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Safety performance of selected bus stops in Ibadan Metropolis, Nigeria

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ABSTRACT

Bus systems cannot be fully explored if issues such as safety of bus passengers on-board or at bus stops are not addressed. This study was aimed at assessing the safety of bus stops in Ibadan metropolis. Twenty bus stops were purposefully selected for this study from the five urban local government areas in Ibadan metropolis. A field survey involving interviews with 50 passengers and direct observations of hazardous acts was carried out at the bus stops. Casual factors of hazardous acts were noted as well. A score survey was conducted with 17 experts (civil engineers and transportation engineering researchers) where they were asked to rate how much each casual factor contributes to its corresponding hazardous act using a scale of 1–4 (1 being 'not important at all' and 4 being 'very important'). Experts were also asked to make pairwise comparisons among hazardous acts and consistent responses were analyzed using Analytic Hierarchy process (AHP). Results from the score survey and AHP were used to model the safety levels of the selected bus stops. With safety levels ranging from 2.38 to 4.83 (10 being the best and 0 being the worst), all bus stops fell short of an acceptable level of safety. Also, Interviews conducted revealed passengers' dissatisfaction with their user-experience. Recommendations were therefore made based on the findings.

Introduction

Road transportation is the prevalent mode of transportation in Nigeria (Amamilo and Agbor, 2018). A survey of the transport sector in Lagos, the most populous city in Nigeria, reveals that 40% of the total number of daily trips involve walking. Of the remaining 60%, 'Danfo' accounts for 72%, Bus Rapid Transit (BRT) accounts for 3%, conventional bus accounts for 2%, automobile accounts for 18%, motorcycle accounts for 2%, truck accounts for 1%, and other modes of transport account for 1% (JICA Japan International Cooperation Agency, 2014). 'Danfo' is a mini commercial passenger bus (Aduwo et al., 2019). Minibus services are preferred in Nigeria because they are widespread, accessible, and cheap (Christopher and Adewumi, 2017). The typical 'Danfo' minibus has the capacity to carry 14–18 people (Otunola et al., 2019).

An important component of road transportation in Nigeria is public transportation. This is because public transportation is the major approach to the mobility of people, goods and services (Christopher and Adewumi, 2017). It is basically the responsibility of a joint group of private and public sector operators in Nigeria, although the private sector owns more than 90% of the urban public transport services (Amamilo and Agbor, 2018). In Ibadan, over 90% of the transport demands are met by individual public transport operators (Christopher and Adewumi, 2017).

Public transportation promotes road transportation efficiency and provides means of transporting people in large numbers (Yingjiu et al., 2019). The bus system in particular has the potential of providing transport services to larger proportions of urban commuters, hence, plays a significant role in reducing the number of vehicles on urban roads and consequently reducing traffic chaos in cities (Ali, 2014). For a better bus system, it is necessary to improve the quality of service and the standards of safety. Improving the standards of safety should include improving the safety of passengers on-board and the safety of passengers at bus stops (Cheranchery et al., 2016).

The need for safe bus stops is necessitated by the tendency for vehicle-pedestrian interactions at bus stops. (Cheranchery et al., 2019). Bus stops are operated by both private and public sectors in Nigeria and studies have shown that bus stops in Ibadan metropolis are largely unorganized. According to Olowosegun and Okoko (2012), bus stops in Ibadan are not properly located. Bus stop locations in Ibadan metropolis leave drivers with no choice than to park along curbs (Fatunmibi, 2018). The availability of basic bus stop facilities is highly unsatisfactory (Christopher and Adewumi, 2017). There are no developed guidelines or manuals for design, location and spacing of bus stops in

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Ibadan metropolis. Bus stops are not clearly designated and are used for other purposes, causing road users to experience chaotic situations during morning and evening peak hours (Akintayo et al., 2019).

This study is therefore aimed at evaluating the safety of bus stops in Ibadan metropolis. The study applies the methodology proposed by Cheranchery et al. (2016), which includes the identification of hazardous acts and casual factors at bus stops and the establishment of a model to evaluate the safety levels of bus stops. The methodology provides a rational approach to assess bus stop safety especially in developing countries where reliable accident records are unavailable (Cheranchery et al., 2016). An analysis of the user-experience of passengers is also included in this study since passengers are the predominant users of bus stops. The study starts with an introduction to the safety of bus stops and continues with a literature review on various methods of analyzing bus stop safety, including the Analytic Hierarchy Process (AHP). Section 3 shows the map of the study area. Section 4 presents the bus stops analyzed alongside the method of analysis, and Section 5 continues with the results of the analysis. Section 6 concludes this study by stating the implications of the study and recommending solutions based on findings.

Table 1
Bus stops and their locations.

S/N	Bus Stop	Location
1	University of Ibadan	Ibadan North
2	Living Spring Sango	Ibadan North
3	Bodija Market	Ibadan North
4	NTA Shopping Complex	Ibadan North
5	Honors Filling Station	Ibadan North-West
6	Okepadi	Ibadan North-West
7	Task Filling Station, Iwo road	Ibadan North-East
8	Academy	Ibadan-North
9	Honors Filling Station, Orita aperin	Ibadan North-East
10	Lister Oil, Beere	Ibadan South-East
11	Total Filling Station, Beere	Ibadan South-East
12	Iwo Road Interchange	Ibadan North-East
13	Abe Bridge, Iwo Road	Ibadan North-East
14	Oba Akinyele	Ibadan North-East
15	Arisekola, Bestway Road	Ibadan North-East
16	Gate	Ibadan North
17	Samonda	Ibadan North
18	Orita aperin- Iyana beere	Ibadan South-West
19	Iyana merin-Ogunpa	Ibadan South-West
20	Beere-Orita merin	Ibadan South-West

Literature review

The characteristics and performance of bus stops in Ibadan metropolis and Nigeria at large have been generally assessed. However, focusing on the safety performance of bus stops would better address the need for safety improvements. Many studies on bus stop safety have assessed the safety of bus stops using crash data. Srinivas and Vinay (2008) developed a geographic based method of identifying and ranking hazardous bus stops using a vehicle-pedestrian crash data of two years. Long and Sekhar (2011) further presented another Geographic Information System (GIS) method of identifying pedestrian-vehicle conflict spots and ranking unsafe bus stops using crash data. Marco and Tommaso (2012) developed an algorithm for determining the safety levels of bus stops using the geometrical features of bus stops and the data of automobile crashes around bus stops.

One disadvantage of using crash data is that it may not necessarily reflect the safety performance of bus stops. Some road locations may have high accident rates but low fatality rates while some may have high no record of fatal accidents but high potential of accident occurrence. Also, comprehensive crash data may not always be available. Zhirui et al. (2016) applied a method which did not require crash data in China but the method is not flexible enough to be used in Nigeria. However, a more flexible method was developed by Cheranchery et al. (2016) and further expounded by Cheranchery et al. (2019). This method involves the use of Fuzzy Analytic Hierarchy Process (AHP) to analyze the safety levels of bus stops without crash data. Developing countries with bus stop management challenges have been encouraged by Cheranchery et al. (2016) to adopt this method.

The Analytic Hierarchy Process (AHP) is one of the Fuzzy Multiple Criteria Decision Making (FMCDM) methods (Oguztimur, 2011). AHP actually reflects how a problem is perceived by the involved stakeholders (Ghorbanzadeh et al., 2018). The process can be generalized as; decomposing a complex situation into individual parts, arranging the parts in a hierarchy, and synthesizing the judgments of experts in order to determine the most important variables that would change the situation when acted upon (Oguztimur, 2011). Prioritization is based on pairwise comparisons (Epigmenio et al., 2012).

Pairwise comparisons provide effective means of overcoming the difficulty in comparing various alternatives at a time, allowing the evaluator compare only two alternatives (Brunelli, 2015). Each pair of comparisons is given a relative value estimating the importance of one alternative over the other (Epigmenio et al., 2012). In doing this, a scale is necessary (Damjan et al., 2016, 90–114). Apart from the traditional nine-point scale system developed by Saaty, other scale systems such as the logarithm scale system and power scale system have been used (Epigmenio et al., 2012). However, Saaty's nine-point scale is the most commonly used scale for pairwise comparisons (Despodov et al., 2011).

For pairwise comparisons to be carried out successfully, questionnaires are distributed among a number of experts (Hamed, 2017). Experts make their judgments by completing the questionnaires (Ehsan and Morteza, 2017). The geometrical average of individual judgments forms the group judgment of the AHP (Hamed, 2017). Researchers have indicated that a minimum population of ten experts is required for maximum reliability (Ehsan and Morteza, 2017). Evaluating AHP questionnaires requires a serious mental exercise from the respondents (experts) (Szabolcs 2012). As such, highly qualified experts should be used for consistency of results (Henrikas and Lijana, 2010).

AHP ensures that the pairwise comparison judgments are checked before they are used for decision making (Damjan et al., 2016, 90–114). The consistency of priority vectors and pairwise comparisons are checked using the consistency ratio (CR) (Oğuztimur, 2011). If the CR is less than 10%, the judgments are consistent but if the CR is greater than 10%, the judgments are inconsistent (Damjan et al., 2016, 90–114). When CR exceeds 0.1, experts may have to redo the pairwise comparisons (Ehsan and Morteza, 2017). The consistency ratio is calculated as C.R = C.I/R.I, where R.I is the random index and CI the consistency index (Epigmenio et al., 2012).

One advantage of the AHP is its ability to make both quantitative and qualitative comparisons on the same preference scale. Other advantages include its ability to decompose complex problems and verify the consistency of analysis (Ishizaka and Labib, 2009). AHP allows decision makers to be richly involved in the evaluation process (Seyedeh et al., 2009). The method is widely used because of its ease of application (Ishizaka and Labib, 2009). It is easy to combine AHP effectively with other techniques because it is flexible (Vaidya and Kumar, 2006).

The Analytic Hierarchy Process has been successfully applied in various fields and disciplines (Epigmenio et al., 2012). Today, AHP has been used by engineers, mathematicians, planners, lawyers, scientists, etc. (Oguztimur, 2011). Vaidya (2014) used AHP to assess the relative performance of 26 public transportation companies in India. Similarly, Boujelbene and Derbel (2015) used AHP to evaluate the performance of public transportation in Tunisia by comparing different public transport operators. Henrikas and Lijana (2010) determined the most significant quality criteria of rail transportation using AHP. Szabolcs et al. (2012) successfully applied AHP in assessing the quality of public bus transportation in Yurihonjo, a Japanese city. Pradeep et al. (2013) proposed a method of assessing hazardous road locations using AHP.

Cheranchery et al. (2016) developed a model which uses AHP to assess the safety levels of bus stops.

This study adopts the model developed by Cheranchery et al. (2016). AHP Priority Calculator software is used in this study to ensure accurate evaluation and to make the process easier. Computer software makes AHP quick and precise for decision makers (Oguztimur, 2011). The complexity of some problems require the use of computer application software to facilitate AHP (Vaidya and Kumar, 2006).

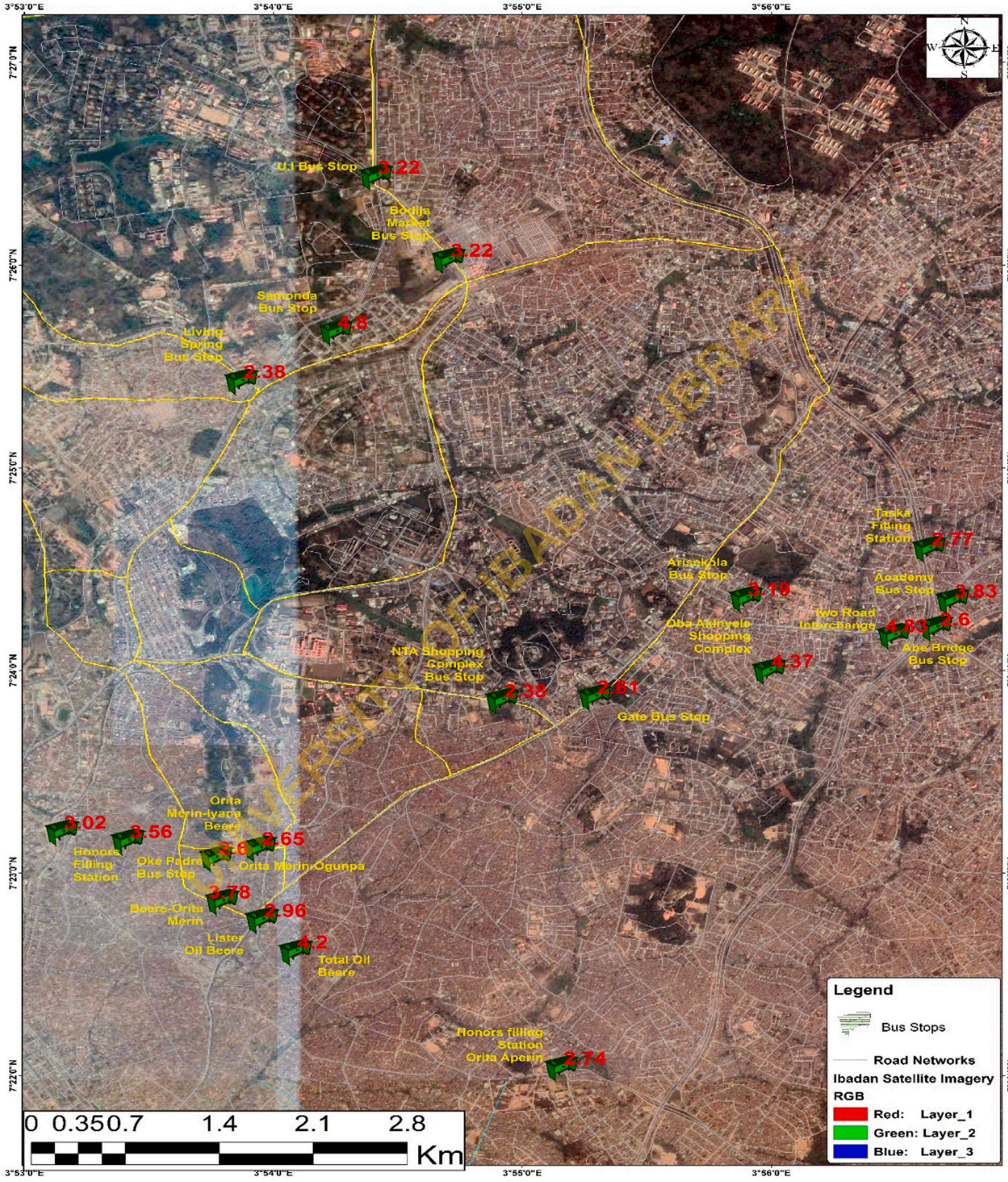

Fig. 1. Map of selected bus stops in Ibadan metropolis.

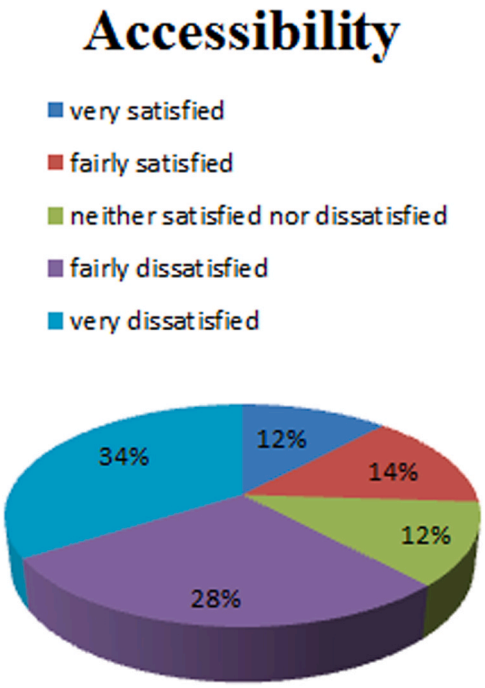

Fig. 2. Passengers' perception of access.

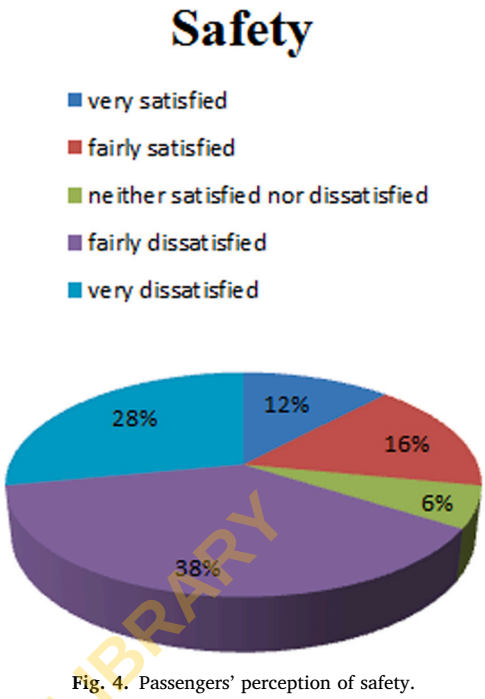

Fig. 4. Passengers' perception of safety.

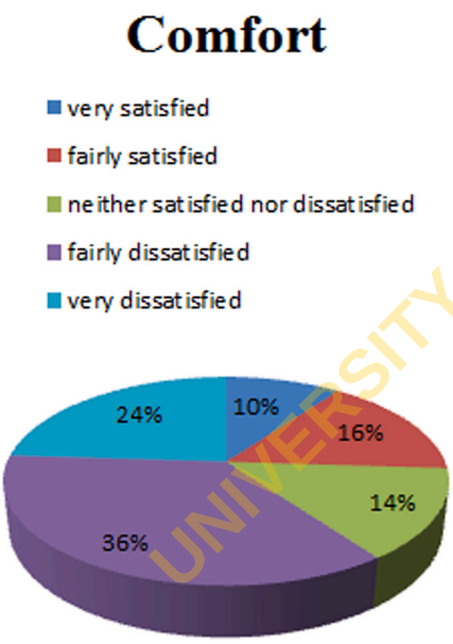

Fig. 3. Passengers' perception of comfort.

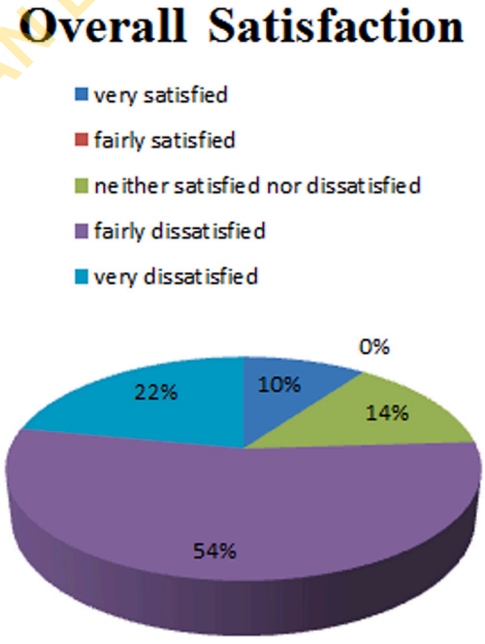

Fig. 5. Passengers' overall satisfaction.

Study area

Ibadan is located in the South-Western part of Nigeria, approximately on longitude 3˚5 East of the Greenwich Meridian and latitude 7˚2 North of the Equator. There are eleven Local Government Areas in Ibadan metropolis consisting of five urban Local Governments and 6 semi-urban or rural Local Government Areas. This study covers the five urban local government areas namely; Ibadan North, Ibadan North-East, Ibadan North-West, Ibadan South-West, and Ibadan South-East. Fig. 2 shows the map of all the bus stops selected for this study.

Data and methodology

Based on enquiries from Federal Road Safety Corps (FRSC) and Nigeria Traffic Warden Service (TWS), twenty problematic bus stops were selected for evaluation from the five urban Local Government Areas in Ibadan metropolis as shown in Table 1 and Fig. 1. A field survey was conducted at each bus stop to determine the user experience of passengers, as well as to identify hazardous acts carried out at bus stops. The survey involved direct observations of hazardous acts and interviews with 50 passengers. Casual factors contributing to hazardous acts were identified from the field survey and also from literature review. Based on evaluations of the hazardous acts and casual factors, the safety level of each bus stop was modeled.

The model, proposed by Cheranchery et al. (2016) is expressed as:

$$S = 10(1 - \sum_{i=1}^{n} x_i \times w_i) \quad (1)$$

Where,

Table 2
Casual factors and contribution indices.

Hazardous act	Casual factor	Average score	Contribution index ($C_{ip\ pp}$)
b1: Drivers stopping on the Carriageway	b1c1	4	0.20
	b1c2	3	0.16
	b1c3	3	0.16
	b1c4	3	0.16
	b1c5	3	0.16
	b1c6	3	0.16
b2: Encroachment of Passengers and Pedestrians to the Roadway	b2c1	3	0.17
	b2c2	4	0.21
	b2c3	3	0.17
	b2c4	3	0.17
	b2c5	2	0.11
	b2c6	3	0.17
b3: Boarding and Alighting at Filling Stations	b3c1	4	0.29
	b3c2	3	0.21
	b3c3	3	0.21
	b3c4	4	0.29
b4: Unsafe Crossing	b4c1	3	0.16
	b4c2	4	0.20
	b4c3	3	0.16
	b4c4	3	0.16
	b4c5	3	0.16
	b4c6	3	0.16

S = safety level of a bus stop,
n = total number of casual factors,
i = total number of hazardous acts,
x_i = a dummy variable representing the presence ($x_i = 1$) or absence ($x_i = 0$) of a casual factor in a bus stop, and.
w_i = weightage of the casual factor.
Weightage of the casual factor could further be expressed mathematically as:

$$w_i = c_{ip} \times d_p \quad (2)$$

Where,
c_{ip} = contribution index, which indicates the relative contribution of i^{th} casual factor to the p^{th} hazardous act,
d_p = degree of danger associated with the p^{th} hazardous act.
Contribution indices and degrees of danger were obtained from a survey with 17 experts (civil engineers and transportation engineering researchers). Questionnaires were administered to the experts where they were asked to rate how much each casual factor contributes to its corresponding hazardous act, using a scale of 1–4 (1 being 'not important at all' and 4 being 'very important'). Geometric averages of scores were obtained, after which the scores were normalized and taken as contribution indices. Experts were also asked to compare one hazardous act against another using Saaty's pairwise comparison 9-point scale for Analytical Hierarchy Process (AHP). Responses obtained were checked for consistency. 16 responses had consistency ratio less than 0.1 and were accepted for AHP analysis. A matrix was formed from the geometric average of the 16 responses and the consistency of the matrix was verified. Thereafter, the matrix was analyzed to generate the degrees of danger using AHP Online System (AHP-OS) software (Klaus, 2020).

Results and discussion

Analysis of passengers' response to interview questions

62% of passengers interviewed indicated low satisfaction with the accessibility of bus stops as 34% were very dissatisfied, and 28% were fairly dissatisfied. 60% of passengers indicated low satisfaction with comfort, and 66% indicated low satisfaction with safety as shown in Figs. 2 to 4. Fig. 5 shows that 76% of the passengers were dissatisfied with the overall condition of bus stops.

Analysis of field observations

Four hazardous acts were identified from the field survey of the twenty selected bus stops. They include; drivers stopping on the carriageway (b1), encroachment of passengers and pedestrians to the road (b2), boarding and alighting at filling stations (b3) and lastly, unsafe crossing (b4). Also known as petrol station, a filling station is a place where fuel is sold to road users, often with small shops along the road. Table 2 groups each hazardous act identified with its casual factors. Table 3 provides the matrix formed from the geometric mean of experts' responses and Fig. 6 shows the degree of danger for each hazardous act.

Drivers stopping on the carriageway (b1)

Drivers were seen stopping on the carriageway to load or drop passengers at bus stops. None of the bus stops surveyed in this study had a shelter, as such, passengers were seen occupying road areas. The presence of previously parked vehicles due to inadequate berth space also made some vehicles stop on the carriageway. As observed by Akintayo et al. (2019), some bus stops were being used as cab stands and bus parks, reducing the berth space of the bus stops. Many of the bus stops were operated by different kinds of vehicles.

Therefore, the casual factors identified with this hazardous act include; (i) Absence of a designated boarding/alighting area (b1c1), (ii) Inadequate berth capacity (b1c2), (iii) Use of bus stops as cab stands or bus parks (b1c3), (iv) Berth occupied by pedestrians and/or passengers (b1c4), (v) Use of bus stop by different vehicles i.e. mixed traffic (b1c5), and (vi) Unruly behavior of drivers (b1c6).

Encroachment of passengers and pedestrians to the roadway (b2)

Passengers and pedestrians were seen in majority of the bus stops using the roadway. According to Srinivas and Vinay (2008), unsafe pedestrian movements could be the result of lack of pedestrian facilities. Cheranchery et al. (2016) gave the predominant reasons for this hazardous act and they include; no or inadequate waiting area, no or inadequate sidewalks, inadequate lighting facility along sidewalks,

Table 3
Geometric mean of pairwise comparisons.

Hazardous acts	Drivers stopping on the carriageway	Encroachment of passengers and pedestrians to the roadway	Boarding and alighting at filling stations	Unsafe road crossing
Drivers Stopping on the Carriageway	1	1	4	2
Encroachment of Passengers and Pedestrians to the Roadway		1	4	2
Boarding and Alighting at Filling Stations			1	1
Unsafe Road Crossing				1

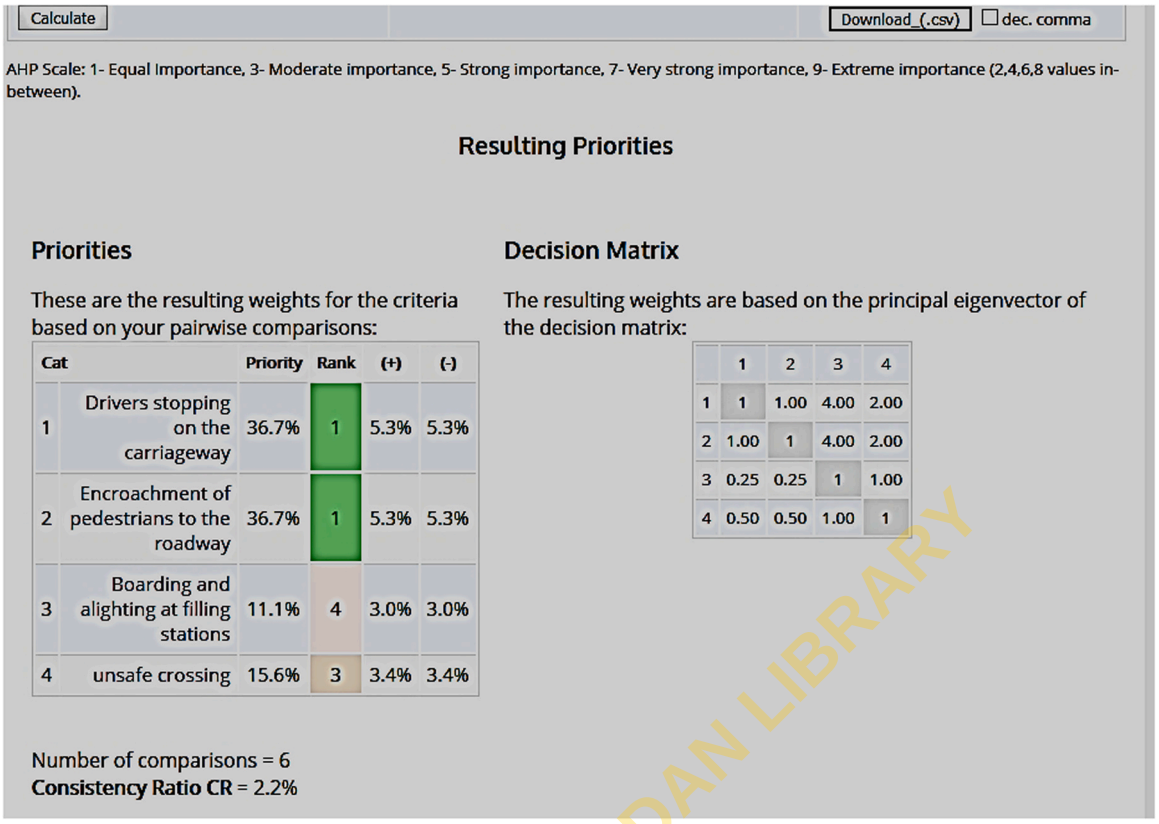

Fig. 6. Pairwise comparison matrix using the AHP Online System (AHP-OS) software by Klaus D. Geopel, business performance management (BPMSG).

Table 4
Safety level of university of Ibadan bus stop (Ibadan North).

Hazardous act	Casual factor	d_p	$c_{ip\ pp}$	w_i	x_i	$w_i \times x_i$	Hazardous act	Casual factor	d_p	$c_{ip\ pp}$	w_i	x_i	$w_i \times x_i$
b1	b1c1	0.367	0.2	0.073	1	0.073	b2	b2c6	0.367	0.17	0.062	1	0.062
b1	b1c2	0.367	0.16	0.059	1	0.059	b3	b3c1	0.111	0.29	0.032	1	0.032
b1	b1c3	0.367	0.16	0.059	0	0	b3	b3c2	0.111	0.21	0.023	0	0
b1	b1c4	0.367	0.16	0.059	1	0.059	b3	b3c3	0.111	0.21	0.023	1	0.023
b1	b1c5	0.367	0.16	0.059	1	0.059	b3	b3c4	0.111	0.29	0.032	1	0.032
b1	b1c6	0.367	0.16	0.059	1	0.059	b4	b4c1	0.156	0.16	0.025	0	0
b2	b2c1	0.367	0.17	0.062	1	0.062	b4	b4c2	0.156	0.20	0.031	1	0.031
b2	b2c2	0.367	0.21	0.077	0	0	b4	b4c3	0.156	0.16	0.025	1	0.025
b2	b2c3	0.367	0.17	0.062	1	0.062	b4	b4c4	0.156	0.16	0.025	0	0
b2	b2c4	0.367	0.17	0.062	0	0	b4	b4c5	0.156	0.16	0.025	0	0
b2	b2c5	0.367	0.11	0.040	1	0.040	b4	b4c6	0.156	0.16	0.025	0	0
						0.473	+						0.205

Safety level, S = 10(1- (0.473 + 0.205)) = 3.22

unkempt environment, encroachment of sidewalks by parked vehicles, presence of hawkers along sidewalks, and poor drainage facility. In line with (Akintayo et al., 2019), it was observed in this study that only a few bus stops had a walkway. Curbs were occupied by street traders, causing pedestrians to use the carriageway. Some bus stops were located in front of commercial buildings and at intersections.

Therefore, the casual factors identified with this hazardous act include; (i) No or inadequate sidewalk (b2c1), (ii) Sidewalk occupied by traders (b2c2), (iii) No or inadequate waiting area for passengers (b2c3), (iv) Untidy surrounding (c4), (v) Unruly behavior of pedestrians (b2c5) and (vi) Inappropriate location of bus stops (b2c6).

Boarding and alighting at filling stations (b3)

Vehicles made use of inappropriate stopping points especially filling stations. This may be attributed to lack of bus stop facilities. Improvised bus stops emerge as the need for bus stops arise (Akindele et al., 2014). This act may also be as a result of lack of bus stop design manuals as noted by Akintayo et al. (2019).

Therefore, the casual factors identified with this hazardous act include; (i) Inadequate bus stop facilities (b3c1) (ii) Locating bus stops in front of filling stations (b3c2), (iii) Lack of manuals for design and location of bus stops (b3c3), and (iv) Lack of law enforcements (b3c4).

Unsafe crossing (b4)

Many pedestrians were seen crossing the road from the opposite end directly to the curbs where vehicles stop to load or unload passengers. Some passengers were also seen crossing the road directly in front of a stopped vehicle. Cheranchery et al. (2019) observed the reasons behind unsafe crossing which include; locating bus stops at near-side intersection, locating crosswalks at far-side intersections, inadequate width of the crosswalk, and locating crosswalk at a long distance from bus stops.

The casual factors identified with this hazardous act include; (i) Near-side bus stops (b4c1) (ii) Absence or inadequate provision for

Table 5
Safety levels of bus stops.

S/N	Bus stop	Safety level
1	University of Ibadan (Ibadan North)	3.22
2	Living Spring Sango (Ibadan North)	2.38
3	Bodija Market (Ibadan North)	3.22
4	NTA Shopping Complex (Ibadan North)	2.38
5	Honors Filling Station (Ibadan North-West)	3.02
6	Okepadre (Ibadan North-West)	3.56
7	Task Filling Station, Iwo road (Ibadan North-East)	2.77
8	Academy (Ibadan-North)	3.83
9	Honors Filling Station, Orita aperin (Ibadan North-East)	2.74
10	Lister Oil, Beere (Ibadan South-East)	2.96
11	Total Filling Station, Beere (Ibadan South-East)	4.2
12	Iwo Road Interchange (Ibadan North-East)	4.83
13	Abe Bridge, Iwo Road (Ibadan North-East)	2.60
14	Oba Akinyele (Ibadan North-East)	4.37
15	Arisekola, Bestway Road (Ibadan North-East)	3.19
16	Gate (Ibadan North)	2.61
17	Samonda (Ibadan North)	4.80
18	Orita aperin- Iyana beere (Ibadan South-West)	2.65
19	Iyana merin-Ogunpa (Ibadan South-West)	2.60
20	Beere-Orita merin (Ibadan South-West)	3.78

crossing (b4c2), (iii) Unruly behavior of pedestrians (b4c3), (iv) Inadequate width or absence of crosswalk (b4c4), (v) Locating crosswalk far from bus stops (b4c5), (vi) Poor maintenance of crossing facility (b4c6).

From Fig. 6, experts considered b1 and b2 the most dangerous hazardous acts, followed by b4, and lastly b3 (d_p for b1 = 36.7%, d_p for b2 = 36.7%, d_p for b3 = 11.1% and d_p for b4 = 15.6%).

Safety levels of bus stops

According to Cheranchery et al. (2016), safety levels of bus stops can be rated from 0 to 10 (10 being the best and 0 being the worst). The safety level of University of Ibadan bus stop was rated 3.22 as shown in Table 4. Table 5, as well as Fig. 1, presents the safety levels of all the bus stops in this study. With safety levels ranging from 2.38 to 4.83, all bus stops fell short of an acceptable level of safety. This is unlike the situation of Cheranchery et al. (2016) where prioritization of bus stops was necessary because some bus stops had high safety levels.

Conclusion and recommendations

This study applied the method proposed by Cheranchery et al. (2016) in assessing the safety of bus stops in Ibadan metropolis. The method involved the analysis of hazardous acts and casual factors by experts. Further evaluations of experts' results were done using Analytic Hierarchy Process (AHP). AHP-OS software by Klaus D. Geopel, was particularly used in this study to facilitate the process and to ensure precise evaluations. This study also included the assessment of passengers' user experience since they are the predominant users of bus stops.

Based on the findings, it is recommended that the State Government, the Local Governments, National Union of Road Transport Workers (NURTW), and Road Transportation Employers Association of Nigeria (RTEAN) work together to develop a standard manual for the design and location of bus stops in Ibadan metropolis. They should synergize to develop guidelines for bus stop operation and enforce the use of the guidelines. Improperly located bus stops should be relocated and where unreasonably practicable, totally removed. Bus stop facilities should be adequately provided while considering pedestrian requirements.

Overall, this study promotes a rational method of investigating the safety of bus stops especially in locations where comprehensive and reliable accident records are unavailable. The method can be used to study the causes of safety challenges at bus stops and also to determine the perceptions of passengers and experts concerning the challenges. However, experts' prioritization of hazardous acts may differ from that of passengers. Further research should include a comparison between the safety levels obtained from passengers' analysis of hazardous acts and those obtained from experts.

CRediT authorship contribution statement

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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