ASSESSMENT OF ADDIS ABABA LRT STADIUM STATION FOR DEVELOPMENT OF AN INTEGRATED TRANSPORT INTERCHANGE

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ABSTRACT

The research paper explored the integration of transit modes at Addis Ababa's Light Rail Transit (AALRT) stadium station, to address the city's growing population and consequent transit challenges. Drawing insights from global transit integration practices, the existing station facilities and passenger characteristics were evaluated so as to propose upgrades for seamless multimodal transit. Through extensive surveys and regression analysis, key factors affecting transit experience and efficiency were identified. Deficiencies in passenger facilities, such as inadequate seating, lack of weather protection, and real-time information were noted, affecting end user comfort and operational efficiency. Integration efforts were also hindered by disjointed transit operator coordination. To address the aforementioned, improving station amenities, active spaces and operator coordination was recommended. It was also key to address operational challenges faced by AALRT, such as electric power cuts and availability of spare parts, to ensure reliable service delivery. Ultimately, the study indicated the importance of passenger centric spaces and services in enhancing the functionality of multimodal facilities like the AALRT stadium station, laying groundwork for sustainable urban mobility in Addis Ababa.

Keywords: AALRT, Integration, Interchange, LOS, Passenger, Waiting times.

1. INTRODUCTION

Addis Ababa is home to 17% of Ethiopia’s urban population and shares similarities with many other cities worldwide in terms of experiencing rapid population growth [4.4% as of 2020] and the consequent strain on transit systems, resulting in increased need of interconnected utilities (Ezana Haddis Weldeghebrael, 2021). However, it's important to note that each city has its unique characteristics influenced by factors such as geography, culture, economic development and governance. Ethiopia is a low-income country, most people rely on government subsidized transport. To address the aforementioned, the Ethiopian government introduced a light rail train as a supplement to buses and taxis (Sekasi & Martens, 2021). However, without coordination of the transit options, their main purpose of effectively transporting passengers is not fully realized hence the need of integration to improve the efficiency of the transit system. Interchanges are intelligent responses to inter-modality needs, hence the need of constant research on parameters related to accessibility, affordability, transit experience and inconveniences inherent to modal transfer among other parameters (Hickman *et al.*, 2015).

1.1 Aim of Paper

To assess Addis Ababa Light Rail Transit (AALRT) stadium station with the objective of identifying opportunities and challenges in developing an integrated transport interchange.

1.1.1 Problem Statement

Having a variety of public transit modes is key for major cities, however without integration their effectiveness is not fully realized. The recently constructed Addis Ababa LRT has to complement the already present transit system. This can be realised on major stations, in this case the stadium station, which houses 2 LRT lines, mini-buses and city buses.

1.1.2 Scope of Paper

The scope of the paper was to assess the feasibility of having an integrated transit facility at the stadium station based on the City Hub Model. The current station facility was investigated if it met the needs of the current and future transit demand.

2. LITERATURE REVIEW

Lack of transit integration has long been a major problem for passengers utilizing public transit systems as indicated from various satisfaction surveys conducted by many transport institutions. To reach a destination, in multimodal transit systems, a rider might be required to utilize multiple transit options, each with different schedules. Multi-modal transit systems serve their purpose when they operate as a seamless and integrated structure which is critical for fast-urbanizing economies such as Ethiopia (Verster, 2005; Bell, 2019). It was noted that the effectiveness of multimodal facilities was affected by transit modes, network position and environment. Parameters of concern include accessibility, end user circulation, amenities, security and psychological factors (Bell, 2019). From studies conducted by Hernandez, Monzon and Ona (2014), a framework to grade the pros and cons of multimodal facilities was drawn up. One of the primary challenges was transit operator coordination to cater for service proximity and transit time, resulting in minimum trip disruption (Cao, Jiang & Wang, 2022). The effectiveness of a multi-modal facility is also dependent on individual attributes (age, sex, culture, luggage, group size) and environment attributes (temperature, location, obstacles, passenger flows, density) (Lindberg, 2019; Lee *et al.*, 2020).

2.1 Pedestrian Level of Service (LOS)

It has been noted that it is not desirable to design pedestrian facilities based on capacity only, but on a desired LOS (Zakwan *et al.*, 2016). The desirable pedestrian environment allows for walking at desired speed, avoiding other pedestrians, and visually interacting with surroundings. LOS is based on average space and flow rate (Bhatnagar & Ram, 2021). According to Singh and Jain (2011), the current practices for evaluating pedestrian facilities can be grouped into 2 types; capacity and roadway characteristics-based methods. Capacity based methods use principles of highway capacity to evaluate transit facilities. Roadway characteristics based methods consider perception and comfort of pedestrians and include the Australian LOS method, SCI model, and trip quality LOS method amongst others (Singh & Jain, 2011). The most used method is the HCM, as its methodology has tremendous advantages in data collection and evaluation of the subsequent LOS. However, it does not accurately reflect the complex pedestrian experience as it does not take into account environmental and psychological factors (Banerjee, Maurya & Lämmel, 2018).

2.2 Case Studies

A set of interchanges were selected based on location, transit modes, passenger capacity and necessary facilities to improve passenger circulation as summarized below:

Partick Interchange [Scotland]: It is one of the main transit hubs in Glasgow and caters for the subway, local buses and rail. It has an annual demand of 4 million travelers. The facility allows for safe traffic flow within its spaces, separating pedestrians away from the bus maneuvering area. The transit facility is equipped with high-quality weather protection shelter, real time Information displays, LED lighting, seating, and high access kerbs for level entry access to buses and wheelchair movement caters for people with disabilities. This promotes high safety standards, comfort and accessibility (Health & Paper, 2014).

Manukau Interchange [New Zealand]: The facility caters for South Auckland's integrated public transit network of rail and buses. The interchange has an expected annual demand of 600 000 passengers. To improve modal transfer the facility was equipped with shelter for passengers, 24-hour CCTV security, bus bay roofs for passenger shelter which can accommodate double-decker buses, bike racks, drop-and-ride areas, luggage lockers, convenience kiosks, real time information, waiting area, toilets, and bus staff and office facilities. The downside of the interchange is the saw tooth design for the bus station, which poses a collision risk for people, buses and amenities (Auckland Transport, 2018).

Kuyasa Transport Hub [South Africa]: It was initiated by the Provincial Government of Western Cape, implemented by Meyer and Vorster, to setup a vibrant urban node in Khayelitsha through introduction of high-quality public spaces to meet end users' needs. An existing community centre and high school, were integrated into the facility. In addition, formal and informal trading opportunities, a butchery, medical suites, a police station, bicycle lock-up stores and banking facilities were provided linked by a high-quality public space and covered walkways (African Development Economic Consultants, 2012).

3. METHODOLOGY

3.1 Addis Ababa Light Rail Transit (AALRT) background

The AALRT covers 34 kilometers and consists of two lines namely the North-South line and West-East line. Joining the 2 lines, is a 2.7-kilometer elevated common section with 5 stops. The stadium station lies along this section and is co-located with a bus and taxi station (Rode, Terrefe & da Cruz, 2020). Investigations were considered necessary to evaluate required improvements to meet current and future transit demand. Factors like location, active spaces, information and state of waiting areas, were considered key for controlling commuter circulation. The assessment of transit facility was conducted with reference to the City-HUB model due to its holistic approach which considers parameters affecting multi-modal transit facilities delivery, based on user requirements (Turnbull & O'higgins, 2013).

3.2 Data Collection

The respective methodology used for conducting the research is shown in Figure 1.

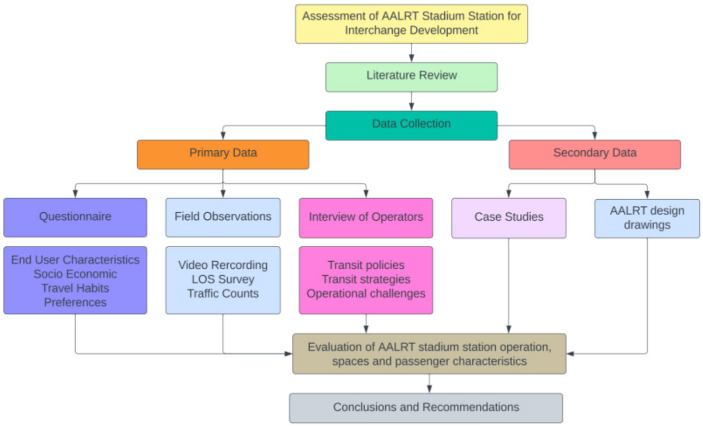

Figure 1: Research methodology

To assess commuter behavior, pedestrian counts and video recording were utilized. Station space and distances were obtained from google earth and design drawings. LOS evaluation was evaluated using Table 1 obtained from the Highway Capacity Manual 3rd edition 2013.

Table 1: Level of Service assessment table (Brinckerhoff, 2013)

Walkway LOS

LOS	Pedestrian Space (m^2/p)	Avg. Speed, *S* (m/min)	Expected Flows and Speeds: Flow per Unit Width, *v* (p/m/min)	*v/c*
A	≥ 3.3	79	0–23	0.0–0.3
B	2.3–3.3	76	23–33	0.3–0.4
C	1.4–2.3	73	33–49	0.4–0.6
D	0.9–1.4	69	49–66	0.6–0.8
E	0.5–0.9	46	66–82	0.8–1.0
F	< 0.5	< 46	*Variable*	*Variable*

Waiting Area LOS

LOS	Average Pedestrian Area (ft²/p)	Average Pedestrian Area (m^2/p)	Average Inter-Person Spacing (ft)	Average Inter-Person Spacing (m)
A	≥ 13	≥ 1.2	≥ 4.0	≥ 1.2
B	10–13	0.9–1.2	3.5–4.0	1.1–1.2
C	7–10	0.7–0.9	3.0–3.5	0.9–1.1
D	3–7	0.3–0.7	2.0–3.0	0.6–0.9
E	2–3	0.2–0.3	<2.0	<0.6
F	< 2	< 0.2	*Variable*	*Variable*

Schedules, policies and strategies were obtained through interview of transit stakeholders. Quantitative means were utilized in gathering passenger characteristics in the form of a questionnaire which was evaluated at 95% confidence level with margin of error of +/- 5%. The required sample size was determined using the following formula;

$$n = \frac{X^2 \text{ x } N \text{ x } P \text{ x } (1-P)}{\left((N-1) \text{ x } ME^2\right) + (P \text{ x } X^2 \text{ x } (1-P))}$$

- Where; **n** = sample size, **N** = Population size [100 000], **ME** = Margin of Error (0.05)
- **P** = Population proportion (50%), $\mathbf{X^2}$ = Chi-Square at 95% confidence level (3.841)

3.3 Binary Logit Regression Model Evaluation

Variable selection for the model was based on theoretical considerations, literature review, and the relevance of variables to the research objective. A bivariate analysis was used to determine how each explanatory variable related to the dependent variable Assumptions made during analysis included the linearity of the relationship between the independent and dependent variable, autonomy of observations, absence of multicollinearity in independent variables, and the assumption of a binary outcome. Multicollinearity and goodness-of-fit tests were conducted to ensure the validity of these assumptions and the overall model fit. The Hosmer-Lemeshow goodness test was used to assess whether the number of expected events from the logistic regression model reflected the number of observed events in the data. Model calibration was based on the Pearson χ_2 statistic which evaluated the model fit by comparing observed and expected outcomes within K groups based on ranking and the predicted probabilities. Furthermore, stepwise regression and backward elimination were conducted to refine the model by selecting the most relevant variables and eliminating non-significant ones. This iterative process helped streamline the model while ensuring its robustness and interpretability. Descriptive statistics such as means, standard deviations and percentages were evaluated through use of Excel 2013 and IBM-SPSS statistics.

4. RESULTS AND DISCUSSIONS

4.1 Level of Service Survey

4.1.1 Train Platform

Speed observation was done during peak hours (morning 7:00 to 10:00 and evening 16:00 to 19:00) and non-peak hours. Movement on the platform was evaluated through sampling of 100 passengers. Figure 2 summarizes the observed passenger speeds.

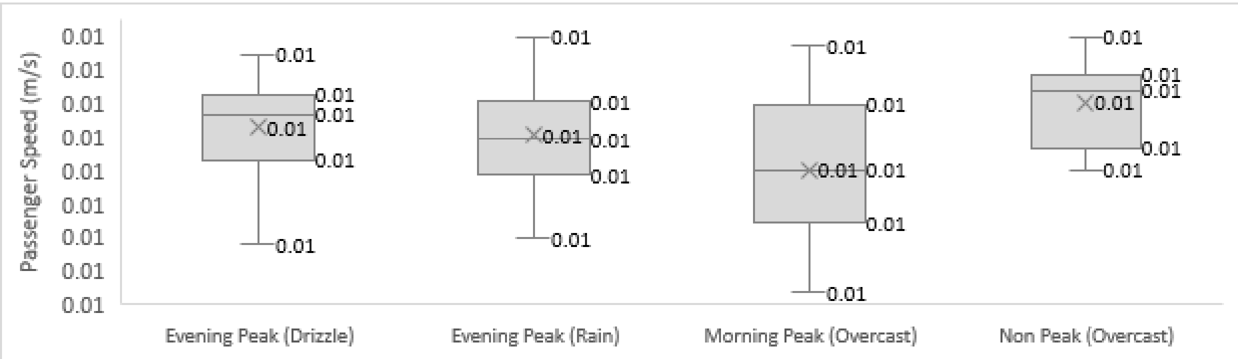

Figure 2: Train Station Platform Passenger Speeds

Passengers normally had less varied speeds during non-peak hours due to lower numbers and less competition for services. During peak hours, there was a more variation in speeds as a result of varying passenger density, passenger avoiding mechanisms being required to smoothen movement. Lower speeds were also as a result of passengers who were either disabled, walking with children or carrying luggage. Commuters changed their speed in response to changes in weather conditions. Figure 3 shows transit space evaluation.

Figure 3: Passenger LOS Characterization for Train Station

The facility mostly operated at LOS D (35%) implying that there was restricted space availability. This implied that there might be need to extend station spaces to accommodate the current demand as for most multimodal facilities, the design LOS should be C to D or better. However, this was mainly influenced by train operation as passengers crowded in certain platform areas in anticipation of the train stopping area for ease of access.

4.1.2 *Bus and Taxi Station (Walkways)*

Figure 4 summarizes passenger speeds observed.

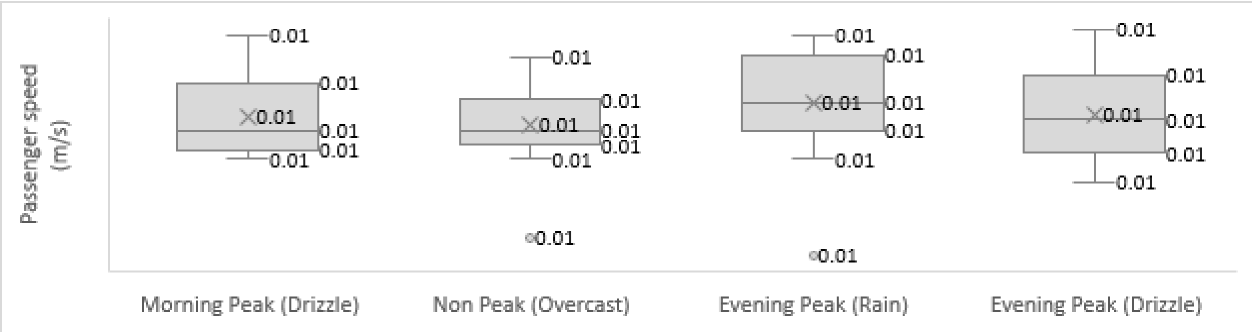

Figure 4: Passenger Speeds (Walkways [Taxi and Bus Station])

It was noted that passengers had less varied speeds during non-peak hours due to less competition for services. During peak hours, it was noted that there was increased variability between passenger speeds. Outliers represented people with mobility challenges, the disabled, elderly and those moving with children/luggage. Passengers in queues were noticed to occupy about 0.5 to 1m when queuing and LOS D (11%) (Figure 5), mainly experienced during peak hours. Available pedestrian space decreased as the LOS deteriorated, more likely to inconvenience end user accessibility and circulation.

Figure 5: Walkway LOS Characterization

4.1.3 *Waiting Spaces and Queue Lengths*

Transit environment conditions are summarized in Figure 6.

Figure 6: Passenger Queuing Conditions

Queue lengths for buses went beyond 100 people per line and coupled with no designated loading points, contributing to the haphazard movement of commuters. Commuters shared transit space with buses, posing a threat to their safety. People were observed to either stand or sit on sidewalks whilst waiting for transit due to lack of seats. Similar conditions were observed for taxis. Both stations had no weather protection facilities which is not ideal for service with non-fixed time tables. For the train station, there were limited seats also owing to vandalism. There was no provision of real time information for modal schedules updates. The train station is elevated above the taxi and bus station, access for disabled people is a challenge as the elevators and escalators were not working.

4.2 Passenger Survey

The transit facility serves about 80 000 to 100 000 passengers per day, hence the effective sample for questionnaires was determined to be 384. Questionnaires were distributed with the aid of 5 enumerators so as to have intrinsic information about end user travel habits and characteristics with relevance to the stadium station. The questionnaire was voluntarily completed by randomly selected 500 travelers at Addis Ababa LRT stadium station. A short face-to-face interview was initially conducted, to explain the main objective of the survey.

4.2.1 Demographic Factors

Demographic factors mainly focused on population characteristics hence gender and age were considered as shown in Figure 7.

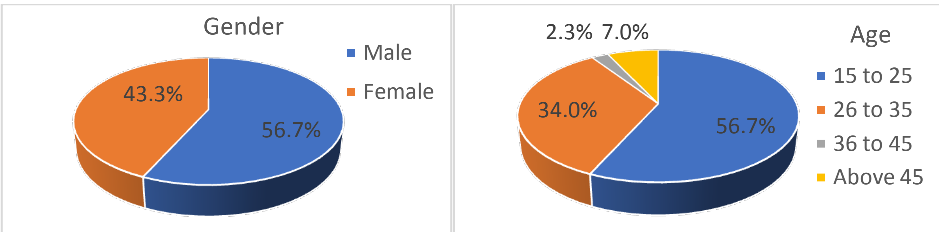

Figure 7: Observed Sample Characterization

The sample was balanced in terms of gender (56.7% male, 43.7% female] eliminating bias. the most dominant age group was the 15-25 (56.7%) age group, [26 to 35 (34%), 36 to 45 (2.3%) and above 45 (7%)]. Commuters below the age of 15 were not sampled.

4.2.2 Socioeconomic Factors

Socioeconomic aspects evaluated factors impacting living standards. Family size, access to a private vehicle, employment, education level, and household income were all considered. Majority of survey participants (88.2%) had completed at least high school, more than half of them were deemed to be literate. Since over 86.6% of the population was employed or enrolled in school, it was crucial that they get at their destinations as quickly as possible. 69.6% of the sampled population had a household income of less than 8000 Birr (133 USD), 51% of the sample cited that they lived in houses which had 4 or more people. From this analysis, it is critical to relate it with private car access of 29.3%, indicating that most people relied on public transport due to availability of resources.

4.2.3 Travel Habits

Transit habits and characteristics are summarised in Figure 8.

Work and school had the most trips with a combined percentage of 81.9%. Although most of passengers were likely to travel alone (53%), a substantial number (47%) were likely to face mobility challenges. About 8% was observed to be affected with some disability of some sort, 20% were observed to be travelling with children and 7% were moving with luggage. This group was largely affected by non-functionality of station elevators and escalators since there was elevation change between stations. 40.3% of the trips were of modal change and 59.7% of the trips were either in their starting/ending stage. This plays a pivotal role in design as there is a difference in behaviour of transferring passengers and those who are either starting or ending their journey. Most trips (65.7%) were done during peak hours hence waiting facilities were required especially for buses and taxis which were located in the open.

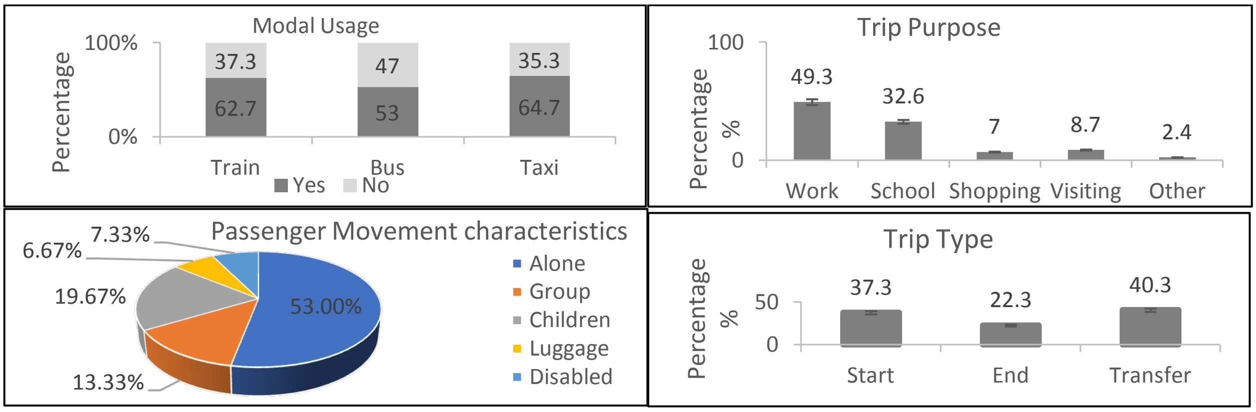

Figure 8: Public Transport Usage and Commuter Trip Characteristics

4.2.4 Institutional Factors

84% waited for more than 20 minutes for conveyance, and 72% of respondents preferred to wait for 15 minutes or less. 71.3% supported introduction of bicycles [63.7% male and 33.6% women]. This was reliant on timetables, waiting times, and distances from the station.

4.3 Policies and Development Strategies

To address concerns about transport routes, schedules, and policies, interviews with the relevant transit stakeholders were held. Taxis are privately owned whilst Anbessa city buses and AALRT are state parastatals. Absence of integrated ticketing, trip information, and end user centered facilities was evaluated. AALRT's development had stalled due to budgetary restrictions, despite its initial concentration on line expansion. The bus station was intended to be a temporary due to its location along the LRT route hence Anbessa concentrated on delivering the transit service without the required facilities. The system has been in place for seven years; hence operators are now currently looking for integration methods through the Ministry of Transport and the Addis Ababa City Transport Administration Bureau.

4.4 Analysis of Factors Affecting Interchange Design (Regression Analysis)

Variables to asses passenger perception and experience were obtained from demographic, socioeconomic and institutional factors. Multi-collinearity was evaluated using a correlation matrix [magnitude less than 0.5] to test for linear dependency, proving that there was no data overlapping. Prediction power and goodness fit was tested through use of R-Squared values, at a range of 0-1 (0-100%), with higher values indicating a better model fit. A modified Cox and Snell parameter was also incorporated to allow for the R-Squared to take values in the full range of 0-1, making pseudo R-Squared more compatible to the conventional R-Squared statistic. The model was evaluated at a confidence level of 95%.

4.4.1 Transfer Times (ease of transfer)

Variables considered for analysis are defined in Table 2.

Table 2: Ease of Transfer Regression Model

Ease of Transfer (Transfer Times)				
Variable	B	S.E.	Wald	Sig.
Q1	-2.453	0.386	7.375	0.041*
Q13	-2.746	0.413	9.262	0.021*
Q19	3.868	0.400	8.722	0.030*
Q1.3	-3.333	0.410	9.662	0.016*
Q1.4	-1.261	0.380	11.986	0.001*
Q1.5	-2.549	0.435	14.649	0.000*
Q1.7	2.828	0.560	2.183	0.140^{ns}
Q1.8	-1.296	0.601	4.652	0.071^{ns}
Q1.10	-2.976	0.527	10.426	0.024*
Constant	-2.015	0.500	16.261	0.000*
Q1(gender), **Q13**(trip time), **Q19**(travel conditions), **Q1.3**(transfer distance), **Q1.4**(coordination), **Q1.5**(ease of movement), **Q1.7**(signage), **Q1.8**(travel Information) and **Q1.10**(weather protection)				
Hosmer and Lemeshow Test	Chi-Square		8.26	
	P		0.39	
Model Summary	Cox and Snell R Square		0.77	
	Nagelkerke R Square		0.85	
Note: ns indicates not significant at 0.05 and * indicates significance at 0.05 (95% confidence level)				

The analysis yielded a Cox and Snell R Square value of 0.77 (77%) and modified Nagelkerke R Square value of 0.85 (85%). These values indicated that there was substantial variance in choices made by commuters about transfer conditions. Hosmer and Lemeshow goodness fit test produced a value of 0.39 which is well above 0.05 indicating that the model fits the data well. The model also produced a Hosmer and Lemeshow Chi-square value of 8.26 and a p value greater than 0.05 hence indicating that the model is a good fit. Passengers who accessed the station during peak times were likely to experience increased transfer times as a result of increased passenger flow and modal delays. Travel conditions were considered critical as a person travelling alone was likely to experience shorter transfer times than people travelling with luggage or in a group. Most passengers indicated that transfer distances were long hence affecting transfer times. Most passengers indicated that there was minimum coordination based on the availability of critical services (ticketing, ATMs, travel information etc.) which affected their ease of transfer. Ease of movement within the transit environment was noted to affect transfer times. From principles of station design, increased difficulty in movement within station (barriers) is likely to negatively influence ease of transfer. Transfer times were also noted to be affected by availability of adverse weather protection infrastructure. The study was conducted during the rainy season, hence most of the passengers were heavily affected by rain which increased difficulties in modal transfer.

4.4.2 Waiting Experience and Environment

Analyzed variables are summarized in Table 3.

The analysis yielded a Cox and Snell R Square Value of 0.73 (73%) and modified Nagelkerke R Square value of 0.84 (84%). The values indicated that there was a substantial variance in choices made by commuters about the waiting environment. The Hosmer and Lemeshow goodness fit test yielded a value of 0.35 which was well above 0.05 indicating that the model fits the data well. The model produced a Hosmer and Lemeshow Chi-square value of 9.45 and a p value greater than 0.05, indicating that the model is overall a good fit. Passengers who were employed or in school preferred shorter waiting times and efficient waiting services to smoothen the waiting experience due to expected arrival times and raised standards of living. Commuters who travelled during peak times were likely to be affected by increased waiting times due to increased delays. The waiting experience was also affected by the trip type as passengers starting their journey or transferring between modes were likely to wait for transit due to different modal schedules. Passengers moving alone or with luggage were likely to perceive increased waiting times compared to those in groups due to the socialization effect. Lack of sheltered seating areas negatively affected the waiting experience and environment perception by commuters waiting for transit. Weather conditions affected the waiting experience as the survey was conducted during the rainy season. Commuters who perceived waiting times to be longer were likely to be more critical of the waiting times and environment. The waiting experience was also affected by activities carried out by passengers whilst waiting. Passengers who indicated that they usually stand or are not using any gadgets, negatively viewed the waiting environment hence it was critical to introduce like seats, cafeterias and Wi-Fi to cushion the waiting experience. Lack of travel information in terms of schedules, transit times and mode position, was found to negatively affect transit planning and perceived waiting experience.

Table 3: Waiting Experience Regression Model

Waiting Experience and Environment				
Variable	B	S.E.	Wald	Significance
Q4.4	-2.545	0.101	5.446	0.032*
Q13	-2.723	0.322	7.038	0.025*
Q14	-2.842	0.304	15.692	0.006*
Q18	3.182	0.334	1.298	0.585^{ns}
Q19	-2.302	0.301	6.010	0.031*
Q1.4	2.405	0.347	1.363	0.243^{ns}
Q1.6	-2.675	0.447	10.284	0.013*
Q1.10	-1.779	0.573	7.847	0.024*
Q2.1	-2.017	0.412	9.002	0.016*
Q2.2	-2.681	0.301	8.129	0.024*
Q2.4	-2.764	0.295	11.686	0.010*
Q2.6	-1.331	0.313	18.066	0.000*
Constant	-1.337	0.440	16.252	0.002*
Q4.4 (employment), **Q13** (trip time), **Q14** (trip type), **Q18** (trip purpose), **Q19** (trip conditions), **Q1.4** (coordination), **Q1.6** (seats and sheltered areas), **Q1.10** (weather protection), **Q2.1** (waiting times), **Q2.2** (preferred waiting time), **Q2.4** (waiting activity), and **Q2.6** (waiting information).				
Hosmer and Lemeshow Test	Chi-Square	9.45		
	P	0.35		
Model Summary	Cox and Snell R Square	0.73		
	Nagelkerke R Square	0.84		
Note: ns indicates not significant at 0.05 and * indicates significance at 0.05 (95% confidence level)				

4.4.3 Station Environment and Coordination of Operators

Variables considered for analysis are summarized in Table 4.

The analysis yielded a Cox and Snell R Square Value of 0.80 (80%) and modified Nagelkerke R Square value of 0.89 (89%). These values indicate that there was substantial variance in choices made by commuters about the station environment. The Hosmer and Lemeshow goodness fit test produced a value of 0.36, well above 0.05 indicating that the model fits the data well. The model produced a Hosmer and Lemeshow Chi-square value of 9.77 and a p value greater than 0.05 hence indicating that the model is overall a good fit. Literate people were noted to be more affected by lack of operator coordination which was likely to contribute to poor transit service due to high expectations of service delivery. People travelling during peak hours were likely to experience challenges as a result of increased demand for station facilities. People walking in groups or with luggage required more space, less barriers and attention compared to people walking alone. Passengers who were likely to stay in the station for longer times indicated need of services to enhance the travel experience, as a station is more than just a transit point. Lack of travel information was also found to negatively influence the perception of passengers about the transit environment and operator coordination as travel information was critical in knowing modal schedules, arrival times and boarding areas. Lack of safety and security was found to negatively influence passenger perception about their comfortability when within station premises. Lack of weather protection structures negatively influenced the passengers in their views about operator coordination as it affected interchangeably between modal stations.

Table 4: Station Environment Regression Model

Station Environment and Coordination between Operators				
Variable	B	S.E.	Wald	Significance
Q3	-2.423	0.765	7.459	0.043*
Q9	2.227	0.297	1.585	0.444^{ns}
Q13	-1.706	0.417	16.721	0.000*
Q19	-1.822	0.306	11.369	0.020*
Q1.6	-2.055	0.494	9.554	0.033*
Q1.7	2.757	0.512	2.183	0.140^{ns}
Q1.8	-2.165	0.575	7.115	0.043*
Q1.9	-1.874	0.582	14.370	0.001*
Q1.10	-3.342	0.330	16.598	0.000*
Constant	-3.408	0.941	13.107	0.000*
Q3(education), **Q9**(trip frequency), **Q13** (trip time), **Q19** (trip conditions), **Q1.6** (sheltered seating areas), **Q1.7** (signage), **Q1.8** (travel information), **Q1.9** (safety) and **Q1.10** (weather protection).				
Hosmer and Lemeshow Test	Chi-Square	9.77		
	P	0.36		
Model Summary	Cox and Snell R Square	0.80		
	Nagelkerke R Square	0.89		
Note: ns indicates not significant at 0.05 and * indicates significance at 0.05 (95% confidence level)				

5. CONCLUSIONS

The research aimed to assess the practicality of modal integration at AALRT stadium station, with focus on improving the transit experience, addressing challenges faced by commuters.

The evaluation shed light on both the opportunities and challenges inherent in developing an integrated transport interchange. Despite the addition of the LRT as a supplement to buses and taxis, it was evident that there was lack of modal integration, leading to inefficiencies in passenger transit. Furthermore, the study revealed that the existing transit facilities at stadium station were inadequate to meet passenger needs. Issues such as long waiting times, limited seating, lack of weather protection and real-time information, and infrastructure to assist the disabled were identified as major challenges faced by commuters. The analysis of passenger demographics, travel habits, and institutional factors highlighted the diverse needs of transit users, emphasizing the need of inclusive and user-centric design solutions. Moreover, the regression analysis conducted in the study provided valuable insights into the factors influencing transfer times, waiting experiences, and station environments. Variables such as trip time, travel conditions, travel information, weather protection, ticketing systems, safety, operator coordination, and amenities amongst other factors, significantly impacted the overall quality of transit service and passenger satisfaction. In conclusion, the findings of this research underscored the importance of integrating transit facilities, improving infrastructure, and addressing the diverse needs of transit users to enhance the overall efficiency, accessibility, and safety of the transit system. By implementing targeted interventions based on the recommendations derived from this study, authorities can work towards creating a more seamless, efficient, and user-friendly transit experience for Addis Ababa residents and visitors alike, thereby contributing to sustainable development and liveability of the city.

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