

# SPATIO-TEMPORAL COMMUTING PATTERN IN THE UNIVERSITY ENVIRONMENT: A GENDER PERSPECTIVE

BUSARI AYOBAMI<sup>1</sup>, OLUWAJANA SEUN<sup>2</sup>, EDE ANTHONY<sup>1</sup>, JOSHUA OPEYEMI<sup>3</sup> & ADEYANJU EMMANUEL<sup>1</sup>

<sup>1</sup>Department of Civil Engineering, Covenant University, Nigeria

<sup>2</sup>Department of Civil and Environmental Engineering, York University, Canada

<sup>3</sup>Department of Building Technology, Covenant University, Nigeria

## ABSTRACT

Transportation is an important part of campus life. The need to study the male–female differences in the choice of walking is essential in calibrating a robust travel demand model of the university environment. Subsequently, there is a need for a novel approach in the trip pattern of the university environment. This study assessed the spatio-temporal commuting pattern in three universities in Nigeria, with a special focus on gender. Information sheets ( $n = 1500$ ) were distributed to three categories of university in Southwestern Nigeria: private university, State government-owned university, Federal government university. This was backed up with focus group discussions in the selected schools. We assessed the frequency of trips, trip distance, trip pattern, gender and the modal split of the respondents. Results showed that the female gender accounted for the highest frequency of trips, but the lowest frequency of long-distance trips. The results also revealed that distance, time, travel cost, comfortability and accessibility had a positive influence on the volume of trips. Pearson's Correlation of the variables was done and the Pearson's  $r$  value for distance was 0.844 and time, 0.77. The results showed a strong positive correlation for gender, as compared to the other variables, affecting trip-making. The research showed that gender difference influences the choice of mode and frequency of trips, which are essential variables in travel demand models.

*Keywords: gender, university, trip pattern, commuting, travel behaviour.*

## 1 INTRODUCTION

### 1.1 Motivation

In Nigeria and other developing countries, pedestrian facilities are not usually provided, especially for Trunk C roads, which institutional roads are often categorized as; however, going by the population of undergraduates in Nigeria (Table 1) [1], there is a need for a green and novel approach in the trip pattern of this group, for effective transportation planning. Several studies have worked on the trip pattern in the university environment, but a dearth of literature exists on gender differences in the travel behaviour of students in the university environment. The need to study the male–female differences in the choice of trip pattern in the university environment, for effective transportation planning, spurred this research.

### 1.2 Introduction

Assessment of travel demand is necessary for forecasting trip generation within cities. Owolabi [2] stated that the travel demand forecasting process is a fundamental operation within any urban transport planning exercise. Years ago, not as many means of transportation existed around university communities. Students were limited to walking from their hostels to their respective classes, and only a few had the opportunity to own personal cars. Globally, in recent years, walking behaviour for school trips has been a subject of debate within developed countries; however, much remains to be learned about this in developing



Table 1: Overview of education in Nigeria. (Source: [1].)

Education in Nigeria	
Population	174.5 million
Language of instruction	English
Compulsory education	Primary school and lower secondary school
Academic year	September–July
Number of universities	128
Public	77
Private	51
Number of university students	1,700,000

countries, as asserted by Hatamzadeh [3]. Additionally, there has been an increase in the volume of motorized trips, which have affected the rate of physical activity and similarly, led to health issues [4]–[6]. Based on this, there is a need to promote active transportation to school, especially for students confined to the four walls of the university environment.

Studying travel behaviour and trip patterns in the university environment is necessary, because universities are trip attractors that may take a pronounced amount of structure to support a huge number of commuters [7]. Also, the promotion of transit and active travel agrees with institutional sustainability aims [8]. Campus transportation concerns have become a noticeable subject for research outlines in several countries [9]–[15]. Additionally, university towns are known to support mixed land-use characteristics, whereby amenities are located near the main campus. Consequently, Khattak et al. [11] highlighted that most university communities represent a suitable environment that is alternative-mode friendly, with higher density and mixed land use; however, this is not the case with most universities in Nigeria, as these institutions lack basic transportation facilities. Moreover, it seems likely that travel behaviours are differences among male and female students. The reasons behind male–female differences in choosing the mode of transportation have not been well established for African countries, but have been researched in some developing countries [16]–[18]; although work has been carried out on the under-representation of female students in tertiary institutions [19], [20].

Developing a better understanding of the travel behaviour of students can help to generate valuable information about the factors that sustain the habit of using active transportation. Based on new evidence, active transportation to school reduces the risk of obesity [4]–[6]. Developing a culture of sustainability within the university setting, through both education and by providing programs and infrastructure to support sustainable travel behaviour, is essential for transportation planning within the university environment.

Previous research on gender differences in travel behavior by Boarnet and Hsu [21] used various theoretical perspectives. This could be broadly classified into clusters, such as theories of internalized gender differences, theories of gendered structural contexts, and theories of socially constructed gender differences; which are used to explain gender differences in travel behavior [21]. Many studies on trips to school have found that girls are less likely to walk than boys [22]–[24]. Nigeria is a developing country with a high

undergraduate population (Table 1); however, most of the universities lack the necessary transportation facilities to accommodate the increase in the student population. This study aims at assessing the spatio-temporal commuting pattern, with a special focus on gender differences within the university environment. This will help in the calibration of a robust travel demand model, for the proper planning of university transportation systems.

## 2 METHODOLOGY

### 2.1 Description of the study area

Three universities in Southwestern Nigeria fall under the purview of this study [25]. The Federal University studied remains one of the most competitive in the country, with admissions of approximately 45,000 students, as of 2010. The state government owns the second university: it caters to a population of over 61,000 students enrolled in full-time and part-time programmes at the diploma, undergraduate and postgraduate levels. The third category is represented by a private Christian university, a member of the association of commonwealth universities. These three universities are in Southwestern Nigeria, according to the map of Nigeria [26].

### 2.2 Strategy for data collection

We distributed 1500 information forms to the students in the three categories of university studied in Southwestern Nigeria (one university from each category). This was done to capture all income classes within the study area. It is normal to believe that high-income earners' children attend the third category of university, private university. The methodology used in this research was based on the work of Tolley [27]. The parameters were captured in the detailed information form that we used in this research. We used SPSS version 21 in coming up with a Pearson's model for the analysis of the data.

## 3 RESULTS AND DISCUSSION

### 3.1 The distribution between gender and preferred mode of transport

Our research results showed that based on gender, using the shuttle and walking were the most predominant mode of transportation in the three universities considered (Fig. 1). Comparative assessment of the two prominent modes showed that the male gender preferred the use of walking, while the female gender preferred the use of the shuttle for an intra-campus trip (Fig. 1). The choice of walking may be as a result of the compactness of the university environment, as suggested by Busari et al. [25]. Based on this, the provision of pedestrian facilities in a university environment will further encourage students to embark on walking, as this has a lot of advantages over other modes of transportation [27]–[30]; however, the use of a bicycle is high among the male respondents. Based on the focus group discussion, some of the male respondents would have preferred the use of the bicycle for intra-campus trips, but there are no transportation facilities set up for it.

### 3.2 Relationship between trip time and modal choice of university staff and students

In Table 2, we show that for most of the trips (short and long distance) of the teaching staff, the choice of private car is preferred; however, the shuttle is the most predominant mode for



non-teaching staff. This may be a result of the fact that most teaching staff are categorized as high-income earners, as compared to non-teaching staff. A positive relationship has been established between income and car ownership [25]. This to a very large extent affected the modal difference between the two groups.

Considering the modal split of the students, most of the first- and second-year students adopt the use of walking for most trips; however, the choice to walk reduces as the level increases. The non-vehicle owning group exhibits a higher tendency to walk than the vehicle-owning group.

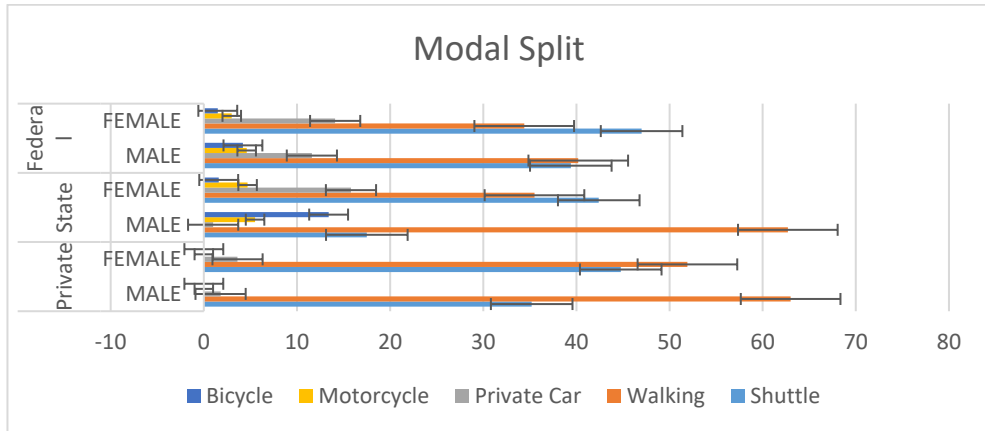


Figure 1: Distribution of preferred mode of transport based on gender (CU).

Table 2: Modal split of students and staff.

	< 5 min	5–10 min	11–15 min	16–20 min	> 20 min
Teaching staff	Private cars	Private cars	Private cars	Private cars	Private cars
Non-teaching staff	Shuttle	Private cars	Shuttle buses	Shuttle buses	Shuttle buses
Students					
<b>Results based on current level of students</b>					
100 level	Walking			Shuttle buses	
200 level	Walking	Walking	Walking	Walking	Shuttle buses
300 level	Shuttle buses	Walking	Shuttle	Shuttle buses	Private car
400 level			Motorcycles		Shuttle buses
500 level	Walking	Shuttle buses	Shuttle buses	Shuttle buses	



### 3.3 Spatio-temporal commuting pattern

A trip to class is regarded as a compulsory trip for students. The majority of the female respondents, 36.7%, chose the travel time between their halls of residence/apartment to school as being 5–10 minutes. This may be the factor responsible for the choice of to walk, as shown in Fig. 1; however, those of male gender chose to travel farther than females, in the university environments considered (Fig. 2). Male gender accounted for the highest percentage of long-distance trips (11–16 min and more than 20 min). This may be the more reason why a majority of the male gender would have preferred the choice of bicycling within the campus.

### 3.4 Relationship between gender and frequency of trip

No significant relationship can be drawn from assessing the relationship between gender and frequency of trips. According to Busari et al. [25], trips for lectures is usually categorized as a compulsory trip. In most universities, a certain percentage has been allocated to attendance, and so embarking on such trip cannot be wrought; however, based on the research, most females did embark on more recreational trips than the female in the three universities considered. The aggregate of both work trips and recreational trips made the overall number of trips taken by the female gender higher than the male (Fig. 3).

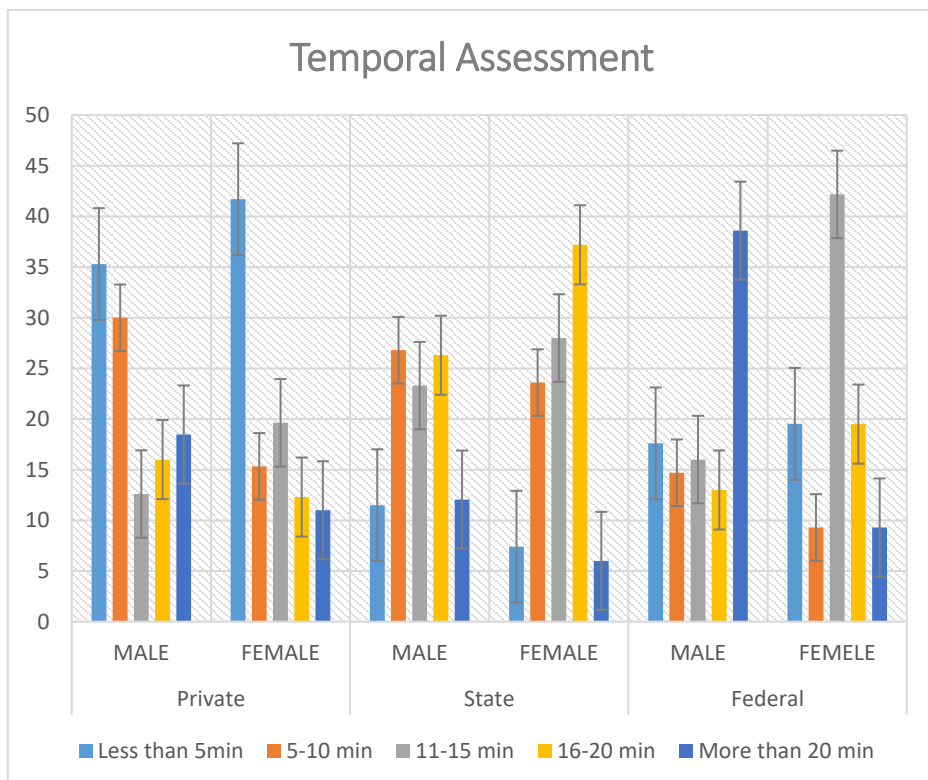


Figure 2: Distribution of travel time based on gender (CU).

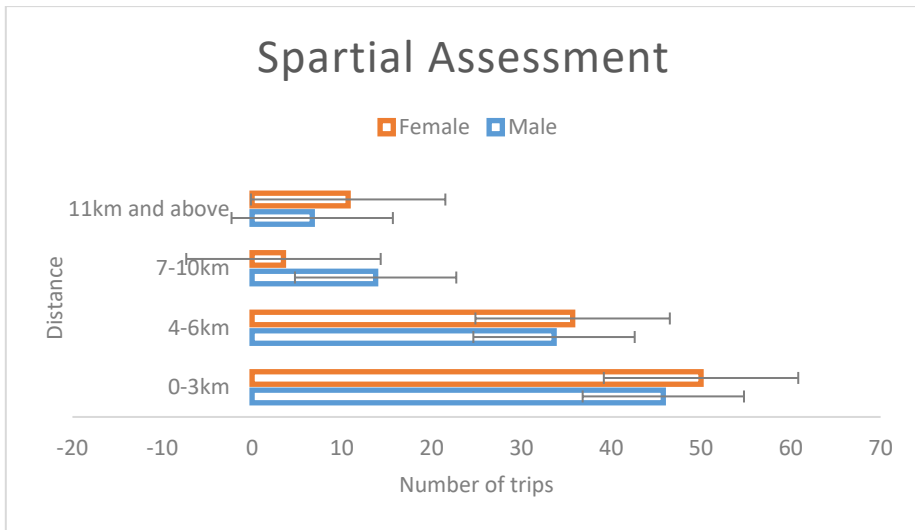


Figure 3: Distribution of travel time based on gender (CU).

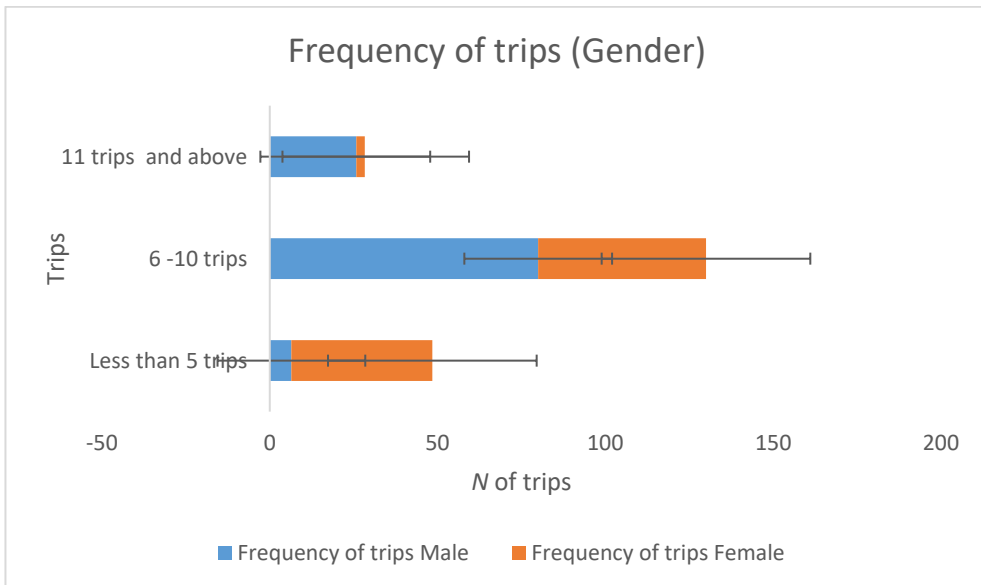


Figure 4: Distribution of number of trips based on gender (CU).

### 3.5 Pearson's correlation of the variables

Our results showed that distance, time, travel cost, comfort, and accessibility have a positive influence on the volume of trips. As one variable decreases, the frequency of trips increases.



In the analysis, the Pearson's  $r$  value of distance was 0.844 and time was 0.77. This showed a strong correlation, as compared to the other variables.

Factors that influence a respondent's choice when selecting a preferred mode of transportation for a trip was based on gender (based on Pearson's correlation). The correlation is significant at the 0.01 level (2-tailed). From our study, it can be concluded that all the factors (travel cost, comfort, accessibility, and reliability) have a positive effect on the selection of the preferred mode of transportation, based on the respondent's gender.

#### 4 CONCLUSION

Our research assessed the commuting patterns within three university environments in Southwestern Nigeria. The spatio-temporal commuting patterns considering gender differences was our focus of research. We assessed the frequency of trips, the relationship between trip distance and gender, and the transportation mode split of the survey respondents. We also assessed the Pearson's Correlation of the variables. In the analysis, the Pearson's  $r$  value of distance was 0.844 and trip time was 0.77. This showed a strong correlation, as compared to the other variables. From the results of this research, it can be concluded that:

- Based on gender, the factors influencing transportation mode choice are availability, distance, travel time, frequency, travel cost, comfort, accessibility and reliability; and they all have a positive influence on the transportation mode choice decision.
- Comfort, accessibility, distance, and frequency have a positive effect on the respondent's choice of transportation mode; while reliability had an adverse effect on the modal choice.
- Availability influences the transportation modal choice decision positively; whereas distance, frequency, comfort, accessibility, and reliability influence the modal choice decision negatively.

Our recommendation is that bicycle and walking facilities should be incorporated in the transportation infrastructure of universities.

Table 3: Correlation between gender and the factors affecting traveller's choice of mode of transportation.

Correlation	G	A	D	T	F	Tc	Co	A	Re
P.C.	1	0.22**	0.844**	0.711**	0.144**	0.573**	0.235**	0.716**	0.207**
Sig. 2-tailed		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	1146	1118	1095	1087	1039	1096	1107	1105	1108

\*\* Correlation is significant at the 0.01 level (2-tailed).

Where: G is gender, A is availability, D is distance, T is time, F is ?, Tc is travel cost, Co is comfort, A is age, Re is reliability, and P.C. is Pearson Correlation.



## ACKNOWLEDGEMENT

The authors are grateful to Covenant University, in Ogun State, Nigeria, for providing an enabling environment, so we could carry out this research.

## REFERENCES

- [1] Ademola, E.O., Ogundipe, A.T. & Babatunde, W.T., Students' enrolment into tertiary institutions in Nigeria: The influence of the founder's reputation – A case study. *Computing, Information Systems, Development Informatics & Allied Research Journal*, **5**(3), 2014. www.cisdijournal.net.
- [2] Owolabi, A., Trip pattern in Akure, Nigeria: A land use analytical approach. *Journal of Transport Management*, **21**(2A), pp. 63–71, 2009.
- [3] Hatamzadeh, Y., Walking behavior across genders in school trips, a case study of Rasht, Iran. *Journal of Transport & Health*, 2016. DOI: <http://dx.doi.org/10.1016/j.jth.2016.08.011i>.
- [4] Sahlqvist, S., Song, Y.N. & Ogilvie, D., Is active travel associated with great physical activity? The contribution of commuting and non-commuting active travel to total physical activity in adults. *Preventive Medicine*, **55**, pp. 206–211, 2012.
- [5] Cooper, A.R., Jago, R., Southward, E.F. & Page, A.S., Active travel and physical activity across the school transition: The PEACH project. *Medicine and Science in Sports and Exercise*, **44**, pp. 1890–1897, 2012.
- [6] Roth, M.A., Millett, C.J. & Mindell, J.S., The contribution of active travel (walking and cycling) in children to overall physical activity levels: A national cross-sectional study. *Preventive Medicine*, **54**, pp. 134–139, 2012.
- [7] Lovejoy, K. & Handy, S.L., Mixed methods of bike counting for better cycling statistics: The example of bicycle use, abandonment, and theft on the UC Davis campus. *90th Annual Meeting of the Transportation Research Board*, Washington, DC, 2011.
- [8] Al-Rukaibi, F., Ali, M.A. & Aljassar, A.H., Traffic safety attitudes and driving behaviour of university students – a case study in Kuwait. *Transportation Research Record*, **1969**, pp. 65–71, 2006.
- [9] Toor, W. & Havlick, S.W. *Transportation and Sustainable Campus Communities. Issues, Examples, Solutions* Island Press: Washington, DC, 2004.
- [10] Koppelman, F.S. & Lyon, P.K., Attitudinal analysis of work school travel. *Transportation Science*, **15**, pp. 233–254, 1981.
- [11] Khattak, A., Wang, X., Son, S. & Agnello, P., University student travel in Virginia: Is it different from the general population? *Transportation Research Record*, 2011.
- [12] Limanond, T., Butsingkorn, T. & Chermkhunthod, C., Travel behaviour of university students who live on campus: A case study of a rural university in Asia. *Transport Policy*, **18**, pp. 163–171, 2011.
- [13] Krueger, T. & Murray, G., *TCRP Synthesis No. 78: Transit Systems in College and University Communities*, Transportation Research Board: Washington, DC, 2008.
- [14] Norzalwi, N. & Ismail, A., Public approach towards sustainable transportation in UKM's campus, Australia. *Journal of Basic & Applied Sciences*, **5**(5), pp. 1332–1337, 2011.
- [15] Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton, T. & Bull, F., Active commuting in a university setting: assessing commuting habits and potential for modal change. *Transport Policy*, **13**, pp. 240–253, 2006.
- [16] McDonald, N.C., Is there a gender gap in school travel? An examination of US children and adolescents. *Journal of Transport Geography*, 2012.





- [17] Hsu, H.P. & Jean Daniel, S., Impacts of parental gender and attitudes on children's school travel mode and parental chauffeuring behavior: Results for California based on the 2009 National Household Travel Survey. *Transportation*, **41**(3), pp. 543–565, 2014.
- [18] Guliani, A., Gender based differences in school travel mode choice behaviour: Examining the relationship between the neighborhood environment and perceived traffic safety. *Journal of Transport and Health*, 2015. DOI: <http://dx.doi.org/10.1016/j.jth.2015>.
- [19] Busari, A., Ogbiye, A., Ogundeji, J., Akinwumi, I., Emenike, P. & Abatan, O., Twenty first century feminism in engineering education: Girls under representation. *INTED 2016 Proceedings*, ISI Thompson Reuters, 2016. DOI: 10.21125/inted.2016.1642.
- [20] Busari, A.A., Okeniyi, J.O., Bamigboye, G.O., Tenebe, I.T., Oniemayin, B.I. & Durotoye, T.O., Tutoring and parenting influence on engineering: Impact on female teenagers. *INTED 2016 Proceedings*, ISI Thompson Reuters, 2016. DOI: 10.21125/inted.2016.1642.
- [21] Boarnet, M.G. & Hsu, H.P., The gender gap in non-work travel: The relative roles of income earning potential and land use. *Journal of Urban Economics*, **86**, pp. 111–127, 2015.
- [22] McMillan, T., Day, K., Boarnet, M., Alfonzo, M. & Anderson, C., Johnny walks to school. Does Jane? Sex differences in children's active travel to school. *Children Youth and Environments*, **16**, pp. 75–89, 2006.
- [23] Marten, N. & Olds, T., Physical activity: Patterns of active transport in 11–12 year old Australian children. *Australian and New Zealand Journal of Public Health*, **28**, pp. 167–172, 2004.
- [24] Johnson, T.G., Brusseau, T.A., Darst, P.W., Kulinna, P.H. & White-Taylor, J., Step counts of non-white minority children and youth by gender grade level race/ethnicity, and mode of school transportation. *Journal of Physical Activity & Health*, **7**, pp. 730–736, 2010.
- [25] Busari, A.A., Owolabi, A. & Modupe, A., Modeling the effect of income and car ownership on recreational trips in Akure, Nigeria. *International Journal of Scientific Engineering and Technology*, **4**(3), pp. 228–230, 2015.
- [26] Oluseyi, O. et al., Wind energy study and energy cost of wind electricity generation in Nigeria: Past and recent results and a case study for Southwest Nigeria. *Energies*, **7**, pp. 8508–8534, 2014. DOI: 10.3390/en7128508.
- [27] Tolley, R., Green campuses: Cutting the environmental cost of commuting. *Journal of Transport Geography*, **4**, pp. 213–217, 1996.
- [28] Busari, A. et al., Trip pattern of low density residential area in semi urban industrial cluster: predictive modeling. *International Journal of Human Capital Urban Management*, **2**(3), pp. 211–218, Summer 2017. DOI: 10.22034/ijhcum.2017.02.03.00.
- [29] Busari, A.A., Owolabi, A., Modupe, A.E., Modelling the effect of income and car ownership on recreational trip in Akure, Nigeria. *International Journal of Scientific Engineering and Technology*, **4**(3), pp. 223–225, March. ISSN: 2277-1581.
- [30] Busari, A.A., Owolabi, A.O., Fadugba, G.O. & Olawuyi, O.A., Mobility of the poor in Akure Metropolis: income and land use approach. *Journal of Poverty and Investment Development*, **15**.