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Research Paper

Impact of Road Users Behaviour on Intersection Performanceusing Vissim Micro-Simulation.

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ABSTRACT: *The behaviour of motorist at the studied intersection constitute serious hazards as well as long queue and delay at intersection approaches especially during the peak periods, morning and evening. This study evaluated traffic performance at selected intersection, through the evaluation of intersections performance with reference to current traffic conditions in Ilorin city.Traffic data was collected at Maraba Intersection area in Ilorin city using Drone camera because it provides long lasting record of data with minimum manpower. Data were extracted through manual counting, and processed using EXCEL sheets.AVISSIM micro-simulation model was used to create a virtual environment representing the current traffic scenario.The study reveals that there are different Levels of Service (LOS) available on different approaches, the Post Office Road, Kulende Road and Sabo-oke Road records the critical LOS of D (Approaching unstable flow with tolerable delay) from all the turning movements, while the Amilegbe Road records the best LOS of B (Stable flow with slight delays).From the evaluation of the average approach delays obtained from the field study and VISSIM simulation model,it could be observed that the percentage difference between the field and model data is less than 10% which indicates that there are no significant differences.It is therefore appropriate to note that Maraba intersection operates at a very low level of service.Hence, there is need for government to make theexisting Automated Traffic Control signalling functionaland inscribe pavement markings on all the approaches lane to enhance the intersection performances.*

KEYWORDS: *trafficdelay,queue, level of service,intersectionperformance,microsimulation, VISSIM.*

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I. INTRODUCTION

Here, in Ilorin, Kwara State capital, the road intersections are currently becoming a scenario for a serious gridlock, as most of the intersections can be said to lack proper projection coupled with the road users' deviance to traffic laws and regulations. In this regards, a thorough evaluation of road intersection which is a major part of the fixed facilities of road transport sub-system is therefore required.

Traffic intersections are major complex location on any highway, this is as a result of vehicles moving in various directions tend to occupy the same place almost at the same time (Dukiya and Ajiboye, 2011). Furthermore, the pedestrian also seeks same space for their crossway. Driver has to make second decision at an intersection by taking his route into consideration, as well as the intersection geometry, direction and speed of other vehicles etc.

Intersection's performance is one of the main design criteria, which requires the evaluation of capacity and traffic performance which it offers or will offer in the future. According to traffic/ highway engineering, intersection must be treated as a system of vehicle related, human related, as well as road related factors. Examination of an intersection's performance involves three main stages. The first involves characterisation of traffic flow demand that takes into consideration their variability in time and space. The second have to do with the very functioning of the intersection determined by traffic organisation and control by mode of road signs. The third requires the estimation of the intersection's performance, majorly on the premise of the capacity of intersection entries, queued vehicles and delays associated in driving through it (Atomode, 2013).

Road users are individuals that make use of roadway day in day out. Road users include pedestrians, drivers, commuters, hawkers, and cyclists. Individual behaviour in the traffic stream is frequently the critical determinants in most of the characteristics of highway traffic. Road users' behaviour at intersection is not only affected by the rules of priority but also by the arrangements of the intersection, coupled with the behaviour of other road users (Eljamassi, et al., 2011). Road users' behaviour is largely determined by the observed features of the road and everything pertaining thereto, other traffic and the own vehicle. Partly, these features induce certain spontaneous behaviour and the observed features lead to certain behaviour because of the significance attributed to them, for instance due to a knowledge of physical laws and road traffic regulations.

VISSIM is a microscopic, time step and behavior-based simulation model developed to model urban traffic and public transport operations and flows of pedestrians. VISSIM is software that can simulate traffic for multi-modal microscopic, public transport and pedestrians, developed by Planning Transport Verkehr (PTV) AG in Karlsruhe, germane. VISSIM is the most advanced tools available to stimulate traffic flows multi-modes, including vehicles (cars, buses, trucks) public transport (auto-rickshaws, buses) cycles (bicycles, motorcycles, tricycles) pedestrians and hawkers (Eidmarand Hultman, 2014).

The following are some of the behaviors observed at Maraba Intersection, that were affecting its performances:

1. Motorists that do not obey the stop sign of the traffic warder;
2. Pedestrians crossing the road at the middle of the intersection;
3. Illegal parking along the intersection approaches lane;
4. Beggars moving within the intersection causing reductions in the approach lane width.
5. Public transport like KekeNapeb and Taxis' picking up and setting down passengers at the intersection.
6. Observation of long queue thereby causing delay to motorist at the intersection.

In addition, poor land use planning and poor traffic control measures have made traffic queue and delay an important problem on the major and minor roads of the intersection.

Figure 1. Traffic scenario with normal camera and drone

II. MATERIALS AND METHOD

The flow chart of the process adopted in the study are shown Figure 2

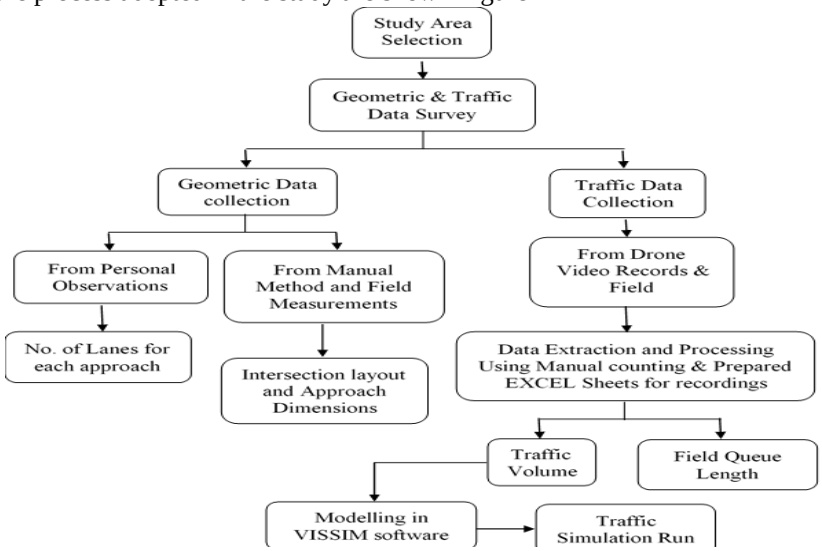

Figure 2.Schematic drawing of the processes involved in the study

2.1 Geometric Features and Data

Field survey and observationshowsthe intersection characteristics, corridors/ approaches names, lane type/ widths, right of way as well as the physical features of the intersection legs that are affecting its traffic flow. Geometry featureand datais presented in Table 1.

Table 1: Geometric data of the Study Area

Name of Intersection/ Characteristics	Name of Intersection Corridors	Lane type	Lane width (m)	Right of Way (m)	Physical features that are affecting traffic flow
Maraba Junction with Four Arms (A Crossed Intersection)	Post office Road (WB)	Multi-lane (3)	10.0	30.7	1. Location of motorcycle park. 2. location of snacks kiosk near the intersection at Sabo-oke approach 3. loading/ off-loading of passengers by taxis at intersection 4. pedestrians crossing at the middle of intersection
	Kulende Road (EB)	Multi-lane (3)	10.0	36.7	
	Amilengbe Road (NB)	Multi-lane (3)	9.0	33.9	
	Sabo-Oke Road (SB)	Dual-lane (2)	9.0	12.2	

(Source: field measurement results)

2.2 Traffic Volume Data

Data collection on traffic volume were done by extracting data on Average Peak Hour Traffic Volume (APHTV) of the road users (such as Vehicles, Motorcycles, Heavy vehiclesand Tricycles) from the video recorded using visual/ manual counting.The video recording was carried out during the morning peak period between 7:30am and 8:30am for a period of one week.Data collected is as presented in Table 2, Figure 3.

Table 2: Average Peak Hour Traffic Volume

Approaches	Movements	Vehicles	Motorcycles	Tricycles	H.Vehicles	Total
Kulende Road (EB)	RT	169	265	103	6	543
	TH	402	352	100	17	871
	LT	71	192	25	0	288
Post office Road (WB)	RT	19	20	5	0	44
	TH	407	270	89	34	800
	LT	276	194	12	13	495
Amilengbe Road (NB)	RT	68	115	10	3	196
	TH	49	101	46	0	196
	LT	256	304	138	14	712
Sabo-oke Road (SB)	RT	50	37	7	0	94
	TH	52	175	50	5	282
	LT	30	34	2	2	68

(Source: drone video recording results)

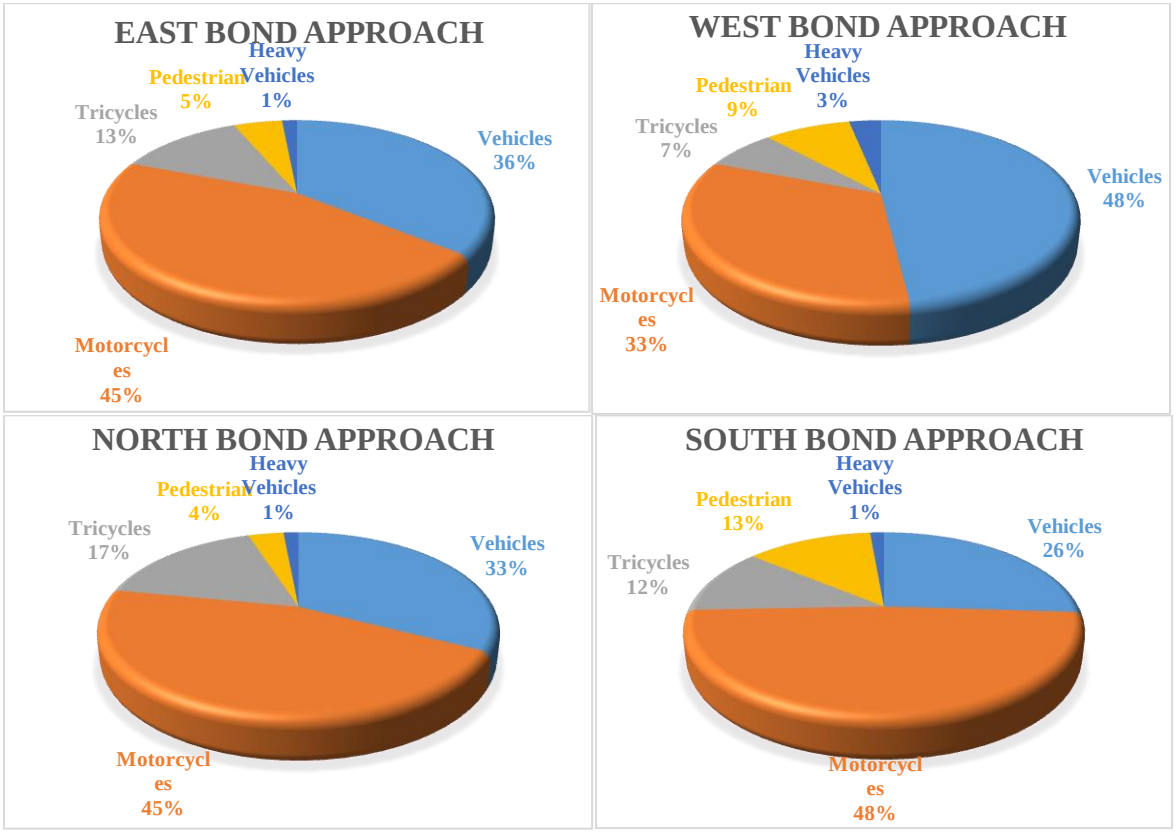

Figure 3. Vehicle composition

2.3 Vissim Simulation

A well detailed network geometry is modeled through VISSIM graphical user interface. Tobuild model representative of the real field, bus, truck, car etc. are well defined. There is no enforcement of lane discipline which results non-lane based traffic situation in the study area.

PTV VISSIM provides tools to create a representative model of a traffic network. The first tools tomodelledwere links and connectors to represent the lanes or the approaches, followed by modelling the reduced speed areas and the conflicts points area, which enables vehicle movement to be slowed down when turning to different directions. Then, vehicle inputs to all the approaches were described,as well asvehicle routes definitions for through, left and right turning movement respectively. These tools regulate and defined the traffic flow of vehicles. Finally, node creation for evaluation measures were described, which were used to collect simulation data after simulation running.Figure 4a to 4f. represents theVISSIM simulation model of the study area.

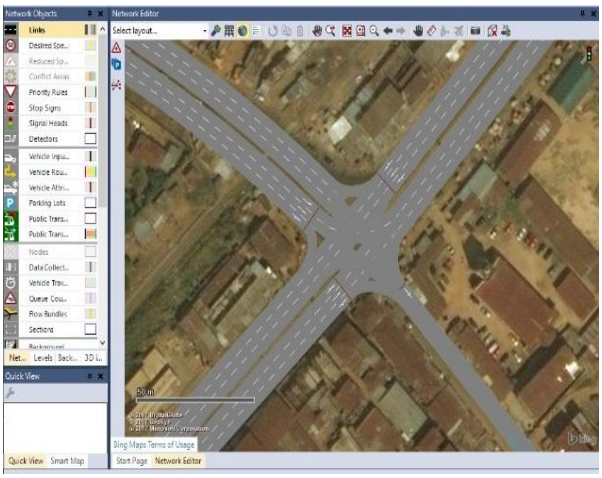

Figure 4a.Links and connector

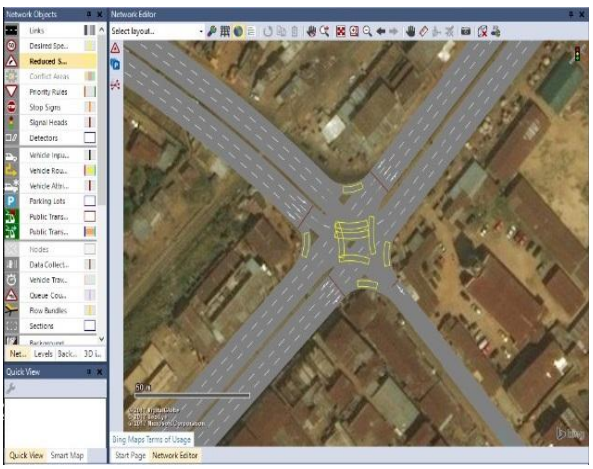

Figure 4b.Reduced speed areas

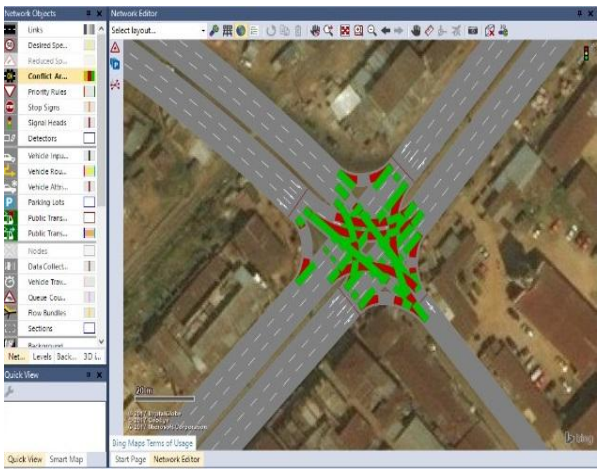

Figure 4c.Conflicts points area

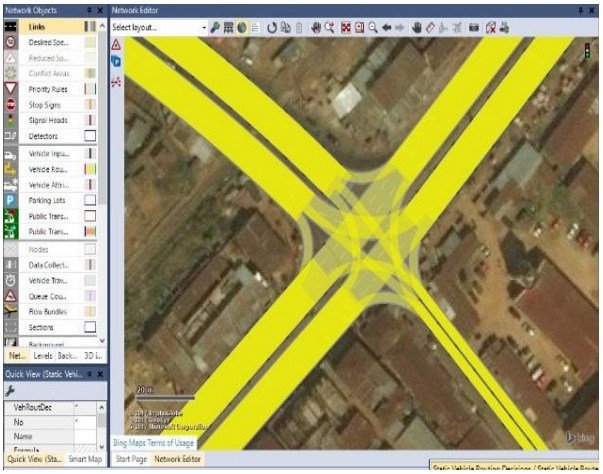

Figure 4d.Vehicle inputs and routes

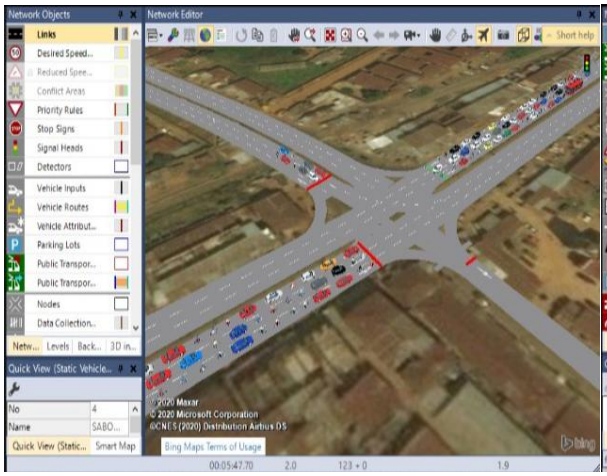

Figure 4e.Simulation 3D view

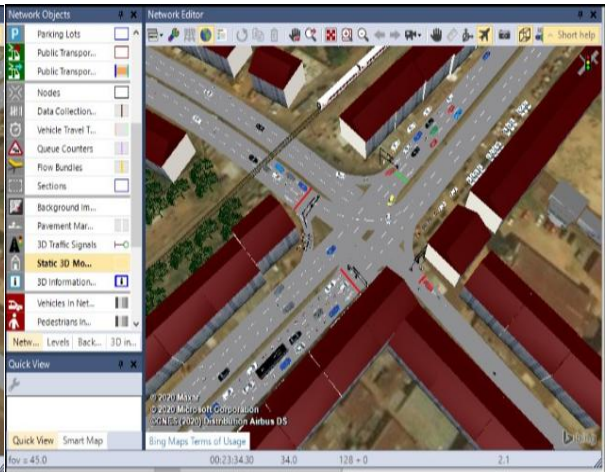

Figure 4f.Simulation 3D view

Figure 5.VISSIM simulation model

III. RESULTS AND DISCUSSION

3.1 Delays

After the model was calibrated, simulation was run to find thedeficiencies in the model in terms of queue lengths and stop delays. From VISSIM simulation model results, the study reveals that there are different Levels of Service (LOS) available on different approaches, the Post Office Road, Kulende Road and Sabo-oke Road records the critical LOS of D (Approaching unstable flow with tolerable delay) from all the turning movements, while the Amilegbe Road records the best LOS of B (Stable flow with slight delays), as presented in table 3.

Table 3: Queue length and Stop delay results from VISSIM

APPROACHES	DIRECTIONS	QLEN	QLEN MAX	VEH DELAY	STOP DELAY	AVG. DELAY	LOS	
POST OFFICE ROAD (EB)	SB EXIT	8.67	15.42	36.82	35.06	37.61	D	D
	WB EXIT	8.67	15.42	38.87	36.84		D	
	NB EXIT	8.67	15.42	44.09	40.93		D	
SABO-OKE ROAD (SB)	EB EXIT	9.08	22.23	57.04	54.52	53.21	D	D
	WB EXIT	9.08	22.23	60.31	59.63		E	
	NB EXIT	9.08	22.23	47.31	45.5		D	
KULENDE ROAD	EB EXIT	12.81	23.7	36.65	35.35		D	

(WB)	SB EXIT	12.81	23.7	46.08	45.98	38.78	D	D
	NB EXIT	13.13	23.7	38.48	35.02		D	
AMILEGBE ROAD (NB)	EB EXIT	9.15	17.24	25.47	24.31	17.12	C	B
	SB EXIT	9.15	17.24	26.21	25.32		C	
	WB EXIT	9.12	17.24	2.32	1.72		A	

(Source: VISSIM Software data results)

3.2 Traffic Queue Length

Figure 5 shows thegraphical representation of the queue length in which West Bound (WB) approach has the longest length of queue and while the shortest length of queue and maximum queue is at the East Bound (EB) approach respectively.

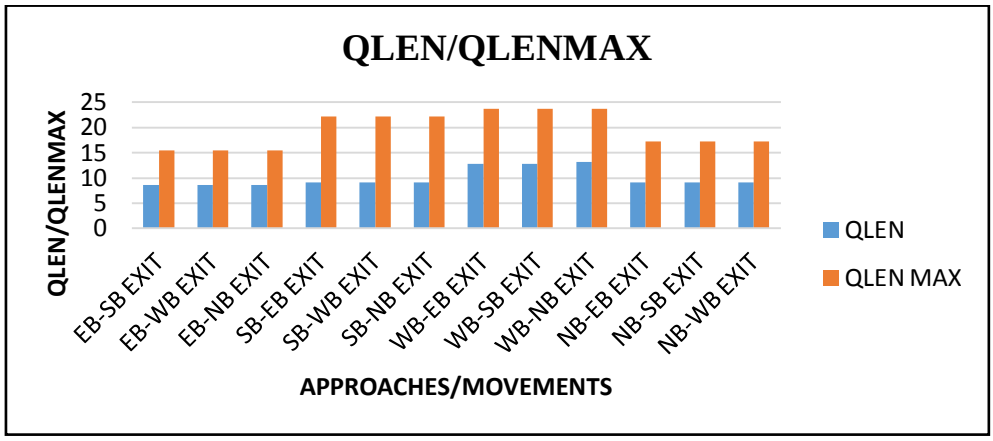

Figure5. Graphical representation of queue length

3.3 Model Validation

It could be observed that the percentage difference between the field and model data is less than 10% which indicates that there are no significant differences.Figure 6 graphically show the differences between the average approach delays obtained from the field results and model created through VISSIM simulation.

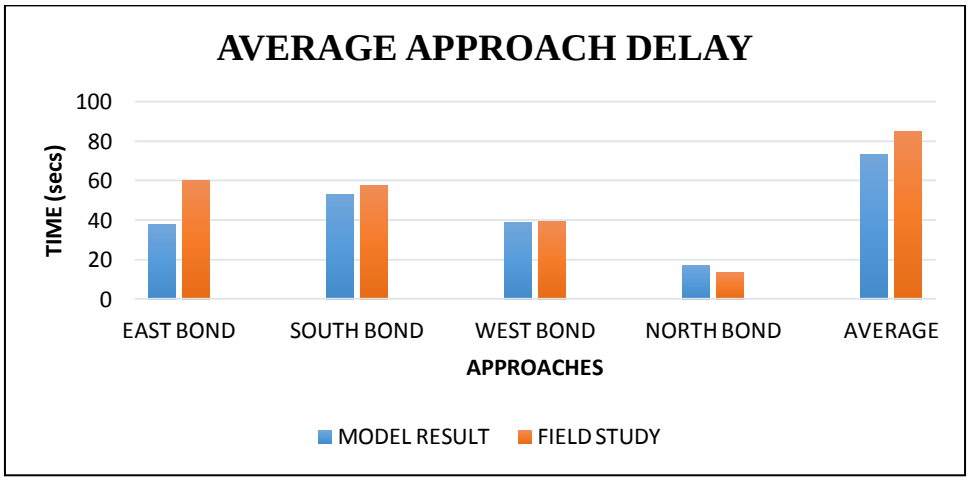

Figure 6. Comparison between Model and Field Results

IV. CONCLUSION

(i) The study reveals that there are different Levels of Service (LOS) available on different approaches,

(ii) At the Post Office Road, Kulende Road and Sabo-oke Road records the critical LOS of D (Approaching unstable flow with tolerable delay) from all the turning movements, while the Amilegbe Road records the best LOS of B (Stable flow with slight delays).

(iii) From the evaluation of the average approach delays obtained from the field study and VISSIM simulation model, it was observed that the percentage difference between the field and model data is less than 10% which

indicates that there are no significant differences. It is therefore appropriate to note that Maraba intersection operates at a very low level of service.

V. RECOMMENDATIONS

In order to address the poor level of service at the Maraba Intersection, it is recommended that the Government make the existing Automated Traffic Control signalling functional, as well as inscription of pavement markings on all the approaches lane to enhance the intersection performances and also enforcement should be put in place to improve the compliance of road users to traffic control.

REFERENCES

[1]. Atomode, T. I. (2013). Assessment of traffic delay problems and characteristics at urban road Intersections: A case study of Ilorin, Nigeria. IOSR Journal of Humanities and Social Science, 12(4), 06-16.
[2]. Dukiya, J. J., and Ajiboye, A. O. (2011). Performance analysis of urban road intersections and its environmental implication: a case study of the Lagos metropolitan area. Urban Transport XVII: Urban Transport and the Environment in the 21st Century, 116, 167.
[3]. Eidmar, E., and Hultman, J. (2014). Traffic Network Evaluation using Microscopic Simulation and Analytical Modelling. A Study of the Traffic Situation Arising after a High Profile Event at a Planned Football Stadium in Falkenberg (Master's thesis).
[4]. Eljamassi, A. D., Almasri, E. H., and Sarraj, Y. R. (2011). Behavior of Road Users in Gaza, Palestine, Islamic University of Gaza.
[5]. PTV. (2013). PTV VISSIM 6 User Manual. Karlsruhe: Planung Transport Verkehr AG.
[6]. PTV Vissim 2020 User Manual. (2019). Planung Transport Verkehr PTV AG, Haid-und-Neu-Str. 15, 76131 Karlsruhe, Germany.
[7]. The Transportation Research Boards. Unsignalized Intersections Chapter-17 “Highway Capacity Manual”. Washington D.C. USA. 2000, National Research Council.