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AN EVALUATION OF PLANNING AND DESIGN PARAMETERS INFLUENCING STAKEHOLDERS' ACCEPTANCE OF PUBLIC TRANSPORTATION INFRASTRUCTURE FACILITIES

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Abstract

Purpose
This study investigates the incidence of stakeholder acceptance of infrastructure assets using transportation infrastructure asset exemplars. It engaged with the assessment of planning and design parameters which impact on the level of stakeholder acceptance and the relationship between these parameters.

Research Method
The study utilized two transportation infrastructure assets situated in Bloemfontein as case studies. Data was collected using sequential mixed method. Questionnaires were administered to a a purposively selected sample (n=303) for the assessment of planning and design parameters extracted from literature. Afterwards, a focus group discussion involving 7 discussants, and the interpretative structural modeling (ISM) process was used in determining the relationship between the identified parameters.

Findings
Findings revealed that walking distance to the facility proved most influential of the 19 parameters evaluatedpromote the health and ensure the safety of women on construction sites, factors needing consideration are physical work capacity, personal protective equipment, and anthropometry, biological and physiological composition.

Value
The study's findings are expected to guide the development of a protocol for improving stakeholder acceptance of public infrastructure projects.

Keywords: Bloemfontein, Stakeholder Acceptance, Transportation Infrastructure, Interpretative Structural Modelling

INTRODUCTION

Transportation infrastructure plays a critical role in national economic and social development[1]. It provides linkages upon which the movement of goods and services are predicated. The quality of transportation systems has been applied as a yardstick for measuring national competitiveness. Also, transportation infrastructure assets have been identified as a major contributor towards the attainment of the sustainable development goals (SDGs). As such, the development of relevant transportation infrastructure and/ or systems has become priority for most nations. High degree of complexity is usually associated with the planning, procurement, delivery, and management of public transportation infrastructure. Such complexity derives from the involvement of a multiplicity of stakeholders with varied and conflicting expectations, differences in policy guidelines, and the challenging terrain of the project delivery environment.

Based on the foregoing, several economies across the globe have made considerable investments in improving their transportation infrastructure. However, these efforts have recorded underwhelming performance, particularly within the developing economies context. This is evident in the increasing number of failed and abandoned transportation projects which have continued to dot the project landscape in these economies.

Although successive studies have sought to investigate the failed and/or abandoned transportation infrastructure projects and assets, a paucity of studies seeking to investigate the nexus between the project abandonment or non-, or underutilization of completed assets and stakeholder acceptance has been observed. This trend is worrisome especially as scholars have highlighted the salience of optimal levels of stakeholder acceptance in engendering project success [2]. This study stems from this observation. As a major proposition, the study postulates that the level of stakeholder acceptance or non-acceptance of transportation asset infrastructure is influenced by various planning and design parameters. Accordingly, this study seeks to identify these planning and design parameters albeit using transportation asset infrastructure situated within the Bloemfontein. In furtherance to this, the study evaluates the relationship between critical planning and design parameters identified relying on the instrumentality of the interpretative structural modelling protocol. It is expected that an understanding of these relationships will facilitate better decision-making towards achieving optimal stakeholder acceptance during various stages of a transportation infrastructure delivery process.

In order to accomplish the objective of the research study, the rest of this paper is structured as follows: a review of relevant literature, justification of the research methods deployed, presentation and discussion of the study's findings/results as well as the conclusion.

LITERATURE REVIEW

Transportation infrastructure for economic development

More than ever, the unprecedented levels of population growth have challenged countries to promote programs and activities that enhance citizen welfare whilst promoting national and international relationships[3]. These activities are often expected to drive economic growth within various country-contexts. Nistor and Popa[4] note that the effectiveness and efficiency of economic and social activities are hinged on the mobility of goods and services. Often, national economic development is measured by the quality of its infrastructure stock, inclusive of transportation infrastructure. Transportation infrastructure is a type of infrastructure that provides platform for transportation services. According to Chen, Bai and Zhang[5], transportation infrastructure improves economy of a region through creation of job opportunities and motivation of enterprises. This assertion implies that the success of transportation infrastructure is assessed based on the economic benefits it offers to the populace.

Due to its critical role in facilitating economic development, developed countries like USA, Canada and China have prioritized transportation infrastructure delivery. Similarly, developing countries like South Africa and India have employed similar strategies to promote domestic and international trade and, create employment opportunities thereby making significant contributions to a country's total gross domestic product (GDP) [6,7]. Despite the contributions of transportation infrastructure for economic development, it is evident that countries lacking in good transportation infrastructure have suffered setbacks in terms of social and economic development. Furthermore, certain areas witnessing high agricultural production have failed to contribute to economic development due to poor transportation infrastructure network[8]. Therefore, it is essential that quality transportation infrastructure and sufficient transportation network is prioritized by any nation or region for economic development.

Factors influencing transportation infrastructure project delivery success

The provision of transportation infrastructure is usually aimed at solving challenges associated with the movement of goods, services, and persons from one point to another[9]. Adequate assessment of land use, population growth and traffic growth are carried out to forecast future transportation needs and services. This assessment and the attendant forecast help planners and other decision-makers alike in engendering successful planning, design, and delivery of sustainable transportation infrastructure.

Planning for transportation infrastructure is often multi-faceted in the sense that various factors, particularly the type of transportation infrastructure and its location, influence the planning process. The factors associated with the location of transportation infrastructure projects are extant government policy, the social norms and culture of a people and households distribution[10]. It is considerable that public transportation infrastructure is situated in a manner that supports increased accessibility by potential users. The location must be in proximity to residences and places of social and economic activities[11,12]. Also, funding for transportation infrastructure has been one of the factors affecting the delivery of transportation infrastructure. In this regard, adequate financial preparation for such projects becomes imperative to forestall successful completion[13]. The safety and security of the users remain another factor that must be considered during the planning and delivery phases of such projects. As such, safety and security consideration should be paramount in transportation infrastructure design and planning considerations.

Transportation infrastructure project stakeholders' management and acceptance

The management of stakeholders involves their engagement and participation within a given transportation infrastructure project. Therefore, effective stakeholders' management is important because, every transportation infrastructure project affects or is affected by an individual or group of individuals. In this way, the objective of meeting their transportation needs will be met. Tammer[14] emphasizes that early identification, engagement, and consultation of stakeholders enables identification of risks, development of trust among them, and drives active participation thereby culminating in successful transportation infrastructure delivery. The uncertainties associated with the project are better managed through an in-depth elicitation of stakeholders' knowledge, experiences, and innovative ideas [15,16]. Yet, effective engagement of stakeholders is often undermined by various factors like the diversity of views and interests held by a multiplicity of stakeholders and project complexity. These factors tend to make the attainment of the required levels of stakeholder acceptance, an arduous task. The attainment of stakeholder acceptance is deemed critical to project success as failure in this regard can result in stakeholder apathy in the infrastructure asset, in this case, transportation infrastructure.

Yazdanpanah, Komendantova and Ardestani[17] identify optimal use of transportation infrastructure assets by prospective users as an indicator of stakeholders' acceptance. Certain factors have been established in the corpus of extant literature as influencing the stakeholder perceptions towards a project, thereby resulting in their acceptance or otherwise of the asset being delivered. These factors include trust and knowledge about the infrastructure project[18], effective communication[19], the degree of socio-economic benefits associated with the infrastructure, among others. These socio-economic benefits associated with transportation infrastructure comprise of the following features, namely, accessibility, affordability, and safety [12]. In addition to these socio-economic factors, some environmental factors have been shown to affect the degree of stakeholder acceptance of an infrastructure project. These factors include air pollution, noise, temperature and exposure to sunlight[20]. Furthermore, other factors associated with planning and design of the infrastructure projects like travel time, waiting time, presence of security agents, proximity to residences also influence stakeholders' perceptions and subsequent decisions on acceptance[21]. It is seemingly commonplace for stakeholders to weigh benefit against cost implications in their choice of a particular transportation infrastructure over another. The choice is mostly common in event where a transportation infrastructure provided offers similar services with an already existing at the same location. In order to allow for increased buy-in of a new transportation infrastructure project by stakeholders, there should be reasonable improvement in services and benefits to the stakeholders[22]. It is therefore essential in transportation infrastructure project delivery to effectively manage stakeholders for its success. To enhance stakeholders' acceptance of a project or asset, the various social, economic, environmental, planning and design factors must be given adequate attention during various phases of the transportation infrastructure lifecycle. These factors as sourced from relevant literature is presented in Table 1.

TABLE 1

PLANNING AND DESIGN PARAMETERS INFLUENCING STAKEHOLDER ACCEPTANCE OF INFRASTRUCTURE PROJECTS

S/No	Parameters	Source
1	Availability of business opportunities	Chen, Bai and Zhang (2019); Mejía Dorantes, Paez and Vassallo Magro (2010)
2	Walking distance to public transport facility	Boschmann and Brady (2013); He, Mol and Lu (2016); Bashingi, (2016); Zoellner, Scheizer-Ries and Wemheuer (2008)
3	Shelter at passengers waiting area	Goshayeshi, Zaky, Fairuz and Khafi (2013)
4	The boarding time of vehicles	Lenne, Ruddin-Brown, Navarro, Edguist, Trotter and Tomasevic (2011)
5	Available space between parked vehicles	Naude (2015)
6	Method for aged and disable people to access public transport facility	Boschmann and Brady (2013); Bromley, Matthews and Thomas, (2007); Soltani, Sham, Awang and Yaman (2012)
7	Vehicle parking type	McCoy, P.T., Ramanujam, M., Moussavi, M. and Ballard, J.L., (1990); Morency, C. and Trépanier, M. (2008)
8	Vehicle waiting time at public transport facility	Zheng, Zheng, Chatzimisios, Xiang and Zhou (2015)
9	Traffic capacity	Sun and Cui (2018)
10	Traffic signals	Lenne, Ruddin-Brown, Navarro, Edguist, Trotter and Tomasevic (2011)
11	Traffic signs	Trifunovic, Pesic, Cicevic and Antic (2017)
12	Size of parking lot or parking bay	Bester and Da Silva (2012); Damen and Huband (2006)
13	Size of passengers' waiting area	Yang, Yang, Xue, Zhang, Pan, Kang and Wang (2019)
14	Vehicle restrictions on the use of public transport facility	Hanna, Kreindler and Olken (2017)
15	Road width	Chandra and Kumar (2003); Eniola, Njoku, Seun and Okoko, (2013); Olagunju (2015); Zheng, Sun and Yang (2015)
16	Sight distances	De Santos-Berbel, Castro, Medina and Paréns-González (2014)
17	Road grade/ steepness	Bauer and Harwood (2013)
18	Vehicle turning radius	Savkin and Teimoori (2010)
19	Pavement marking to guide movement	Adedeji, Abejide, Monts'l and Hassan (2019); Rehman and Duggal (2015)
20	Security operatives at public transport facility	Rundmo, Nordfjærn, Iversen, Oltedal and Jorgensen (2011)
21	Passengers' waiting time	Vansteenwegen and Oudheusden (2005)
22	Number of vehicles waiting for passengers	Kim (2012)
23	Nearness to U-turn to public transport facility	Pannela and Bhuyan (2017)
4	Advanced energy and water performance	Reward smart building technologies that reduce plug loads and employ smart energy scheduling to provide power when needed.

Source: Authors' compilation (2020)

However, the planning and design phases are considered most critical in engendering improved stakeholder acceptance of infrastructure assets. And transportation infrastructure is not an exception. The rising spate of underutilization of transportation infrastructure by intended users, particularly bus terminals, within the developing country context has necessitated this study. Accordingly, this study investigates the issue of stakeholder acceptance of transportation infrastructure within the aforementioned context, identifying as it were, the planning and design parameters influencing the levels of acceptance experienced and exploring the relationship between the critical parameters, relying on the ISM methodology.

RESEARCH METHOD

More than ever, the unprecedented levels of population growth have challenged countries to promote programs and activities that enhance citizen welfare whilst promoting national and international relationships[3]. These activities are often expected to drive economic growth within various country-contexts. Nistor and Popa[4] note that the effectiveness and efficiency of economic and social activities are hinged on the mobility of goods and services. Often, national economic development is measured by the quality of its infrastructure stock, inclusive of transportation infrastructure. Transportation infrastructure is a type of infrastructure that provides platform for transportation services. According to Chen, Bai and Zhang[5], transportation infrastructure improves economy of a region through creation of job opportunities and motivation of enterprises. This assertion implies that the success of transportation infrastructure is assessed based on the economic benefits it offers to the populace.

Description of Case

To seek the understanding of planning and design factors influence on stakeholders behaviour in South Africa, Central Park Interstate Bus Line (IBL) and Mangaung Intermodal Transport Facility (MITF) were identified. Whereas the MITF is not operational following users' protest concerning its usability in 201224. These infrastructure facilities are situated in the Bloemfontein Central Business District (CBD) where shopping centers and government departments and agencies offices are located. They are located adjacent to each other.

Central Park Interstate Bus Line (IBL)

The IBL is an elevated transportation infrastructure with shopping malls underneath. It has a one-way entry lane which measures 7.3m wide, 64.8m long and a one-way exit lane with 7.3m long and 55.2m long. All the lanes are connected to Hanger Street which runs between IBL and MITF. The IBL has twelve parking lots measured 52.0m each. Seven of the parking lots has the width of 7.0m and the other seven have width of 4.0m. Between every two parking lots is a passengers' waiting area which measures 4.0m wide except an area in the middle of where hawkers make their sales as well as a stairway connected to it. These passengers' waiting areas have shields and seats for passengers' comfort during the waiting period. The IBL is built with a traffic capacity of six interstate buses.

Mangaung Intermodal Transport Facility (MITF)

The MITF consists of a three-storey building with parking lots evenly distributed across each each floor. It has a one-way entry lane measuring 7.5m wide and one-way exit lane measuring likewise in width. Between the first and second floor is a two-way driveway of 7.5m and the second and third floors are connected by two-way driveway of 7.5m. The facility at first floor has 21 parking lots that measured 42.0m long and 2.6m wide each with a driveway, 7.2m wide round the parking lots. The second floor has 23 parking lots which measured 42.0m long, 2.6m wide and 1.8m wide passengers' waiting area between the parking lots. A driveway of 7.0m around the parking lots and connected to the exit and entry driveway. Unlike the first and second floor, the third floor has 76 parking bays which measures 10.0m each. The parking bays are segmented into four separated by two-ways driveways with cross junction at the center and two driveways at opposite ends for discharge of traffic from parking bays and the third floor.

The IBL and MITF were used as cases to examine the influence of planning and design parameters on stakeholder acceptance of transportation infrastructure projects based on the perceptions of various stakeholders

Data Collection and Analysis

Infrastructure projects are complex undertakings involving a multiplicity of tasks and stakeholders across their lifecycle. As such, in a study of such nature, there is need to adopt data elicitation methods that can allow for the collection of data from a wider sample of stakeholders in a timely and cost-effective manner without undermining the quality of such data at different intervals. Accordingly, the use of a sequential mixed method methodological choice became a veritable option for achieving the study's objectives.

In the first instance, data was elicited using self-administered questionnaires. The respondents to the survey were drawn from the stakeholder population comprising of the project team, passengers, drivers, and professionals who belonged to the project team at various phases, mostly recruited from the municipality. The survey sought to establish the critical planning and design parameters affecting stakeholder acceptance of both assets. As such, the questionnaire was delineated into two sections. Whereas the first section was aimed at eliciting demographic information, the second part tried to obtain information concerning stakeholders' perception of the importance or criticality of 23 planning and design factors identified from the literature. See Table 1. The questions were designed on a five-point Likert scale25,26. The five-point Likert Scale was calibrated according to the following: 1=strongly disagree to 5=strongly agree. It was

Journal of Construction **Vol13** | **Issue 3**

necessary to carry out pilot stakeholders' survey to assess a common understanding of the questions by respondents and researchers27. During piloting of the questionnaire, 22 respondents were randomly selected using the purpose of the research28, 29. The respondents were advised to make suggestions or indicate if any question on the questionnaire was not properly understood. After administering the questionnaire, 22 completed questionnaires were collected, signaling a100% response rate. It was checked for understanding of the questions by respondents and suggestions were treated. Following the corrections on the questionnaire, it was subsequently administered on 412 respondents in Mangaung Metropolitan Municipality over a 3-month period. A total of 308 responses were recorded and deemed usable for the study. This represented a 75% response rate. The distribution of the respondents is outlined in Table 2.

TABLE 2
RESPONDENTS' DEMOGRAPHICS AND DISTRIBUTION

Nature of Stakeholder	Number of Questionnaires Administered	Number of Completed Questionnaires Received
Project Client (Municipality)	9	7
Project Team (Contractors, Designers, Planners, Engineers)	16	11
Taxi owners and drivers	178	138
Passengers	209	152
Total	412	308

Source: Authors' compilation (2020)

Descriptive statistics such as average weighted mean and standard deviation were used to rank the planning and design factors thereby assessing the criticality of the various parameters. The completed questionnaire data were checked for double responses to a questionnaire which such were considered not answered. The various questions and demographic information about the respondents were entered into SPSS 16.0 software for analysis. The 23 planning and design factors of public transportation infrastructure projects were analysed with SPSS software to determine the average weighted mean and standard deviation (for internal consistency of responses).
In the second phase of the data collection process, a focus group discussion panel was convened. The purpose of the discussions was to explore the relationships between the parameters. The need for such was based on an understanding of the impact that such relationships will have on stakeholder acceptance of the infrastructure

assets. Also, this understanding will assist decision-makers and planners to determine the parameters to focus on to engender improved stakeholder acceptance. To determine the relationship between parameters and their degree of influence on other parameters in the relationship, the interpretive structural modelling (ISM) methodology was utilized[27].

An ISM methodology establishes interrelationship between factors that influence a phenomena[30]. The interrelationship is determined between each pair of the factors through ideas contributed by people with expert knowledge about them. Due to probability of subjective opinions about a particular relationship between factors, a group discussion is required[31]. In this study, a purposive random sampling technique was used to identify and engage discussants. The researchers identified 2 academic staff with at least 5 years' experience in transportation research, 2 transportation infrastructure project planners with at least 10 years in planning, 2 taxi drivers and 1 construction manager as shown in Table 3.

TABLE 3
THE DEMOGRAPHIC INFORMATION ABOUT DISCUSSANTS

Discussants	Number	Years of experience	Female	Male
Academic staff	2	>5	0	0
Transportation planner	2	>5	0	0
Vehicle drivers	2	>5	1	1
Construction manager	1	5>	0	1

Source: Authors' compilation (2020)

The focus group discussion (FGD) was arranged with sampled academic researchers, taxi drivers and consultant for discussion. The group discussion was held and facilitated by one of the researchers who introduced the purpose of the discussion. They were further assured of confidentiality of their discussion which was for the purpose of research. They were also advised to respect each person's opinions despite any diversity in the opinions. The planning and design factors were presented to the discussants in a matrix form, from where the facilitator guided discussants to give causal relationships among them. The discussion exhausted the determination of the relationships in 1 hour and 38 minutes which showed the ease-to-understand process and the matrix by the discussants.

Presentation of Findings

The findings from both phases of the data collection methods deployed in the study are presented in this section. Firstly, an assessment of the influence of the 23 parameters on stakeholder acceptance of transportation infrastructure asset is presented in section 3.3.1. In section 3.2.2, the analysis and findings of the focus group discussion panel as provided through the ISM methodology is presented.

Perception of public transportation infrastructure project planning and design parameters influencing stakeholder acceptance

Table 4 shows the number of respondents, the average weighted means, standard deviation, and percentage of responses. The ranked factors indicate that 19 of the factors have Likert index mean of above 3.0 which amounts to an agreement of a certain parameter's influence on stakeholders' acceptance about the public transportation infrastructure asset.

TABLE 4
PLANNING AND DESIGN FACTORS INFLUENCING STAKEHOLDERS' ACCEPTANCE

S/No	Factors	Number of respondents	Mean	Sd	Rank
1	Availability of business opportunities	303	4.21	0.83	1
2	Walking distance to public transport facility	308	4.08	0.99	2
3	Shelter at passengers waiting area	302	4.01	0.93	3
4	The boarding time of vehicles	301	3.82	0.95	4
5	Available space between parked vehicles	301	3.72	1.10	5
6	Method for aged and disable people to access public transport facility	308	3.67	1.26	6
7	Vehicle parking type	306	3.64	1.23	7
8	Vehicle waiting time at public transport facility	299	3.63	1.11	8
9	Traffic capacity	307	3.59	1.21	9
10	Traffic signals	305	3.56	0.86	10
11	Traffic signs	306	3.56	0.86	11

12	Size of parking lot or parking bay	302	3.47	1.30	12
13	Size of passengers' waiting area	308	3.46	1.07	13
14	Vehicle restrictions on the use of public transport facility	308	3.44	1.22	14
15	Road width	308	3.44	0.97	15
16	Sight distances	308	3.36	1.10	16
17	Road grade/ steepness	307	3.34	1.04	17
18	Vehicle turning radius	303	3.13	1.02	18
19	Pavement marking to guide movement	307	3.12	1.40	19
20	Security operatives at public transport facility	308	2.97	1.21	20
21	Passengers' waiting time	304	2.89	1.01	21
22	Number of vehicles waiting for passengers	306	2.77	1.00	22
23	Nearness to U-turn to public transport facility	301	2.26	1.10	23

Source: Authors' compilation (2020)

Relationship between the planning and design parameters influencing stakeholder acceptance

The relationship between the planning and design parameters as determined by discussants is modelled using the ISM. Further discussions are provided subsequently.

Self-structured reachability matrix.

In the relationship between two planning and design factors, i and j were used to represent the factors. Four relation dimensions are used between i and j. These dimensions are i influences j denoted as V; i is influenced by j, denoted as A; i and j influence each other as denoted by X and parameter i and j have no influence on neither of them as denoted as O. The various relationships influences are presented as SSIM in Table 5 with i on the rows and j on the columns.

TABLE 5
SELF STRUCTURE-INTERACTION MATRIX (SSIM)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1	A	A	V	O	O	O	O	O	X	A	A	O	O	O	O	O	O	O
2		1	X	X	V	O	O	O	O	V	X	X	O	O	O	O	O	O	O
3			1	O	A	O	O	O	O	A	X	O	O	O	O	O	O	O	O
4				1	O	O	O	O	O	V	O	O	O	O	O	X	V	O	X
5					1	O	A	A	O	O	X	V	O	O	O	O	O	O	O
6						1	A	O	O	O	A	O	O	V	O	O	O	O	O
7							1	O	O	X	O	V	O	V	V	V	O	O	V
8								1	O	V	O	O	O	V	O	O	O	O	O
9									1	O	O	O	V	O	O	O	V	O	V
10										1	O	O	O	O	O	V	A	V	X
11											1	O	O	O	O	O	O	O	O
12												1	O	X	O	O	O	O	O
13													1	V	O	O	V	O	O
14														1	A	O	O	O	O
15															1	V	O	O	O
16																1	O	V	V
17																	1	O	O
18																		1	V
19																			1

Source: Authors' compilation (2020)

Reachability matrix (RM)

It is customary to develop a reachability matrix from the SSIM. Reachability matrix exists in two forms: initial reachability matrix and final reachability matrix. The initial reachability matrix is developed by substituting V, A, X and O letters from SSIM with 0s and 1s. The guiding principles of the substitution are that (1) if the (i, j) entry in SSIM is V, then (i, j) entry in initial RM is 1 and (j, i) entry is 0; if the (I, j) entry in SSIM is A, then (I, j) entry in initial RM is 0 and (j, i) entry is 1; if the (I, j) entry in SSIM is X, then both (i, j) and (j, i) entry are 1 and if the (i, j) entry in SSIM is O, then both (i, j) and (j, i) entries are 0. The initial reachability matrix is presented in Table 6.

TABLE 6
INITIAL REACHABILITY MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0
3	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
4	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1
5	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
6	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
7	0	0	0	0	1	1	1	0	0	1	0	1	0	1	1	1	0	0	1
8	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0
9	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1
10	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	1
11	1	1	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0
12	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
14	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0
16	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
17	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
19	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1

Source: Authors' compilation (2020)

After the development of initial RM by substituting the various relationships with binary numbers, the final RM is then developed through incorporation of transitivity. The transitivity is checked by using the opinions received from participants in Table 3. Transitivity concept is a situation where if parameter A influences parameter B and parameter B influences parameter C, then it implies that parameter A influences parameter C. In this case, a 0 in the intersection cell of parameter A and C is replaced with

TABLE 7
FINAL REACHABILITY MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	DP
1	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	10
2	1	1	1	1	1	1	0	0	0	1	1	1	0	1	0	1	1	1	1	14
3	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	9
4	1	1	1	1	0	0	1	0	0	1	1	1	0	0	0	1	1	1	1	12
5	1	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	7
6	1	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	5
7	1	0	0	1	1	1	1	0	0	1	0	1	0	1	1	1	0	1	1	12
8	1	0	1	0	1	0	1	1	0	1	1	1	0	1	0	1	0	1	1	12
9	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	0	1	6
10	1	0	1	0	1	1	1	0	0	1	0	1	0	1	1	1	0	1	1	12
11	1	1	1	1	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	10
12	1	1	1	1	1	0	0	0	0	1	1	1	0	1	0	0	0	0	0	9
13	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	1	0	0	5
14	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	4
15	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	5
16	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	7
17	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	8
18	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	3
19	1	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	0	1	1	8
D	14	10	11	9	8	6	7	1	1	15	7	13	2	12	3	10	7	11	11	158

Source: Authors' compilation (2020)

Level partitioning
The final reachability matrix is used to determine the reachability sets and antecedent sets. Reachability set is a set of parameters containing itself and other parameters that it may influence while the antecedent set is a set of parameters containing itself and parameters that may influence it. After determination of reachability set and antecedent set for all the parameters, intersection set for each of the parameters is generated. The parameter for which the reachability set, and intersection set are equal sets occupies the first and topmost level. In this case, the factor 18 in Table 6 have equal reachability set and intersection set, hence, occupy the first and top-most level in ISM. Then, parameter 18 is therefore removed from the list of factors under consideration. The process is repeated until the level of every factor is obtained from the level partitioning process. Table 8 shows the iterations which determine the various levels of each parameter in the ISM model. After the level of each parameter is obtained from the iterations, an ISM model is formed from the iterations and the final reachability matrix.

TABLE 8
LEVEL PARTITIONING FROM ITERATION I TO ITERATION X

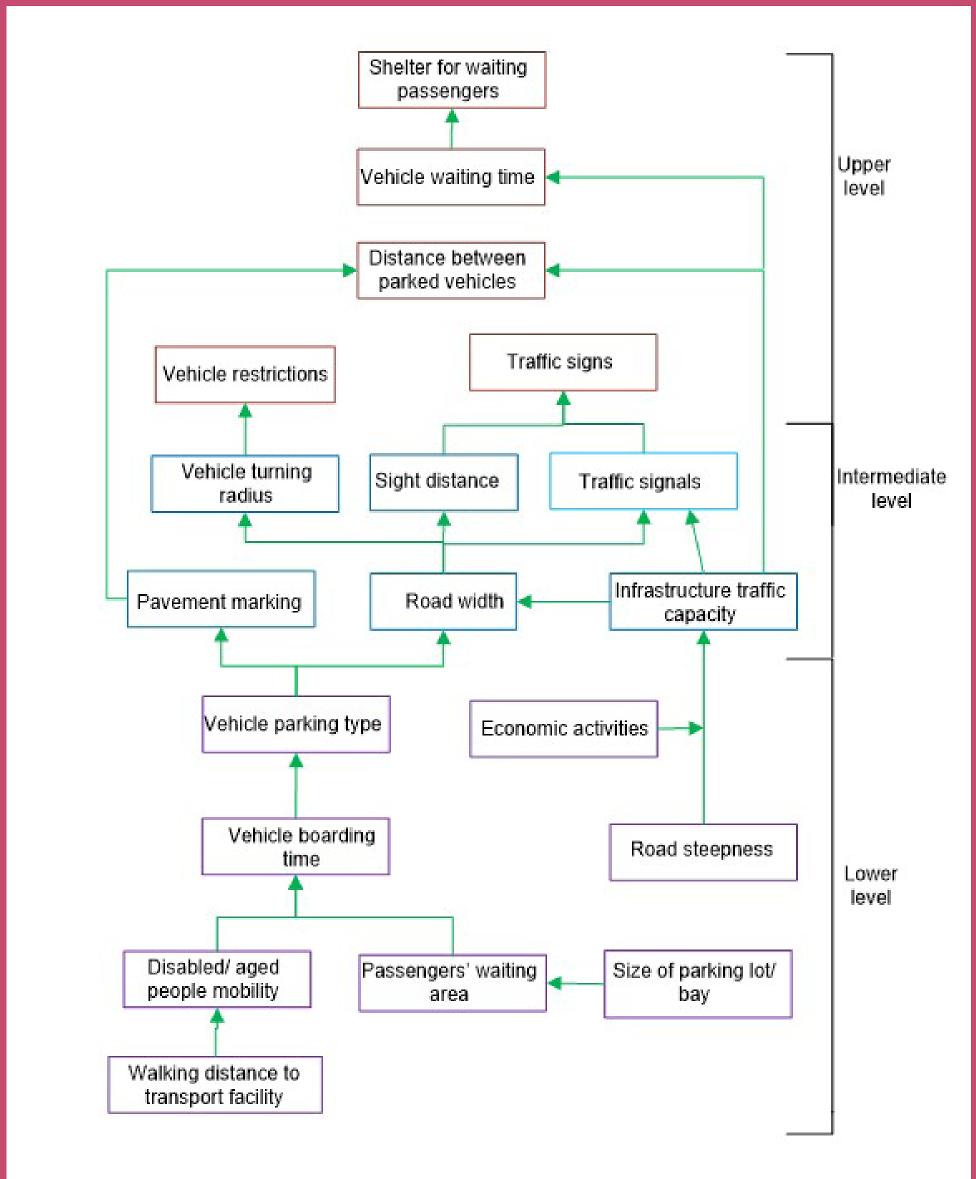
S/No	Factor	Reachability set	Antecedent set	Intersection set	Level
1	18	10, 18, 19	1, 2, 4, 7, 8, 10, 15, 16, 17, 18, 19	10, 18, 19	I
2	16	2, 4, 10, 16, 17, 18, 19	1, 2, 4, 7, 8, 10, 15, 16, 17, 19	2, 4, 10, 16, 17, 19	II
3	1	1, 2, 3, 4, 7, 10, 16, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 14, 17, 19	1, 2, 3, 4, 7, 10, 17, 19	III
4	12	1, 2, 3, 4, 5, 10, 11, 12, 14	2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15	2, 3, 4, 5, 10, 11, 12, 14	IV
5	14	1, 2, 12, 14	2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15	2, 12, 14	IV
6	5	1, 2, 3, 5, 11, 12, 14	2, 3, 5, 7, 8, 10, 11, 12	2, 3, 5, 11, 12	V
7	6	1, 2, 6, 12, 14	2, 3, 6, 7, 10, 11	2, 6	V
8	15	12, 14, 15, 16, 18	7, 10, 15	15	V
9	3	1, 2, 3, 4, 5, 6, 10, 11, 12	1, 2, 3, 4, 5, 8, 10, 11, 12, 17, 19	1, 2, 3, 4, 5, 10, 11, 12	VI
10	7	1, 4, 5, 6, 7, 10, 12, 14, 15, 16, 18, 19	1, 4, 7, 8, 10, 17, 19	1, 4, 7, 10, 19	VI
11	10	1, 3, 5, 6, 7, 10, 12, 14, 15, 16, 18, 19	1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19	1, 3, 7, 10, 12, 16, 18, 19	VI
12	11	1, 2, 3, 4, 5, 6, 10, 11, 12, 14	2, 3, 4, 5, 8, 11, 12	2, 3, 4, 5, 11, 12	VII
13	19	1, 3, 4, 7, 10, 16, 18, 19	1, 2, 4, 7, 8, 9, 10, 16, 17, 18, 19	1, 4, 7, 10, 16, 18, 19	VII
14	8	1, 3, 5, 7, 8, 10, 11, 12, 14, 16, 18, 19	8	8	VIII
15	17	1, 3, 7, 10, 16, 17, 18, 19	1, 2, 4, 9, 13, 16, 17	1, 16, 17	VIII
16	2	1, 2, 3, 4, 5, 6, 10, 11, 12, 14, 16, 17, 18, 19	1, 2, 3, 4, 5, 6, 11, 12, 14, 16	1, 2, 3, 4, 5, 6, 11, 12, 14, 16	IX
17	4	1, 2, 3, 4, 7, 10, 11, 12, 16, 17, 18, 19	1, 2, 3, 4, 7, 11, 12, 16, 19	1, 2, 3, 4, 7, 11, 12, 16, 19	IX
18	13	10, 12, 13, 14, 17	9, 13	13	IX
19	9	9, 10, 13, 14, 17, 19	9	9	X

Source: Authors' compilation (2020)

An ISM formation
The iterations from I to X gives different levels at which these planning and design factors relate in the system of public transportation infrastructure project. The level of its criticality in influencing other factors in the system as given in Table 5 is presented from the bottom to the top in Figure 1. The ISM model shows the relationship that exists between factors influencing stakeholders' perception about public transportation infrastructure. The levels are further grouped into three: the lower level, the intermediate level and the upper level. The factors at the lower level such as walking distance to transport facility, size of parking lot, road steepness, passengers waiting area, disabled/ aged people mobility facility, vehicle boarding time, vehicle parking and economic activities are very critical in planning and design of public transportation infrastructure for stakeholders' acceptance. They are most critical because, they have influence on determination of other factors in model. The intermediate level factors like infrastructure

capacity, pavement marking, and road width also influence upper factors above them as shown with arrow direction in Figure 1. The upper level factors are mostly dependent on the lower factors. These factors are sight distance, traffic signals, vehicle turning radius, vehicle restriction, traffic signal, distance between parked vehicles, vehicle waiting time and shelter for passengers. The results and findings from the ISM model and structure are further discussed in section 5.

TABLE 8
LEVEL PARTITIONING FROM ITERATION I TO ITERATION X



DISCUSSION OF FINDINGS

Public transportation infrastructure enhances public mobility for social and economic activities. The planning and design factors of public transportation infrastructure have influence on one another which builds into a system. From ISM model in Figure 1, the planning and design factors lower in the model influence those that are above them as demonstrated by the direction of arrows. This makes the factors at the bottom in the model very critical for improved stakeholders' acceptance of public transportation infrastructure project or asset.

Lower level planning and design factors

It is found from the ISM model that the walking distance to public transportation infrastructure is essential in locating a transportation infrastructure. The distance between a public transportation infrastructure and trip generation points should be as short as possible for quick access by stakeholders. Aside from the healthy stakeholders that can access public transportation infrastructure, the model shows that distance between trip generation point and the infrastructure contributes to accessibility by disabled/ aged people to access public transportation infrastructure. The provision of facilities such as ramp, hoist or elevator to support physically challenged people[32]. Boschmann and Brady[33] further pointed out that distance from public transportation infrastructure can influence provision of support to disabled people for trip. However, there are also evidence of stakeholders non-acceptance of public transportation infrastructure project as the result of its close proximity to their residents as 'not in my back yard' due to environmental factors like noise and pollution[34]. It is also critical to note that road steepness influence the level of stakeholders' perception about public transportation infrastructure for use. The grade of roadway normally affects the convenience in using the infrastructure. A road grade that is not more than 7% is more ideal for roadway and convenient for public transportation infrastructure usage and improved acceptance.

Another factor in the public transportation infrastructure planning and design that is critical for improved acceptance of the infrastructure is available economic activities. Such economic activities include shopping, businesses and public transport services. For a public transportation infrastructure to be accepted by stakeholders for use, there is expectation that such infrastructure is associated with activities that can improve livelihood and living standard of individual and households. This implies that public transportation infrastructure planning must incorporate providing shopping malls, business centers and jobs for stakeholders. The opportunity to generate income due to stakeholders demand usually draws people to carryout business activities around the infrastructure[5]. Other planning factors at the lower level of the ISM model are passengers waiting area. In every public transportation infrastructure that requires passengers to wait for vehicles to be boarded or wait for schedule time, there is need to have adequate space for intended number of passengers that might wait for continuation of trip[35]. The number of waiting passengers might be small that need small area for waiting passengers if the other factor, vehicle boarding time is scheduled for short time. The shorter vehicle boarding time mostly encourages people to use a public transportation infrastructure like the case of bus rapid transit (BRT) or intelligent transport system (ITS). The type of vehicle parking is a concern of stakeholders for efficient use of transport facility. A parallel parking for instance, can allow easy entry and exit of vehicles in a parking lot. At the lower level of planning and design factors, there are design factors that are very critical in the system and influence other planning and design factors above them.

The size of parking lot gives how the number of vehicles that can be parked in a parking lot. This can further affect the size of passengers waiting areas as waiting passengers also depend on the available vehicles to board them. Where there is no or small area for waiting passengers, the model indicate that the boarding time will be influenced by ensuring that passengers do not wait at public transport facility. In this way, the choice of vehicle parking type is made based on planned boarding time for vehicles such that the movement out of a parking. These planning and design factors at lower level of the ISM model influence the choice or determination of the factors that appear in the intermediate level.

Intermediate level planning and design factors

In the intermediate level of factors in ISM model of Figure 1, pavement marking is a planning factor in public transportation infrastructure project that guides users on the use of public transportation infrastructure to minimize conflict in mobility[36]. The pavement marking is further used to show the space within which a vehicle must park in a parking lot to allow reasonable space like minimum of 1.5m between them as a standard. It is also critical planning and design of public transportation infrastructure that infrastructure capacity is considered in decided for traffic signal. The public transportation infrastructure projects or assets with high capacity require installation of traffic signals at intersections to ensure free flow of traffic[37]. It is also important that road widths of highways or driveways in public transportation infrastructure be designed to accommodate the designed capacity of the infrastructure to ensure that there is no congestion on the road as the result of inadequate number of lanes. Krishnamurthy and Thamizh[38] however state that road width and design speed of highway are the determinant factors of transportation infrastructure capacity. The model indicates that road width is critical in design due to its influence on other design factors such as sight distance, vehicle turning radius and traffic signals. The design process with increasing road width provides more area for increased turning radius for improved effectiveness on drivers or operators on a roadway. It is also indicated that sight distance is influenced by the width of a road due to the fact that some roadways are built within side walls. Such walls serve as obstacle to long sight distance. Moreso, road width, sight distance and transportation infrastructure capacity as independent factors are evaluated in the entirety of the infrastructure system to assess the importance of traffic signals at an intersection

The upper level planning and design factors

The various planning and design factors at the upper level in the model are planning oriented. These factors do not influence the choice or characteristics of other factors but are influenced by other planning and design factors from the lower and intermediate levels. These public transportation infrastructure planning factors include vehicle restrictions, traffic signs, distance between parked vehicles, vehicle waiting time and shelter for waiting passengers. The need for these factors is determined which must be carefully planned or designed for effective service delivery of a public transportation infrastructure.

CONCLUSION AND FURTHER RESEARCH

Transportation infrastructure has been a critical platform which facilitates efficient and effective social and economic activities. Its provision further strengthens the transportation services of a nation. Therefore, transportation infrastructure projects are key contributors to national development and gross domestic product. It is however, found from the literature that transportation infrastructure projects delivery is influenced be some factors which cause success or failure. Some of those factors are available funds, accessibility, affordability of services, planning, design, stakeholders' management, trust, transparency, cost, time and benefit-cost ratio. All these factors including stakeholders' management are managed by stakeholders. The success of transportation projects delivery is found to be associated with stakeholders' perception about it. The perception about transportation infrastructure projects have influence on stakeholders' acceptance that may result to succeeded or failed projects. In order to improve on managing stakeholders and their perception, such factors which are planning and design related that influence their perception are identified from the literature.

The identified factors from the literature are used to design a questionnaire and stakeholders' opinions on their perception is sought using stakeholders' survey. In order to understand how the individual factors do influence the entire transportation project for stakeholders' acceptance or non-acceptance, this study has used an ISM model to model the relationship between the factors. The modeled relationship shows that the location of transportation from residences and places of economic and social activities, the economic activities around the project, the transportation infrastructure capacity, the roadway grade and parking lot size have influence on other factors in the model. Therefore, their characteristics must be properly planned and designed due to their critical influence in transportation infrastructure project. It is also noted from the model that factors in the intermediate level like road width, vehicle turning radius, and pavement markings are critical for stakeholders' acceptance.

Based on the results and findings, it is therefore recommended from the study that the lower level planning and design factors from the ISM model can be further tested for their influence in the relationship of planning and design factors. This will be done using different transportation infrastructure projects and in other contexts.

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