Carpooling Characteristics in Large Employment Centers: higher institutions as a case study

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Abstract— **Congestion resulting from commuting remains a challenge mobility management is facing. In a developing African city where public transport is poorly managed, many employees who would have happily been a public transport patron strive to drive to work to escape the use of public transport. An alternative to the use of personal auto is carpooling for this group of employees. This paper takes the workplace as research unit to analyse the use of carpooling by higher institution employees in Ado Ekiti, Nigeria. The analysis reveals that a high percentage (63.4%) of employees drive to work while only 12.2% carpool. It also indicates that the ride-sharing practice may not include sharing the cost of travel by the carpooling partners. This analysis gives insight to the which group of people may more likely adopt carpooling and the motivations for it, and may thus contribute to the development of sustainable transport policies.**

Index Terms— **Carpooling, mobility management, ride-sharing, sustainable transport.**

I. INTRODUCTION

Growing size of cities and the increasing need for mobility has been a reason for increasing traffic on the streets and the resultant congestion. The spatial nature of growth a city experiences may however alter the level of congestion experienced. Mono-centric city structure is often regarded as a cause to congestion as urban growth continues. On the other hand, poly-centric cities have the benefits of reduced congestion and shorter commute times, amidst others.

Commute time is an important theme as cities develop. This is because commute time is a function of city size [1]. Generally, in spatially large cities, commute times are longer. However, when dispersed spatial structure/polycentric structure is adopted, they tend to reduce rather than lengthen commute times [1]. In addition, commuting traffic is usually a contributor to urban congestion as it always occurs during the peak travel period. The mode adopted by individual employee is therefore important. It is common place to observe a high percentage of commuting by driving " of its flexibility, convenience, and privacy" [2]. However, more single-occupant-vehicle means more traffic and more traffic results in congestion. Since congestion extends commute time, many schemes are adopted as traffic management measures to deal with the conflicting interest between the use of single-occupant-vehicle and the adoption of more traffic efficient modes such as cycling, public transit, carpooling etc. This paper looks in more details on carpooling scheme in commuting.

Carpooling is one of the many travel alternatives promoted in mobility management schemes in many places across the globe as a response to the issue of sustainable transport. It has also been used to address infrastructure consumption such as to reduce the number of vehicles on the road, or the amount of fuel consumed by transport. Carpooling is, however, widely understood to mean more than one thing. Terms such as ride-sharing and car-sharing have been used to mean carpooling [3]. These two terms nevertheless do not mean the same thing. Car-sharing, for example, may mean a structure where by a car may be booked by persons who need a rental service occasionally. Ride-sharing on the other hand relates to when more than a trip are performed simultaneously in the same vehicle [4]. It is this ride-sharing that is more appropriate for the discussion in this paper.

Carpooling can be classified in various ways. One way is classification based on trust. This is relevant as carpooling may be between members of a family, or friends or colleagues or even unrelated persons [2,3]. These groups vary in their level of trust, being highest with family members and lowest with unrelated persons. Carpooling may also be classified on the bases of the type of matching between origins and destinations. Origins and/or destination may be a central location agreed to by people carpooling in the same vehicle. Thus, there may be the case of different origins but the same destination, as in the case of colleagues carpooling. Family members carpooling will have the same origin but different destinations. Nevertheless, because carpooling is practiced across different socio-demographic groups, it has not been common to detect strong correlations between socio-demographic and carpooling propensity [5,6]. Notwithstanding, lower income classes have been found to manifest a higher propensity to carpool. This, according to [3] is due to the fact that car availability is limited with lower income people.

Despite the environmental, financial and social benefits it offers, carpooling has nevertheless been criticised. For example, carpooling results in a longer mean travel time [1]. This is in the form of the pick-up/drop-off delay and, at times, extra travel and waiting time that come with carpooling. This often makes it less attractive, especially for short trips. Moreover, carpooling is strongly limited by privacy issues and the fear to travel with strangers [3]. In addition, there have been arguments in favour of public transport for areas where the both residential and employment densities are high. Public transport provision are regarded as more viable and efficient for such origins/destinations [1]. Finally, the availability of inexpensive parking/ parking subsidy usually provided by some employers negatively affects carpooling. When parking spaces are made available to drivers, it often acts as a vital inducement to commuting by single-occupant-vehicle [7] rather than promote carpooling.

The above, notwithstanding, carpooling is one of the measures being promoted by employers against single-occupant-vehicle [7]. For example, in the US, despite the popularity of single-occupant-vehicles, carpooling is still

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modestly adopted, and have been found to account for over 10% of commuters in some studies [1]. Carpooling research has however not been an area of study in many developing African countries and Nigeria in particular. Observation shows that the practice is popular as commuters wait by the roadside to flag down car drivers and request for a ride. The extent to which this is done is however not known. The aim of this study is therefore to describe the carpooling characteristics of employees in a city in Nigeria. As noted by [3], traditional research on mode choice usually takes the individual or the household as the unit of observation.. A workplace perspective is however an alternative with some benefits. Vanoutrive et al., [3] note that it is usually the case that employers are used as intermediaries in mobility management strategies. In addition, the subjective norm and corporate culture in workplaces affect workers' travel behaviour. Two higher institutions in a medium-size city in Nigeria were therefore selected to find out the practice of carpooling amidst their employees. Various classes of workers were recruited to complete a questionnaire survey. The result of the survey is presented.

The paper is organised as follows. In the next section, a discussion on data collection and analysis processes is provided. This is followed by the reports the data analysis6 while the last section provides a brief conclusion.

II. DATA

The aim of this paper is to analyse carpooling in a medium sized city in Nigeria (Ado Ekiti) using a workplace perspective. Two big workplaces with a large number of workers were selected for the study. These two workplaces are higher institutions of learning, each located at different end of the city. A workplace is said to be large if its site contains at least 30 employees out of its at least 100 employees [3]. Each of the two workplaces employs over a thousand workers and each sites attracts over a thousand employees daily. One of the workplaces is a University owned by a State government while the other institution is a Polytechnic owned by the federal government. Being in a medium sized city of a developing country, the two workplaces have abundant supply of parking spaces. In addition, the workplaces are fairly well served by public transport for most hours of the day. None of the two workplaces have any scheme to promote any mode, whether public transport, carpooling or personal auto except for the abundant supply of parking spaces. A questionnaire survey was designed to collect information on the characteristics of the sample of employees in each of the two workplaces and their journeys to work. With sample size of approximately 5% of employees, 400 questionnaires were given out and 328 were returned, making 82% returned. Workplace A returned 150 questionnaires out of 200 while workplace B returned 178 questionnaires out of 200. The distribution was based on the number of units in each of the workplaces as provided by the respective registry departments. The data collection exercise took place in August, 2015.

III. EXPLORATORY DATA ANALYSIS

A. *The University Data*

The data analysis shows that for the junior non academic employees, 23.33% indicate that they carpool to work. This is lower than the percentage of employees who drive (43.33%) and those who use public transport (33.33%). From the group of employees who carpool, 57.14% indicate that they do not own a car. 14.28% indicate that the cost of fuel is high while the remaining 28.57% indicate that they cannot drive a long distance.

About 17.46 percent of the University senior non-academic staff commute by carpooling. Of this group, 27.27% carpool because they have access to free transport. 36.36% carpool because they do not own a car while another 36.36% carpool because they cannot drive a long distance.

The academic staff commuting habit is different. Only 5.36% carpool. Another 10.71% commute by public transport while 83.93% drive to work. Amidst those who carpool, 33.33% chose the mode because they do not own a car while the remaining 66.67% cannot drive a long distance to work.

Table 1: University Carpooling Characteristics

Reason for Choice of Travel Mode	Employee cadre		
	Junior employees	Senior non-academic employees	Academic employees
I have access to free transport	0	3	
I don't own a car	4	4	1
Cost of fuelling is high	1		
I can't drive long distances	2	4	2
Total	**7**	**11**	**3**
Total respondents for all modes	30	63	57

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B. *The Polytechnic data*

Following from the analysis of data, it is found that 10 out of 78 junior staff at the Polytechnic regularly carpool to work. This accounts for about 12.82% of this cadre of workers. It is however less than the percentage of employees who drive to work (which is put at 50%) and those who commute by public transport (put at 33.33%). Employees who carpool give various reasons for their choice of the travel mode. 10% chose this mode because they have access to free transport. 70% engage in carpooling because they do not own a car. The remaining 20% indicate that they cannot drive a long distance.

The characteristics for the senior non-academic staff is not very different from their junior colleagues. About 16.67% of this group carpool. This is much lower than those who drive to work (58.33%) and those who commute by public transport (20.83%). For the carpooling group, the reason 50% of them have for carpooling is that they do not own a car. They remaining 50% do not want to drive a long distance.

The Polytechnic academic staff members generally drive to work. 73.68% of them drive to work while only 6.58% of them carpool. For the population carpooling, 20% do not own a car, 40% attribute their choice of travel mode to the cost of

fuelling their cars to work while the remaining 40% cannot drive a long distance to work.

Table 2: Polytechnic Carpooling Characteristics

Reason for Choice of Travel Mode	Employee cadre		
	Junior employees	Senior non-academic employees	Academic employees
I have access to free transport	1		1
I don't own a car	7	2	
Cost of fuelling is high	0		2
I can't drive long distances	2	2	2
Total	**10**	**4**	**5**
Total respondents for all modes	78	24	76

IV. Discussion

The above exploratory analysis shows that a fairly large percentage of people drive to work. About 63.4% of employees indicate that they drive to work. this figure is high for a developing country with car ownership as low as less than 100 per thousand population. It is however important to note that higher institution employees are among the most well paid workers in Nigeria public service. In addition, some of the employees and their spouses are working together in these workplaces and coming in one's spouses' car was interpreted to mean driving to work. Moreover, some of those who indicated that they drive to work may not be driving every day. The self esteem that goes with owning a car and driving would have contributed to their indicating that they drive to work. Driving may however be more regular than other modes being adopted. Another reason for the high percentage of employees driving to work is that the available public transport is used by students some of whom are regarded as not decent. The drivers too are regarded as not being decent and the vehicles are usually poorly maintained.

As earlier noted, carpooling in this study is essentially ride-sharing for commute purpose. It must be mentioned that while ride-sharing in many workplaces in developed cities is a deliberate and planned scheme, this is not always the case in developing countries. In many instances, commuters wait by the roadside and plead with car owners to help. Commuters are therefore usually at the mercy of the car owners who may chose not to help. In addition, this practice is possible because insurance policies are not very functional in Nigeria and no law compels car occupants to be insured in the event of accident. This is different from the practice in many developed cities where car occupants have some form of insurance. Nevertheless, there are some planned carpooling with defined origins and destinations.

The selected sites have destination pool-size effect to their advantage. But this does not seem to reflect in the share of carpooling recorded. The overall average percentage carpooling are 14% and 10.67% for the University and Polytechnic respectively. It is misleading to assume that the actual values are 28% and 21.34% following [3]. This is because that assumption pre-supposes that each driver has a single carpooling passenger. This is not the case as vehicle occupancy is usually higher than two in the study area. It is therefore likely that the actual overall percentage carpooling may be in the range of 14% and 28%, and 10.67% and 21.34% for the University and the Polytechnic respectively. This poor share of carpooling may be partly due to the fact that the scheme is not promoted in any way by the two workplaces.

The percentage of junior staff who indicate that they carpooling in the University is about twice that of the Polytechnic at 23.33% and 12.82% respectively. The reason for the huge difference in the percentages in the two workplaces is not clear. Further investigation may be required to find this out

For the senior non-academic employees, the percentages carpooling are 16.67% and 17.46% for the University and the Polytechnic respectively. Unlike the junior staff employees, the percentages here are close. The same trend can be observed with the academic staff in the two workplaces. The percentage carpooling stands at 5.36% and 6.58% respectively for the University and the Polytechnic. This lower values for the academic employees is expected as they do not have a fixed work schedule unlike the non academic employees. As noted by [3], the lack of fixed work schedule is negatively correlated with carpooling.

Furthermore, while one of the benefits of carpooling has been shared travel cost, carpooling in the study area largely does not offer such benefit. Observation shows that many people who carpool wait by the road side to flag down their acquaintances, usually a colleague. In addition, the analysis shows that between a third and two-thirds of those who carpool do so because they do not own car amidst the University employees and between 20% and 70% amidst the Polytechnic employees. Some employees note that they carpool because they have access to free transport. Many others indicate that they cannot drive a long distance to work. there is nothing to indicate that these carpooling employees share the cost of travel with the car owners.

Finally, the percentage of those indicating that they cannot drive a long distance is high considering that fact that the longest home-to-workplace journey within the city will be less than 20km, considering the size of the city. These employees may however be part of those residing outside the city. There are employees who travel about 50km to reach their place of work. Such employees may prefer to carpool if they cannot drive that distance daily. Notwithstanding, the percentage of employees who indicate that they cannot drive long distances is high. More studies need to be done to understand why this is so.

V. Conclusion

This paper report the carpooling characteristics of employees of two large workplaces. It points out that the pool effect which should normally favour carpooling does not. While it is easy to imagine that the availability of good public transport is responsible, the analysis shows that only 23.78% commute by public transport as against 12.2% who commute by carpooling. A large percentage of the employees commute by

driving. The abundant availability of parking spaces may be partly responsible for this pro-driving and less-successful uptake of carpooling [7]. There may therefore be the need for both government and the employers to design policies that promote carpooling to make its uptake more successful.

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