and effective operation of an off-street car park is primarily dependent upon its layout. Generally, the functional design seeks to maximize vehicle capacity and ease of maneuverability and circulation as well as pedestrian safety and convenience. Entrances should be far back from a busy intersection so that queuing vehicles do not interfere with the intersection operation or control. Entrances on one-way streets should be upstream of exits so that entering queues of cars do not block the exits. If the access street is two-way, it may be necessary to provide a central right-turning lane in the street where entering vehicles can be stored until gaps appear in the opposing traffic stream (Feitelson&Rotem, 2004).

D. Multi-Storey Parking

Most multi-storey car parks are located where land costs are so high, e.g. in or about the central areas of large towns, that it is more economical to build vertical facilities rather than purchase additional land for surface parking. Multi-storey facilities can be single purpose, i.e.

used only for parking, or multi-purpose, i.e. containing other uses (e.g. offices or shopping) within the same structure; however, the more expensive the land the greater the likelihood of a parking facility being designed for multi-usage purposes. At some locations the geography of the land, e.g. at a hillside site, may make it practical to build a multi-storey car park and allow direct entry to a number of parking levels. In some cases there is no need to connect the various levels and each can be designed as a surface car park; in others, the need for internal vehicle circulation may make ramp connections if necessary (Jiri H., 2020).

2.1.3 Smart Parking

In the new era, where technology has been accepted as one of the most critical tools for solving some of the challenges faced in the 21st century, especially in urban areas, the issue of parking space supply has not been left behind. With the adoption of the Smart City model in most urban areas, smart digital solutions have emerged. Among them is the smart parking spot supply system which, as argued by (Naphade et al, n.d.). Smart parking: is a technological approach to improve the parking process and the cars' positioning in a city with a shortage of space supply. The basic goals of smart parking systems are: Real-time data and guidance to drivers so they can locate the best available parking space supplied quickly using parking operators mobile apps or Internet of Things (IoT); Parking asset control for cities, operators and facility management so they can understand occupancy, payment compliance and much more; and A direct way to affect climate change with cars searching for parking space supply would be less. So city dwellers have got a sustainable future on this planet. (Francisco D., 2021).

Smart parking systems could be subdivided into five categories:

1. Parking Guidance and Information Systems (PGIS),
2. Transit based information systems,
3. Smart payment systems,
4. E-parking, and
5. Automated parking,(Ferdous C., et al. 2017.)

1. Parking Guidance and Information Systems (PGIS): Provide information for drivers to aid in the decision-making process involved in reaching their destination and locating

vacant parking spaces within the parking facility. PGIS consists of smart systems such as static/dynamic variable message signs (VMS); global positioning systems (GPS) within mobile phones; and vehicle detection sensors. VMS can help direct drivers to open lots as they near their desired destination. The GPS within the vehicle can interface with a parking guidance system to help direct drivers to parking space supply lots using their current location, and vehicle detection sensors installed at parking lot entrances/exits/or individual spaces can detect vehicle occupancy (MY IdnaI., et al, 2009).

2. Transit Based Information Systems**:** Uses the same technology as PGIS except that its goal is to guide users to park-and-ride facilities. Real-time information includes public transit schedules and traffic conditions, which provide users with the ability to make the best decision to meet their needs. This type of parking system aids in parking management while promoting the use of public transportation, thus increasing transit revenue. (Leng, 2009).
3. Smart Payment Systems: Includes the use of smart phones, smart cards, debit cards, and credit cards to efficiently pay for parking, including directly paying a meter. These systems allow drivers to adjust their time as needed, without the added stress of trying to make it back to their car before their time expires and has the potential to provide refunds or credits to users who pay for more time than needed. (Tamil E., et al, 2009).
4. E-parking**:** Uses text messages or the internet to allow drivers to reserve or check the availability of vacant parking spaces before arriving at a parking facility. Improving the information used in the planning process allows users to make better-informed decisions as they can choose a parking location based on both supply and proximity to their destination. Users do not have to include an end time and can park indefinitely, eliminating the worry of expired times.(Noor, 2009).
5. Multilevel /Automated Steel Structure Parking: In this type of smart parking, vehicles are parked on different layers, floors of a building. These floors are accessed with the help of external or internal mediums such as ramps or other lift type structures. There is a vertical lift (mechanized) for the movement of vehicles in the Y-axis direction and then arranged left and right in the X-axis direction horizontally to put on pre allocated open spots supply. This arrangement helps in less ground space which directly associates with cost reduction of the building. And this arrangement helps to accommodate more cars and

produce a faster parking process. Also, sensor arrangement in this system helps to control and optimize the parking procedure. The system is designed so that the ground level gets filled first and then moves to the next level above it, and once this level is filled, it moves to the next level and next so on. The vertical lifting mechanical parking system also called "Tower", and the vehicle is mainly transported by lifting and lowering the lifting device and the intelligent carrier mounted on the lifting device to access the vehicle. (FerdousC., et al. 2017.)

2.1.4 Smart parking Developments Constraints

Business development is promoted by the availability of convenient parking space supply and discouraged by a lack of parking spots. Parking facilities are a major cost to society, and parking conflicts are among the most common problems facing designers, operators, planners and other officials. Such problems can be often defined either in terms of supply (too few spaces are available, somebody must build more) or in terms of management (available facilities are used inefficiently and should be better managed). Modern parking industry Management solutions tend to be better than expanding parking space supply because they support more strategic planning objectives: (Trista L., et al, 2017).

However, the nature of the problem as identified there is not enough off-street parking, and too much on-street parking. For example," Critical issues in the Transport Sector" was a clear Transport Policy, "lack of off-street parking facilities and over utilization of road space by parked vehicles" is high on the list of infrastructure issues. The issue of parking supply especially the overutilization of road space by parked vehicles, lack of off-street parking facilities, and the need to create and incentivize the use of park-and-ride facilities related to mass transit services is indeed an important area of concern for sustainable transport policy. However, this phenomenon is better understood as a market failure, rather than as a problem of infrastructure. While there are instances when developers flout the law and do not provide the necessary off-street parking or illegally convert for parking space supply allotted to other uses, the main issue is that parking supply in general is not appropriately recognized as a commodity and regulated as such. In reorienting parking policy along these lines, parking can be a useful tool to help and shape streets as the building blocks of neighborhoods (Trista L., et al 2017).

2.1.5 Smart Parking is one of Congestion Relief Strategies

Smart Parking Supply is one of the most adopted and fastest growing Smart City Solutions across the world. Airports, Central Business District (CBD) areas, Trade Hub Centers (THC), shopping (Malls) and city open spaces are just a few entities that have begun to realize the significant benefits of automated parking technology.

The ability to connect, analyze and automate data gathered from devices, powered by and described as the Internet of Things (IoT), is what makes smart parking reality is possible. Smart Parking involves the use of low cost sensors, real-time data and applications that allow users to monitor available and unavailable parking spots. The goal is to automate and decrease time spent manually searching for the optimal parking floor, spot and even lots. Some solutions will encompass a complete suite of services such as online payments; parking spots supply time system notifications and even car searching functionalities for very large lots.(Litman, 2013).

2.1.6 Regulation of Smart Parking Supply Use

Parking supply use should be regulated that aimed to use efficiently parking spaces and travel commuters smooth. Discount for residents parking and limit parking duration according to land-use type, and traffic volume, expected to increase the parking turnover rate and it favors shorter-term users or parking duration for deliveries and shopping. Regarding this, (Victoria Transport Provision Institution (VTPI), 2009) discussed the feature of good parking use that minimizes congestion as follows: limit on-street parking of large vehicles (e.g., vehicles over 22 feet long) that obstacle the traffic movement, prohibit on-street parking on certain routes (arterials roads), during rush hour so as to maintain the smooth traffic flow traffic ,and special parking regulation to favor priority vehicles, like ambulances, fire fighters (emergency giving vehicles), and service, etc. Obviously, in reducing congestion, it is important to eliminate or minimize free parking in a specific place (Seattle Urban Mobility Plan, 2008); Environment Pollution (Prevention and Control Authority, 2009).Variable-rates parking price has a great role in reducing parking demand when compared with free parking, like higher rates during peak periods and lower rated during off-peak periods on-street spaces is more effective in reducing peak use.(Marsden, 2006).

2.1.7 Parking Management

Parking management will Results the activity of supply, fare pricing, manpower training and regulation of parking facilities and, significantly affects travel behavior: if parking becomes more abundant and cheaper, will lead to increase automobile demand that result in large volume of vehicles .On other side, it can play a great role in solving congestion problem if it managed well. The provision of smart parking space supply should not be too much as well as insufficient. Thus, parking policy and provision requirements are essential in reducing traffic congestion. Parking is an asset which needs to be managed. It is a common misconception that providing as many parking spaces as possible is the best way to managing parking so as to maximize access. Rather, the key is to ensure that your parking stock is managed so that spaces are made available for customers when and where is deemed appropriate for their needs. In this context, it is the number of parking acts that can be accommodated that is important, not the absolute number of parking spaces provided. (Litman, 2020).

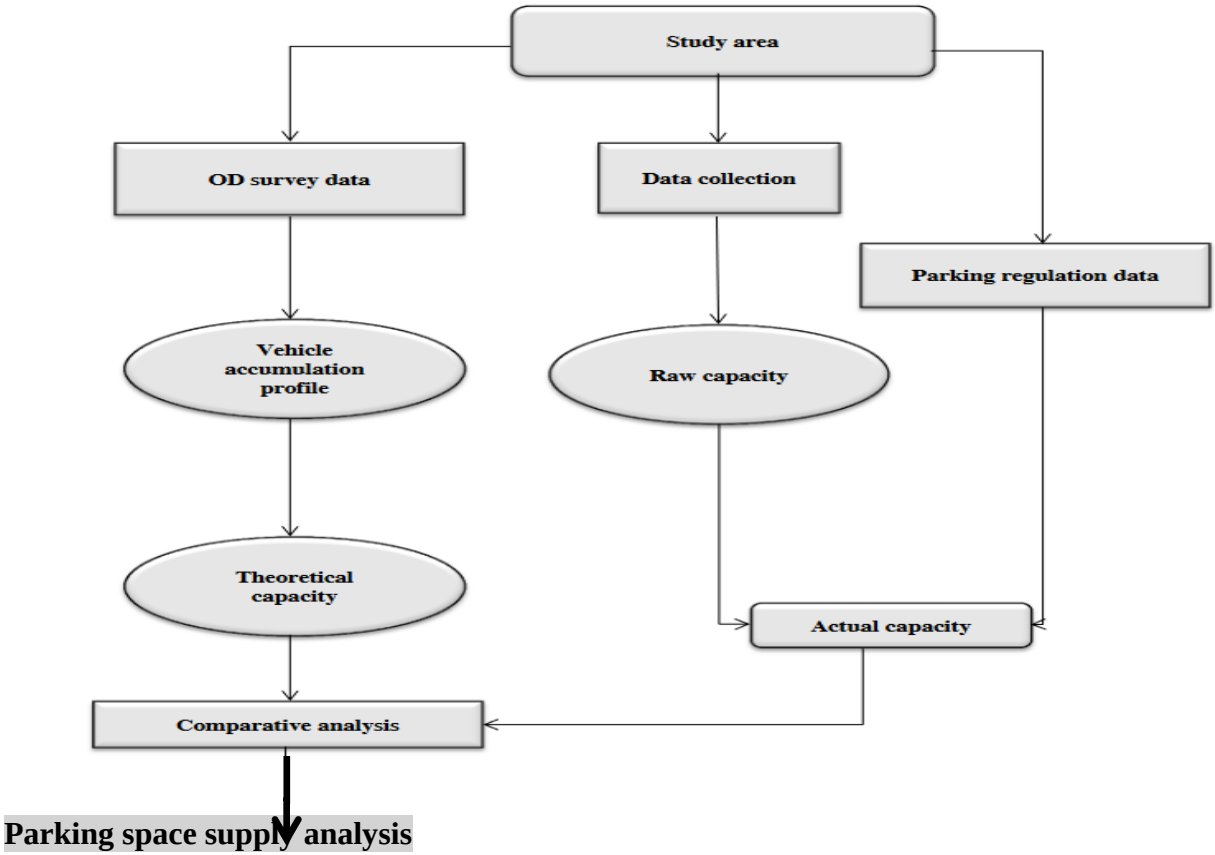
Proper management of parking will benefit cities in many ways, including contributing positively to economic performance and visual amenity. A parking 'free for all', with no restrictions or controls on parking and a lack of enforcement, represents a failure to manage city asset and a failure to provide good customer service. This may then adversely affect economic performance. Management of parking supply can have a positive impact on economic viability by enabling 'better' (more productive) use to be made of the available spaces supplies within towns, providing that it is done sensitively and appropriately. Public space supply is often limited within market towns, and it is not uncommon for the most attractive parts of the town, such as historic market squares, to be hidden behind a sea of parked cars. Where towns have appropriate sites on the approach routes to the town, there is an opportunity to develop 'gateway parking' to free up space supply within more sensitive central areas for other uses, whilst at the same time helping to keep moving traffic out of these areas too. Alternative uses may take the form of a smaller amount of prioritized parking for particular users, but preferably other activities which provide an important 'draw' for some important truism visitors. (Litman, 2020).

Parking management methodology of smart parking space supply demand assessments composed of three main steps presented in the following Figure 2.1:

I. The first step is to estimate, from the Origin-Destination (OD) survey, the accumulation of vehicles and the theoretical holding capacity for the nearby block areas,

II. The second step is to determine the raw parking capacity (without regulations) and the actual capacity (taking into account the regulation information) based on a field survey;

III. And; the third step is to compare the data obtained in the first two steps to determine the real difference between the actual parking capacity supply and the theoretical holding capacity demand.



Source**: (**Tong et al, 2004.)

Figure: 2. 1 **Methods to explore customer use of parking spaces supply (SD) from OD.**

Here are some important benefits of Parking Management:

1. Optimized parking: Users find the best spot available, saving time, resources and effort. The parking lot fills up efficiently and parking space supply can be utilized properly by commercial and corporate entities.

2. Reduced traffic: Traffic flow increases as fewer cars are required to drive around in search of an open parking space supply.

3. Reduced pollution: Some research shows that, searching for parking spot burns around one million barrels of oil a day. An optimal parking space supply solution will significantly decrease driving time, thus lowering the amount of daily vehicle GHG emissions and ultimately reducing the global environmental footprint.

4. Enhanced User Experience: A smart parking supply solution will integrate the entire user experience into a unified action. Driver's payment, spot identification, location search and time notifications all seamlessly become part of the destination arrival process.

5. New Revenue Streams: Many new revenue streams are possible with smart parking infrastructure technology. For example, lot owners can enable tiered payment options dependent on parking space location. Also, reward programs can be integrated into existing models to encourage repeat users.

6. Integrated Payments and POS: Returning users can replace daily, manual cash payments with account invoicing and application payments from their phone. This could also enable customer loyalty programs and valuable user feedback.

7. Increased Safety: Parking lot employees and security guards contain real-time lot data that can help prevent parking violations and suspicious activity. License plate recognition cameras can gather pertinent footage. Also, decreased spot-searching traffic on the streets can reduce accidents caused by the distraction of searching for parking.

8. Real-Time Data and Trend Insight: Over time, a smart parking solution can produce data that uncovers correlations and trends of users and lots. These trends can prove to be invaluable to lot owners as to how to make adjustments and improvements to drivers.

9. Decreased Management Costs: More automation and less manual activity saves on labor cost and resource exhaustion.

10. Increased Service and Brand Image: A seamless experience can really skyrocket a corporate or commercial entities brand image to the user. Whether the destination is a retail store, an airport or a corporate business office, visitors will surely be impressed with the cutting edge technology and convenience factors.

So the implementation of a smart parking space supplies as a solution would be surely be a great investment for any city government or company in the world. As the city population continues to grow and urbanize, it is vital to implement a well-planned and convenience-driven parking solution that can be utilized globally (Litman, 2009).

2.1.8 Parking Stocks as Warehouse

Since every car trip begins and ends inside a parking space, the capacity of the supply side largely depends on the availability of parking areas at destination. As shown by many authors Policy and Practice inadequacy and mismanagement of parking facilities will cause congestion to rise. This merely means shifting from car flows to parking stocks. In this perspective, parking spaces supplies become a “product”, and the municipal authorities the “manufacturers” of these products. From this point of view the city municipality providing parking spot supply areas acts as a vertically integrated manufacturing company storing its parking stocks in streets. (Raturi, A. et al, 1990).

The off streets parking become as introduction of logistics principles warehouses, filled and emptied according to the individually rational choices of motorists. The focus on demand prediction, brought by city traffic office Transport Demand Management (TDM) plans, pushes the municipality to build its inventory upon forecasts. In manufacturing, when the production lead-time (The time interval between the placement of a contract and receipt into the supply system of material purchased) is greater than the delivery lead-time (the planned time from pick-up to delivery) requested by customers, firms are forced to rely upon forecasts producing to build inventory. The so-called make-to-stock approaches, typically, tend to oversize capacity (and stocks) to keep an acceptable service level against any occurring demand peak. High demand variability can only increase the risk of stock-outs and

over-stocks. So in managing parking space supply areas, the municipality acts in a very similar fashion way: (de Leeuw, et al., 2011).

Since it is impossible to add parking space supply areas in real-time when demand arises, because of parking slots are produced in advance, so one of the drivers for this attention is that holding inventory represents a significant cost along the supply chain. The short came of parking spaces supply in relation to the average of the peaks indicates that parking slots stock-out during peak flows of inbound cars (stimulating not allowed parking behaviors). Conversely, since the focus was placed on the flow of cars, on-street parking rotation charges, following the "market", are often free during times of lower demand (nights and holidays). In other words, the over-stock of parking spaces, dimensioned according to the average peak demand, is such as to make them worthless when demand falls below the required level. (deLeeuw, et al., 2011.)

2.2 Review of Empirical Studies

2.2.1Parking Industry affects Countries Economy

This section of the literature review will present the findings of other empirical studies that are related to the subject matter. The aim of this part is to review what other researchers have contributed in respect of smart parking developments as a strategy to reduce parking space supply problems; the empirical studies have supported smart parking utilizations regulations.

As urban areas around the world continue to grow, transportation and mobility systems are undergoing major transformations, from the adoption of traffic rerouting and other control systems to the modernization of parking options. Evolving parking ecosystems are increasingly part of smart community planning and budgeting, as well as environmental improvement programs to reduce congestion, air and noise pollution, and to generally make cities more livable. According to a report published by the UN, over 56% of the world's population lives in cities. By 2030, that percentage is expected to grow to over 60%. As more people attempt to move through aging infrastructure, congestion and climate change seems inevitable.(Loftus, 2021).

City leaders understand they need to build more intelligent systems, including bridging the built and digital world as infrastructure funding is expected to increase dramatically, in large part due to the economic recovery programs coming on the heels of the global pandemic in 2020, forecast in the trillions of dollars in the U.S. Scholars caught up with David Parker, Chief Operating Officer at Clever Citi, and a pioneer in high-tech solutions for outdoor and on-street parking detection, monitoring, and guidance. Headquartered in Munich, Germany, with offices in Atlanta, Georgia, U.S., the company's mission is to reduce traffic and emissions, increase revenue for local businesses and parking operations, while allowing drivers to enjoy a smooth, stress-free parking experience. (Loftus, 2021).

"Smart city technology can make cities more effective and efficient, which modern cities must do, given the projected rapid growth in urban populations over the next few decades**,"** Parker said **"**Exciting technologies, including air quality sensing, traffic congestion management, and more are making a huge impact already in leading smart cities around the world. Smart parking space supply plays a crucial role in reducing the amount of time spent in vehicles and the harmful emissions those vehicles cause, while also allowing cities and local businesses to capitalize on additional revenue streams**. "**Parker said that economic development and a greater focus on revenue generation is helping cities to counteract the negative effects of the pandemic and finance the deployment of smart technologies as the world begins to emerge from the health crisis as more people are vaccinated. **"**Some smart technologies like smart parking space spot supply even contribute directly to economic development and increased city revenue generation**,"** Parker said (Loftus, 2021).

With the stated intention to invest trillions of dollars into infrastructure improvements in the U.S., Parker believes city municipality can expect the growth of smart city technology to surpass the $244 billion forecast in 2021 (more than double the $118 billion spent in 2016).

"Sensor-based technologies as part of the IoT and Industrial IoT will continue to play an integral role in tomorrow's cities with high-value use cases including environmental monitoring, crime detection and prevention, smart lighting and traffic, as well as parking control and guidance" Parker said. "Smart parking sensors, for example, combine the power of edge computing, machine learning, and AI with hardware to allow for real-time monitoring of parking spaces."(Loftus, 2021).

For instance, a case study by the (Environment Pollution Prevention & Control Authority, 2009), carried in a country of Japan shows a positive change after formulation and effective implementation of a new on- street and smart parking regulation (high price with time variable-rates) since June, 2006 on major cities in Japan. Three months later, it is reported that nearly 74% and 73.3% decline in illegal on-street parking in Tokyo and Osaka respectively which reduced the traffic congestion level on main roads from 27% to 23% at 2.0p.m to 4.0p.m than the previous time. The same to America, have stated that, in USA variable pricing policy on smart parking in peak hours also encouraged the short stays, high turnover rate and faster deliveries.(Weinberger et al, 2014)

As study estimation shows that 14% of traffic density is created by searching for parking space spot and 50% of increase in congestion-related time loss on roads has been generated due to shortage of parking space supply (Brooke, 2015).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 supply (Weinberger et al, 2014). 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 economic impact on the country and the government expending more money to adjusting this congestion problem due to shortage of parking space supply. For instance, in USA studies show that in the case of traffic congestion the government losing up to 48 billion US dollars in 1990 and in this time the government losing up to 124 billion US dollar per year with an expectation of rising the cost up to 186 billion USD in 2030 (Fabusuyi & Hampshire, 2018).

2.2.2 Impact of COVID-19 on Smart Parking Industry

The Covid-19 affected many industries negatively, and the smart parking systems market was no exception. In the wake of the lockdown during the pandemic, the demand for smart parking decreased dramatically. According to National Associations of International Organization in Pandemics, the Commercial Real Estate Development Association, the New York City is projected to lose around USD 600 million in parking revenues in 2020. On the other hand, Tom Traffic Index reveals that traffic decreased in 387 major cities around the world in 2020. Additionally, the 2020 Global Traffic Scorecard states that the number of

hours spent by the US drivers in traffic went down from 99 hours in 2019 to 26 hours in 2020. For German drivers, the number went down from 46 hours to 26 hours. Fewer hours in traffic directly means less traffic on roads and decreased demand for smart parking systems. (Global In-Cabin Automotive AI Market, Competitive & Forecast, 2017-2027.)

Reduced traffic on roads and closing of offices, malls, gyms, restaurants, among others, led to reduced parking demand. The Chicago Mayor announced that, based on first six months of the year, the city was poised to write 52% fewer parking tickets in 2020. Smart parking systems markets, however, are expected to rebound by the end of 2021 due to mass vaccination campaigns and companies planning to call in their employees. (Global In-Cabin Automotive AI Market, Competitive & Forecast, 2017-2027.)

Therefore Lack of Smart Parking Space Supply (SPSS) Impacts on unable to reduce city parking problems which will in turn increase in congestion-related and; city parking infrastructure development strategy will be affecting by different factors which are an impact on smart parking operation Performance., smart parking space supply site selection practices variables that will be affected by challenges which in turn identifying by service efficiency performances which can also one of the measuring parameters to improve the level of service. Therefore the conceptual framework represents the specific direction to be undertaken; and will describe the relationship between variables to be identified in this study (A Kianpisheh, et al 2011).

2.3 Conceptual framework of the study

2.3.1 Conceptual framework

Based on the review of the smart parking space supply demand provision challenges, the conceptual framework is prepared in the following way. This framework comprises three criteria to achieving adequate parking space supply demand.

These criteria have been used in the analysis of existing parking space supply demand could relief city traffic congestion. These frameworks tested from off-street parking supply demand on the study are;-

Conceptual framework of Smart Parking System

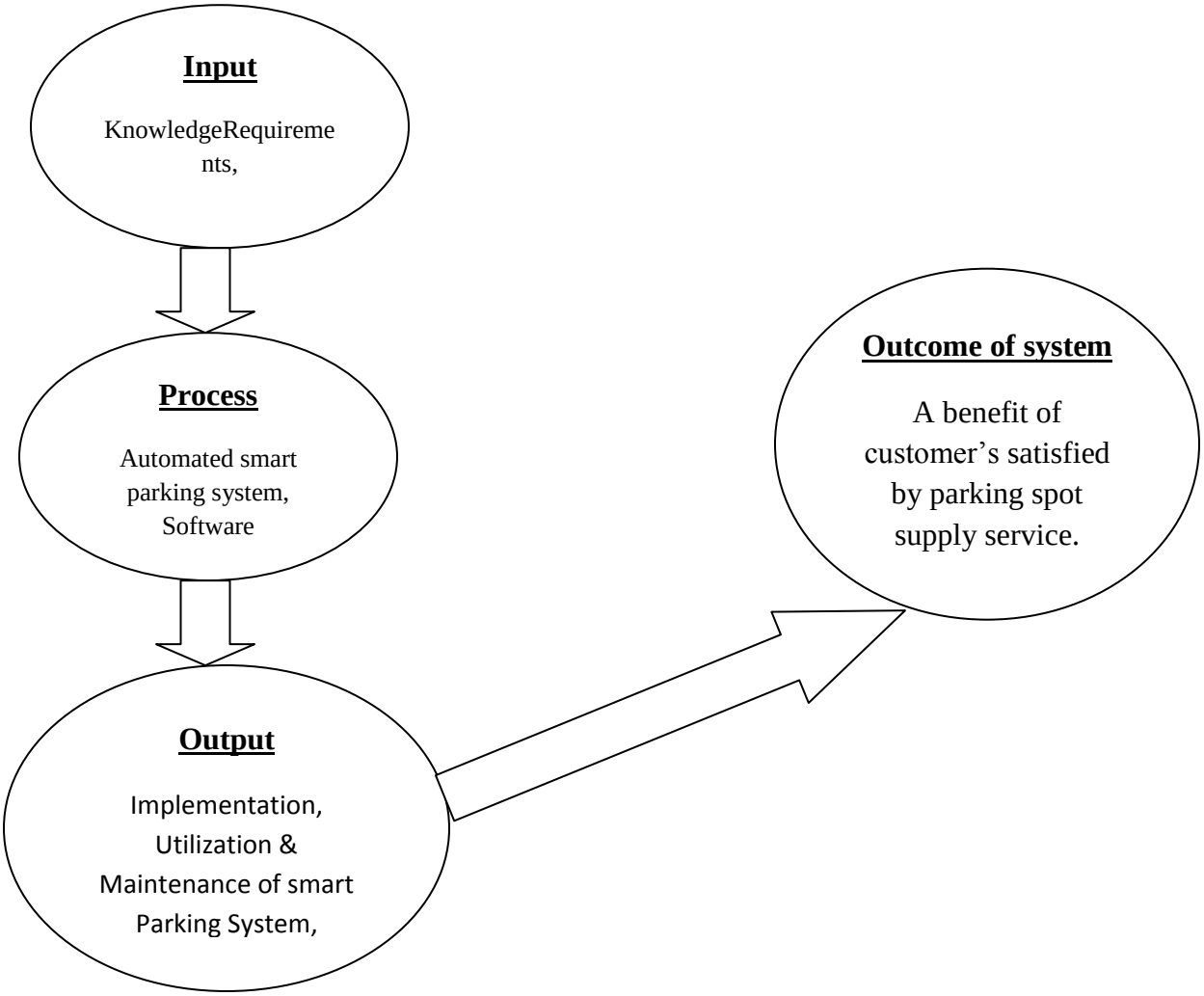


Figure: 2. 2 **schematic diagram of smart parking model.**

2.4 Lesson and Gap of the Literature

2.4.1. Lesson from the literature

Here most of the literature, journals, and reviews showed for the researcher very interesting ideas to how to write about the related study of city smart parkings. From the above-referred literature, the researcher got different gaps of the study from the readings, how to organizing the paper of the proposal, how to reviewing important reading materials on chapters, books to referring and depending on the literature review to the next research. Generally, lessons from the literature review parts were, what are the selection criteria of parking space supply demand, how to calculate parking space provision areas, the factors affecting parking space supply provision and the methodology of the analyzing research data, totally the researcher got many knowledge and lessons to the next proposed research, that is assessment on the smart parking developments in Addis Ababa: the case of MSP and MAMSP.

2.4.2. Gap of Literature

The major findings of the books or articles reviews were summarized as follows: - on the above literature parts so many researchers and articles had referred to the smart parking supply demand challenges.

For example,(Manaye, 2019), done analyzing and optimizing car parking areas, and his finding depends on the optimization of parking space, (Yilma, 2014). She, study on overall traffic management practices of the city and her, recommendations were to curb the traffic problems must be done good traffic lighting. Finally, from, Tanzania Darussalam city study about demand and supply will affect parking space provision, (Tesfaye, 2011) study about public open spaces to develop appropriately for public use especially for car parkings. But still, they have studied only on-street parking evaluation and congestion. So the gap is helpful to prepare a well-organized document and designing optional adequate off- street smart parking space supply in more congested areas of the Addis Ababa City.

CHAPTER THREE

3. METHODOLOGY

This chapter will presents the overall research description of the study area, research approach adapted and design, the population and sample, the data sources and types will use, the data collection/gathering techniques employ, the sampling frame, the data collection procedures, ethical consideration and the data analysis and presentation approach will be use in planning and carrying out this particular research thesis proposal paper study.

3.1. Description of the Study Area

A. The newly functioned smart parking located in Yeka sub city at Adwa Avenue Square, MSP found adjacent to Ze-fmesh Grand Mall in which considered to be one of the transport transit corridors intersections and business area.

B. The other study area is located in Addis ketema sub city around MAM,SP which is one of the country's and the continent THC and the most congested areas by different modes of vehicles entering together was the other particular physical setting of the study areas.

The average house hold size in Addis Ababa was 5.08. The people in Addis Ababa were in average in the age groups range from 18-40 years. The income level is low and the average house hold monthly income of the city is 735 Birr. Nearly 50% are below poverty line(less than 500 birr per household per month) and about 23% are in absolute poverty (less than 300 Birr per household per month). The total asphalt road coverage of the city becomes 22%, the mobility is normal at 1.07 per capita trip rates with walk/pedestrians' being the predominant mode of (60.5%). Vehicular ownership is very low. Vehicular trip rate is also very low at 0.47 per capita, According to the household survey of (the Urban Transport Study, 2004/2005). Based on the recently preliminary estimated census results, Addis Ababa has around more than 4,700,000.00 million people estimated to be lives in the city (CSA Feb, 2017 report).

3.2. Research Approach

The Mixed Methods Research Approach type and data triangulation research design was used by the researcher to explore and explain the existing city parking space supply constraints. Mixed methods research approaches was involved collecting and analyzing using quantitative (metrics), qualitative (comments and opinions); and Experts (professional analysis) Approach in this particular thesis paper accordingly. Therefore, the basic idea behind the rationale for the researcher was using mixed methods and data triangulation approach is a selected method to found research findings increases the credibility and validity of the findings when different methods yield the same results. The basic purpose of using this approach was in "giving a more detailed and balanced picture of the situation under study" (Altrichter et al. 1996).

3.3. Research Design

This research is cross sectional research design type it has its own objectives, to attain the objectives of the study; the researcher was used a descriptive case research design type. To deeply explore and explain the existing parking space supply constraints of the city. The research approach was followed by verifying the nature of the existing problem of the study and the quality of this research design to explain and validate findings (Kothari, 2003). The explanation were emerged following creative exploration, and serves to organize the findings in order to fit them with better explanations, and then analysis or validate those empirical extracted data's. (Krathwohl, 1993).

3.4. Population and Sample

3.4.1. Target Population

The target/study population or the sample frame is the actual accessible population that can be used for these particular study areas that can the researcher was used them in sampling method strategy. Because of this the researcher was try to address populations like city parking workers, automobile drivers using those smart parking spots, regulators and city traffic police particularly those who work around smart parking areas are the right target populations for this study, (Israel, 1992).

3.4.2 Sample Size Determination

Perhaps the most frequently question is going to be ask concerning in determine sampling size like, "What sample size do the researcher need?" The answer to this question is influenced by a number of factors, including the purpose of the study, the risk of selecting a "bad" sample, and the allowable sampling error (Israel, 1992).

The researcher uses a purposive Sampling size using on basis of a specific identity or purpose to save a great deal of time. For example: for Automobile drivers because in every roads and parking places there are unknown numbers of drivers which uses the service, Therefore the sample size determination for infinite homogenizes population will be employee as follows; If the researcher takes for example one of the possible sample frame (n), to choose sample using Scott M. Smith in his Book of stated that, sample size (N) and margin of error (e) = possible to take 5 - 10% accordingly the error margin. The sample size determination will be determined by the following;

The researcher takes sample frame in one of the study area at a time was found 175 liable target populations, that is 10% of them were parking operators and 90% were customers on those SP spots; so 175 possible sample frame (n) could be found at a time, to choose sample using Scott M. Smith in his Book of stated that margin of error (e) = 5 %. Therefore Determining of Sample Size (N) through the following:

Formula $N = n / 1+n (e) 2$

$175 / 1+ (175)*(0.05)2$

$121.74 \approx \mathbf{\underline{122}}$**.**Were believed to be as possible as enough sample size for one of the SP spot; so the researcher considering the nature of the two SP spots Megenagna and Markato smart parking site locations, types and customers similarities in addition budget and time limitations of the researcher; 50% of sample was applied for (MSP) and the other 50% of sample was also applied to (MAMSP).

3.5. Data Sources and Types:

Primary and Secondary sources of data will be collect from different sources, hence they are important in attaining the aim of this study. Primary data is collected through investigating physically on-street close looks/survey, through preparing questionnaire and one-to-one interview. The secondary sources of data also will collect from various offices of city transportation bureaus especially from the city (AATMA) data base and from (AATB) journals, Addis Ababa Traffic Police (AATP) traffic control report, internet, and reports/journal/article written on the same topic by other researcher.

3.6. Data Collection Procedures

3.6.1 Sampling Technique and Procedures

Because of its nature and goal of the study to be attaining, the researcher was applied Purposive sampling design techniques which were applied handpicked sampling techniques to adhere to the underlying principle of deliberately. However, in the real sense, all methods of sampling are subcategories of purposive sampling method since they are sampling with purpose (Cress well, 2012:207). Thus, the procedure of the sampling techniques handling according the importance and variety of each sub group population in providing tangible information, so the researcher was accommodated each valuable respondent's types accordingly.

3.6.2 Data Collection Methods and Instruments

Primary Data Collection

1. Questionnaire: These questionnaires used to dig out the information from the smart parking customer drivers, parking lots operators, nearby building owners and government officials such as Addis Ababa Building Permit Office (AABPO),Addis Ababa Plan Commission (AAPC), Addis Ababa Traffic Management Agency (AATMA) and Addis Ababa Transport Beauros (AATB) about car parking system, parking space supply shortage effects on the transport system, the drivers and nearby business owners feelings and opinions are very important to identity the main issue parking space supply problem of the city through distributing semi-Structured and Open-ended Questionnaires.

2. Interview: The main purpose of interview used to collect data from the government responsible officials such as traffic management office, Addis Ababa transport beauros and Addis Ababa Plan Commission about parking facility design in the perspective of supply consideration around the buildings(malls, business centers, terminals, market centers and the likes…),design consideration and site selection criteria for parking services, and to identify parking supply space unavailability effects on the Addis Ababa transportation system and it was very important to obtain more relevant primary data about the overall activities, polices and strategies of Addis Ababa parking space supply infrastructures developments department.

Secondary Data Collection

1. Books and papers: Review of books and research papers on the smart parking system which are journal articles, Manual reports, books and seminar reports, porches from Addis Ababa transport beauros and Addis Ababa city traffic management office, project papers on the smart parking space supply spot development from Addis Ababa city transport offices, dissertation and thesis papers on smart parking system and review of the different parking strategy and parking management police in the world.

2. Documents: The Relevant documents data was collected directly from the Addis Ababa traffic management agencies particularly parking infrastructure development departments such as reports, manuals, worked project documents on the parking, and police documents of parking facilities from the government or parking area operators. In addition, Addis Ababa parking system standard documents and other countries parking development experiences.

3.7. Data Analysis Methods

Data triangulation was used in this critical research because, it ″refers to the use of more than one research approach to the investigation of a research question in order to enhance in the confidence in the ensuring of research findings,″ (Bryman, n.d. 2017).

This particular research also Analyzed Data using Pivot Tables in Microsoft Excel Spreadsheet to illustrate the respondent response in order to draw a percentile, pie charts,

histograms and to calculate parking supply demand gaps, customers service satisfactions, and concerned government office staffs and officials (expert analysis). Winding up findings altogether to express through frequency analysis, is a descriptive statistical method that shows the number of occurrences of each response chosen by the respondents.

3.8. Ethical Consideration

The researcher of this thesis paper was maintain the ethical issues and respondents confidentially through using codes to link the respondent to a questionnaire and sorting the name to code linkage information separately from the questionnaire, and will refuse to give the names of respondent to anyone outside the research project and maintain from biased decision making and plagiarism.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1 Introduction

The main purpose of this chapter is to present and discuss the data generated from the questionnaire and interview. To that end, the chapter has three sections. Hence the researcher was used data triangulations. In section one, the questionnaire for the building owners nearby SP spot block is presented. In section two, the particular SP spot under study customer's (automobile driver's) questionnaire is presented. In the third section, the results of the interview with the concerned government office officials (expert's view & opinion) are summarized.

4.2. Socio-Demographic Characteristics of Respondents

Table: 4. 1. **Respondents Categories, Sex and Returned / Un-returned Paper data analysis**

No.	Categories of Respondent	Sex		Re-turned Paper		Un-returned Paper		Total Re & Un- paper		Remark
		M	F	No	Pc. (%)	No	Pc.(%)	No	Pc. (%)	
1.	Automobile Drivers	60	24	84	68.85	07	5.74	91	74.59	
2.	Parking Workers	10	02	12	9.84	-	-	12	9.84	
3.	SP nearby Blocks bldg. Owners	13	1	14	11.47	-	-	14	11.47	
4.	Transport Regulators	2	3	5	4.10	-	-	05	4.10	
5.	Total Sum =	85	30	115	94.26	07	5.74	122	100. %	

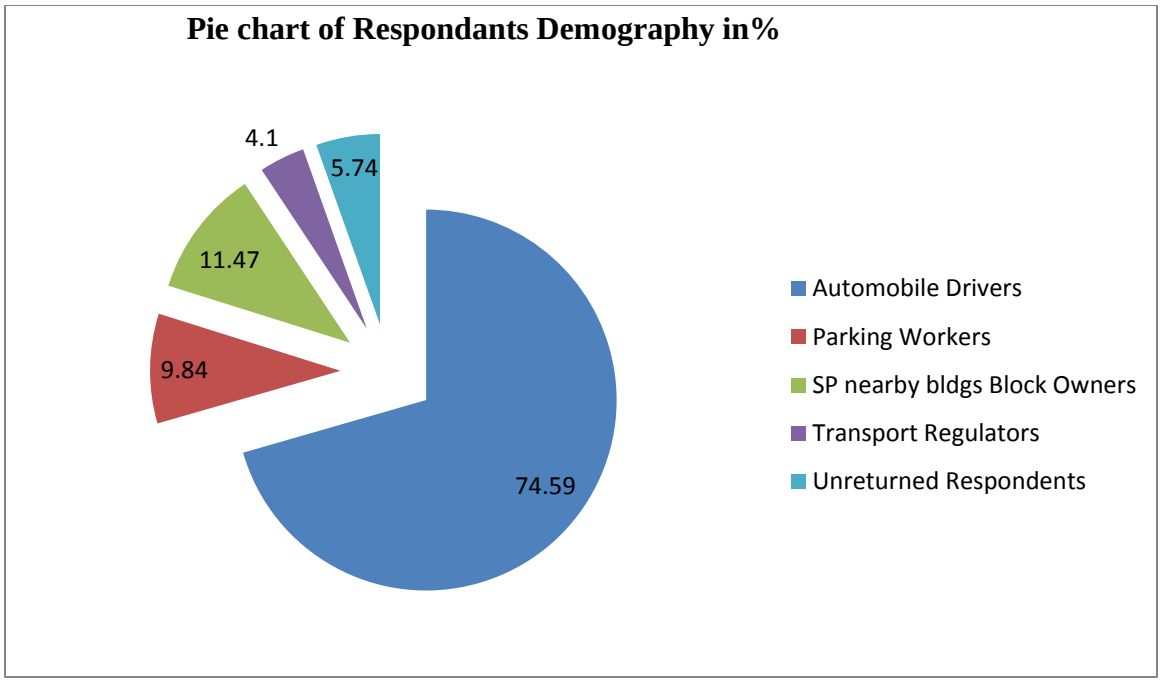


Figure: 4.3 **Pie - charts shows Respondents personnel information.**

Table: 4. 2 **Age, occupation and Educational background of Respondents**

Age ranges								**Remarks:**
21-30	**%**	**31-45**	**%**	**46-55**	**%**	**56 & above**	**%**	
18	15.66	74	64.34	15	13.04	08	6.96	
Occupation of Respondents								**Remarks:**
Business work	**%**	**Office work**	**%**	**Others**	**%**			
76	65.78	27	23.79	12	10.43			
Educational Background								**Remarks**
BA/BSC & above		Diploma: 12+2 or 3		12 & 12+1Certificate		Below 12		
52	48.15%	18	16.66%	10	9.26%	21	19.45%	

Based on the above table Respondents Categories, Sex, Returned and Unreturned Paper, age, occupation and educational back ground respondent's data analysis were not considered as variable for this research purpose, a summary of their personal information has been presented above in table 4.1 and 4.2. Regarding gender issue, as can be seen from above

table4.1, 66.39% of the respondents are males and 27.87% of the respondents are females. 5.74% respondents were not responding or return the question papers. As to their age ranges, shown in table 4.2, 77.38% of the respondents' age range lay within 31-55 and the majority of the respondent are business workers which was65.78%.

Respondents were also asked about their educational back ground and the survey shows that 48.15% were well educated first degree and above, 19.45% were also completed below grade twelve, 16.66% also had diplomas, and the rest were certificate holder 9.26%.

4.3. Results of Parking Supply Demand Gap Analysis

4.3.1. MSP nearby building blocks supply demand gap assessment

The Addis Ababa City Traffic Management Agency recently supplies the need for smart parking space supply spot in to sites; the real-world statistics of parking demand has become very important for drivers informed decision-making. In this study, the researcher has presented compact and highly effective parking space utilization with camera control system vacancy spot detection, which can deliver round-the-clock statistical analysis of in-doors steel structured automated parking spaces supply. The parking spot system was tested in a real-world general-purpose automated indoor parking space spot supply in Megenagna transit business corridor and Markato market center of Addis Ababa City, and the researcher presented with deep observation. The proposed method that was used in this system to collect the statistics uses data triangulation to determine occupancy status and parking supply demand based on visual features extracted from Smart Parking nearby blocks supply demand analysis done for both SP spots accordingly.

✓ As Norms and Standardsof the Addis Ababa Structure Plan Components (May, 2002):

Table: 4. 3Building type and parking requirement standards.

Building type	**Parking requirement**
Flats in rental apartments and condominium housing	1 parking/flat
Offices	1 parking/every 40 m^2 floor space
Supermarkets, Department stores, trade fares etc.	1 parking/every 60 m^2 floor space
Primary and secondary schools	1 parking/2 class rooms
Universities	1 parking/every 5 employees
Hospitals	1 parking/every 40 m^2 floor space
Museums and libraries	1 parking/every 40 m^2 floor space
Hotels and motels	1 parking/every 5 beds
Theatres and Cinemas	1 parking/every 10 sitting spaces
Stadium	1 parking/every 10 spectator
Restaurants, bars, coffee houses, pastries etc.	1 parking/every 10 sitting spaces
Worships and over whole halls	1 parking / every 15 seats

As shown in the above Norms and Standards of the Addis Ababa Structure Plan Components of Building type and parking requirement standards depends on built up area per flats and the accommodations accordingly facilitations the required components.

Table: 4. 4**Megenagna SP spot nearby buildings block parking SD assessments**

Building name	**Total built up in (meter square)**	**Net built up in (m2)**	**Parking space supply available in numbers**	**Parking space demand gaps in numbers**
Haile C/ C. bldg.	6,084.76	4,680.00	69	48
Genet C/C	4576.00	3520.00	34	54
Rahem bldg.	5,460.48	4,200.37	20	85
Residence Apartment	1,924.27	1,480.21	12	25
Tamega's bldg.	4,109.27	3,160.98	14	65
Beta Engineering bldg.	3,433.11	2,640.85	07	59
Bethlehem Plaza	3,639.99	2,799.99	21	49
Zefmesh G/Mall	25,661.96	19,739.97	150	179
Metebaber bldg.	10,815.60	8,319.69	36	172
Zurga bldg.	1,300.00	1000.00	05	20
Yeka sub city bldgs.	25,635.86	19,719.89	280	213
Total building blocks parking space supply available			**648**	**969**
Total building blocks parking space demand required spot =				

*****Commercial Centre (C/C), *Building (bldg.)

* To get the total built up area of each building, the researcher extracted directly surveys on the site by asking building managers or looking from construction building blue print permit plan or from G.I.S. map directly measuring and then multiplying by their respective flats accordingly.

So Parking space Demand = Parking space demand gaps _ Parking space supply available

= 969 _ 648

= **321**building spot supply difference

As the researcher investigated SP nearby buildings there are only few off-street parking areas or parking space inside buildings. There is no readily accessible parking area around the buildings compound. Thus, parking remains one of the critical issues that need to be addressed by the city council.As Norms and Standards of the Addis Ababa Structure Plan Components (May, 2002); illustrated building type and parking requirement standards according building type in the above table 4.21. So to get the net built up flat; total built up flat area multiply by 30% (considered to be standards in building flats common usage areas such as corridors and stair case),then deducted the result from the total built up flats area will get Net built up areas.

The MSP lay dawn in an area of 4000 meter square plot and consists of a 15- Stories facility holding capacity of [(15storey * 6 vehicles/flat) = 90vehicles at a time] spreading over an area of 170 square meters automated steel structure smart parking, and It has the capacity to accommodate a total number of 140 cars, out of which 50 will directly park on the surface.

- To calculate the gaps of parking spot supply in MSP

Gaps of MSP parking supply = building spot supply difference _ MSP supply

= 321_140

= **181**. Therefore the result of Parking Supply Demand Analysis for Megenagna Smart Parking spots nearby Building Blocks still shows the shortage/gap of 181 parking spot supply in block assessments.

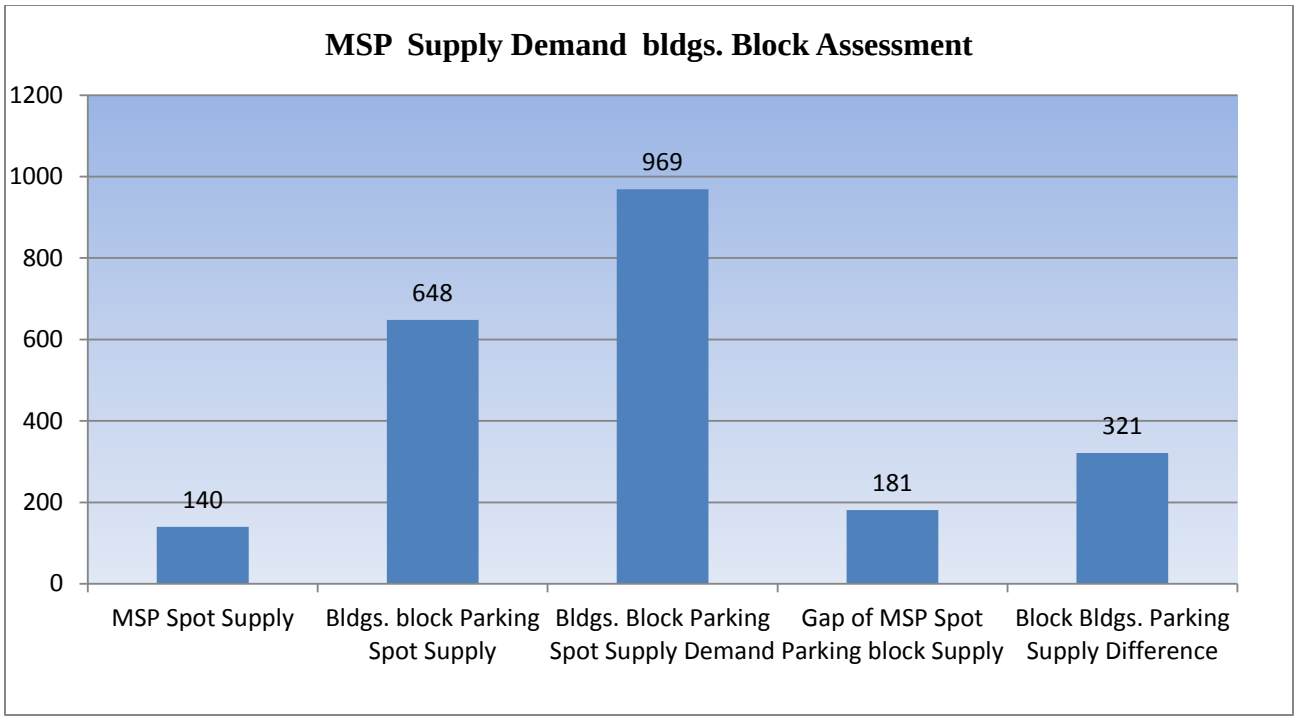


Figure: 4.4MSP spot nearby blocks parking supply demand gap assessments.

4.3.2. MAMSP nearby building blocks supply demand gap assessment

Markato smart parking found around markato one of the biggest market place to the Addis Ababa as well as to the rest parts of Ethiopia regions, especial this SP found in front of one of the big name of mosque in the city that is called Anwar mesgid. Presently around the smart parking spot block the city council applied renewal projects by demolishing the existing slums and redesigning each parcels by the newels established city plan commission office revised the former local development plan (LDP) according the Master Plan. Due to this most neighbors plot of the SP parking spot under construction according the new developed LDP. Even though the surrounding parcels under construction the project owners fencing each plot, there is a sever traffic congestion resulted by shortage of parking space supply.

Table: 4.5 **MAMSP spot nearby blocks parking supply demand gaps assessments**

Building name	Total built up in (meter square)	Net built up in (m2)	Parking space supply available in numbers	Parking space demand gaps in numbers
Anwar mesgid	6,493.50	4,995.00	50	283
Waged C.C	4,108.14	3,160.11	11	68
Menshewa C.C u/c	-	-	-	-
Wagid C.C u/c	-	-	-	-
Raye C.C u/c	-	-	-	-
»»u/c	-	-	-	-
»»u/c	-	-	-	-
»»u/c	-	-	-	-
»»u/c	-	-	-	-
»»u/c	-	-	-	-
»»u/c	-	-	-	-
Total building blocks parking space supply available			61	
Total building blocks parking space demand required spot =				351

*****Commercial Centre (C/C), *Building (bldg.), and Under Construction (u/c.)

* To get the total built up area of each building, the researcher extracted directly through surveys on the site by asking building managers or looking from construction building blue print permit plan or from G.I.S. map directly measuring.

So Parking space Demand = Parking space demand gaps _ Parking space supply available

= 351 _ 61

= **290** building spot supply difference

As the researcher investigated MAMSP nearby buildings there are no off-street parking areas or parking space inside buildings. Presently around the markato smart parking spot block the city council applied renewal projects. Thus, ever parcel under construction so parking

remains one of the critical issues that need to be addressed by the city council. As Norms and Standards of the Addis Ababa Structure Plan Components (May, 2002); illustrated building type and parking requirement standards according building type in the above table 4.21. So to get the net built up flat the same process was applied as the above MSP nearby buildings done.

The MAMSP lay dawn in an area of 3000 meter square plot and consists of a 10- Stories facility a holding capacity of [(10storey * 8 vehicles/flat) = 80 vehicles at a time] spreading over an area of 160 square meters automated steel structure smart parking, and It has the capacity to accommodate a total number of 180 cars, out of which 100 will directly park on the surface.

- To calculate the gaps of parking spot supply in MSP

Gaps of MAMSP parking supply = building spot supply difference _ MAMSP supply

= 290_180

= **110**. Therefore the result of Parking Supply Demand Analysis for Markato Smart Parking spots nearby Buildings Block still shows the shortage/gap of 110 parking spot supply in block assessments.

The City currently owns and operates the above two public on-street automated steel structured parking garages under the Smart Park brand. Opportunities to improve capacity through operational changes and capital improvements could be explored. While capital construction could be costly, it will add capacity for many years; In addition, operational improvements such as changing existing uses would optimize public parking capacity. This strategy will require additional scoping, cost estimates, and engagement with stakeholder's entities use and benefit from Smart Park operations to determine feasibility. Given the unique qualities of individual communities, it is difficult to say what the minimum or maximum parking requirements in Addis Ababa region should be, even if specified by land use. Litman considers 'optimal parking supply' to be "the amount that motorists would purchase if they paid all costs directly and had good parking and transport options" (2006).

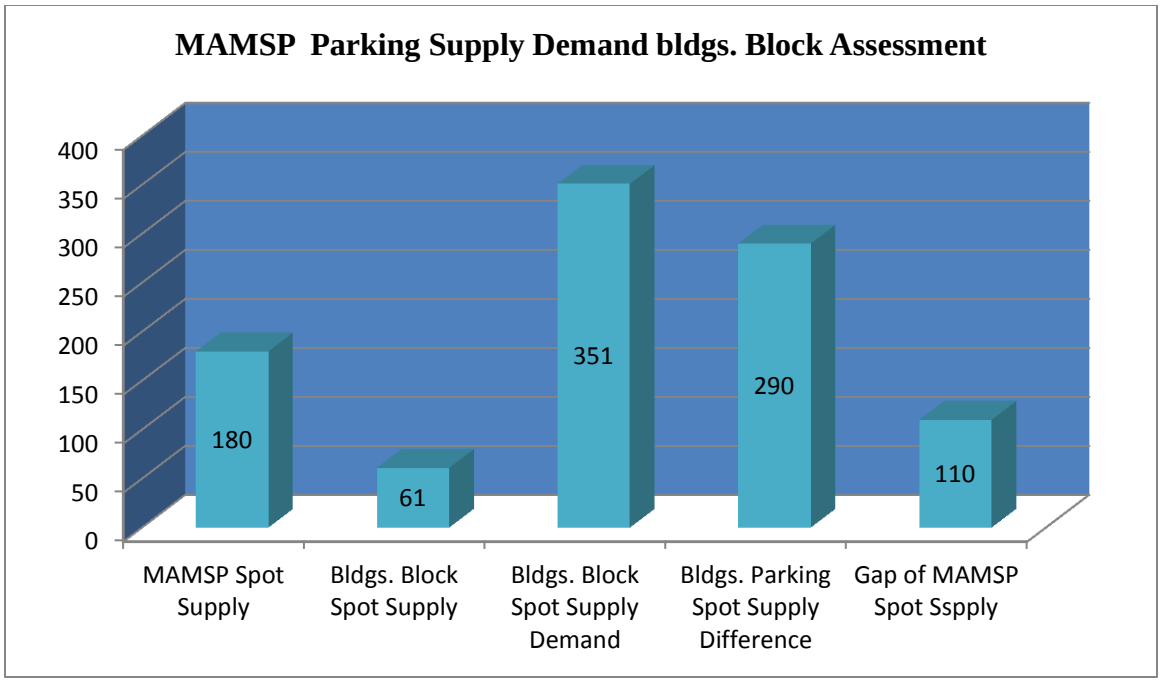


Figure: 4.5 **MSP spot nearby bldgs. Block parking SD gaps assessments.**

4.4. Data Analysis of SP customers satisfaction respondents

Main source of data used for this study, as discussed in chapter three, was questionnaire for smart parking customers, operators and government officials. One purpose of the questionnaire was to gather information about the driver's agreement on the challenges and opportunities of smart parking supply lots. Also, the questionnaire was intended to find out the extent of the personnel behavioral satisfaction with the provisions of the parking service. Below table the results of the questionnaire for smart parking customers and parking operators organized and presented.

The purpose of the following questionnaire was for customer of SP and parking operator's satisfaction with the current provision of smart parking space supply practice. Therefore, in this section, how far they were **satisfied** or **unsatisfied** with the (SP) space supply services in MSP and MAMSP spots were analyzed and presented.

For the following questions please put, "√"mark on your preferred answer, in the table provide.

Table 4.6Likert scale table for MSP and MAMSP

No	Statement about the current smart parking practice and performance	Very Satisfied		Satisfied		Very Unsatisfied		Unsatisfied		Neutral	
		No	%	No	%	No	%	No	%	No	%
1.	a fair price for SP services	51	50.49	21	20.79	27	26.74	1	0.99	1	0.99
2.	The SP accessible and suitable	63	62.38	25	24.75	13	12.87	-	-	-	-
3.	Micro and small enterprises operate the SP well	75	74.26	17	16.83	-	-	9	8.91	-	-
4.	The automated SP serviced professionally always.	-	-	-	-	85	84.16	10	9.90	6	5.94
5.	The buildings around SP block enough parking space supply?	-	-	25	24.75	59	58.41	10	9,90	7	6.94
6.	The SP space supply lots service safe and secure	73	72.28	22	21.78	-	-	6	5.94	-	-
7.	The SP mart service related to like car wash, grease…café'	-	-	21	20.79	69	68.32	11	10.89	-	-
8.	Availability of park for disable persons vehicles	31	30.70	29	28.71	35	34,65	-	-	6	5.94
9.	SP spots equipped with sensors technology, like cctv cameras, Ventilation, toilet and light.	42	41.58	31	30.70	19	18.81	9	8.91	-	-
10.	These two SP service made a significant changes in the city parking space supply problems.	-	-	14	13.86	70	69.31	16	15.84	1	0.99

As can be seen from table 4.6 above, the statements five and ten were intended to measure up the satisfaction levels of respondent concerns on city smart parking space supply industry by the researcher. In this regard, the respondents (25.74%) expressed their view that, they were unsatisfied with the government parking supply, and the automated elevator service (84.16%) of the respondents forwarded their view that they were very unsatisfied with the service.

But, on micro and small enterprise concern to parking service, the respondents (91.09%) were satisfied and most of the respondents comment the government should give them

training to the new technology up take of smart parking service. On the issue of smart parking accessibility and suitability,(62.38%) of the respondents were very satisfied; with availability of park for disable person's vehicles (34.65%) very unsatisfied. The last the main impact result on this particular research were the significance of parking supply of these two multi-story automated parking's; (69.31%) of respondents were unsatisfied by the current smart parking space supply services because the reason they raised were most of time the automated lift not function and luck of skilled personnel to maintain the machine.

Addis Ababa's 'Megenagna and Markato Anwar Mesgid Smart Parking' as an Instrument to Reduce Green House Gas (GHG) Emissions, Improve Air Quality, and Reduce Traffic Jams Addis Ababa's parking system is mainly dominated by on-street parking, although there are a few off-street parking areas or parking spaces inside buildings.

However, there are no readily accessible parking areas near public transport terminals, which contribute to the inefficient utilization of the road network, especially in terms of road users' safety and traffic congestion.

This, in turn, contributes to higher carbon emissions from vehicles and further impacts on air quality. Addis Ababa's Traffic Management Agency (AATMA) is making efforts to solve parking issues through the development of space supply optimized parking systems, particularly with the construction of smart parking systems equipped with modern devices, such as CCTV cameras and sensors.

Therefore Smart parking facilities in Addis Ababa City areas have become less appealing. Due to increasing car use and increasing concentration of offices, businesses, and market areas consequences demand for parking spaces has exceeded their supply. As shown in the above.

4.4.1. Summary of respondents

The answers given by the smart parking customers and parking operators of the Addis Ababa smart parking space supply were summarized as follows:

Smart Parking Supply Challenges:

i. Poor road network, i.e. narrow and not accessible,
ii. Smart parking cost of construction,
iii. Misuse of building's basement parking spots nearby SP block,
iv. To equipped with modern communication infrastructure,
v. unauthorized parking barriers to pedestrian and creates road congestion and accident,
vi. No enough parking area around public and market center,
vii. Accommodation of smart parking space supply facility is less than from demand
viii. fixed payment for parking fee
ix. Shortage of SP nearby off street parking

Smart Parking Space Supply Opportunities:

i. create job for organized fresh graduate as the micro & small scale enterprises
ii. helps to transfer smart technology and skilled knowledge
iii. on active smart parking spot related business could developed like car washing and mart shop
iv. create effective use of land use and free roads traffic
v. brought security and safety for the properties of parking customers
vi. means of income to government and parking operators
vii. Available market for rental parking service,
viii. reduce fuel consumption, GHG emissions reduction and air quality improvement by alleviating traffic congestion

Smart Parking Current Situation:

i. high needs for smart parking space demands
ii. limited parking space supply

iii. Poor parking land management
iv. Poor smart parking management
v. Luck of attentions by concerned government officials for parking sector
vi. Luck of integrated developments parking service based on city master plan
vii. Un able to implement parking supply Policy and regulation
viii. Unable to use Internet of Things (IoT) for smart parking apps.

Smart Parking Future Trends:

i. the smart parking supply demand will increase
ii. Supply of parking lots based on research and master plan
iii. Participating private and public partnership (PPP) in the parking industry
iv. encourage mass mode of transportation system
v. improve level-of-service
vi. Clear policy and strategy for parking sector developments
vii. Applying modern technology apps for demand and supply of parking services
viii. Change the design of smart parking to concrete structure buildings.

Future Location for Smart Parking:

i. Parking under the high rise building shall be enforced by concerned building permit office
ii. Parking required at the congested area and market center
iii. Standard road shall be considered like Addis Ababa to Adama Toll Roads which

Considered parking bays supply

iv. Use of reserved land spaces for parking services accordingly as much as needed;
v. Especial attentions parking facilities around Public festival areas, convention& business centers and Market &religious areas….etc

4.5 Expert analysis on smart parking performance.

To calculating the sample size the researcher used the formula. The formula used a 95% confidence level and precision level p=0.05 and the sample size used to determine the needed amounts of experts in decision making process (Israel, 1992).

Formula; where, n= sample size, N =n / 1+n (e) 2

=3AATMA+2AATB+1AATP

1+3AATMA+2AATB+1AATP (0.05)2

Sample size (n) = 5.911, 6 experts are needed for the decision making process. Based on the results one coordinator, two high experts were selected from AATMA, two high level expertise also selected from AATB, and one field officer of AATP.

4.4.2. Results of Questionnaire for Government experts

Before the researcher discuss the results of Government experts, let's look at their entities (S.W.O.T.) analysis entities Internal Strength and Weakness, and entities External Opportunities and Threat faced the current City Transportation Infrastructure Systems:

The analysis of strengths, weaknesses, opportunities and threats is an input to achieve the Gap on Academic disciplines on the manner to apply on city smart parking space supply and other transport demand and planning problems success. Prior identification of those problems helps the entity to build on the strengths, to improve the weaknesses, to use the opportunities and put in place some solution mechanisms for minimizing the impact of the threats in order to achieve the goals and objectives set in entity strategic improvement plan of smart parking developments to facilitate city transportation system.

A. Strengths

I. Presently higher education graduates made many researches paper on the Addis Ababa city parking problems trying to indicate the short came.
II. New Transport office Establishment and structuring of those offices with professionals.
III. The sector recently has given a special attention by the city council.
IV. A good start has been seen to bring a quality customer service by the newly established service provider.
V. Sorting out the problems and zonal route assign of public transport and encouraging the organizing of transport giving share companies accordingly.

B. Weaknesses

I. Lack of approved city transport policy and transport master plan connectivity network
II. The urban transport studies which have been studied by different scholars have not yet approved
III. Shortage of professional in the field of city transportation system.
IV. Lack of coordination of activities with stakeholders like (AATMA), (AATB), city traffic police commissions, the city master plan and information institute …e.t.c.
V. Problems of the newly established offices to attract professionals' with computable basic salaries
VI. Lack of using modern technological instruments to control city parking sector
VII. Unable office professionals to manage the problems, all those route fares and transportation vehicles parking gaps in all places of the city.
VIII. Unable the proper use of the existing city roads, utilities, traffic lights and road signs.

C. Opportunities

I. The ministry of transport and communication commitment to improve the city transport services by restructuring the sector.
II. Availability of potential electric power for the electrified buses and light rail transits.
III. Technical and financial support for the sector from local and international donors (like ADB, World Bank…so on)

IV. The availability of well-organized Universities in the country helps to equip the sector with professionals in different transportation fields.

V. The availability of modern Traffic route control mechanism by using technological advancement in transportation sector.

D. Threat

I. Air pollution consequences climate changes and sound, noise, problems due to motorized vehicles and luck of adequate parking supply.

II. Rising cost of modern parking supply facility

III. Due to rising of foreign currency makes very much expensive the development of city parking infrastructure.

IV. From time to time the population of the city extremely increases due to continuous local migrations for different reasons.

V. The topology of city dwellers housing settlement makes difficult in respect to on-road and off-road parking infrastructure development

VI. And city route connectivity. Road safety and durability problems.

The questionnaire used for the government experts were made for six staffs those who are work at (AATMA), (AATB) and (AATP) stakeholders on the study and two questionnaires for each. It was intended to know two things regarding the smart parking space supply. Part one was the applicability of parking practice and part two was the satisfactory effects on parking by considering key performance indicators.

Table 4.7Parking practices of the city

No	Statement	Strictly Applicable		Applicable		Inapplicable	
	Addis Ababa current car parking condition	**No**	**%**	**No**	**%**	**No**	**%**
1.	has coordinated traffic management system strategy like road network, terminals and parking supply, roundabouts and junctions	-	-	1	16.66	5	83.34
2.	recognizes the challenges and give alternative solution for parking supply problems	-	-	3	50	3	50
3.	pays attention to serve the underground parking for their purpose rather than using for shops, store, etc	-	-	1	16.66	5	83.34
4.	has special flow up to give training for illegal parking, street trade, the needs of disabled, children and pedestrian	-	-	2	33.33	4	66.67
5.	ensures the performance of parking space supply lots are efficient	-	-	3	50	3	50
6.	try to see other option to optimize parking space supply lots challenges	1	16.67	2	33.33	3	50
7.	ensures that the smart parking places areas properly/effectively utilized	1	16.67	2	33.33	3	50
8.	has feasibility study for the parking spots arrangement and future service improvement	-	-	2	33.33	4	66.67
9.	critically consider and enhance land supply for parking and terminal development in the central part of the city	-	-	2	33.33	4	66.67
10.	ensure adequate parking space supply in the issuance of construction permit, monitor and control its implementation	-	-	2	33.33	4	66.67
11	the on progress railway transport considers parking station at the train start and ends	2	33.33	2	33.33	2	33.34

As indicated in table 4.7 above, the respondents were made to decide how seriously affect lack of coordinated traffic management system strategy like road network, terminals and parking places, roundabouts and junctions. On second variable, the current condition of car parking in Addis Ababa were recognized by the staff's to give alternative solution for

parking challenges, the respondents (50%) witnessed that it was applicable. On the issue of critically considering and enhancing parking land supply demand for car parking and terminal development in the central part of the city, (66.67%) of expertise responded was inapplicable. But, the same percent agreed that the presence of feasibility study for the parking station arrangement and future service.

4.5. Smart Parking Service Delivery Challenges

A. Poor Land use Managements: It is already known that scarcity of parking space lots especially around CBD and THC of the city leads to the idea of developing SP, hence, such types of parking lots accommodates maximum flat depending on the provided spaces/area, whereas here MSP and MAMSP space given for each smart parking is around 4000m2 compared to surface parking space, the automated smart parking space was very much limited as shown below on the table and graph.

Table 4.8 Area of MSP or MAMSP Service Activities Land Coverage

No		Land Coverage by Area Square Meter				Remark
1.	Land use Type	Smart Parking	Surface Parking	Circulation roads	Utilities & others	
2.	Area in Sq. Meter	170m2	2036m2	1200m2	574m2	

B. Adjustment of CCTV camera inside the parking compound: is only available on the ground floor of automated parking, and in the main gate of entrance and exit, but around surface parking plus from 1st floor up to 15th floor of in the automated parking, there is no surveillance camera in which they are considered to be very much importance for customer safety, security and other government official's needs.

C. There is no a clear cut policies, rules and regulations on smart parking developments and management these and other governmental bureaucratic issues in luck of integrations with each other leads ambiguity for those local PPP or foreign interested investors to participate on smart parking lots supply developments industry. as (AATMA) and

(AATB) Authorities mentioned recently a team from concerned government and Addis Ababa University scholars under intensive hard work to revise existing rules and regulations and making modern drafts by sharing from developed countries to make compatible input for policies, strategies and directives of the city overall traffic flow management.

D. Fixed Parking Price: is also one of the problems for smart parking customers, most of the clients' commented that the variable price on the day of time could a better approach.

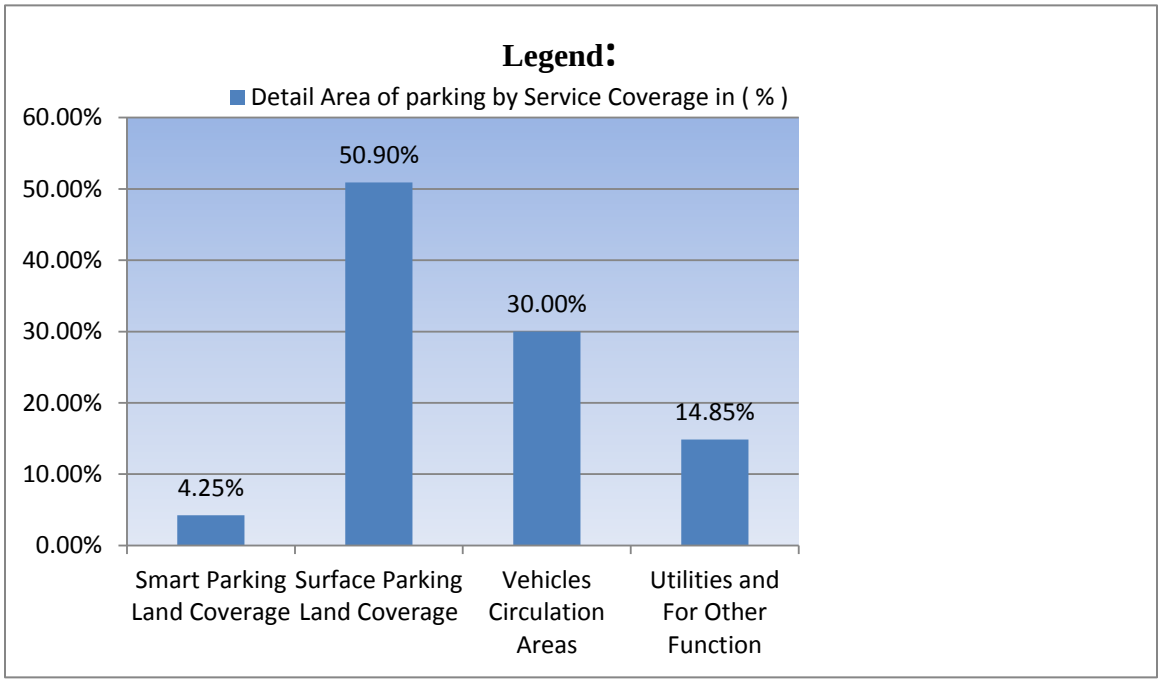


Figure 4.6 Shows Land Usage of Existing Smart Parking's:

(Source: on site measurement by the researcher, June 2022).

Most of customer awareness on the automated parking were very much less, as most of MSP and MAMSP workers witnessed the time taken to park to automated flat two times less than of that parking on the surface spaces, but as shown in the above figure the land coverage very much less than of that of surface parking, these impacts on the smart parking efficient service.

Furthermore, it also helped solve parking and traffic flow issues in the area by providing more parking slots, and functioning every nearby building basements parking accompanied by traffic policies and other transport controls or regulators banning street-parking in the nearby highly-congestible areas. Moreover, it presented a job opportunity for 38 organized micro and small scale entrepreneurs, becoming the leading example for other smart parking systems being built across the city. The simple steps in using the facility involve payment via a credit card system is not working due to manipulation problems; then one's car is placed on a platform and taken up for parking. Parking prices across the facility are identical: 6 birr's for the first hour (≈ USD 0.20) and 9 birr's (≈USD 0.30) for every additional hour. As most of the parking attendant's data's testify, "The Park has good demand throughout the day on the average". To assure let's see the last four month empirical dates on the following table and graph.

Table 4.1 Shows that Number of Vehicles Parked the Past Four Months (VP/M)

NO		**Average Numbers of Vehicles parked per Month**				**Remark**
1.	Months	March,2014	April ,2014	May,2014	June,2014	
2.	Numbers of Vehicles Parked	7456 VP/M	8124 V/M	11678 VP/M	12,019 VP/M	VP/M: (vehicles parked per month)

- (Source: Average Numbers of VP/M from (MSP) 4th-quarter report, 2014E.C.).

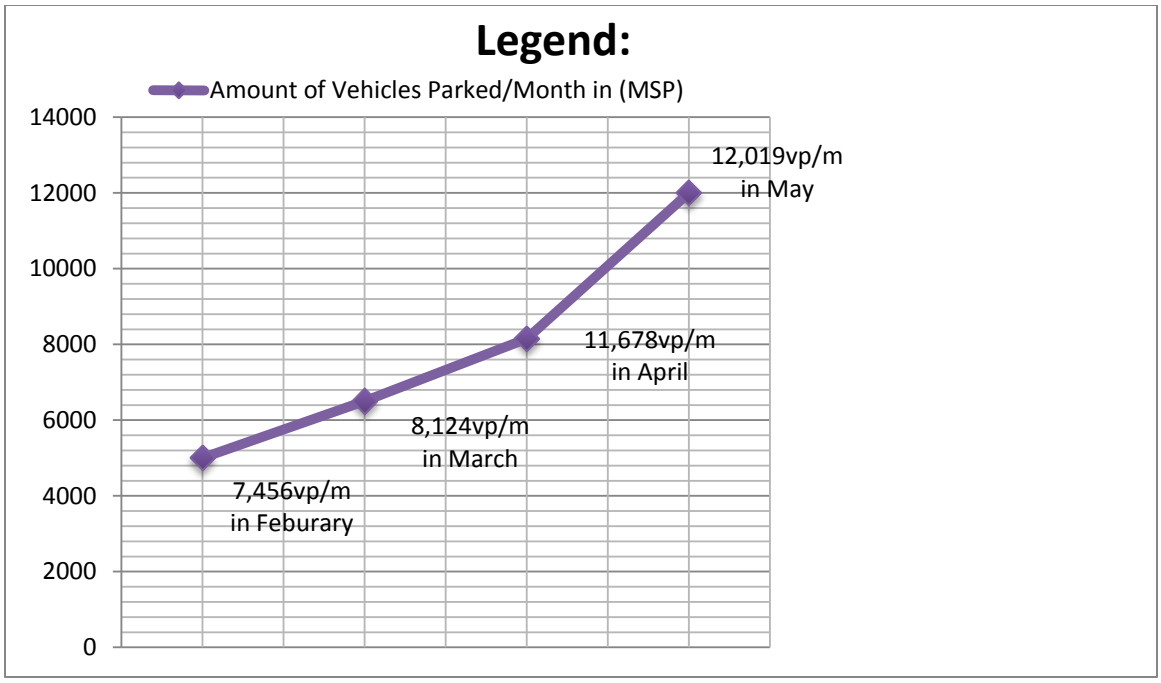


Figure 4.7 Shows Numbers of Vehicles Parked for the last four month in MSP

As shown in the above figure indicated that the smart parking service become increased in the past four months, these shows that the customer of the service delivered had abundant pull factor for parking demand service, because these spots were the only safe and secure public smart parking supply founds around the study areas.

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS

5.1. Summary

The major findings of the study are summarized as follows.

i. The first results obtained from that of smart parking nearby buildings block parking capacity assessment showed that there is still a gap in parking space supply demands and results from that of misuse of parking buildings space spot other than parking services customers indicates that the challenges of car smart parking are a crucial issue where the stakeholders participate to solve these difficulties. These includes the automated steel structure most of time out of service due to lack of regular maintenance and unable to cover cost of maintenance to buy spare parts, this resulted poor follow up from (AATMA) and (AATB) concerned officials, and poor parking management of parking operators resulted luck of continues training, the contemporary parking management skilled required in general the current situation of smart parking space supply practices affect the customers daily activities.

ii. Almost all respondents of the participant agreed that the opportunities obtained from smart parking space supply industry to building concrete high rise structure. It accommodates a large number of vacant jobs, and it can be a means of income for the government and parking operators. Some of the opportunities includes: legal car wash service with parking supply service side-by-side, a safe and secure parking place will be established, parking garage, recreation center at the top of the building, public toilets, and beauty salon will be some of them.

iii. However, the results from questionnaire made to the participant appeared to indicate that the level of satisfaction except micro and small scale enterprise parking operator activity, all the other stakeholders concern is unsatisfied by the service. For instance, there is little idea from the government and investors for the establishment of smart parking space supply industry. Besides, no concern about smart parking spaces vehicles for disabled and high cost of construction when buildings includes parking base on the regulation.

iv. The findings from government officials show that there is no coordinated traffic flow management from officials, because of they doesn't give attention for miss use of underground parking supply control, on side road parking and luck of special follow-up to give training for illegal parking drivers. And also, they did not have information about the availability of smart parking system technologically operational functions.

v. Based on the key performance indicators, the officials unsatisfied by the current parking situations which could not to accommodate the required services to the customers. The officials responded about smart parking customer, visitor, reservation system, proximity to market place, parking policy, parking management, disabled facilities and unallocated parking which are shared by any individuals are very unsatisfactory. But, staff parking, cost of public parking and allocated parks which are owned by private operators are satisfied.

vi. Regarding parking industry, there were no detail investigations to develop the sector in Ethiopia. But, the city administration will try to solve those challenges within the next five years plan and it is under investigation side by side with the revised Addis Ababa master plan which was ratified a few years ago.

vii. The appropriate car parking supply locations are under investigation with the new master plan. And the current car parking practice is not giving appropriate service to the community and need to be improved in terms of design and level-of-service. There are no enough smart parking spaces supplies even in these two study areas, more attention was given for surface parking as figure: 4.8 shows (50.90%), because the existing places are not accommodating the increasing number of motorization rate.

5.2. Conclusion

The first objective of the study was to assess the city current smart parking space supply demand gaps, as the researcher observed the study areas smart parking service were increased from time to time, as the survey showed that the parking service creating Pull and Push factors, that is the pull factor was the Demand for free smart parking spaces supply due to there is a gap of parking space supply around SP buildings block whereas the Push factors were inadequate service nearby buildings parking space Supply of MSP and MAMSP resulted recurrent traffic congestions at the peak hours and holidays around study areas.

So, most of respondents believe that smart parking space supply demand gaps around CBD and THC based on empirical city traffic volume congestion was real evidence for shortage of parking space supply.

The second objective of the research was to evaluate the smart parking space supply service satisfactions required in contribution of alleviating city vehicles parking problems these has been seen when the researcher survey parking spots. From respondent's point of view, there is satisfactions on service delivery as shown in the above likert scale table, if the city administration keep it up the development of smart parking space supply demands around most congested areas of the city in better design and service giving , as a strategy to reduce parking problems of the metropolitan city, the participant replied in near future the city council will be mitigate or/alleviate the contemporary parking space supply problems, even if the investment cost was very much expensive, the respondents was suggested that a collaboration with private and public partnership (PPP) with government incentives and allowing foreign direct investment with other stakeholders/investors could be the other option for the SP developments.

The third objective of the research was to investigate the city administration expertise on smart parking service performance. On this issue of critically considering and enhancing parking land supply for car parking and terminal development in the central part of the city, (66.67%) of expertise responded was inapplicable. So to implement parking service in different parts of the city they said the current service should be improved. Thus, first the government should consider incentive free lease land for smart parking supply buildings

which made available for every investor, so as to give social and economic benefit of the cities. Particularly, the road side of the rivers banks at the cross bridge of the city land is not considering for use. And thus, it is possible to have multistory smart parking building at the left and right side of the bridge which is located in different sub cities based on the nature of the terrain. These means, some of the river are dipper and the others are wider.

Finally, based on from the above data triangulated findings similarities, it can be concluded that the developments of smart parking adequate space supply demand is vital. Especially, in the commercial and market places were a high vehicular and pedestrian traffic generating. Thus, supply demands for parking spaces supply and other parking facilities are high. The inability of supplying parking facilities for the existing situation to cope with the supply demand has later led to parking problem and traffic congestion which has a consequence on the social and environmental aspect. And therefore, the main conclusion for this research was, even if the existing city Smart Parking Space Supply delivery service of MSP and MAMSP was it looks like active, but their overall contributions to the study areas of parking supply demands service was insignificant, which shows a great gaps in parking space spot supply demands.

5.3 Recommendations

In light of the findings of this research work, the following recommendations were suggested to enhance the smart parking service delivery.

A. Addis Ababa Construction Permit and Supervision Office, and all local Planning Authorities should be co-operate each other's to specify and enforced the provision of parking space supply in conjunction with new building and off road parking. Even though, there is proclamation on the building permit procedures, it is found that most of the buildings that are required to provide parking facility were functioning for other purpose. Therefore, Construction Permit and supervision Office should have to take enforcement action for the implementation of the law; Addis Ababa Road Authority needs to consider road side-bay for taxi and bus stops around MSP and MAMSP.

B. If MSP and MAMSP services properly managed. By skilled parking industry professionals it will creates different opportunities for the growth of the city by reducing unemployment for micro and small scale entrepreneurs and pave way to new parking industry formation. The following parking facilities should be considered and need to be developed in the future by the government, PPP and/or jointly with private investors to solve the existing parking situation of the Addis Ababa. By providing different parking space supply strategies, the overall aesthetics of the parking areas should receive due attention.

Introducing Surface Car-parks and peripheral parking schemes (park-&-ride)

Concrete structure Multi Story Car-parks
Under-ground Car-parks
Garage and Valet parks

These facilities are costly to provided and maintain. However, the service render is so enormous to smooth traffic management.

C. In order to reduce the parking supply problems, the parking management requires changing current parking 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 operators 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 which relates the other fields such as transportation management associated with parking activities to improve the enforcement and addressing different opportunities obtained when parking space supply developed.

D. The study also suggested the following solutions which are obtained from the practice of Tanzania, Nigeria, and China to reduce smart parking space supply in Addis Ababa.

5.4 Suggestions for future research directions

1 In this new era, smart parking space supply aided by technological development, which drives globalization, so the contemporary type of parking supply services gives option which can give real time data information about parking space for the drivers through website or mobile application were one of the features of most developed countries parking supply, but the so called "MSP and MAMSP" of the study areas of this research does not have a such kind of facility/infrastructures out of the parking spots, so these should be change in the future direction of smart parking developments

2. As the field survey showed that the ultimate Land use utilization for current automated steel structure smart parking space supply was very much small (4.25%) out of the given parking area, which was obvious to affect the service performance efficiency of the parking space supply demands, so for future it should be improved. Even if, the development of MSP and MAMSP creates a start-up businesses for fresh graduate from city technical colleges; hence they organized business entrepreneurs who runs, manage and administer the current city SP overall services.
3. In this regard, the above research finding showed related businesses like car wash and accessory shops. It creates jobs for the parking operators to work in different vacant positions and helps to transfer new technology with knowledge in the new industry formation. Besides, it can be a means of income to the government by giving rental services or collect income tax from the sector. It can also help for the effective use of roads and lease land in the city. Therefore, it has to been noticed that providing parking lots reducing traffic congestion and different business opportunities to the communities.
4. Therefore, it can be constructing either public parking about five or above stories building parking garage considering environmental and social issues. The importance of parking policy and strategies grows and will continue to grow over the coming decades as car ownership continues to rise. The parking charges are presented in small and large urban cities and effective parking policies with variable price consideration based on traffic situations will coordinated and managed by the city government.
5. Even if, Policies alone cannot solve Addis Ababa city parking supply shortage, the government should provide clear policy and strategy. These policies have to be backed by enforcement to address this issue. The researcher suggested that public parking place

should be around markets, business areas, religion and cultural festival areas, and downtown of the city for the purpose of smooth traffic system, but it is unable to accommodate the needs of the society. Even if, the city administrators weren't able to supply additional parking spaces until now in different sub cities, the government needs to give attention for the challenges occurring in their policy and strategy decision making, due to the fact that Addis Ababa City is the seat of continental and international offices.

6. Shared parking: The parking facilities can be utilized by multiple users or destinations. Motorists can share parking space available nearby, rather than being assigned as a reserved space. Shared parking in the destinations should be encouraged such a technique are very effective in the office building which can share parking with restaurant or theaters since the peak demand for offices occurs during the weekday and on weekend evenings for restaurants or theater. Public parking including on-street, municipality's off-street and commercial parking (for profit) facilities generally may serve multiple destinations. The developers must donate funds to build public parking facilities instead of providing private facilities which served as a single destination. This technique tends to be more cost effective and efficient when implemented accordingly.
7. Parking tax reform: This includes the tax policies that support parking management such as commercial parking taxes (a special tax on parking rental transaction) per space parking levies. This helps to reduce the parking supply and increase parking costs, as well as providing revenue for public programs. Therefore, the researcher is believed that, the suggested solutions represented in this paper are effective to change the current parking spot supply demands practices of Addis Ababa. Besides, it helps to overcome the parking supply challenges in order to achieve the optimal point when the city administration begins implementing the tasks.

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ATTACHEMENT

APPENDIX: A

AAU College of Business & Economics School of Commerce

GRADUATE EXTENSION PROGRAM IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT STUDENT PREPARED QUESTIONER.

Dear Sir/Madam:

This questionnaire is prepared by graduate student of extension logistics and supply chain management based on the MA thesis proposal on: Impacts of Smart Parking Development as a Strategy to Reduce Parking Space Supply Problems: the case study of Megenagna and Markato Smart Parking in Addis Ababa: The Users Perspective In partial fulfillment of the Requirement for the Award of Masters of Arts in Logistics and Supply Chain Management and for the use of educational service, on the other hand it uses for all stakeholders and concerned government party to solve the contemporary issues that the city serious smart parking space supply problems facing. The questionnaire has no other objective. The questionnaire will take approximately minimum 5 up to maximum 10 minutes.

I guarantee that all of your answers will be completely confidential.

Thank you in Advanced for taking your time and willingness to cooperate.

By; Tesfaye Getachew (0911219607 or 0904400935)

Notes: Advisor; Tariku Jebena (PhD).

- Not necessary to write your name and address.
- If you have additional suggestion use the space provided or you can add your own papers.
- Sex; Male□ Female □
- Level of Education; BA/BSc degree and above □ Diploma (12+2) □
- Grade; 12 complete and certificate (12+1) □ Below Grade 12□
- Occupation; Business □ Worker □ Driver□ or other profession □
- Age; 21 - 30 □, 31- 45 □, 46 – 55□, 56 & above□.

Section 1

Questionnaire for Smart Parking nearby block building owners

1.1 (MSP) bldg. block parking supply assessments format table

Block name	Total built up	Net built up	Available parking space	Required parking space

1.2: (MAMSP) block bldg. parking space assessments

Block name	Total built up	Net built up	Available parking space	Required parking space

Table 1.1 and 1.2 smart parking nearby blocks buildings parking lots assessments forms

Section 2

Questionnaire for Automobile Drivers

The purpose of this Likert scale table is to determine smart parking customers are either satisfied or unsatisfied with the items listed in the table below. Therefore, please read the statement about parking and then decide your level of satisfaction by putting a tick along the scales (strongly satisfied to strongly unsatisfied) that most closely fits your level of satisfaction to assess the views and opinions about the (SP) space supply services in MSP and MAMSP spots.

For the f/g questions please put, "√"mark on your preferred answer, in the table provide.

No-	Statement about the current smart parking practice and performance	Agree	Strongly Agree	Disagree	Strongly Disagree	Neutral
1.	Do you think a fair price for SP services?					
2.	Do you think the SP accessible& suitable?					
3.	Is there a queue when customers want park on surface parking.					
4.	Are the automated SP functions always?					
5.	Is the bldg. around SP block enough parking space supply?					
6.	Do you believe the SP space supply lots are safe and secure?					
7.	Is the SP place are other related services like car wash, grease…etc					
8.	The SP service impacts on city traffic accidents & congestions?					
9.	Is these two SP spots equipped with sensors technology, like CCTV cameras, Ventilation, toilet and light.					
10.	Is these two SP service brought a significant change in the city parking problems					

Section 3

Semi- Structured and Open ended Questionnaire for Automobile Drivers

For the following questions please put "√" mark on your answer, if there is a box.

1. How often do you use this smart parking?

Once in a day □ twice in a day □

Three Times in a day □ more than three times □

2. How much is fair the price of smart parking from other parking types?

Fair□ not fair □ should be revised □

3.What is the new thing came by smart parking supply? ----------

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---.

4. Do you think if the City Administration keep develop smart parking a solution for the contemporary parking problems? ----------

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5. Is there anything else that could do the city traffic management office to improve the parking infrastructure developments problems?

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6. Any comment or suggestion regarding to the parking service of the Addis Ababa City in MSP or MAMSP write in details?----------

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Section 4

Questionnaire for Parking Workers

For the following questions please put "√" mark on your answer, if there is a box.

1. How much interested the automobile drivers to park in this smart parking?

---.

2. How much is fair the price of smart parking, answer based on the most repeated comment of the automobile drivers?

Fair□ not fair □ too much □ should be revised □

3. Are you interested working as parking ticketer? ----------

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---.

4. Do you think if the City Administration keep develop smart parking a solution for the contemporary city parking problems? ----------

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---.

5. Do you think that smart parking could be the solution to improve the traffic congestion?

---.

6. Any comment or suggestion regarding to the parking problems of the Addis Ababa City in most central or market areas write in details?----------

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APPENDIX: B

AAU College of Business & Economics School of Commerce

GRADUATE EXTENSION PROGRAM IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT STUDENT PREPARED QUESTIONER.

This interview questionnaire will prepare by graduate student of fellow extension logistics and supply chain management student based on MA thesis proposal on: Impacts of Smart Parking Development, As a Strategy to Reduce Parking Space Supply Problems: the case study of Megenagna and Markato smart parking in Addis Ababa: In partial fulfillment of the Requirement for the Award of Master of Arts in LOGISTICS AND SUPPLY CHAIN MANAGEMENT and for the use of educational service, on the other hand it uses for all stakeholders and concerned government party to solve the issues that the Addis Ababa City the contemporary serious parking problem facing. The questionnaire has no other any objective.

The questionnaire will take approximately maximum 30 minutes.

I guarantee that all of your answers will be completely confidential.

Thank you in Advanced for taking your time and willingness to cooperate.

By; Tesfaye Getachew (0911219607 or 0904400935)

Advisor; Tariku Jebena (PhD)

Section 1

Discussion checklist for officials and staffs of Addis Ababa transport bureau, traffic management agencies, traffic police and parking operators.

Discussion Points:

Background

• Name• Educational level• Occupation status to this organization

---------- ---------- ----------

 could you please tell the challenges and opportunities of smart parking? How can be improved the performance of parking?

 Have Addis Ababa Traffic Management Agency or Bureau or Traffic Police identified issues or Problems regarding to the smart parking problems?

 How differ underground parking from that of automated smart parking?

 Have this automated smart parking bring new things to customer?

 What did the (AATMA) learn from these smart parking developments problems/strength?

 What types of strategy and policy provide to solve the current parking practice?

 Are there any near future scaling-up similar projects in different parts of the city?

• If yes, will there be a change in the plan?

• Is there any near future proposal in system or approach of smart parking facility owning the service with stakeholders such as public private partnership (PPP); when planning and developing of these kinds of similar projects?

 What do you suggest and/or recommend to parking practice and future trend, and any other comments in relation to parking?

Section-2

- **Questionnaires for parking practices of the city.**

Key Performance Indicators: (KPI's)

No	Statement	Strictly Applicable		Applicable		Inapplicable	
	Addis Ababa current car parking condition	**No**	**%**	**No**	**%**	**No**	**%**
1.	has coordinated traffic management system strategy like road network, terminals and parking supply, roundabouts and junctions						
2.	recognizes the challenges and give alternative solution for parking supply problems						
3.	pays attention to serve the underground parking for their purpose rather than using for shops, store, etc						
4.	has special flow up to give training for illegal parking, street trade, the needs of disabled, children and pedestrian						
5.	ensures the performance of parking space supply lots are efficient						
6.	try to see other option to optimize parking space supply lots challenges						
7.	ensures that the parking places areas properly/ effectively utilized						
8.	has feasibility study for the parking spots arrangement and future service improvement						
9.	critically consider and enhance land supply for parking and terminal development in the central part of the city						
10.	ensure adequate parking space supply in the issuance of construction permit, monitor and control its implementation						
11	the on progress railway transport considers parking station at the train start and ends						

Annex -01

✓ As Norms and Standards of the Addis Ababa Structure Plan Components (May, 2002):

- **Parking and stopping places provision standards**

- Off - street of carriage way stopping points should be provided along major traffic lines at distance of 400 - 500m and at end points of buses trips.

- Types of on - street parking and standards

- **Formula:** Net built up area: = net built up area _ (net built up area*30%)

  Remark: (30% includes common features like stair case, corridors, lifts and other utilities)

  Formulas for different types of parking

Parallel parking: 2.5 x 5.9 m per car P No. $\frac{L}{5.9}$

30^0 angle parking: 5 x 2.5 m P No. = $\frac{L-1.25}{5}$

45^0 angle parking: 5 x 2.5 m P No = $\frac{L-1.77}{3.54}$

60^0 angle parking: 5 x 2.5 m = P No = $\frac{L-2.16}{2.89}$

90^0 angle parking: 5 x 2.5 m = P No = $\frac{L}{2.5}$

Notes:

L = Length of Kerb

P No = Number of parking spaces

Annex -02

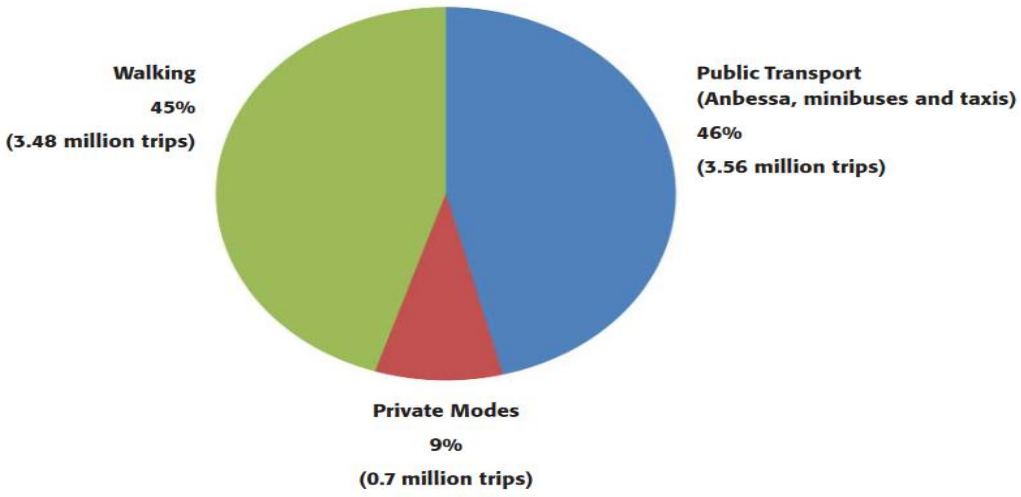

Figure source: Addis Ababa master plan, (2006) city transport modal share

Figure shows Meskel Square Underground Parking Lot Goes under Operation.

- **Photo of city parking lots**

Figure: 1:1 shows MSP

Figure: 1.2 Detection camera sensors showparking inbound/outbound cars control**.**