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Travel time and speed differential analysis between Lagos bus-stop and rivers state university commercial bus corridor

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Abstract

This study examined the travel characteristics of commercial buses operating on a 6.3 km corridor between Lagos Bus-stop located in a residential area and Rivers State University (RSU) Bus-stop during morning peak hours (7 - 9 am). Data were collected over seven days on travel time, passenger boarding/alighting, delay time, journey speed, and running speed for both directions. Results revealed significant directional asymmetry, with the RSU → Lagos direction demonstrating superior weekday performance including lower travel times (0.37 hr vs. 0.38 - 0.41 hr) and higher journey speeds (17.22 - 17.30 km/hr vs. 15.46 - 16.54 km/hr). The RSU area functioned as a friction zone, slowing entering buses while allowing departing buses to accelerate faster. Passenger activity peaked on Monday (35 boarding) and Friday, with the RSU → Lagos direction handling higher volumes. Wednesday recorded the highest delay (0.19 hr toward Lagos), while weekend delays dropped by 40 - 50% (0.09 - 0.11 hr). The gap between running speed (26.31 - 33.45 km/hr) and journey speed (15.46 - 22.65 km/hr) indicated that dwell time and traffic delays constituted 30 - 40% of total travel time. The findings align with international research documenting 11-16% lower speeds on working days compared to weekends and significant land use impacts on bus performance. This study provides empirical evidence for evidence-based transit planning, recommending dynamic scheduling, targeted infrastructure improvements at RSU, and differential weekend operations to enhance service efficiency on this corridor

Keywords: Commercial bus; Travel time; Journey speed; Running speed; Passenger; Bus-stop

1. Introduction

Transportation is the actual physical movement of people and goods from one place to another [1]. Transport connectivity creates economic growth, jobs and infrastructural development [2]. In Nigeria, road transportation is the commonest and most extensively used form of transportation. It involves the use of bicycles, motorbikes, cars, buses, trailers, lorry, tankers, etc, in moving people, goods and services from one location to another where they are needed [3]. It remains true that no great civilization has been built without some well-defined system of transportation [4]. Transportation takes a crucial part in the manipulation of logistic [5]. It is the most potent tool for human accomplishment [6] and a dynamic sector of society, seemingly set for continued growth without natural limit [7].

Journey speed is a crucial parameter in the assessment of the quality of public transport services in cities, evaluation of road performance, determination of the efficiency of a route with respect to its ability to carry traffic, identification of locations with relatively high delays and the causes for those delays [8]. The average journey speed describes the distance travelled divided by the total journey time, which encompasses all delays.

Commercial vehicles play a crucial role in road transport by facilitating the movement of goods and people, for various industries and essential services. They are vital to logistics industry [9], economic impact, connectivity and job creation [10]. Buses are a crucial for wider economy and health of our city economies, it is the most efficient user of road space,

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and vital part of an environmentally-friendly local sustainable transport system [2]. Commercial vehicles impact journey speed due to their potential of causing delays. The increase in traffic from commercial vehicles has contributed to congestion and decrease in speed, requiring infrastructure and traffic management improvements.

The determination of journey speed of commercial vehicle is crucial tool to check the commercial vehicle performance and efficiency. It can be defined as the average journey speed of commercial vehicle between two points, including any delays at stops [11].

2. Materials and method

The equipment were used in this study were a stopwatch, Gps used to determine distance and commercial bus.

The travel time and delay studies was carried in accordance with [12] manual for transportation studies. A stopwatch was used to record the total travel time of the commercial vehicle as it moves from Lagos bus stop to Rivers State University (RSU) bus stop and from RSU bus stop to Lagos bus stop. This process was done from Monday to Sunday for 4 weeks between 7 am and 9 am. Time spent during spots by the vehicle was also recorded**.** The journey and running speed of commercial vehicle was determined. Result of the of the travel time of a commercial vehicle from RSU bus stop to Lagos bus stop are presented in Table 1 and 2

3. Results and discussion

The length of the road from Rivers State University bus stop to Lagos bus stop is approximately 6.3km

Table 1 Travel characteristics of commercial vehicle from Lagos bus-stop to RSU bus-stop

Days	Average Travel Time (hr)	Average Number of Passenger Entered	Average Number of Passenger Dropped	Average Delay Time (hr)	Average Journey Speed (km/hr)	Average Running Speed (km/hr)
Monday	0.37	13	14	0.16	17.14	29.52
Tuesday	0.40	9	16	0.17	16.02	27.53
Wednesday	0.41	11	13	0.19	15.46	26.31
Thursday	0.39	9	15	0.16	16.10	27.67
Friday	0.38	12	15	0.14	16.54	26.45
Saturday	0.33	8	10	0.11	19.32	29.38
Sunday	0.31	7	14	0.10	20.32	30.07

Table 2 Travel characteristics of commercial vehicle from RSU bus-stop to Lagos bus-stop

Days	Average Travel Time (hr)	Average Number of Passenger Entered	Average Number of Passenger Dropped	Average Delay Time (hr)	Average Journey Speed (km/hr)	Average Running Speed (km/hr)
Monday	0.41	14	21	0.20	15.75	30.47
Tuesday	0.37	11	17	0.15	17.22	29.08
Wednesday	0.37	10	20	0.14	17.3	28.25
Thursday	0.37	11	14	0.14	17.23	28.07
Friday	0.37	11	15	0.17	17.22	31.42
Saturday	0.28	5	14	0.09	22.65	33.45
Sunday	0.34	9	16	0.11	18.89	28.48

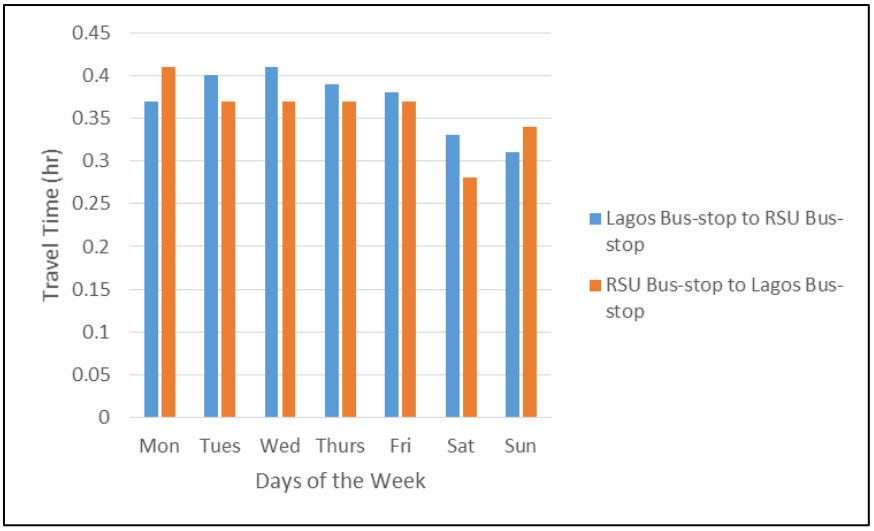

Figure 1 Chart of Average Travel Time of Commercial Bus in Days of the week

During typical weekdays (Monday - Friday), the morning peak period heavier traffic flowing from the residential areas (Lagos Bus-stop) to commercial/institutional areas (RSU) see figure 1. The data captures the net effect across the full day, suggesting that the RSU-bound direction experiences greater cumulative demand and congestion on most weekdays [13]. A study on bidirectional bus services found that "two-way bus corridor systems always suffer severe demand imbalance between their two operational directions during peak hours. This imbalance creates asymmetric travel times, as buses in the heavier direction face more boarding/alighting delays and traffic congestion. The directional difference is most pronounced on Saturday (0.05 hr) and Wednesday (0.04 hr), while Friday shows near-balance (0.01 hr difference). Weekend travel patterns differ fundamentally from weekdays due to: Shift from commuter to recreational/leisure travel, Different activity nodes (markets, entertainment venues), Reduced directional peaking.

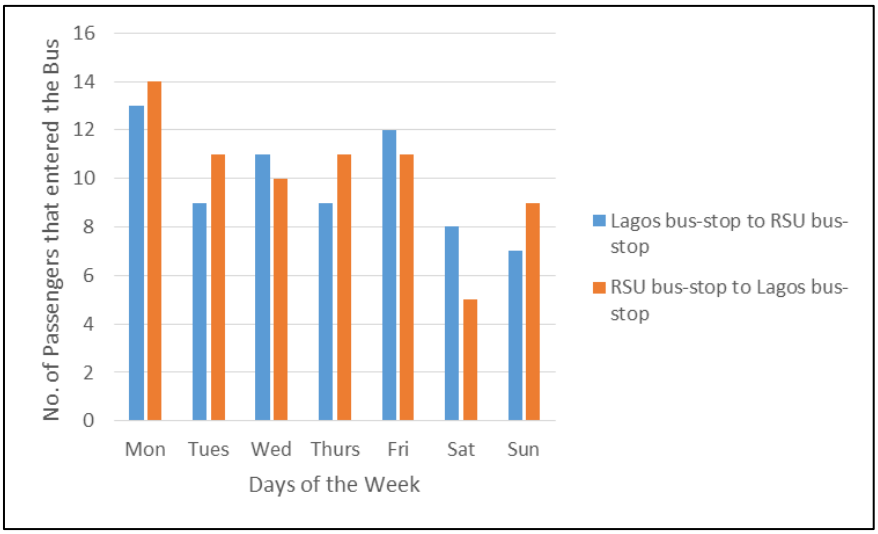

Figure 2 Chart of No. of Passengers that entered the Commercial Bus in Days of the week

The higher boarding toward Lagos bus stop during weekday mornings reflects the comprehensive travel pattern of students who live near the university and traveling outward for morning activities and also represent return trips from overnight stays near campus

A study on transit ridership patterns in Seoul classified districts based on boarding/alighting patterns during peak hours (7-9 am, 18-20 pm) and identified residential-oriented vs. activity-oriented groups [16]. During morning peak, residential areas show high boarding volumes, while activity centers (like universities) show high alighting volumes [16]. Your data showing boarding toward Lagos (residential) during morning peak aligns with this pattern—students are boarding buses *from* the university area to reach residential zones, suggesting some students reside near campus

and travel outward. The shift in directional preference on weekends reflects different trip purposes. On Saturday, higher boarding toward RSU (8 vs. 5) suggest students traveling to campus for academic activities, sports, or social events. Sunday's pattern toward Lagos (9 vs. 7) may reflect religious activities or return trips to prepare for the week.

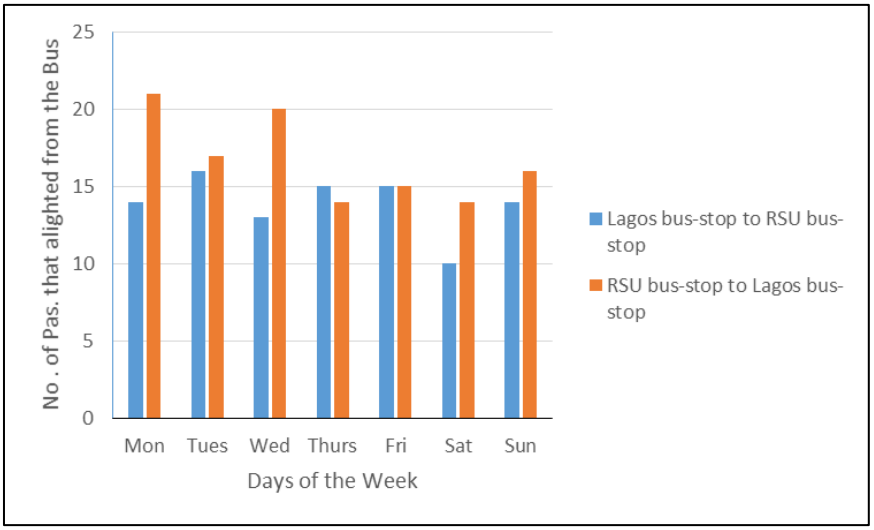

Figure 3 Chart of No. of Passengers that alighted from the Commercial Bus in Days of the Week

The passenger boarding data from 7 am to 9 am reveals that Lagos Bus-stop which is located in residential area functions as the primary boarding generator during morning peak hours, with higher boarding toward Lagos on 6 of 7 days, see Table 1 and 2. This pattern reflects established transportation principles: residential areas generate high morning boarding regardless of destination direction, while activity centers (RSU main campus and Mile III market) generate high alighting. The presence of both a university and a market at RSU bus-stop creates complex, multidirectional travel patterns that vary by day of week. Monday shows highest total volume as students return to campus; Wednesday shows greatest directional imbalance possibly reflecting market activity; Friday shows perfect balance as weekend approaches; and Sunday shows strong boarding as students return to campus residences. These findings align with international research demonstrating that land use configuration fundamentally shapes transit ridership patterns, with residential, educational, and commercial land uses creating distinct temporal and directional boarding profiles [15; 16; 17]

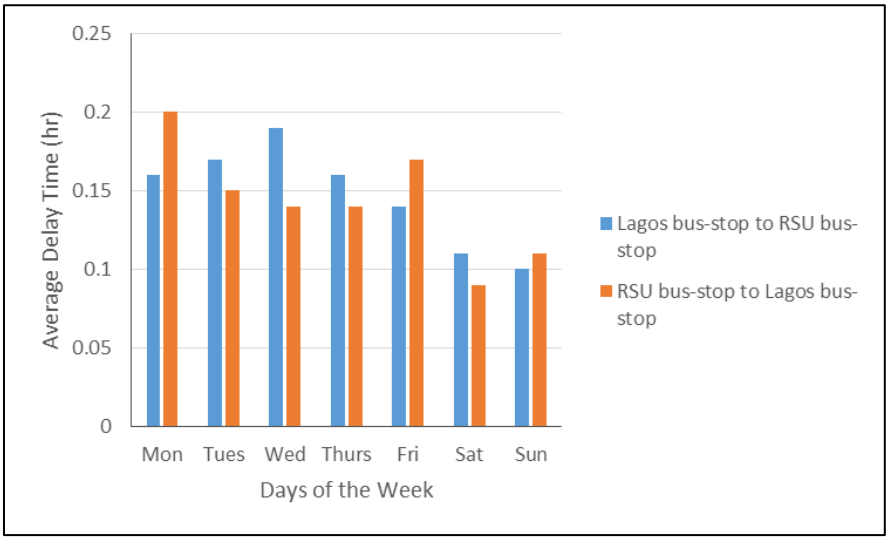

Figure 4 Chart of Average Delay time in Days of the Week

Research on bus delay composition identifies that delay at bus stops can be divided into several components. [18], in their study of bus delays in Beijing, found that bus delay includes entering delay (waiting to enter the stop), dwelling delay (time spent boarding/alighting), and exiting delay (waiting to re-enter traffic) [18]. Their research, based on data

collected during morning rush hours (7:00-9:00), demonstrated that different load factors of passengers significantly influence average boarding and alighting time per person. The delay values in your data (ranging from 0.09 to 0.20 hours = 5.4 to 12 minutes on a 6.3 km route) are consistent with findings from Beijing where bus operational speed during peak hours dropped to 22 km/h due to delay accumulation [18].

The directional variations reflect the land use configuration (university + market at RSU, residential at Lagos), with mid-week days showing highest delays and weekends showing 40-50% reduction. These patterns align with international research demonstrating that dwell time, traffic signal delay, and queuing at stops constitute the primary components of bus delay in urban corridors.

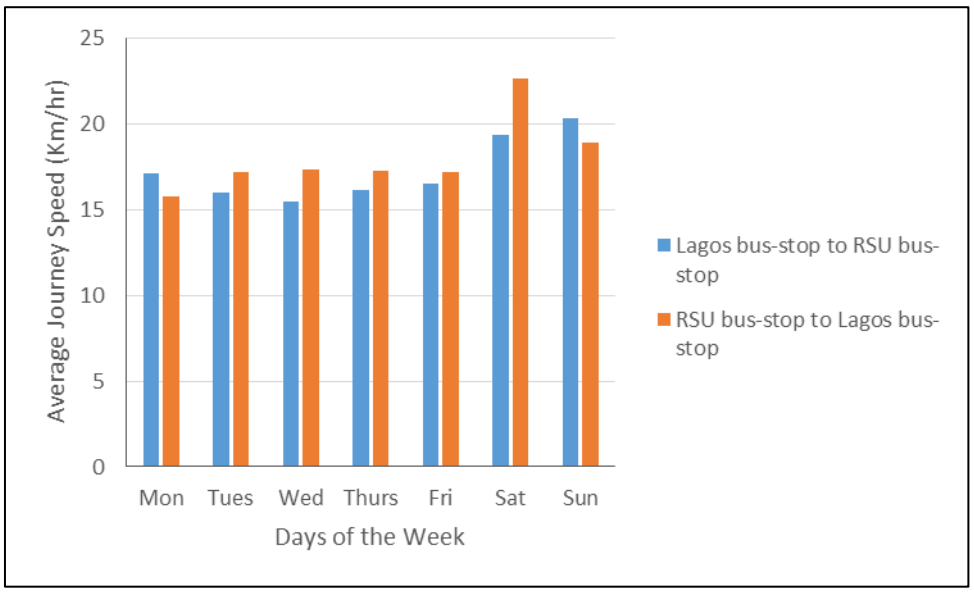

Figure 5 Chart of Average Journey Speed of Commercial Bus in Days of the Week

Research on bus travel time variability confirms that journey speed is the most direct indicator of operational performance, integrating the effects of traffic congestion, passenger activity, and roadway characteristics [19]. . A study in Kampala found that bus travel times on mixed-traffic routes (Right-of-Way C) are subject to high variability, with journey speeds reflecting cumulative delay impacts [19]. The average journey speed data reveals that bus performance on this route during morning peak hours is strongly influenced by land use characteristics at each end. The RSU area functions as a speed-reducing friction zone on most weekdays commercial activity and school, making the direction toward RSU slower. This aligns with international research identifying retail land use as a significant negative factor affecting bus speed.

Weekend speeds improve by 20-30% due to reduced traffic volume, lower passenger demand, and different trip purposes—a pattern documented in university communities worldwide [20; 21]. The observed speeds (15.46-22.65 km/hr) are comparable to or better than those in other developing country contexts, though Wednesday's 15.46 km/hr approaches the threshold where transit becomes uncompetitive with private vehicles [21].

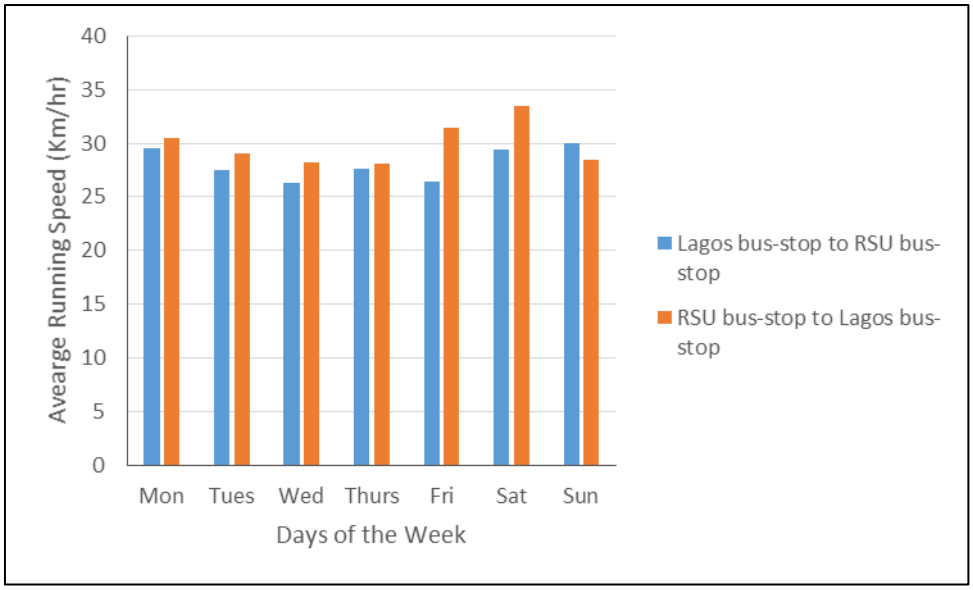

Figure 6 Chart of Average Running Speed of Commercial Bus in Days of the Week

The average running speed data reveals that bus performance on the route is strongly influenced by the land use characteristics at each end. The RSU area (university + market) functions as a speed-reducing friction zone on weekdays, making the direction entering RSU (Lagos→RSU) consistently slower. This aligns with international research documenting that working day speeds are 11-16% lower than weekends [22] and that university towns exhibit distinct transit patterns with high student ridership.

Friday's extreme directional gap (4.97 km/hr) reflects combined academic and market activity peaking at weekends, a pattern documented in transportation research since the 1970s. Weekend speeds improve substantially, with Saturday reaching 33.45 km/hr in the RSU→Lagos direction.

The running speeds (26-33 km/hr) are substantially higher than journey speeds (15-20 km/hr from your earlier data), confirming that dwell time at stops constitutes a major portion of total travel time on this route. This gap between running speed and journey speed represents the cumulative time lost to passenger boarding/alighting, traffic signals, and congestion—all areas where targeted interventions could improve overall bus performance.

4. Conclusion

The following conclusions are made based on the study carried out**:** The RSU → Lagos direction performs better on most weekdays with lower travel times (0.37 hr vs. 0.38-0.41 hr) and higher journey speeds (17.22-17.30 km/hr vs. 15.46-16.54 km/hr). The RSU area functions as a friction zone, slowing buses entering the area while allowing departing buses to accelerate faster. The RSU → Lagos direction handles higher passenger volumes, with Monday recording 21 passengers dropped at Lagos—the highest weekly value. This confirms the residential area as a primary morning destination. Wednesday records the highest delay (0.19 hr toward Lagos). Weekend delays drop by 40-50% (to 0.09-0.11 hr) due to reduced traffic and passenger demand. The difference between running speed (26.31-33.45 km/hr) and journey speed (15.46-22.65 km/hr) shows that dwell time and traffic delays constitute 30-40% of total travel time. Monday has highest passenger activity; Wednesday shows poorest performance; Friday has largest directional speed gap (4.97 km/hr); Saturday achieves best overall performance.

The findings align with similar research showing working day speeds are 11-16% lower than weekends, retail/educational land uses significantly affect bus speed, and directional demand imbalance is inherent in bidirectional corridors.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest.

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