International Journal of Civil Engineering and Technology (IJCIET)
Volume 10, Issue 01, January 2019, pp. 2210–2223, Article ID: IJCIET_10_01_199
Available online at http://iaeme.com/Home/issue/IJCIET?Volume=10&Issue=1
ISSN Print: 0976-6308 and ISSN Online: 0976-6316
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INTEGRATED AND COORDINATED TRAFFIC MANAGEMENT BASED ON CENTRAL BUSINESS DISTRICT IN MAKASSAR CITY INDONESIA

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ABSTRACT

The research objective is to evaluate the performance of intersections around the central area of urban activities, analyze queues and delays that occur in the area, openings and existing canalization, analyze the level of accessibility from the influence of traffic management, from obstacles to various privacy activities, determine the optimization of traffic light functions coordinated and integrated. The research method is generally carried out through direct surveys, mathematical analysis and comparative analysis. Mathematical analysis is done iteratively to get the best cycle time as an integrated and coordinated intersection function. Graphically, it can facilitate the drawing and reading of the best cycle times for various intersections that are included in the design. The results obtained showed that the densest traffic volume in the CBD area occurred at the intersection 7 and 12, with the 42.02–72.59% composed of vehicles dominated by motorbikes, while jeeps between 6.72 – 35. 63%. The capacity of Intersection in this area averages 6,809 passenger car unit (pcu) / hour, so that the Degree of Saturation averages 0.895 with the maximum is 0.917. The highest chance of queuing occurs in unsignalized intersections in the CBD area between 42-84% which occur at the intersection 7 and 12 with the highest delay was 38.18 seconds (intersection 2). The level of accessibility of this region was high but because of the high side barrier. Intersection capacity improvement through geometric improvements, channelization, improvement and optimization of integrative traffic light functions, has the potential to contribute up to 36% and based on simulations with VISSIM program aids until the projections for 2025 can be maintained contributing to an increase in capacity of up to 22%.

Key words: central business district, queue, delay, integrated, coordinated, transportation.

Cite this Article: Lambang Basri Said and Ilham Syafey, Integrated and Coordinated Traffic Management Based on Central Business District in Makassar City Indonesia, *International Journal of Civil Engineering and Technology (IJCIET)* 10(1), 2019, pp. 2210–2223.
http://iaeme.com/Home/issue/IJCIET?Volume=10&Issue=1

1. INTRODUCTION

Traffic congestion is a challenge that leads to undesirable impact on the spatial and economic development of cities and regions in most cities in the world. It may reduce the investment of transport infrastructure [1]. Many large and medium cities in developing countries, especially the central business district (CBD) encounter this challenge and are very much affected by the mobility problem [2].

The success of the regional development leads to the growth of various sectors including transportation. The development of urban centers, superblock areas, and several other activity centers that have been carried out lately has a direct impact on the movement of traffic on the road network system that exists around the area both on roads and on junctions. Development will certainly lead to the occurrence of seizures and traffic pulls caused by activities in the region. Traffic Impact Analysis (TIA) is still understood as an analysis of the influence of the development of land use on the system of movement of traffic flow around it. The effect of this traffic movement can be caused by the generation of new, switched traffic, and of vehicles going in and out of / to the development land. Traffic movements generally experience high barriers precisely at the intersection area, even about 70% of the problems stem from the junction and have a wide impact on roads. This situation occurred in many cities in Indonesia including Makassar. Administratively, Makassar is the provincial capital of South Sulawesi. The city area is 175.77 square kilometers covering to 14 sub districts, while the number of vehicles in South Sulawesi reaches up to 2.2 million units. The growth of four-wheeled in South Sulawesi for motor vehicles reach 8-10% each year [3].

Various previous studies suggest that each activity space generates movement in a certain amount, whose intensity depends on the type of land use. The development areas such as modern and conventional shopping centers, malls, hotels, apartments and others, cause additional generation of new traffic due to additional activities around the area. The study of traffic-orderly areas and their application has been limited to roads and does not integrate with intersections or not fully area-based which combines both between roads and intersections. The previous study asserts that synchronizing time slots between traffic lights is very important to maintain a stable traffic flow [4]. The objectives of this study are to (1) evaluate the performance of intersections around the central city area, (2) analyzes congestion and delays that occur in the area, openings and existing canalization, (3) analyze the level of accessibility from the influence of traffic management, from obstacles to various private activities, and (4) determine the optimization of coordinated and integrated traffic light functions. This research is expected to provide diversified benefits to identify traffic area problems by conducting surveys related to road infrastructure, sections and intersections, road users, vehicles, traffic conditions and data compilation and analysis and design and development of Low Cost Traffic Management (LCTM) through the use of integrated traffic light management and coordinated.

2. METHOD

This study was done in Panakukang area the Makassar city. This area is a central business district consisted of many shopping centers, and hotels. In this study site 26 the street network and 14 intersections in crowd area was selected as the location of observation. The diagram of the network of the intersection was presented in Fig. 1, while the names of the intersection were presented in Table 1.

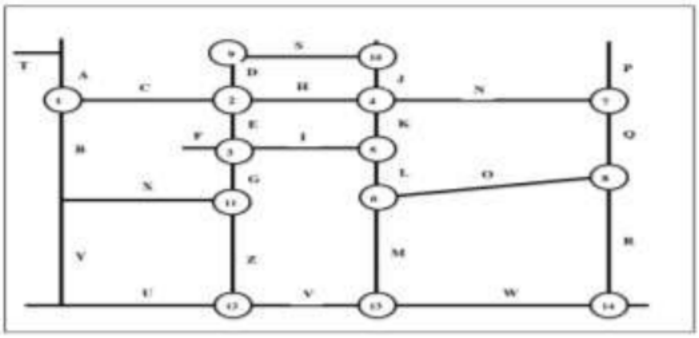

Figure 1 Survey was conducted in 26 the street network and 14 intersections

Table 1 Names of intersections in CBD of Makassar city

No.	Intersection name	No.	Intersection name
1	Abd. Dg. Sirua1– Adyaksa	8	Hertasning – Bau Mangga
2	Adyaksa Baru–Boelevard–Meranti	9	Pandang Raya – Mirah Seruni
3	Boelevard – Boegenville	10	Pengayoman – Mirah Seruni
4	Adyaksa Baru – Pengayoman	11	Boulevard - Bau Mangga
5	Boegenville – Pengayoman	12	A.P.Pettarani – . Boelevard
6	Bau Mangga – Pengayoman	13	A.P.Pettarani - . Pengayoman
7	Adyaksa Baru – Hertasning	14	A.P.Pettarani – Hertasning

Data taken in connection with this research and its sources can be described as follows; Direct (primary) surveys were directed in the area for four days in all 12 sections of 8 intersections to find out the latest vehicle volume, travel time at a certain distance and optimize the use of crossing roads in the area. Secondary data related to Regional Regulations, Legislation, Government Regulations and Decrees of the Minister of Transportation. The collected data were made in the form of tables to facilitate processing, some of the variables needed include: traffic volume, queue length and the chance of queuing, saturated flow, travel time, delay, assessing the existing intersection performance as the basis for determining traffic orderly areas. Data associated to all the parameters needed in designing traffic light along with an overview of the potential integrated and coordinated intersections to help planning. The study carried out mathematical and graphical formulations of the identification and problems related to the policy of carrying out road traffic that had been carried out, along with this study of the theory and other related literature. Questionnaires as a technique of gathering supporting information by offering a series of questions put to respondents in this case road users from various communities proportionally.

Mathematical analysis was done iteratively to get the best cycle time as an integrated and coordinated intersection function. Analysis can also be held by the Vissim or Transit program to guarantee the accuracy of computations. Diagrammatically, it can ease the drawing and reading of the best cycle times for several intersections that are included in the plan.

Signal management of a number of coordinated and integrated intersections, namely experiencing additional to 14 intersections. Signal timing included indicators based on Indonesia's road capacity manual including: a). Cycle time is a subprogram of the total lost time per cycle and the ratio of the current to the saturated current, b). Green time where the vehicle can cross at the intersection before giving the opportunity to other vehicles alternately, c). Saturated current values can be shown as a result of multiplication of basic saturated currents, namely saturated current in the standard state of the adjustment factors (F) for deviations from the real conditions of a set of conditions (ideal) that have been previously defined, namely [3], d). Capacity and degree of saturation that describe the ability of a segment or intersection to accommodate the flow of traffic movements in a certain time unit. The degree of saturation is the ratio of traffic flow to the capacity for an approach. e). Queues are also estimated as opportunities and the number of vehicles queuing in an intersection approach, f). Delays were additional travel times needed to go through intersections when compared to trails without going through intersections, delays can usually be divided into traffic delays and geometric delays. The average traffic delay (TD), due to mutual influence with other movements at the crossing, whereas the average geometric delay (GD), due to deceleration and acceleration when waiting for about at an intersection and or when stopped by a red light. The average delay for all intersections (DI), was obtained by dividing the number of delay values by the total current (Q) in pcu / hour, as in the following equation:

$$DI = \frac{\sum (QxD)}{Q_{TOT}} \tag{1}$$

where :

D : delay for approach A, (s/pcu)

Q : Adjusted flow for approach A, (pcu/h)

Traffic delays at intersections that do not use signals represent the average traffic delay for all motorized vehicles entering the intersection.

- **For DS (0,6:**

$$DT_I = 2 + (8{,}2078 \times DS) - [(1 - DS) \times 2] \tag{2}$$

- **For DS > 0,6:**

$$DT_i = \frac{1{,}0504}{[0{,}2742 - (0{,}2042 \times DS)]} - [(1 - DS) \times 2] \tag{3}$$

3. RESULTS AND DISCUSSION

3.1. Daily Traffic Volume Intersection

Table 2 Traffic volume (pcu/hour) of vehicle at all intersections

TIME	TRAFFIC FLOW (Q) PCU/hour													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
07.00 - 08.00	3,528	3,736	3,421	3,549	2,975	2,046	3,209	1,985	2,655	3,494	2,363	5,896	5,078	8,096
08.00 - 09.00	2,958	3,873	3,652	3,706	3,014	2,250	3,985	3,621	3,642	3,695	2,599	7,322	6,306	6,789
09.00 - 10.00	2,377	4,784	3,516	3,555	2,801	1,945	2,788	2,875	3,199	3,548	2,247	5,123	4,412	5,454
10.00 - 11.00	1,883	4,324	3,733	3,717	2,631	1,937	2,196	2,433	3,072	3,748	2,237	4,035	3,475	4,321
11.00 - 12.00	2,399	4,962	4,090	3,787	2,786	1,911	2,727	3,045	3,553	3,966	2,207	5,010	4,315	5,505
12.00 - 13.00	2,149	5,170	4,168	4,262	3,307	2,351	3,463	3,433	3,792	4,234	2,715	6,364	5,481	4,932
13.00 - 14.00	2,330	5,162	4,278	4,613	3,288	2,404	3,381	3,357	3,819	4,452	2,777	6,213	5,351	5,348
14.00 - 15.00	1,984	5,091	3,896	4,095	2,829	2,140	2,438	2,738	3,300	4,024	2,472	4,479	3,858	4,553
15.00 - 16.00	2,112	5,026	3,820	4,149	2,918	2,201	2,415	2,866	3,342	3,998	2,542	4,438	3,822	4,847
16.00 - 17.00	2,587	5,046	3,937	3,960	3,265	2,448	2,802	2,960	3,445	3,973	2,827	5,149	4,434	5,937
17.00 - 18.00	2,728	5,615	4,090	4,300	3,037	2,919	3,582	3,676	3,888	4,214	3,371	6,582	5,668	6,262
18.00 - 19.00	2,967	5,685	3,952	4,024	3,050	2,575	3,602	3,730	3,854	4,017	2,974	6,618	5,700	6,810
19.00 - 20.00	3,002	4,830	3,883	4,413	3,657	2,551	3,755	3,523	3,725	4,160	2,946	6,900	5,942	6,891
20.00 - 21.00	3,000	4,835	3,620	4,246	3,499	2,382	3,257	2,494	3,101	3,935	2,751	5,985	5,154	6,885
AVERAGE	2,572	4,867	3,861	4,027	3,076	2,290	3,114	3,053	3,456	3,961	2,645	5,722	4,928	5,902

This study showed that vehicle volume on 7 of the 14 intersections was fairly dense. One of them is shown in Table 4 that the total traffic volume that crosses the intersection on average from morning to afternoon is 4,027 pcu / hour, where the highest value is 4,613 pcu / hour and the smallest volume is 3,549 pcu / hour. Overall, it can be seen that the accumulation of vehicle movement concentrations occurred at the approach of intersection 13 and 14. In other words the direction of movement was dominated by straight movement of a vehicle.

The phenomenon of traffic movement from one of the intersections in the study area, along with the composition of each type of vehicle can be described as follows:

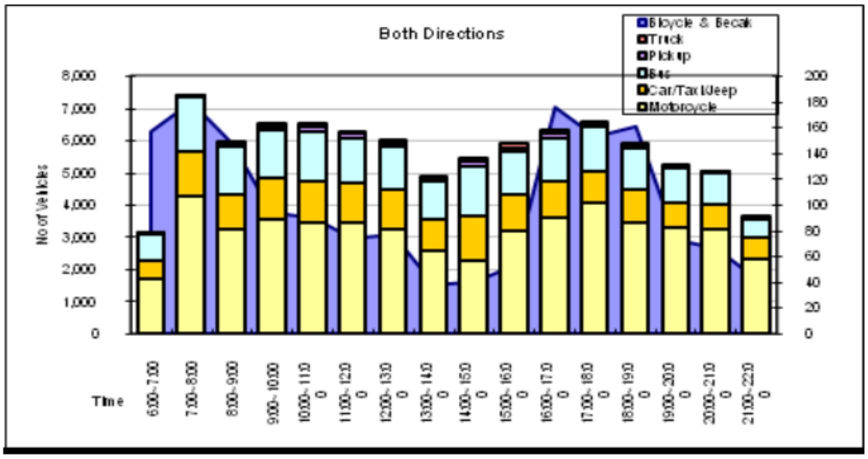

Figure 2 One of the phenomena of volume in the CBD area

That the composition of the largest vehicles was dominated by motorcycle with a composition of 42.02% - 72.59%, then followed by citycar/jeep, van and mini bus vehicles (private vehicles) with a composition of 6.72% - 35.63%.

3.2. Analysis of Intersection Performance

Table 3 Intersection capacity in CBD area

TIME	INERSECTION CAPASITY (C) PCU/hour													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
07.00 - 08.00	6,345	5,968	4,792	5,402	3,961	3,054	4,267	3,669	4,231	5,097	3,359	7,467	6,401	9,518
08.00 - 09.00	4,086	6,412	4,688	5,402	4,174	3,024	3,981	4,316	4,502	5,045	3,326	6,967	5,972	6,129
09.00 - 10.00	4,660	7,464	4,751	5,402	4,489	3,078	4,035	3,803	4,277	5,077	3,386	7,061	6,053	6,990
10.00 - 11.00	5,319	6,463	4,626	5,402	4,176	3,070	4,223	3,131	3,879	5,014	3,377	7,390	6,335	7,979
11.00 - 12.00	5,342	7,461	4,723	5,402	4,333	3,033	4,169	3,787	4,255	5,063	3,336	7,296	6,254	8,013
12.00 - 13.00	6,054	6,714	4,662	5,402	4,251	3,010	4,032	4,116	4,389	5,032	3,311	7,056	6,048	9,081
13.00 - 14.00	6,068	6,901	4,780	5,402	4,178	3,106	4,011	3,726	4,253	5,091	3,417	7,019	6,017	9,102
14.00 - 15.00	5,542	6,965	4,442	5,402	4,041	3,075	4,203	3,364	3,903	4,922	3,383	7,355	6,305	8,313
15.00 - 16.00	5,662	6,971	4,586	5,402	4,122	3,083	4,094	3,457	4,022	4,994	3,391	7,165	6,141	8,493
16.00 - 17.00	5,539	6,728	4,605	5,402	4,133	3,110	4,252	3,524	4,065	5,004	3,421	7,441	6,378	8,309
17.00 - 18.00	5,523	6,915	4,596	5,402	4,160	3,063	4,103	4,000	4,298	4,999	3,369	7,180	6,155	8,285
18.00 - 19.00	5,526	7,590	4,517	5,402	4,326	2,991	3,698	3,889	4,203	4,960	3,290	6,472	5,547	8,289
19.00 - 20.00	6,255	6,457	4,479	5,402	4,768	3,040	3,685	3,624	4,052	4,941	3,344	6,449	5,528	9,383
20.00 - 21.00	6,012	6,320	4,536	5,402	4,635	3,054	3,668	2,777	3,657	4,969	3,359	6,419	5,502	9,018
AVERAGE	5,567	6,809	4,627	5,402	4,268	3,057	4,030	3,656	4,142	5,015	3,362	7,053	6,045	8,350

Intersection capacities in this study range from 3,057 to 8,350 pcu/hours. The lowest capacity was found at intersection 6. In this intersection the capacities ranged from 2,991 pcu/hour (at the evening) to 3,110 pcu/hour (at the afternoon). The highest capacity was found at the intersection 14. In this intersection the capacities ranged from 6,129 pcu/hour to 9,518 pcu/hour (at the morning) (Table 3).

The Degree of Saturation of Intersections in the CBD area was considered high. It ranged from 0.714 to 0.835. This phenomenon showed that traffic movements in the CBD area were disrupted and experience long queues of vehicles to delays. Hence, travel time became longer with very low service levels. The description of the phenomenon of all intersections reviewed can be pictured in Table 4 as follows.

Table 4 Degree of saturation in CBD area

TIME	DEGREE OF SATURATION (DS)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
07.00 - 08.00	0.556	0.626	0.714	0.657	0.751	0.670	0.752	0.541	0.628	0.686	0.704	0.790	0.793	0.851
08.00 - 09.00	0.724	0.604	0.779	0.686	0.722	0.744	1.001	0.839	0.809	0.733	0.781	1.051	1.056	1.108
09.00 - 10.00	0.510	0.641	0.740	0.658	0.624	0.632	0.691	0.756	0.748	0.699	0.664	0.726	0.729	0.780
10.00 - 11.00	0.354	0.669	0.807	0.688	0.630	0.631	0.520	0.777	0.792	0.748	0.663	0.546	0.549	0.542
11.00 - 12.00	0.449	0.665	0.866	0.701	0.643	0.630	0.654	0.804	0.835	0.784	0.662	0.687	0.690	0.687
12.00 - 13.00	0.355	0.770	0.894	0.789	0.778	0.781	0.859	0.834	0.864	0.842	0.820	0.902	0.906	0.543
13.00 - 14.00	0.384	0.748	0.895	0.854	0.787	0.774	0.843	0.901	0.898	0.875	0.813	0.885	0.889	0.588
14.00 - 15.00	0.358	0.731	0.877	0.758	0.700	0.696	0.580	0.814	0.846	0.818	0.731	0.609	0.612	0.548
15.00 - 16.00	0.373	0.721	0.833	0.768	0.708	0.714	0.590	0.829	0.831	0.801	0.750	0.620	0.622	0.571
16.00 - 17.00	0.467	0.750	0.855	0.733	0.790	0.787	0.659	0.840	0.848	0.794	0.826	0.692	0.695	0.715
17.00 - 18.00	0.494	0.812	0.890	0.796	0.730	0.953	0.873	0.919	0.905	0.843	1.001	0.917	0.921	0.756
18.00 - 19.00	0.537	0.749	0.875	0.745	0.705	0.861	0.974	0.959	0.917	0.810	0.904	1.023	1.028	0.822
19.00 - 20.00	0.480	0.748	0.867	0.817	0.767	0.839	1.019	0.972	0.920	0.842	0.881	1.070	1.075	0.734
20.00 - 21.00	0.499	0.765	0.798	0.786	0.755	0.780	0.888	0.898	0.848	0.792	0.819	0.932	0.937	0.763
AVERAGE	0.467	0.714	0.835	0.745	0.721	0.749	0.779	0.835	0.835	0.790	0.787	0.818	0.822	0.715

As previously explained, traffic delays are time lost due to obstacles arising from various activities around the intersection. The term of semi-empirical adjustments in the Webster model have been modified and calibrated based on field observations of delays for different control conditions at signaled intersections [5]. Traffic Delays ranged from 6.78 to 31.90 vehicles/second. The lowest delay was found at intersection 2, while the highest was found at intersection 4. It meant that if there were 1,000 vehicles in the queue, then the potential delay became around 8 hours. The magnitude of the delay of each intersection from the results of the analysis can be seen in the table 5.

A previous study has used queuing theory and suggested possible solutions to encourage greater efficiency, thereby reducing customer waiting time and wasted money [6]. In addition, another study also argues that the queues at each intersection almost always occur, so there needs to be an effort to analyze the contribution and application of queuing theory in the field of traffic congestion [7].

The different analytical queuing models for traffic on the road network needs to be presented [8]. In the literature, it has been shown that queuing models can be used to model flows that are not adequately disturbed. This paper provides a broad review of this literature. In addition, it is shown that published developed methodologies (which are primarily oriented on a single node) can be extended to the queue network

Table 5 Traffic delays in CBD intersections

TIME	DELAY (D)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
07.00 - 08.00	10.251	6.019	8.062	21.823	8.697	8.626	12.287	6.293	9.257	11.823	7.018	10.901	8.058	9.337
08.00 - 09.00	12.126	5.702	9.183	22.031	9.442	9.434	19.073	9.567	11.070	12.031	6.702	15.027	11.167	12.189
09.00 - 10.00	9.964	6.106	9.822	21.909	8.555	8.181	11.313	6.612	9.308	11.909	7.125	8.874	7.763	9.946
10.00 - 11.00	8.558	6.255	9.387	22.238	8.550	8.195	9.403	6.401	8.875	12.238	7.254	7.576	6.589	8.837
11.00 - 12.00	9.376	6.368	10.111	36.432	8.715	8.216	10.843	6.923	11.123	16.432	7.357	8.542	6.889	10.064
12.00 - 13.00	8.520	7.387	12.379	38.182	10.032	9.783	14.361	7.343	12.497	18.182	8.443	11.257	8.518	8.447
13.00 - 14.00	8.756	7.116	12.927	37.697	10.117	9.672	14.003	7.924	12.527	17.697	8.114	11.242	9.122	9.126
14.00 - 15.00	8.468	6.857	9.952	36.761	9.321	8.849	9.828	6.834	11.109	16.761	7.815	7.768	6.759	9.866
15.00 - 16.00	8.693	6.869	9.811	37.064	9.336	9.065	10.102	7.034	11.247	17.064	7.868	7.592	6.993	9.563
16.00 - 17.00	9.504	7.097	11.790	36.544	10.150	9.836	10.931	7.167	11.877	16.544	8.087	8.557	6.778	10.256
17.00 - 18.00	9.711	7.786	14.215	36.534	11.939	12.123	14.711	8.161	13.398	16.534	8.789	11.254	10.245	11.457
18.00 - 19.00	10.198	7.117	13.825	36.522	9.320	10.737	15.892	8.593	13.263	16.442	8.118	12.118	12.451	11.202
19.00 - 20.00	10.000	7.197	14.009	32.469	10.759	19.908	16.906	8.621	13.990	16.459	8.193	10.998	13.269	11.003
20.00 - 21.00	9.880	6.990	12.333	30.325	9.887	16.985	15.001	8.557	12.675	15.789	8.555	9.977	11.250	10.963
AVERAGE	9.572	6.776	11.272	31.895	9.630	10.686	13.190	7.574	11.587	15.422	7.817	10.120	8.989	10.161

Opportunities for the intersection queue in the CBD area ranged from 10% to 53%. The lowest opportunities occurred at the intersection of 2, while the largest occurred at the intersection of 12 (table 6).

Table 6 Opportunities for Regional Junction Queues

TIME	CHANCE OF QUEUING (Q) %													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
07.00 - 08.00	42	5	25	25	26	28	80	27	26	25	29	84	72	63
08.00 - 09.00	25	6	30	26	20	21	40	12	21	28	22	42	36	38
09.00 - 10.00	16	8	27	24	20	20	26	13	20	26	21	27	23	24
10.00 - 11.00	21	7	32	26	21	20	36	14	23	29	21	38	32	32
11.00 - 12.00	16	12	47	37	30	30	59	15	31	42	32	62	53	24
12.00 - 13.00	18	11	51	41	31	30	57	19	35	36	32	60	51	27
13.00 - 14.00	15	10	32	28	25	24	29	14	23	30	25	30	26	23
14.00 - 15.00	17	10	30	27	24	26	31	15	23	29	27	33	28	26
15.00 - 16.00	23	11	44	38	32	31	37	16	30	41	33	39	33	35
16.00 - 17.00	24	14	58	49	44	46	60	20	39	54	48	63	54	36
17.00 - 18.00	27	11	56	29	25	37	75	22	39	43	39	79	68	41
18.00 - 19.00	23	11	61	48	36	35	83	23	42	55	37	87	75	35
19.00 - 20.00	22	9	38	32	27	28	48	17	28	35	29	50	43	33
20.00 - 21.00	20	10	35	31	26	24	45	19	27	33	25	47	41	30
AVERAGE	22	10	40	33	28	29	50	18	29	36	30	53	45	33

The timing and phasing of green traffic lights adjusted according to the current situation at the proposed traffic intersection; each intersection should be controlled by traffic signals that will implement the model [9]. The length of time the green light interval must provide at the intersection will be decided by Fuzzy Logic (FL). The FL output will be optimized by Genetic Algorithm (GA), to get higher performance. This performance can be measured by considering the reduction in waiting time and the total number of vehicles arriving at the Queue from three intersections.

3.3. Evaluation of Traffic Management Problems

Based on the results of the analysis of the performance of several intersections reviewed in the CBD area, an evaluation of the existing traffic management problems as presented in Table 7. In general, the results of the assessment indicate that traffic conditions in the center of Makassar are poor to sufficient.

The results of the assessment of road network, traffic management conditions as in Table 7 showed that the intersections that are already in normal condition to critical condition are intersection 1, 4, 7 and 9. The intersection approaching street that was considered critical were 1 and 4. This must be updated to minimize the upper limit of contractions of the exact Newton iteration and introduce the exact projection of Newton's steps to ensure the feasibility of local problems related to the assessment of the condition of traffic management of the road network and intersections [10].

Table 7 Assessment of traffic performance in CBD intersections

Variable	Problem assessed									
	1	2	3	4	5	6	7	8	9	10
Geometric	-	-	-	-		-	-	-	-	-
Movement direction	-	-								
Conflict point		-	-	-	-	-	-		-	-
Side problem	-	-	-	-	-	-	-	-	-	*
Traffic sign and marking	-	-	-		-	-	-	-		-
Vehicle composition	*	*	*	*	*	*	*	*	*	*
Intersection performance										
a. Degree of saturation			-		*	-	-	**		-
b. Delay	-			-					-	
c. Queue chance			-		-	-	-	*		-
8. Road performance	-	*	*	-	**	**	-	*	-	**

Note: - = Poor, * = Sufficient and ** = Good

Table 8 The existing condition

Existing condition	Basic capacity (Co) pcu/hour	Capacity (C) pcu/hour	Traffic current (Q) pcu/hour	Degree of Saturation (DS)	Delay(D) pcu/hour	Queue Potential (QP) %
Lowest	2700	4277	21071	0.453	9.137	21.77 – 9.29
Highest	2900	33397	21949	0.657	11.121	36.726 – 17.829

Table 9 Projections data for 2025

Projections data	Basic capacity (Co) pcu/hour	Capacity (C) pcu/hour	Traffic current (Q) pcu/hour	Degree of Saturation (DS)	Delay (D) pcu/hour	Queue Potential (QP) %
Lowest	2700	4277	2592,5	0,606	10.568	32.36 – 15.39
Highest	2900	33398	29378	0,880	14.972	61.17 – 31.06

Privatization of Public Space as an Inhibiting Factor showed irregular land use patterns, resulting in traffic and transportation congestion, unnecessary vehicle conflicts and traffic congestion, longer travel times and loss of human labor hours during the day [11]. Privatization related to the public space of the city is the process or change in the function of activities and control of those who are impregnated and for the public interest which are owned or controlled privately and in groups for economic interests. In conditions of the process of privatization of city public space in the CBD, it is done by two primary constituents, namely: (a) the city's physical-spatial development policies and schemes that tend to only carry off on market mechanisms commonly referred to as neo-liberalism policies, and (b) spatial planning that has not been able to serve as a legal instrument that can apply limits and direction to the growth of the city, because the regime itself is not consistent in enforcing it. The incompatibility of various parties in spatial planning has caused the uncontrollable development of space in the region, including the dominance of public space for individual interests. The comportment of the big building as the biggest shopping center in Makassar has encouraged reproduction of space or created new places which were loaded with economic interests. The privatization of city public space was unavoidable, which was not entirely caused by capitalists, but also by pre-capitalist societies, and other factors which are under government control, such as Makassar Raya Parking Regional Company. In terms of the nature and status, the management of public spaces for private interests that occur in the

CBD can be temporary or permanent as well as legal or illegal. Mastery of temporary public spaces such as the use of road bodies as parking areas, installation of tents and billboards for product advertising, and street vendors. Control of the public space that expresses the status of its use is legalized, we can see the withdrawal of retribution by elements of the Makassar City Government on street vendors, parking carried out by Regional Company. Makassar Raya Parking, installation of billboards on the sidewalk, placement of electrical panels and Communication Enterprises on pedestrian lines.

The establishment of a building that connects shopping centers, a square and Hotels on the highway which are the city's public spaces as well as the many commercial buildings that stand by ignoring the requirements and spatial plans show the unpowerness of the state to face liberalization and privatization of urban space. Law of the Republic of Indonesia No. 28 of 2002 concerning Building, stating that each building must meet administrative and technical requirements. Incorrect administrative requirements include the status of land rights, ownership status of buildings and building permits that tend to be overlooked at the CBD.

The occurrence of space and building functions that are currently dominant as a commercial function indicate the occurrence of refraction of space in this area. Harvey said that in the process of capital accumulation it always expands so that it always disrupts the formation of balance. One factor that causes an imbalance in the functional space of the city in the CBD is the privatization of urban public space which is an implication of spatial reproduction in the region

Based on observations and interviews with actors who use urban public space, especially roads for parking lot of vehicles at the CBD, it shows the fact that:

- Green in terms of location, closer to shopping centers the wider the city public space used for parking areas. This indicates an imbalance between the size of the parking space provided by the building manager and the extensive parking needs of visitors and employees. We can witness the use of the road body as a parking area every day, especially around the CBD. The great mastery of public space, especially around the CBD, was relevant to the results of the 44th World Urban Planning Congress in Antwerp in the city which stated that the existence of malls in a region besides being a center of trade which moved the city economy and as a means of recreational residents also resulted in disappearances city public space.
- The existence of a illegal taxi near the main gate of shopping center and occupies almost half of the road body space, based on interviews with taxi drivers who make the location every day, stating that choosing to wait for passengers at that location is better than elsewhere. The existence of a 'dark' taxi hangout is one form of violation of Law No.38 of the Republic of Indonesia in 2004 concerning Roads, Government Regulation No. 34 of 2006, and Law No.22 of 2009 concerning Road Traffic and Transportation, as well as signs parking restrictions in these places are ignored.
- Interviews with Rusli, Mikal and Asri who work as motorized rickshaw drivers starting every day at 10 am to 11 pm on the streets is precisely under the connecting building, basically they state that the existence of which was limited to the number of places allowed to stand at each location is a maximum of 22 units, also must be permitted with 'boss'. The boss they referred to was a member of the security forces with the consequence of having to pay the fees. This fact shows the involvement of individual law enforcement officers indirectly in the control of the public space for private interests.
- City Government. Makassar through Makassar Raya Parking has made retribution withdrawals in public spaces or highways. Parking fee levies in public spaces in addition to contradicting the basic principles of public space, namely free access and value-free are also violations of Law Number 38 of the Republic of Indonesia in 2004 concerning Roads, Government Regulation Number 34 of 2006, and Law Number 22 of 2009 about Traffic and

Road Transportation which is very clear forbidding the use of faces or highway bodies as vehicle parking spaces.

- The occurrence of "omission" carried out by Regional Company. Makassar Raya parking in parking fee levies on the road agency indicates the lack of professionalism of the apparatus which tends to prioritize short-term economic approaches in increasing Regional Income, and less considering the cost of using fuel oil from vehicle delays due to congestion caused by road use as an area parking is carried out by institutions that are under the auspices of the City Government. Makassar itself. This is also a violation of the Regional Regulation Number 17/2006 Article 13 concerning the Management of Roadside Parking in Makassar City

Table 10 Time allocation of integrated cycle

Phase	Time (Second)				
	Green	Yellow	Red	All Red	Cycle
I	20	3	187	1	211
II	53	3	154	1	
III	60	3	147	1	
IV	66	3	141	1	

The traffic light simulation results that have been done using the Vissim model can be seen in the following Fig. 5.

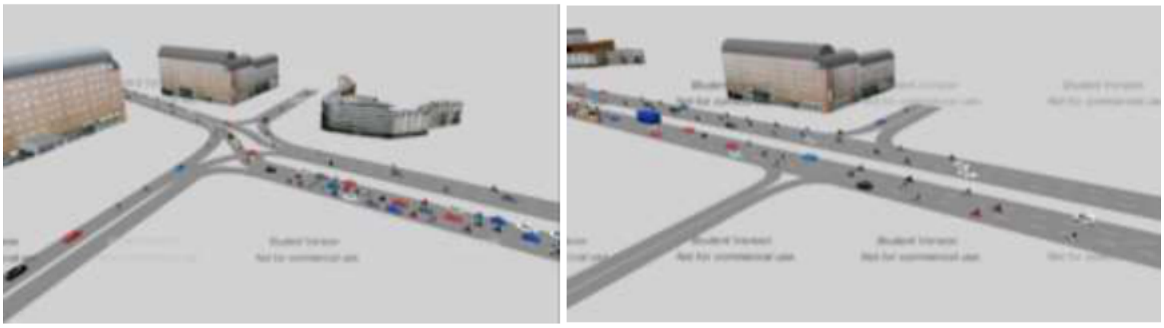

Figure 5 Simulation Condotion Traffic Results

Some of the aforementioned phenomena according are privatization of public space due to road bodies, pedestrian lines that should be used by the public "controlled" by certain parties [12]. This phenomenon is relevant to Arendt's conception that the growth of capitalism and the crisis of the public sphere are reciprocal. The capitalist system is a real threat to the formation of autonomous public spaces, the state and the market carry out hegemonic interventions into public space so that public space becomes the arena of market and bureaucratic interests. Likewise, Habermas's analysis states that public space in capitalist countries is deprived of manipulation and consumption. Road junctions and vehicle parking should be strictly forbidden to reduce traffic congestion and delays at crossroads in the city[13].

Construction of a commercial building that connects and unites many shopping building is the culmination of misuse of public property into a space for private ownership by capital owners. The Indonesia Act. Number 28 of 2002 concerning Building clearly stated one of the requirements for the establishment of buildings, is proof of ownership of the status of land rights as a condition of building license. The construction of the a Hotel which is integrated with the shopping center was the most up-to-date commercial building that stands neglected the EIA administrative requirements. The Indonesia Act. Number 32 of 2009, one of the requirements for the issuance of business licenses and activities is the fulfillment of environmental permits (EIA). Some of the aforementioned phenomena are examples of cases that show how great capitalist influence is in the region.

This fact strengthens Lefebvre's conception which states that the power of capital that determines the design and allocation of space must be of interest, and Harvey's analysis states that the process of capital accumulation will continue and always expand so that it interferes with every tendency towards the formation of balance. According to Habermas, public space in the capitalist countries has been seized by giant investment forces to be manipulated and consumed and citizens become mere consumers or spectators who are subject to the dictation of instinctive needs.

Observations and interviews with several street vendors who sell at Shopping Center showed the fact that:

- The closer to the entrance of shopping centers the more interested the street vendors are developing their businesses.
- If the place for selling street vendors is in the corridor of main street must have permission from leaders of local residents. Unlike the case with street vendors in the western end of Kemerdekaan St. that occupies space above the city drainage canals and sidewalks. Based on interviews it showed that in order to be able to occupy the location, he must "consent" to the Military Court located at the junction of intersection 14. In addition, every day they are charged parking fees and levies to Makassar Raya Parking and elements of the City Government. Makassar. This fact shows the involvement of state officials and government elements in the control of public space.
- Based on observations and interviews with street vendors, their main consumers are employees of shops and shopping centers and other commercial services in the vicinity. The presence of small-scale or pre-capitalist business groups around shopping centers such as food vendors, for some people, destroys ideal views and functions of an area but for some other people who experience life experiences around the area every day, such as shop employees, parking attendants and security and cleaning staff, the existence of these places to eat is very helpful to get a cheap and varied food menu.

Integrated Traffic Light simulation and coordination Crossroads with the aim of minimizing total travel time and energy consumption. Crossing management is communicated with vehicles heading to an intersection, grouping them into groups (called bubbles) when they appear, and determining the optimal trajectory sequence and average velocity profile [14]. The other side of the distributed nonconvex control problem that is solved in parallel without nesting iterations is achieved by applying constraint prioritization. Priority priority constraints introduce priority to vehicles so that lower priority vehicles must provide road rights in the event of a potential conflict without establishing cross-junction orders [15]. The control system can automatically adjust the traffic light control parameters according to changes in traffic flow in various directions, thereby increasing the efficiency of road crossing traffic and achieve the best control for traffic [16]. Synchronizing several traffic light systems at adjacent intersections is a complicated problem considering the various parameters involved [17]. Conventional systems do not handle the flow of variables approaching the intersection. In this paper, cycle times with lower values are used for intersections with road widths <10 m, higher values for larger roads. The cycle time is lower than the recommended value, which will cause difficulty for pedestrians to cross the road.

Where for the type of three-phase arrangement of proper cycle time (seconds) is recommended 80-130 seconds, can be seen in the book Indonesian Street Capacity Manual intersection signaling things 2-60. Cycle times exceeding 130 seconds should be avoided except in very special cases (very large intersections), because this often causes losses in overall capacity. If the calculation results in a cycle time that is much higher than the recommended limit, then this indicates that the capacity of the intersection plan is insufficient. Green times shorter than 10 seconds should be avoided because they can lead to excessive violations and difficulties for pedestrians to cross the road. Based on the description above and data analysis, the cycle time at the Pengayoman and Adyaksa intersections is 211 seconds, where the cycle time is higher than the recommended cycle time limit, which means that the capacity of the intersection plan is insufficient. Due to this situation, an integrated traffic light control system using radio frequency identification (RFID) and fuzzy logic technology has been proposed [18]. This system provides important practical information for traffic light data collection and control information and can track ambulances, Fire Brigades, VIP / police vehicles, criminal or illegal vehicles such as stolen vehicles that avoid tickets, tolls or vehicle taxes. RFID readers have been used to identify vehicles and therefore we evaluate the average vehicle speed, queue length and waiting time. This study enhances the work of previous authors in the field of traffic light control systems using fuzzy logic. Software has been developed in MATLAB. The simulation results verify the performance of the integrated traffic light control system that we propose using RFID radio technology and fuzzy logic.

The phase differences of the exact traffic from the signal to adjacent junctions can reduce operational delay time [19]. Some theorems show how to minimize the total average delay time for operating vehicles at adjacent junctions under certain conditions. If the distance and signal cycle from adjacent intersections satisfying with certain conditions, the total delay time on average will reach zero.If the signal cycle from the adjacent intersection and the phase difference are prime numbers, the total average delay time will be constant, in general, if the signal cycle is from adjacent junctions and phase differences from them are numbers that can be reduced, the total minimum delay time will be solved by the given algorithm

4. CONCLUSIONS

- The results obtained showed that the densest traffic volume in the CBD area occurred at the intersection 7 and 12, with the 42.02–72.59% composed of vehicles dominated by motorbikes, while jeeps between 6.72 – 35. 63%.
- The capacity of Intersection in this area averages 6,809 passenger car unit (pcu) / hour, so that the Degree of Saturation averages 0.895 with the maximum is 0.917.
- The highest chance of queuing occurs in unsignalized intersections in the CBD area between 42-84% which occur at the intersection 7 and 12 with the highest delay was 38.18 seconds (intersection 2). The level of accessibility of this region was high but because of the high side barrier.
- Intersection capacity improvement through geometric improvements, channelization, improvement and optimization of integrative traffic light functions, has the potential to contribute up to 36% and based on simulations with VISSIM program aids until the projections for 2025 can be maintained contributing to an increase in capacity of up to 22%.

ACKNOWLEDGEMENT

The author would like to thank the Head of the Traffic Directorate of the City of Makassar, the Head of the Transportation Service, the Makassar Public Works Office, the Dean of the Faculty of Engineering, the Muslim University of Indonesia, and the Review Team from the Postgraduate Program, Universitas Brawijaya who assisted in revising the initial manuscript.

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