THE ROLE OF PLANNING, DESIGN AND SOCIAL FACTORS IN THE COMMUNITY ACCEPTANCE OF PUBLIC TRANSPORTATION INFRASTRUCTURE

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ABSTRACT

Transportation infrastructure is critical to the socio-economic development of any region. Consequently, it commands the attention of both the private and public sectors. However, the provision of public transportation infrastructure like roads, bus terminals, and railways faces the serious challenge of non-acceptance by communities based on certain factors. This, in turn, affects the growth and development of such communities, be they rural or urban. Evidence from the literature suggests that social factors such as the location of the infrastructure project, the community's trust or distrust of the project executioners, information dissemination about the project, integrity of the proposed project developer, as well as design factors like turning radius at junctions of roads, and traffic capacity are the major causes of community resistance to these infrastructure projects. Little scholarly attention, nevertheless, has been paid to the relationship that exists between these factors and the perception of projects by their host communities. This paper seeks to identify planning factors that influence community perceptions of infrastructure projects and examines the relationship between these factors and the perceptions of community members. The study was conducted using a survey research method that includes physical survey of road geometry, various elements of road transport infrastructure, and traffic survey, as well as a perception survey conducted among stakeholders and users of the road infrastructure. Public road infrastructure such as bus stations and taxi ranks located in the Central Business District of Bloemfontein, South Africa formed this study's context for data collection. The quantitative data were analysed using relevant statistical methods and empirical models. Findings show that infrastructure location without threat to human health, increased job opportunities, reduced passenger waiting time, and reduced vehicle waiting time engender positive community perception towards public transportation infrastructure projects. It is believed that this study will enhance community engagement for improved and acceptable public transportation infrastructure in South Africa.

1. INTRODUCTION

Mobility is a critical human need. Its satisfaction ensures that people, goods and services get to where they are needed. Transportation, as a result, is essential for the smooth running of society's socio-economic activities, which in turn facilitate regional and national development. It is worth noting that transportation infrastructure projects or assets offer several advantages to a nation. For instance, Loto and Nkaogwu (2013), the quality of a nation's transportation infrastructure offers the nation, advantages in international trade.

This may explain why developed countries like the United States of America, Russia, and China possess good transportation infrastructure which link cities, states, provinces, and regions internally, as well as connecting them with neighbouring countries. Developing countries of the world like Brazil, India, Nigeria, and South Africa have also not neglected investment in transportation infrastructure. This is because in facilitating efficient movement, good transportation systems and infrastructure contribute largely to the economic outlook of a nation. This may be through providing employment opportunities for citizens and improving international trade. A good transport infrastructure also enhances regional development as well as improved inter-regional relations. Such a relationship is being the consequence of active participation of people from different locations in social and economic activities. In order to make socio-economic activities highly productive, individuals, organisations, and governments have been investing heavily in transportation infrastructure to the end of incentivising development at all levels.

Despite their socio-economic importance, transportation infrastructure projects and assets are not always favourably received, thereby threatening their successful delivery and sustainability. Some of the factors inhibiting the provision of needed transportation infrastructure include dwindling economic fortunes or political instability (Kwak, Chih & Ibbs, 2009), and poor planning (Azege, Das & Awuzie, 2019). Indeed, poorly planned transportation infrastructure projects or assets such as bus terminal, underground tunnels and roads can lead to negative community perception of the infrastructure. Conversely, building trust through transparency and accountability on the part of developers, together with concrete engagement among all stakeholders involved in transport infrastructure projects are some of the factors that make for host community participation in, and acceptance of, such projects.

Using Mangaung Metropolitan Municipality in South Africa as a case study, this research identifies social, planning, and design factors that influence community members' perception of public transportation infrastructure, and examines the relationship that exists between these factors and such perception. Essentially, this study seeks an understanding of the factors that influence community perception which, in turn, determines the acceptance or non-acceptance of public transportation infrastructure projects in Mangaung Metropolitan Municipality. The researchers have used chi-square to examine this relationship within the context of the study area.

2. COMMUNITY PERCEPTION AND TRANSPORTATION INFRASTRUCTURE PROJECTS

Transportation infrastructure supports the bedrock of economic and social development of an area. The quality of transportation infrastructure of an area is usually an attraction for urban or rural settlements (Rangarajan, Long, Tobias & Keister, 2013). This is only made possible through adequate investment in the sector, providing a transportation network which supports mobility (Chen & Heynes, 2015). In recent times, both the public and private sectors have prioritised transportation infrastructure in order to ensure that the growing needs of mobility – especially associated with urbanisation – are met. Pradhan and Bagchi (2012) pointed out that as various regions do strive to motivate economic growth through development in transportation infrastructure. This is evidenced in the economic activities that flourish around river bank areas due to available water transport networks that support movement of raw materials. Due to the importance of transport infrastructure to human settlements, there is always a need to have coordinated resources and strategic planning towards building it.

The uniqueness of different transportation infrastructure projects demands specific planning and design. However, there are a number of common factors that are considered in most transportation infrastructure projects. According to Yang, Huang and Wu (2011), the success of a transportation infrastructure project lies in meeting the expectations of community members which were built up during project conception. These community expectations in most cases are subjective, and may be contrary to the essence of socio-economic development (Li, Ng & Skitmore, 2013). It is therefore important that the communities be adequately involved in the conception process and be given orientation on a transportation infrastructure project benefits (Abuzeinab & Arif, 2014; Tengan & Aigbavboa, 2017; Verweij, 2015); being that project host communities are a very important stakeholder group as far as transportation infrastructure is concerned, as argued by Di Maddaloni and Davis (2017). They further submit that these communities see transportation infrastructure projects in the light of the developers' relation with the public, channels of communication, project incentives, competence of project management team and contractor, transparency in tendering process, and general transparency of the project. Some literature also identify trust in project development (Leucht, Kolbel, Laborgne & Khomenko, 2010), corruption, educational level, gender, and present culture of a people (Chen, 2011; Duan, Bi, Yuan & Ban, 2010) as factors that influence community perception of a transportation infrastructure project.

In addition to social factors, the design choices made in building transportation infrastructure also influence community perception. A community as a stakeholder in transportation infrastructure projects – being in many cases, beneficiaries of the project – perceives such infrastructure in terms of what and how it is planned (Raoof, 2017). However, Liang and Wey (2009) are of the opinion that the process of transportation infrastructure planning is generally undertaken under a number of uncertainties and limited available resources to plan and execute the project. These constraints form the many factors that must be taken into consideration for proper planning. Proper planning is important because it is imperative that transportation infrastructures be constructed so as to benefit citizens. Central to planning is the cost-benefit ratio analysis because it provides a better understanding of other required factors, how to mobilise the factors, and the involvement of relevant stakeholders.

Nemoto (2009) has affirmed that transportation infrastructure should be planned so that revenue may be generated through charges on its use as well as maintenance strategies established by engaging an organisation with maintenance responsibility. Furthermore, Nemoto suggests the use of toll gates to collect charges, or through distance-based or fuel consumption-based charging. As much as charges are planned for maintenance of transportation infrastructure after construction, the initial funding is critical in planning and subsequent construction. Mobilisation of funding determines the chances of successful delivery of a transport infrastructure project and to a large extent, its sustainability (Liang & Wey, 2009).

3. RESEARCH DESIGN AND METHOD

This study aims to examine the relationship that exists between community perception of public transportation infrastructure projects or assets and its relationship to social, planning, and design factors in Mangaung Metropolitan Municipality (MMM). To this end, the study adopted the quantitative method of data collection, which generally, is an approach for testing theories by examining the relationship among variables which can be measured, and the numbered data analysed using statistical procedures. The study particularly employed the survey approach to seek community members' perceptions on the various factors in connection with their use of public transportation infrastructure. In order to obtain context-specific data, this study is carried out in Mangaung Metropolitan Municipality (MMM), Free State Province in South Africa. The choice of MMM as a study area stems from evidence of the existence of operational and non-operational public transportation infrastructure assets). As a result of the existence of these assets, community members are generally aware and have a good working knowledge of both kinds of public transportation infrastructure projects, providing a wealth of relevant data. Questionnaires were administered to community members of MMM, and the data collected were further analysed statistically by applying chi-square to understand the relationship that exists between community perception and each factor identified.

3.1 Study Area

MMM is one of the eight South African metropolitan municipalities, and it is the seat of government of the Free State Province. The metropolitan municipality is located on latitude -29.10 and longitude 26.22, covering approximately 9,886 km^2 (Das, Burger & Eromobe, 2012). As per the community survey of the metropolitan municipality in 2016, MMM has an estimated population of 787,930 (Integrated Development Plan, 2019), comprising black Africans, coloureds, Indians and whites. The black Africans are in the majority. The municipality's population is spread across her urban settlements such as Bloemfontein City, Botshabelo, Thaba Nchu, Soutpan, Dewetsdorp, and Wepener. Among these urban settlements, Bloemfontein City makes up 63% of the municipality's metropolitan population and is the economic hub of Mangaung Metropolitan Municipality and Free State Province.

Bloemfontein City has a high population and an accompanying bustle of socio-economic activities. Naturally, it contributes a major proportion towards the Free State economy. Land uses such as commercial banks, shopping malls/centres, educational institutions, religious institutions, tourist centres, and small and medium scale enterprises can be found in Bloemfontein City and the other towns in the area. Residents also engage in urban farming. All these institutions and the activities around them place a high demand on mobility within and outside the metropolitan municipality (Feike, Das & Mostafa, 2018). In order to link up the various locations within and without it, the municipality has transportation networks which are made up of roads, railways, rail station, and airport. However, the major transportation infrastructure in the area is the road network. This network connects most of the residences, public offices, and business centers. Emuze and Das (2015) and Feike et al (2018) all are in agreement that the municipality does not have an accessible public transportation system, leading to high private vehicle ownership in the area. This level of private vehicle ownership is one of the major causes of the traffic-related challenges in MMM. In response to managing traffic needs, several public transportation infrastructure projects or assets have been provided by government to ease mobility. Such infrastructure projects include roads, railroads, airport, bus terminals/stations and taxi ranks. While these facilities have been provided, their usability depends on community perception of them – a perception based on different social, planning, and design factors.

3.2 Data Collection and Analysis

Social, planning, and design factors relating to public transportation infrastructure projects were identified from available literature and used to design a questionnaire with two parts. The first part contained respondents' demographic information as shown in Table 1. The table shows that out of the 318 returned completed questionnaires, 29% of the respondents were female whereas 71% were male. As also captured in the table, there were 100 respondents between the ages of 19 and 24 years representing 31% of the total number, 139 respondents between 25 and 34 years representing 44%, 74 respondents between 35 to 65 years which represents 23%, and 5 respondents were above the age of 65 years making up 2% of the total respondents.

Table 1: Demographic data of respondents to the questionnaire

Description	Category	Frequency	Percentage (%)
Gender	Female	92	29
	Male	226	71
Age range in years	19 – 24	100	31
	25 – 34	139	44
	35 – 65	74	23
	65 +	5	2
Common mode of transportation	Public transport	246	77
	Private transport	72	23

The second part of the questionnaire was for the identified factors, tested on nominal scale using 'Yes', 'Unsure', and 'No' to seek community members' opinions. After the questionnaire was designed, a sample of 22 respondents was randomly selected in MMM for the pilot exercise. This was to ensure that the respondents and researchers shared the same understanding about the factors and questions (Flowerdew & Martin, 2013; Murray, 2013). The 22 piloted samples returned completed and were checked for suggestions by respondents for improvement. No suggestions were found.

After the pilot exercise, 412 questionnaires were administered to randomly selected members of the metropolitan municipality. Out of the total administered, 318 completed questionnaires were returned representing a 77% response rate. The completed questionnaires were checked for data integrity; that is, to identify cases of double answers to a question. Next, each respondent's demographic information and responses were entered in an Excel spreadsheet. This was done to ease data grouping for analysis. Given that the answers: 'Yes', 'Unsure', and 'No' were dependent on a factor and these factors were independent of any other variable, chi-square was the most suitable tool for the analysis of the data (McHugh, 2013) in view of the aim of the study. Chi-square requires that the data be expressed as a frequency of occurrence; therefore, Table 2 shows the frequency table of responses of respondents to each factor. Chi-square (x^2) is expressed mathematically as:

$$x^2 = \frac{(O-E)^2}{E} \quad - \quad - \quad - \quad - \quad (1)$$

Where O is observed frequency

E is expected frequency if the response frequency happens by chance.

$$\text{But} \quad E = \frac{M_R \, X \, M_C}{n} \quad - \quad - \quad - \quad (2)$$

(Source: McHugh, 2013)

M_R is the row marginal (row sum)
M_C is the column marginal (column sum)
n is the sum of row sums or column sums.

Table 2: Frequency distribution of responses to social, planning, and design factors

S/No.	Factor	Yes	Unsure	No	Row marginal
1	Passengers' waiting time	72	119	125	**316**
2	Vehicle boarding time	85	91	142	**318**
3	Walking distance to transport facility	248	38	31	**317**
4	Shield for waiting passengers	228	69	18	**315**
5	Safety	144	79	95	**318**
6	Vehicle restrictions	49	47	222	**318**
7	Traffic signs	189	64	65	**318**
8	Traffic signals	167	84	66	**317**
9	Pavement markings	67	46	202	**315**
10	Size of road or walkway	112	69	134	**315**
	Column marginal	**1361**	**706**	**1100**	**3167**

By using equation (2) and the marginal row and marginal column from Table 2, the expected frequencies occurring by chance are presented in Table 3. The chi-square for each cell in Table 2 is determined using the expected frequencies in Table 3, the observed frequencies in Table 2 and equation (1). The cell chi-square values are given in Table 4.

Table 3: Expected frequencies of responses

S/No.	Factor	Yes	Unsure	No
1	Passengers' waiting time	135.80	70.44	109.76
2	Vehicle boarding time	136.66	70.89	110.45
3	Walking distance to transport facility	136.23	70.67	110.10
4	Shield for waiting passengers	135.37	70.22	109.41
5	Safety	136.66	70.89	110.45
6	Vehicle restrictions	136.66	70.89	110.45
7	Traffic signs	136.66	70.89	110.45
8	Traffic signals	136.23	70.67	110.10
9	Pavement markings	135.37	70.22	109.41
10	Size of road or walkway	135.37	70.22	109.41

Table 4: Cell chi-squares

S/No.	Factor	Yes	Unsure	No
1	Passengers' waiting time	29.97	33.47	2.17
2	Vehicle boarding time	19.53	5.70	9.01
3	Walking distance to transport facility	91.70	15.10	56.83
4	Shield for waiting passengers	63.39	0.02	76.37
5	Safety	0.39	0.93	2.16
6	Vehicle restrictions	56.23	8.05	112.66
7	Traffic signs	20.05	0.67	18.70
8	Traffic signals	6.95	2.52	17.67
9	Pavement markings	34.53	8.35	78.36
10	Size of road or walkway	4.03	0.02	5.53

The statistical significance of the public transportation infrastructure project factors was determined by using the sum of the cell chi-squares and the degree of freedom (*df*). The *df* is calculated by using *(c-1)(r-1)*, where *c* is the number of columns and *r* is the number of rows of cell chi-square table. Therefore, *df* = (3-1)(10-1) = 18. These analyses have produced the results and findings which are discussed in the next section.

4. DISCUSSION OF RESULTS AND FINDINGS

The responses to the questionnaire show the perceptions of community members in relation to various social, planning, and design factors. These perceptions inform their choice in the use of a public transport facility or not. The degree of freedom of the statistics is 18 and the chi-square calculated value is 781.01. Given the probability value of 5%, the table value of the chi-square is 28.87.

Passengers' waiting time measures the average time a passenger waits for a vehicle at a public transport facility. From the data collected, the expected responses for choosing to use a public transport facility as a result of waiting time for a vehicle is 135 (42), higher than the observed 72. The observed responses for 'Unsure' and 'No' are respectively 119 (37%) and 125 (39), above the expected responses by chance. This factor, as shown in Table 4 has a chi-square value of 65.56. The calculated chi-square value is greater than the standard chi-square value of 28.87. This implies that the null hypothesis H_o is rejected, and it retains that passengers' waiting time has a relationship with the decision to use transport infrastructure assets or not.

Another planning factor examined in terms of its relationship with community perception is vehicle boarding time. The observed 'Yes' responses amount to 85 (27%), which is less than the expected 'Yes' responses. However, the observed 'Unsure' and 'No' responses to the vehicle boarding time are 91 (29%) and 142 (45%) respectively. These observed values are higher than the respective expected values that would have occurred by chance. From Table 4, the chi-square value is 34.24, which means there is a relationship that exists between vehicle boarding time and community perception of a transportation infrastructure project. This conclusion is in agreement with Vansteenwegen and Van Oudheusden's (2007) submission that people do not like to spend too much time on their journeys. Vehicle boarding time contributes to the total time travellers use for a particular journey.

It is also evident that traffic signs are critical to public transportation infrastructure projects or assets through the messages they communicate to users. The respondents gave 189 (59%) 'Yes' responses as against the expected 136.66 which represent the possibility of it being by chance. There were 64 (20%) 'Unsure' observed responses and 65 (20%) 'No' responses, lower than 70.89 and 110.45 expected responses respectively. The chi-square value is 39.42 which is greater than the standard table value. This is an indication that community perception of public transportation infrastructure projects has a relationship with traffic signs. This makes it essential to have traffic signs as a part of public transportation infrastructure in order to encourage public use of the infrastructure.

It is inarguable that traffic signals minimise traffic conflict at road intersections. The traffic signal as noted from the observed received 167 (53%) 'Yes' responses, above its expected responses of 136.23. The responses for 'Unsure' and 'No' as shown in Table 2 and Table 3 are lower than the expected responses if the responses had happened by chance. The chi-square value is 27.14 which is lower than the table chi-square value. This lower value shows that there is no relationship between community perception about public transportation infrastructure projects or assets and traffic signals. On community perception in relation to pavement marking, the 'Yes' and 'Unsure' responses by the respondents are less than the expected responses for the factor as they are compared in Table 2 and Table 3. The number of 'No' responses is 202 (64%) which is higher than the expected 'No' responses in Table 3. The pavement marking chi-square value in Table 4 is 121.24, being greater than the table chi-square value. Therefore, there is a relationship between community perception and pavement marking.

It was also found from the questionnaires that the 'Yes' responses for size of road or walkway are 112 (35%), lower than expected 135.37; 'Unsure' responses are 69, lower than the expected 70.22; while the 'No' responses are 134 (42%), which is higher than the expected 109.41 responses. Table 4 shows the cell chi-square value of 9.58 for size of road or walkway. This chi-square value is lower than the table chi-square value of 28.86. This implies that community perception of public transportation infrastructure projects is not affected by size of road.

From the analysis, it is clear that except for traffic signals and size of road or walkway, all the factors examined have a bearing on the community perception of the projects. The next subsection discusses the social factors.

5. THE RELATIONSHIP BETWEEN SOCIAL FACTORS AND COMMUNITY PERCEPTION OF PUBLIC TRANSPORTATION INFRASTRUCTURE PROJECTS

Some environmental, community, or government related factors in public transportation infrastructure projects have an influence on the way a community perceives an infrastructure project. Some of these factors, such as walking distance to a public transportation facility, safety, and vehicle restrictions have been examined using chi-square to determine their relationship with community perception of assets.

Out of the 318 respondents, 248 (78%) responded with 'Yes' to walking distance as a factor that influences their choice of using a public transportation infrastructure against 136.23 expected responses. Furthermore, 38 (12%) respondents were 'Unsure' and 31 (10%) responded 'No', which are below their respective 70.67 and 110.10 expected responses. From the analysis and result in Table 4, walking distance has a chi-square value of 163.63, being greater than the table value. This implies that there is relationship that exists between community perception and walking distance to public transportation infrastructure projects or assets. The public transportation infrastructure project location is expected to be within the radius of 450 m to trip generation point.

To the question of shelter at the facilities while waiting to board, there are 228 (72%) 'Yes' responses from completed questionnaires, more than the expected 135.37 responses which might happen by chance. Also, 69 (22%) respondents are unsure, and 18 (6%) respondents responded with 'No' against the respective expected 70.22 and 109.14 responses. Table 4 shows the chi-square of 139.78. Evidently, shelter for waiting passengers has a relationship with a community's decision to use a public transportation infrastructure asset or not. In order to protect passengers against adverse weather conditions such as sunshine and rain, it is essential to provide shelter and comfort for passengers who may be waiting to board at the public transportation facilities.

The safety of lives and property at public transportation facilities is one of the factors that motivate patronage. As found, 144 (45%) respondents gave a 'Yes' response to the question, against the expected 136.66 responses. It is also found in Table 2 that 79 (25%)

responses indicate 'Unsure', below its 70.89 expected responses; and 95 (30%) 'No' responses, which are also below the expected 110.45 responses. The factor's chi-square value of 3.48 which is below the standard table value is an indication that there is no relationship between community perception and safety at public transportation infrastructure.

Restrictions on vehicle use are a government policy usually implemented to manage the traffic and transportation infrastructure of an area. The respondents gave 49 (15%) 'Yes' responses to its having a bearing on their use of the facilities, which is below its 136.66 expected responses if the responses occurred by chance. Also, 47 (15%) respondents were unsure about the question of using public transportation assets based on vehicle restrictions, and 222 (70%) 'No' responses were supplied to the question, and are above the expected 110.45 responses. The chi-square value of 176.94 for this factor shows that community perceptions of usability are influenced by vehicle restriction policy. Restricting the vehicle type usable for public transportation negatively affects community members' decision to use public transportation assets.

From the foregoing, it can be deduced that walking distances, shelter for waiting passengers, and vehicle restrictions do influence community members perception about the project or asset. However, the safety of people does not have any influence on community perception and use of public transportation infrastructure projects or facilities in Mangaung Metropolitan Municipality.

6. CONCLUSION

Transportation infrastructure facilities or assets are an essential infrastructure for national development. This is due to their roles as facilitators of socio-economic activities, offering mobility to people, goods, and services. Governments, individuals, and groups have ensured the provision of transportation infrastructure so as to boost national growth and development. But such expected development can only be achieved if there is an efficient use of those transportation facilities. It is however, noted that, the perception of the infrastructure projects or assets by community members, especially in reference to the different design, planning, and social factors is one of the major causes of acceptance or rejection of the facilities in some areas. In the case of Mangaung Metropolitan Municipality in South Africa, such factors like traffic signs, pavement markings, passengers' waiting and vehicle boarding times, the location of the facilities in relation to residences or working places, weather friendly passenger waiting areas, and the restrictions on the type of vehicles influence community members' decision to use public transportation infrastructure assets.

Given that some social, planning and design factors of public transportation infrastructure projects have relationship with community perception as identified in this research, the study has shown the need for concerted and robust community engagement in the projects. Such engagement may enhance the community's relationship with transportation infrastructure project developer, and it may promote the spirit of ownership of the projects by a community which engenders sustainable infrastructure delivery.

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