PARKING DEMAND AND SUPPLY IN THE CENTRAL BUSINESS DISTRICT OF DAR ES SALAAM CITY

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ABSTRACT

The Central Business District (CBD) of Dar es Salaam city is currently experiencing severe congestion. Among the major causes of this condition is lack of enough parking facilities. Obstructions due to vehicles parked on the roadway and increased vehicle circulation by drivers looking for a place to park are major contributors to congestion. This paper reports on a recent study which evaluated the demand and supply as well as usage of parking spaces in the CBD. The findings indicate that there is currently an acute shortage of parking spaces, especially of off-street parking spaces. For the existing facilities, there is lack of enforcement of parking regulations and maintenance as well as poor vehicle security. Suggestions for short term improvements are given together with tips for the development of a long term parking strategy.

1. INTRODUCTION

Parking is one of the three basic elements of a roadway transportation system, the other elements are the road and the vehicle. The arrangement and design of each element influence the overall performance of the total system. The following are characteristics associated with parking.

    (a) Parked vehicles on a stretch of road reduce its effective width and consequently its capacity.

    (b) Parked vehicles are an important cause of accidents.

    (c) Vehicles parked on every available open space brings about aesthetic deterioration.

    (d) Vehicles circulating while looking for a parking place increase the level of congestion.

The Central Business District (CBD) of Dar es Salaam City is currently experiencing extensive parking problems. The extent of these problems is evidenced by vehicles parked on side walks, islands and even before the "NO PARKING" signs. The net result of these parking practices, has been a reduction in street capacity in the CBD resulting in severe congestion, safety has been compromised and pedestrian movement obstructed. In addition, the aesthetic beauty of the city center environment has deteriorated.

1.1 **Objectives**: The purpose of this paper is to report on the study of parking characteristics which was carried out to assess the demand and supply, as well as the usage of parking facilities in the CBD of Dar es Salaam city. Specifically this paper will address the following:

    (a) Determination of parking demand and supply.

    (b) Evaluation of Parking usage in the CBD.

    (c) Suggestion of solutions to tackle current parking problems and evolution of a parking policy for DSM city.

2. BACKGROUND

Parking studies are generally carried out to identify parking inadequacies or to develop proposals for improvement of parking supply. Also a study can be conducted to determine where motorists can and do park, where they would like to park and how their parking practices affect the use of other transportation modes. Common to all types of studies whatever their scale, are parking supply and parking usage surveys. A parking supply survey is concerned with obtaining information regarding those on-street and off-street features that influence the provision of parking spaces, the existing situation with regard to parking spaces and how it is controlled. Whereas the parking usage survey provide useful data for the evaluation of concentration of parked vehicles within the study area, peak parking hour, turnover and duration of parking. It also provides information on the parking practices and parking irregularities and the degree of enforcement.

3. FIELD DATA COLLECTION

3.1 **Project site description:** The study area, referred to as the Central Business District (CBD) is in the context of this project made up of the area bounded by UWT street to the west, Uhuru and Railway streets to the south, Sokoine drive to the east, and Azikiwe with Maktaba streets to the north. This area is shown in figure 1.

3.2 **Parking supply survey:** The purpose of the survey was to quantify and classify the supply of the existing on-street and off-street parking spaces within the study area. On-street parking is defined as parking at the curbside or at the edge of the carriageway while off-street parking refers to parking on a surface lot or car park structure. As a pre-requisite to the inventory a coding system was established. A map of the study area was divided into blocks, bounded by streets on each side and assigned a number. On-street spaces were inventoried on foot by the observer traversing all streets within the study area identifying the number of available parking spaces while also observing other parking characteristics which include parking angle, marked or unmarked, restricted or unrestricted parking space(s), and metered space(s). The condition of the parking meters and the land use activities in the area were also noted.

Metered and marked spaces were counted directly by counting the number of parking meters or the parking stalls as they are marked. For unmarked and unmetered spaces the observer took the measurements of the length of each curb parking section. The measurements were used to determine the available number of parking spaces in a given curb section using the following standard values reported in (1,2,3).

                    parallel parking ---- 6.0 m per parking space
                    angle parking ------- 4.2 m per parking space
                    90 parking --------- 3.0 m per parking space

Off-street spaces were determined by the observer measuring the dimension of each lot in the area. By inspection and direct inquiry it was possible to classify each lot into the following categories private; commercial, public with restriction or public with no restriction. The results of inventory data are shown in figure 2 where the numbers of available parking spaces are also indicated for each type.

3.3 **Parking usage survey:** This was carried out to determine the characteristics of parking demand and supply in the study area. The method adopted was the license plate survey. This method in addition to being cheap can provide information relating to concentration, duration as well as turnover. It can also provide the values of parking demand per block. Because of the large size of the study area, the area was divided into small sections, consisting of 2 or 3 blocks that could be covered by an individual in a given trip interval. These sections are referred to as beats. The survey was carried out during week days that is from Monday to Friday excluding the holidays or days preceding holidays for a duration of 6-10 hours.

Before the survey was carried out a sample survey was conducted to determine the approximate peak parking period so that it may be included within the survey time. The trip interval between two successive checks was 30 minutes for on street parking an interval commonly used in shopping streets [2]. For off-street parking spaces a trip interval of 1 hour was adopted.

Fig. 1: NUMBER OF AVAILABLE PARKING SPACES AND PARKING INDEX

The Information collected is as follows:

    (a)   the last three digits of vehicle's registration number.

    (b)   whether the vehicle was parked illegally or legally
        (a vehicle parked anywhere other than on parking space
        was considered as illegally parked).

    (c)   whether the vehicle was parked on curb or off-street

    (d)   time when the data were collected

    (e)   name of the streets

    (f)   block number

4.   RESULTS AND DATA ANALYSIS

4.1 Parking Supply: There exists a total of 1873 parking spaces in the study area. Out of this total 377 (20%) are for off-street parking while 1496 (80%) are for on-street parking. It was observed that nearly all the available spaces are public with only a few exceptions. Only few agencies and companies have reserved blocks of spaces for their employees and customers parking e.g FAO, CMC Motors, etc., the rest of the private spaces are isolated and reserved for individuals who have businesses or residences near the location. The fee for such spaces at the time of the survey was Tshs. 2000 per year payable to the city council.

The off-street parking lots with a total capacity of 377 spaces, are made up of 5 big lots and a host of smaller ones as shown in figure 2. Of the big lots, the ones on Simu street opposite the Posta Club and the one on the junction of Mtendeni/Mrima street contained very few vehicles at any time compared to their capacities. The off-street parking lot at the junction of Zanaki/Samora streets have an option for drivers who wish to pay for the security of their vehicles. The charge was 200/= at the time of the survey and the service was provided by a private individual. All off-street parking lots have no pavement marking and are unsigned.

Figure 1 shows the total available spaces per block as well as the parking index. The index is the ratio of parking demand to supply expressed as a percentage. Thus:

$$PI = 100p/P \quad \text{where} \quad \begin{array}{l} PI = \text{parking index} \\ p = \text{parking demand} \\ P = \text{parking supply} \end{array}$$

From figure 1 it can be seen that the value of PI varies from block to block. The highest values are found on those blocks that have little or no parking spaces, but where vehicles are found parked on sidewalks during the peak. Eight out of 62 blocks have a parking index of 100 or less, of these three are in blocks that contain an off-street parking lot. For those streets without any parking spaces, the vehicles were always parked in such a way that half the vehicle occupied the pedestrian sidewalk while the rest occupied a section of the street.

A number of things were observed during the parking supply survey, among them the fact that:

    (a) All Parking in the CBD is free apart from the isolated spaces reserved
        by individuals and the parking garage at the Extelecoms Building.

    (b) Nearly all the parking meters are out of order and for those few
        that are still working no attempt is made to enforce payment.

    (c) There are very few parking spaces reserved for residents of the CBD.

Fig. 2: PARKING SPACES INVENTORY DATA.

4.4 Parking turnover: This is an average number of times that a parking space is used by different vehicles during a given period of time.   In the determination of parking turnover only legally parked vehicles were considered. This data is crucial if a commercially run parking system is to be instituted. Different blocks show different values of parking turnover.   The highest value of parking turnover is 1.57 vehicles per space per hour and the lowest value is 0.45 vehicle per space per hour.

4.2   Parking Concentration: Concentration or accumulation shows the variation of the number of parked vehicles with time of day. Figures 3 and 4 shows the typical variation for on-street and off-street parking.   There exists two peaks for the on-street parking, one occurring at about 10.30 am and the others at 3.00 pm.   The 10.30 am peak is the larger of the two.   For the off-street parking there exists only one peak which occurs at about 11.00 am.   This information can be used to set times when one has to pay for on-street parking.

4.3   **Parking Duration**: The purpose of duration surveys was to determine the lengths of time that vehicles are stored within the survey area.   The data used for concentration survey was used again to estimate the time during which each vehicle remained parked in a given space.   Table 1 shows average values for all blocks studied.

Table 1: Parking Duration

Number of times each vehicle was seen	Approximate Duration of Parking (hrs)	Vehicles (Total = 6459)	
		Number	Percentage
1	0.5	4828	74.7
2	1.0	1046	16.2
3	1.5	269	4.2
4	2.0	146	2.3
5-6	2.5-3.0	86	1.3
7-8	3.5-4.0	47	0.7
8+	4.0+	37	0.6

When the data for each block surveyed was analysed it was found that [4]:

(a) For all the blocks surveyed the percentage of vehicles parked for 30 minutes is greater than 60% of the total number of parked vehicles.   The exception is block 22 which has a 47.3% of total parked vehicles with a duration of 30 minutes.

(b) Blocks 48 and 52 have the highest percentage of vehicles parked for 30 minutes (92.3%) and also the lowest percentage of vehicles parked for more than 4 hours (0.2 %).

(c) Block 22 shows the highest percentage of vehicles parked for more than 4 hours (2.7%) and also the largest percentage of vehicles parked for more than an hour (27.5%).

For on-street parking more than 60% of vehicles are parked for about 30 minutes where as for off-street parking more than 70% of the vehicles are parked for about 1 hr.
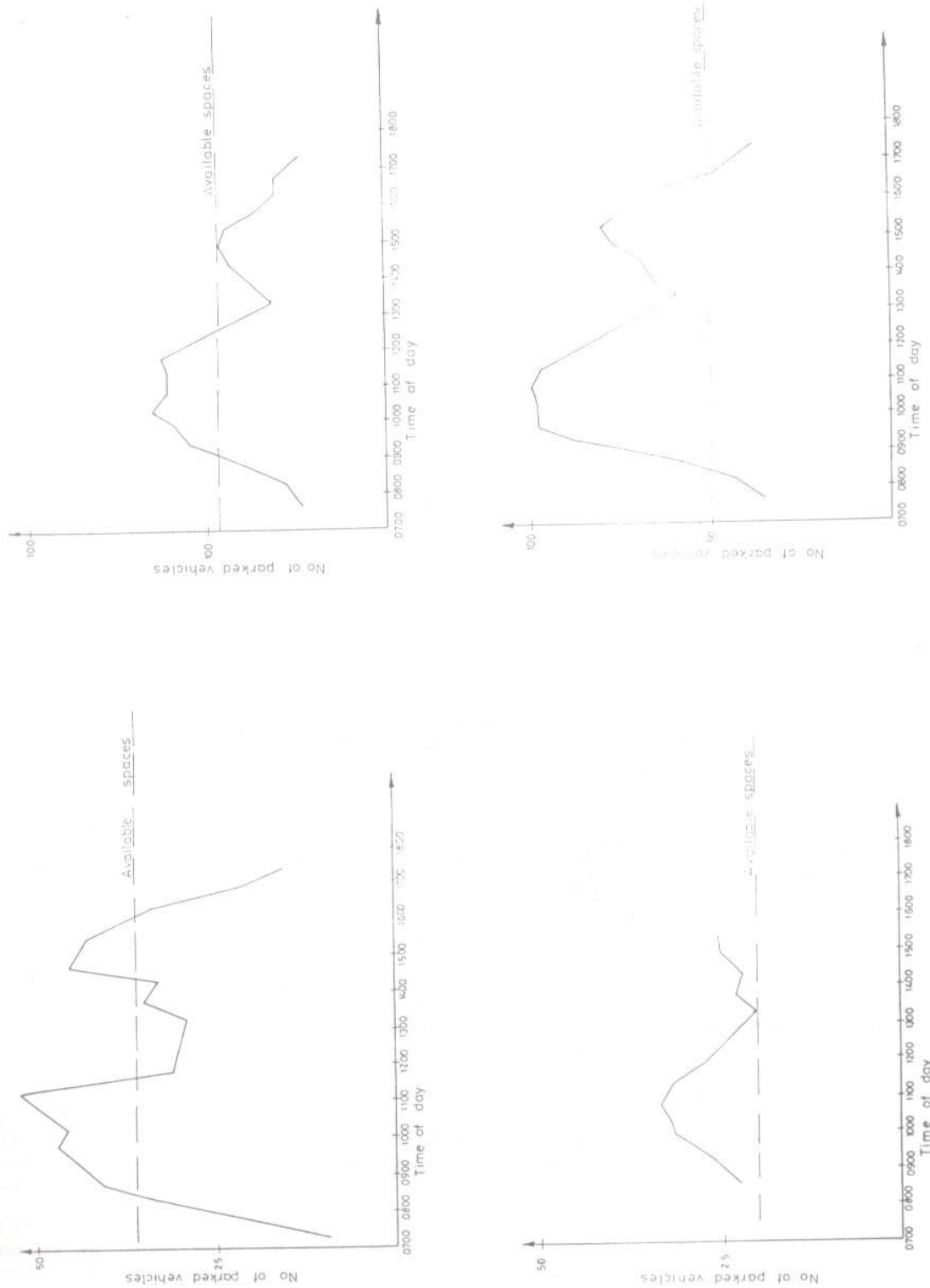
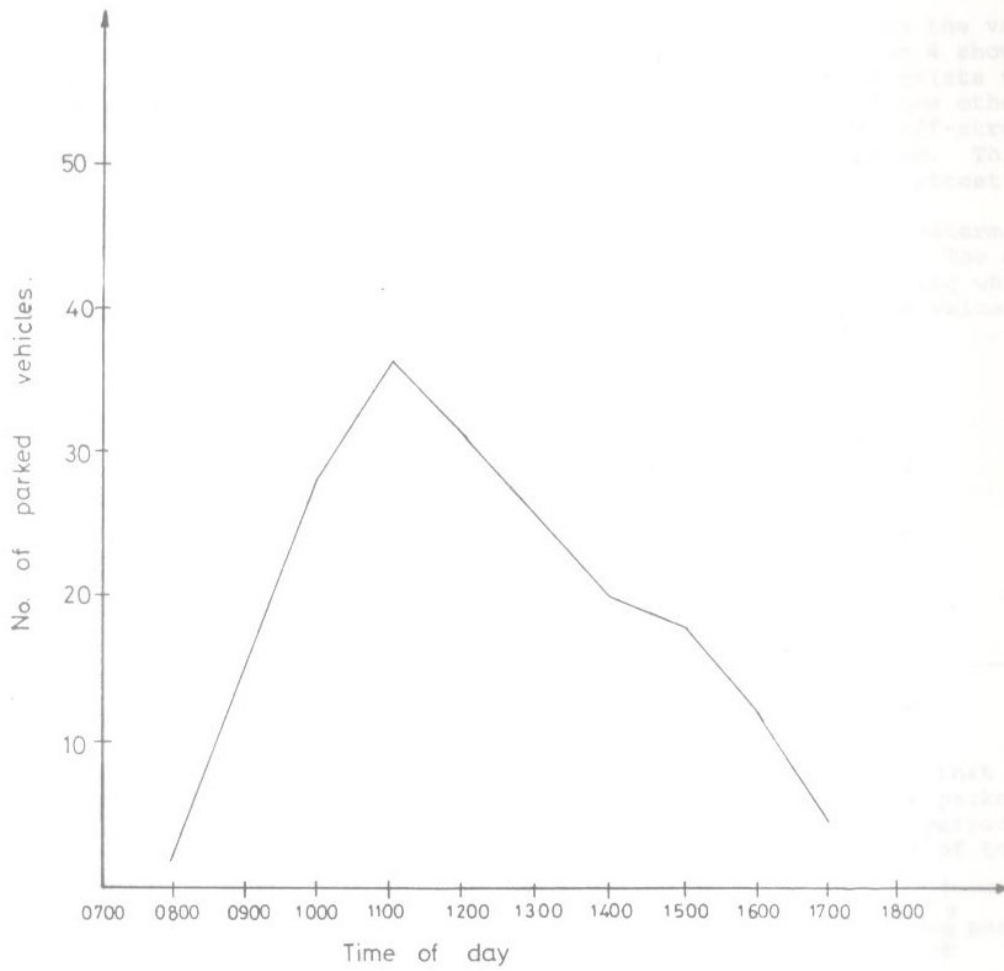Fig. 3: CONCENTRATION OF PARKED VEHICLES FOR ON STREET PARKING

Fig. 4 :   Concentration of parked vehicles at off - street
parking lot opposite Avalon cinema.

Table 2: Values of Parking turnover for Selected Blocks

BLOCK NO	48&52	51	55&56	32	39	26	28&29	22	59	9	13	7	40	43&45
No. of spaces	73	36	20	92	50	52	56	45	23	47	42	33	46	50
Study period h Diff. vehicles parked	10 695	10 252	6.5 150	10 698	6.5 295	10 300	10 386	5.5 157	10 103	10 338	5.5 150	10 350	10 640	5.5 4.32
Turnover	9.52	7.01	7.50	7.60	5.90	6.00	6.90	3.50	4.50	7.20	3.60	10.6	13.9	8.64
Vehicle per space per hr.	0.95	0.70	1.15	0.76	0.91	0.60	0.69	0.63	0.45	0.72	0.65	1.06	1.06	1.57

5.   DISCUSSION OF RESULTS

From the data presented in the preceding sections, the extent of the parking problem in the CBD of Dar es Salaam is apparent. The following discussion refers to the major parameters investigated.

5.1 **Parking capacity and Demand**: Theoretically capacity as described in the inventory, means the number of available parking spaces. The practical capacity is of course less due to the time lost during turnover and drivers who encroach on adjacent spaces. This is an important factor in Dar es Salaam where most of the parking spaces are unmarked. Off-street parking spaces in Dar es Salaam constitute about 20% of total available spaces but contain only 13% of total parked vehicles. From figure 1 it can be seen that of 62 blocks, 56 blocks have a parking index of more than 100 during the morning peak period. This shows that the demand far exceeds the supply by a very large margin. For Samora avenue the parking index varies from 114 to 312 with an average of 167. The result of this block by block analysis is that most of the CBD is highly congested and nearly all existing parking regulation are ignored.

The excess vehicles are parked illegally, mostly on pedestrian sidewalks, streets and before the "NO PARKING" signs. The percentage of on-street parking is very high for a city of this size [4]. The accepted average should be 30% of all vehicles for all trip purposes. This has resulted in severe congestion on most streets, due to the reduction in street widths and the increasing volume of circulating vehicles looking for a parking space.

The obvious solution to these problems would be provision of sufficient off-street parking spaces. But the survey has shown that current available off-street parking spaces are not fully utilised. The reason for this is the apparent lack of security for vehicles. As a result most motorist are not willing to leave their cars at locations far from their destinations, since most of these lots are not provided with any security. Eventually the solution for the parking problem in the CBD will be to increase the number of off-street parking facilities, by provision of parking garages with appropriate security. This will have to be complemented by detailed information by way of signs to indicate the location and availability of these places.

Another approach that can help reduce congestion would be to try and reduce demand by an imposition of parking fees and taxes.[5] Through the judicious use of fees certain groups of users may be discouraged from downtown street parking. Parking meters or other means of imposing a maximum parking time can prevent long term parking in the CBD, and this in turn can alleviate the pressure on parking spaces. Permit systems can likewise effectively control car park occupancy.

Finally strong enforcement of existing prohibitions can prevent a situation like the current one in the CBD, where safety, capacity and the movement of public transport and emergency vehicles are strongly hampered. In order for the enforcement to be successful, the following factors must be considered. The first factor is the detection probability, i.e. the chance that an illegal parker will be ticketed. The second is the punishment probability; what are the chances that he/she will have to pay the fine. And thirdly, the amount of the fine plays a role. Only the product of the three factors is relevant for the level of enforcement.

5.2 Parking Usage: The parking phenomenon is very much based on the law of supply and demand discussed above, whereby supply is the total number of available spaces within a designated area, and demand is the desire to park based solely on the location of the trip destination. However, unlike the true supply and demand situation, there is a third variable; usage associated with parking which reflects the desire to park close to the destination, but within the limitations imposed by the available supply. In other words demand is a constant reflecting the desire to park at the trip destination, whereas usage is a variable that depends upon conditions at the terminal area and upon the characteristics of the trip as well as of the tripmaker. Some other important parameters found in the usage survey are discussed below:

5.2.1 Peak hour: In the CBD of DSM city there are two peaks associated with parking usage. These are the morning peak at about 10.30 am and the afternoon peak at about 3.00 pm. The 10.30 am peak is the highest, at this time parking related to work and business is at its highest and parking linked to residence at its lowest. It is estimated that at this time about 30% of vehicles are parked for shopping and short-term business purposes. These estimates are based on the assumption that parking for work trips is complete by 9.00 a.m and any increased demand after that time as illustrated in figure 3 is for shopping and short term business purposes. One approach to dampen the morning peak would be to discourage long term parking by use of Parking meters. The shopping function in DSM is carried out during weekdays because most shops are closed saturday afternoon and the whole day sunday.

5.2.2 Walking Distance: Every parking manoeuvre ends with a walk to the final destination. A short walking distance is usually considered a positive aspect of a parking system. In DSM however vehicle security was found to be more important, in that motorist want to park where the safety of their vehicle can be guaranteed. In developing an improved system for DSM both the walking distance and vehicle security will have to be taken into account.

5.2.3 The cost of Parking to Users: The cost to the user usually comprises of the money costs for the parking place and other costs as a result of searching time and walking distance. Since practically no charges are collected for any parking place in the CBD with the exception of a few parking spaces, the only major user cost at the moment is that for searching time and other costs associated with congestion.

5.3 Parking Duration: The survey results indicate that more than 70% of the vehicles surveyed (6459) were parked for an average duration of 30 minutes or less. It is usually possible to associate trip purpose with parking duration. In fact trips for shopping, business or to pay a visit are relatively short duration. Home work trips involve longer parking durations and the survey data supports this generally, however there is need for a comprehensive survey to obtain the precise proportion.

6. CONCLUSIONS

On the basis of the data collected and analysed and subsequent discussion the following conclusions seem warranted.

1. Parking supply in the whole CBD of DSM is much less than current peak demand. In some areas of the CBD the supply is less than the demand for most of the day i.e for the period 9.00 am to 4.00 pm.

2. Due to insufficient supply of parking facilities and lack of enforcement, illegal parking takes place almost on all streets of the CBD.

3. Most of the Parking spaces are on-street with no marking and in most cases no information signs.

4. Motorists are reluctant to use the existing off-street facilities due to the lack of security.

5. The effect of illegal parking and vehicle circulation while looking for a parking space has increased the level of congestion in the CBD.

6. Almost all the parking meters are out of order and this has led to an increase in parking duration on busy streets.

7. There are no open spaces within the CBD, therefore development of new facilities will have to be by way of multistorey parking garages.

7. RECOMMENDATIONS:

In order to improve the existing parking characteristics and to provide the solution for the parking demand in the study area, the following measures are recommended.

1. The DSM city council which is the authority responsible for parking in the CBD should conduct a comprehensive parking study so as to enable it to develop improvement measures for both short and long term parking.

2. Parking signs should be installed at all strategic locations to give guidance to drivers as to the existence of parking facilities.

3. DSM city council should provide security at all of its off street parking facilities.

4. As a short term improvement measure all parking meters should be repaired and pavement markings introduced and maintained so as to improve efficiency in the use of existing facilities.

5. Enforcement of Parking regulations should be strengthened immediately so as to alleviate congestion and improve safety.

6. Multistorey parking garage(s) will have to be constructed in the CBD to cater for the current excess demand and the predicted future demand.

8. REFERENCES:

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