

# THE IMPACT OF HUMAN-CENTRIC PUBLIC TRANSPORT DESIGN PRINCIPLES ON THE DESIRABILITY AND OPERATIONAL SUCCESS OF PUBLIC TRANSPORT IN THE GAUTENG PROVINCE

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## ABSTRACT

Commuters in South Africa rely on a variety of public transport (PT) modes every day to access various social and economic opportunities like the workplace, academic institutions, and healthcare. However, captive, reliant commuters are disappointed on countless occasions by unsafe, unreliable transport services and feel transport authorities and modal operators remain indifferent towards their needs and complaints, as solutions being implemented fail to address the actual problems needing attention and commuters are not consulted during PT service design. There exists a need to permanently close this negative cycle by ethically providing for the travel demands of captive lower-income commuters and establish a transport culture based in making human needs the centre of design thinking.

This research paper describes an investigation into whether the inclusion of human-centric design (HCD) in the service- and operational design of PT in the Gauteng Province (GP) of South Africa, would establish a customer-orientated transport culture, and whether more human-centric transport service provision would appeal to commuters and address their specific travel needs and desires. This includes investigating how the priorities of transport institutions can be aligned with the core needs and desires of the commuters they serve, so a harmonious yet practical relationship can be cultivated between these stakeholders.

Devised from primary research and global literature findings, the study tested five principles that combine principles of HCD and PT that were validated by a sample of 300 Gauteng commuters. The findings show that for PT services to be supported, successful and harmonised in Gauteng, the following is necessary: authentic, collaborative stakeholder consultation between leaders, designers and commuters; integrated PT control centres; practical empathy for commuters; centralising human needs, desires, and feedback in the PT design process, and enhancing a commuter's perception and perceived value of a PT service. These principles can be used in the PT design process to promote elevated customer satisfaction, desirability to use PT and, in turn, the operational success of Gauteng's PT services.

## 1. INTRODUCTION

South African commuters rely on public transport (PT) services to access various social and economic opportunities such as the workplace, access to education, and healthcare

(Mthimkulu, 2015). PT services in South Africa were originally designed to provide transport for labourers from suburbs and low-income settlements on the peripheral of towns and cities to workplaces situated in central areas (Khosa, 1995; Lombard & Coetzer, 2007). However, the goal of safe, reliable, and affordable travel services as stipulated in the 1996 White Paper on Transport has not yet been achieved (Lombard & Hugo, 2002). Promising strategies have been introduced by the Department of Transport to create a cohesive, inclusive transport system, yet these strategies and plans are often not implemented due to financial or political reasons (Thomas, 2016; Mabhena, 2019). The potential of South Africa's developing PT system thus remains diluted by a lack of leadership, given that political will is often out of harmony with what is required from transport policies and plans (Mthimkulu, 2015).

Captive, reliant commuters are disappointed by unsafe, unreliable transport services and feel transport authorities and modal operators remain indifferent towards their needs and complaints (Lombard & Hugo, 2002). It seems the faith that commuters have in their government's capabilities has deteriorated over the years, leading many unsatisfied commuters to express their frustration in transport infrastructure locations to make their voices heard (Khosa, 1995). South African commuters have also resorted to behaving vindictively by destroying valuable transport infrastructure (Mabhena, 2019). Seeing as no other viable travel alternatives are available, commuters' lack of loyalty to PT services has resulted in an over-dependency on private transportation that densifies road congestion and leads to unacceptably high road accident rates (Mthimkulu, 2015; Banister, 2005; Říha & Tichý, 2015); carbon emissions and the deterioration of the roads pose further environmental and financial risks (Banister, 2005; Gnap et al., 2006).

Such disrespect and conflict have also manifested in the behaviour of transport service operators like minibus taxis (MBTs), who seem to focus on maintaining ownership over a selected group of reliant passengers and maximising their earnings (Shaw, 2006; Lombard & Hugo, 2002), when in fact the needs of their dependent passengers should be prioritised. Furthermore, control over modal competition has not been properly regulated (Shaw, 2006), so decisions to maximise customer turnover are often made at the expense of modes in the network (Fourie, 2005; Walters, 2014; Mthimkulu, 2015). This undermines the unique contribution of each mode in the network and the specific role they have been assigned to play (Department of Transport, 1998), in turn affecting the balance of modes in the PT system and the distribution of passengers and earnings (Mthimkulu, 2015).

## **2. PROBLEM STATEMENT**

The consequences of a lack of modal integration continue to challenge the incorporation of viable transport plans (Shaw, 2006). These underlying issues continue to limit the capabilities of the desired collaborative, seamless PT system whom so many South Africans rely on to earn an income. As a result, South Africa's PT system is falling short of performing as it is required to fulfil the travel needs of their customer base, likely because customer service has not been prioritised by transport leaders (Lombard & Coetzer, 2007).

## **3. RESEARCH RATIONALE**

This study explores whether increased utilisation of Human-Centric Design (HCD) in Gauteng's PT design would be capable of establishing such a transport culture, investigating whether more human-centric transport service provision would appeal to commuters and address their travel needs and desires. The study aimed to test and offer five human-centric PT design (HCPTD) principles that can be used in the PT design

process to promote elevated customer satisfaction and the desirability to use PT in the Gauteng Province (GP) of South Africa, based on primary research- and global literature findings.

## **4. LITERATURE REVIEW**

### 4.1 Study Constructs

#### *4.1.1 Human-Centric Design (HCD)*

HCD thinking is an innovative process of problem solving that begins with understanding the perspective and central needs of those who are faced with a problem, and designing a product, service and/or system tailor-fitted to meet those needs (Design Kit, 2021; DC Design, 2017). Since these ideas are inspired by real people using the product or service, those who face a problem become an integral part of the design team, assessing whether the solution offered satisfies their stated needs (Thomsen, 2018; DC Design, 2017). The HCD process is thus driven by the needs and aims of the person using the proposed product or service instead of the organisation's goals, integrating these needs into the functionality and interface of the product or service (Norman & Draper, 1986; Rogers et al., 2015).

#### *4.1.2 Public Transport (PT)*

"Public transport" is defined as any local means of passenger transportation available to transport users, where service providers are paid for offering a travel service (Kitchin & Thrift, 2009). These services allow a greater number of passengers to be transported at once along specified travel routes, either operating on chosen time intervals or based on when the vehicle is at full capacity (Conserve Energy Future, 2021).

### 4.2 Public Transport Status in South Africa

Indications are that current policies and strategies relating to PT in South Africa need e-evaluation (Pillay, 2001). Instead of designing and implementing a whole new system, it is important to rediscover the elements of the existing system that are functioning effectively and find out what opportunities they hold for economic growth and sustainable transport practise (Mthimkulu, 2017). The priority of PT development should be aimed at encouraging strong leadership and active citizenry to strengthen commuter's accountability, thus uniting citizens around a common programme and boosting economic growth and subsequent investments (Schoeman, 2014). Initiatives, regulations, and policies to improve PT service quality in South Africa are often introduced, but not carried out. This is often due to a lack of leadership to support the system's growth and drive the project to completion (Poliak et al., 2017), limiting the objective of integrating these transport systems (Department of Transport, 2021; Turok & Watson, 2001). Therefore, it may be simpler for cities to undergo trials to evaluate the effectiveness of their plans or apply changes suggested by new policies in an incremental way (Mitchell et al., 2016; Shaw, 2006). Incremental PT development should be focussed on high-demand corridors that influence high passenger volumes (Shaw, 2006).

### 4.3 Modal Competition

Regulative authorities are concerned that harmful competitive practises may result when introducing competition to a network, as a risk of losing control of the system exists (Van de Velde & Sleuwagen, 1997). The functioning and overgrowth of the MBT industry illustrates this concern perfectly in the South African context, functioning as an informal PT

mode that does not follow timetables, rapidly adapts to commuter demands (Khosa, 1998) and relies heavily on government transport subsidies (Fourie, 2005). Importantly, only cities practising proper control over the enforcement and regulation of transport service operators have found success in transport infrastructure upgrades. The South African government's inability to effectively regulate the detrimental competitive practices of these informal modes has been a reason why South Africa has struggled to develop PT systems and encourage increased ridership (Shaw, 2006).

#### 4.4 Criteria for a Human-Centric Transport Environment

##### *4.4.1 Solutions to Mobility Issues*

Sustainable transport systems and smart cities can be created by promoting transparency and knowledge sharing amongst transport stakeholders, to generate fresh ideas as solutions to existing issues (Lara et al., 2016). Various transport functions should be operated more commercially as opposed to a governmental social service, so that private companies can manage modes more effectively as a commercial product and thus allow a constructive competitive market to form (Khosa, 2001).

##### *4.4.2 Shifting to Human-Centric Design*

Decision-making in transport provision is becoming oriented around the needs, perception, consultation, and satisfaction of passengers (Mitchell et al., 2016; Ko & Stewart, 2002), focusing more on a commuter's basic desire to travel from one destination to the other in the most seamless, affordable way (Mitchell et al., 2016). Transport operators are starting to utilise the potential of HCD in PT to develop products that make commuter interactions and journeys more streamlined, accepting that research in the field of transportation design is vital to enhance a commuter's travel experience (Innovation Team, 2015; Cohen et al., 2017). Mitchell et al. (2016) shed light on this user-centric transport nature by using the term *human-centred mobility*, which places the user at the centre of design thinking and aims to benefit both passengers and operators with the provision of organised, durable transportation strategies. The authors believe a high-quality human-centred mobility system is characterised by centralising the user during design, being system agnostic (allowing swift transfer between different travel modes) and being accessible to support a thriving, evolving city. Furthermore, these systems enable seamless, door-to-door trips via integrated ticketing systems and real-time travel information (Mitchell et al., 2016).

##### *4.4.3 Smart City Characteristics*

The "human infrastructure" domain of a smart city can be enhanced by involving citizens in the joint design and implementation of services within the city, encouraging and allowing citizens to participate in the construction of infrastructure while gathering and utilising regular feedback on its effectiveness in meeting their needs (Rizzo et al., 2013). The concept of smart cities thus aligns well with the human-centric nature of this study (Design Kit, 2021; DC Design, 2017; Thomsen, 2018). To establish such a level of connection between citizens and their city, leaders must discover ways to connect with people such that they create a shared vision for the city they wish to live in (Lara et al., 2016) and encourage a lifestyle that aligns with the values and culture of its people (Ballas, 2013). To make a city and community "smart", all initiatives must comprise of an iterative, user-centric process where the community is involved in design and development (Lara et al., 2016), and all innovative solutions (including technology, infrastructure and transportation) are offered with the central goal of serving the needs of the city and its people. This will ensure the city is both highly independent and economically sustainable (Yigitcanlar et al., 2014).

## 5. METHODOLOGY

### 5.1 Research Design

A sequential exploratory strategy, mixed-methods approach with a quantitative weighting and an embedded mixing approach was selected for this study. Therein, qualitative data is gathered and processed in Phase 1, and quantitative data is collected and analysed in Phase 2 to reinforce and interpolate these initial findings. Numerical data is thus used to interpret the initial narrative findings (Creswell, 2009). Data sets are mixed in the discussion section of the study, where the implications of these findings on the research questions, research objectives and topic of interest are considered. Thus, separate data sets are not mixed or integrated in any way, but merely used to enhance and support one another's findings (Terrell, 2012; Creswell, 2009; Mertens, 2003).

### 5.2 Sampling - Design, Size and Criteria

Both qualitative and quantitative data was collected from PT- and HCD experts, as well as commuters, in the GP of South Africa.

#### *5.2.1 Phase 1 - Expert Interviews*

During the first qualitative research phase, experts were interviewed to gain deeper insight into the strategic focus of Gauteng service provision, and whether the inclusion of HCD measures in Gauteng PT design would satisfy customers and improve the desirability and quality of these services. A sample size of six experts (three HCD- and three PT experts) was decided upon for Phase 1 (Creswell, 2009; Saunders, 2012).

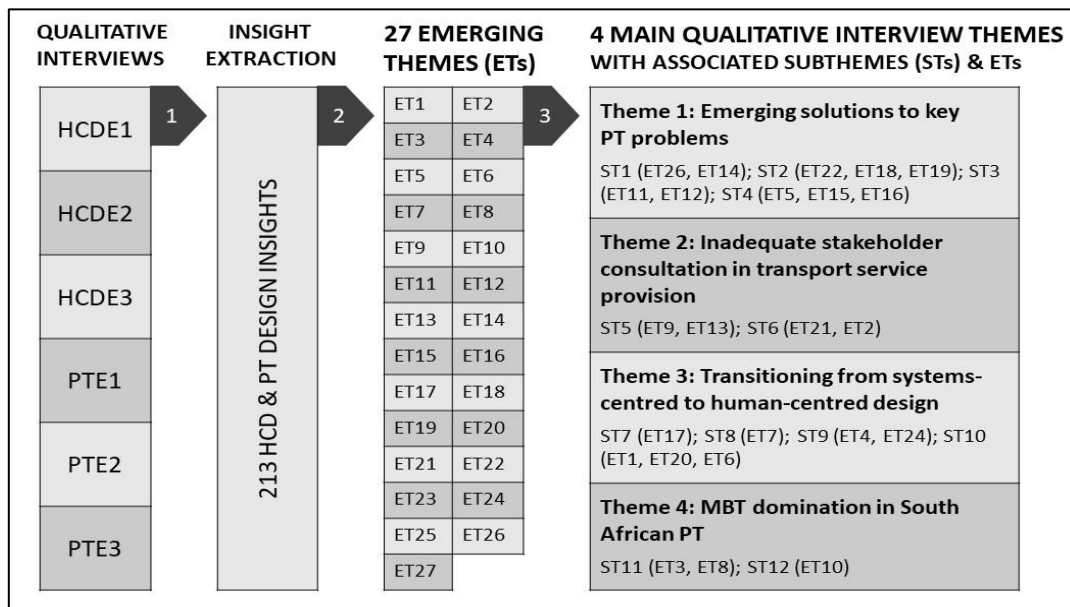
Candidates in Phase 1's qualitative interviews required at least three- or five years' working experience in the field of HCD or Transportation Engineering, respectively, while PT experts were required to possess a strategic position in their respective department, and be working in a Gauteng transport municipality project as these work in parallel with national transport plans (Department of Transport, 1996).

#### *5.2.2 Phase 2 - Commuter Surveys*

The goal of the second research phase was to test the applicability of the insights gained in Phase 1 with Gauteng PT users, to investigate how commuters would respond to more human-centric service provision and whether it would be capable of fulfilling their core needs and desires. A combination of a purposive- and convenience sampling technique was selected for this research phase. While a sample size of 382 surveys was determined for Phase 2 using an equation provided by Etikan and Babatope (2019), a sample size of 300 surveys was set due to the limited resources (time, finances and transportation) available during data collection and the limitations imposed by the COVID-19 pandemic. Commuters in Phase 2 were required to have made use of any Gauteng PT service (trains, buses or taxis) since the beginning of 2018, as figures from the 2018 General Household Survey (GHS) were used to determine the sample size for this research phase. This ensured commuters' familiarity and experience with these services aligned accurately with the data from this year. All candidates were required to be adults over the age of 18 years and were not permitted to have a personal stake in promoting a particular PT mode, thus carrying a clear potential bias and favouring one mode over another (STATS SA, 2018).

### 5.3 Data Collection and Analysis

A total of six semi-structured qualitative interviews were conducted and transcribed. A qualitative thematic content analysis of these transcriptions then took place, in which insights were extracted from the interviews and coded with the expert code and insight number. For example, “HCDE1:17” means the seventh insight obtained from HCD Expert 1. As illustrated in Figure 1, 213 insights were sorted into 27 emerging themes (ETs), and then organised into twelve subthemes (STs) and further into four main qualitative interview themes.



**Figure 1: Summary of Phase 1 qualitative thematic analysis**

These four main themes were developed using the contexts of qualitative interview data that was analysed. A list of 15 initial principles (7 HCD and 8 PT) were then defined by combining literature-based principles (relating to either study construct) with the themed contexts of the qualitative STs. These initial principles are summarised in Table 1.

**Table 1: Initial HCD - and PT principles**

Initial HCD Principles	Initial PT Principles
1) Never assume	1) Prioritise safe, reliable and affordable transport services
2) Consider the entire ecosystem	2) Provide access to as many commuters as possible to use PT services
3) Centralise people’s needs, desires and feedback in the design process	3) Convenience: connectivity, ease of transfers and ease of interoperability
4) Practical empathy	4) Prioritise network integration
5) Enhance a commuter’s perceived value when designing	5) Aligning institutional priorities with PT development
6) Collaboration and consultation with stakeholders	6) Developing local management structures for PT operations
7) People-centred development	7) Define the roles and function of every mode
	8) Promote collaboration and interaction between various stakeholders

Each of these initial principles were tested during the second, quantitative research phase, with the aim of quantifying which principles were most applicable to Gauteng’s local transport context. After conducting two pilot studies of five responses each, a two-paged laminated survey sheet comprising of 24 questions overall was designed to test each one of the 15 initial principles, using a 5-point Likert scale to rate quantifiable responses, and posing a few open-ended questions. A total of 316 survey responses were gathered from Gauteng commuters using both digital (8 responses) and in-person (308 responses) data collection means. The data for all 308 survey responses was inputted into a MS Excel™ template and the applicability of each initial principle was tested using a weighting comparison percentage score (WCPS) – a ratio between the total weighted score for each principle (i.e., strongly disagree = -2 to strongly agree = 2) and the maximum weighted score that *could* have emerged from each principle. The calculations to determine each initial principle’s WCPS can be made available upon request.

## 6. FINDINGS, RESULTS AND DISCUSSION

### 6.1 Correlation Analysis Results

A correlation analysis was done to determine the correlation between the presence of HCD measures in Gauteng PT (**Variable A**) and commuters’ satisfaction with and desirability for these PT services (**Variable B**) as a foundation for the study’s discussion. Questions relating to either variable were matched together appropriately, and their overall weighting scores used, to create a series of 13 datapoints for this analysis as shown in Figure 2. This yielded an  $r^2$ -value of 0.965 and thus a Pearson Correlation Coefficient of  $r = 0.982$ . Notably, this value resulted even with the inclusion of outlier questions. This strong positive correlation implies that the presence of HCD measures in Gauteng PT services are 98.2% correlated to commuter satisfaction with PT service use (Bold, 2001; Leedy & Ormrod, 2005; Cooper & Schindler, 2001). For this reason, it can be concluded that including more HCD measures in Gauteng’s PT services will indeed result in increased commuter satisfaction and desire to use these services, in turn ultimately improving the operational success of these services.

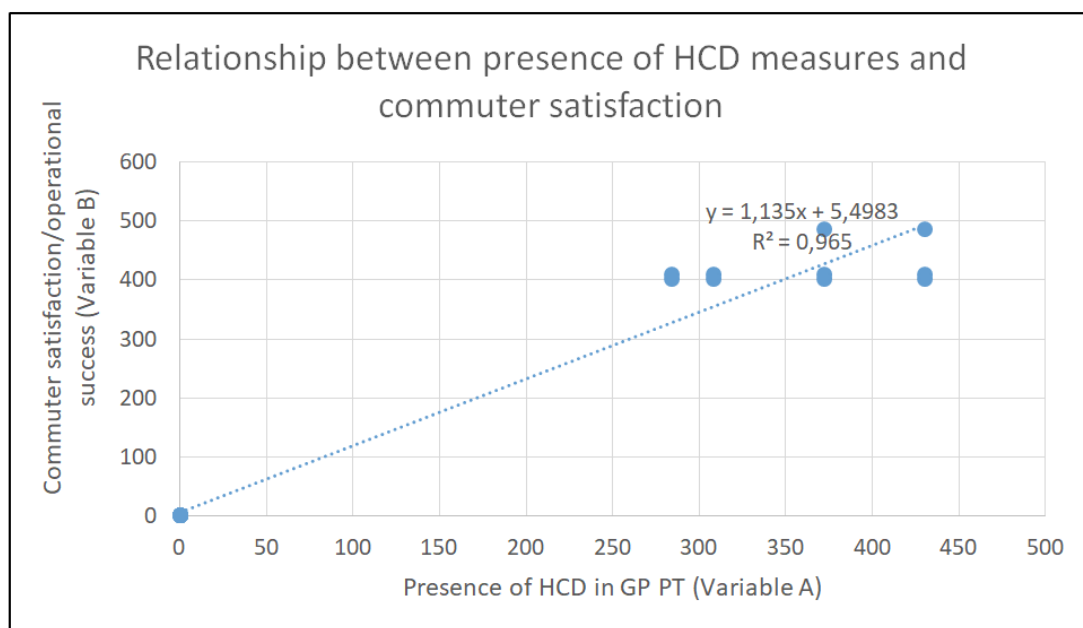


Figure 2: The correlation between Variable A and Variable B in Phase 2’s quantitative analysis

## 6.2 Discussion of Selected Initial Principles

Five initial HCD- and PT design principles, respectively, were selected based on their resulting WCPS scores and discussions on their applicability, considering the quantitative survey data collected. Not all principles could produce a WCPS, as some were tested by survey questions which did not have a Likert scale. As such, their applicability was discussed instead of quantified. Three initial HCD- and PT principles each with relevant, controversial topics were selected for an in-depth discussion on their applicability in the GP.

*6.2.1 Initial HCD Principle 5 - Enhance a Commuter's Perceived Value When Designing*  
HCDE1 stated that value is equal to desire (HCDE1:120), and in order to understand how much a person values something, understanding a person's perception thereof is essential (HCDE1:15). Commuter perceptions were tested using emotive responses to certain survey questions (SQs), assuming that perception is equal to how people feel. SQs 4 to 6 tested this initial principle. While no WCPS score emerged for this initial principle, an overall weighting score of **-45** was observed for Question 4 when commuters were asked how they feel about their PT service. The negative value indicates the sample generally had a negative feeling towards their PT service, meaning their **perception** thereof is also negative. Interestingly, an overall weighting score of **-40** was observed for Question 5, indicating that Gauteng PT users generally *do not* enjoy their PT service; here, enjoyment was related to **desire**. In Question 6, an overall weighting score of **-108** emerged, suggesting that commuters generally *would not* pay more for their PT service if it became more expensive, linking to the **value** they place on the service. The survey data thus illustrates a strong correlation between perception and desire, showing that those who had a negative perception of their service (-45) desired (or enjoyed) it less (-40), and were definitely not willing to pay more for it if it became more expensive (-108). Given all three weighting scores for these questions were well below 0, the following relationship can be expressed:

$$\text{Perception (emotion)} \propto \text{Desire (enjoyment)} \propto \text{Value (willingness to pay)}$$

As such, making an "investment in infrastructure that recognises human desires" (HCDE3:124) may in fact offer transport businesses the increased patronage and growth they desire (HCDE1:120). Thus, Gauteng commuters agree that they would look after their PT services better and be willing to pay more for them if the service is perceived as more valuable (HCDE1:128). If services operate and comply with passenger needs, then they "will be successful moving forward", as commuters will then perceive the service as more valuable and be prepared to pay more to use that service (PTE3:127). Eighteen participants declared they had no other option than to pay more if their PT service became more expensive, stating that they have no other transport alternatives and need to live with fare increases. These comments strongly suggest that these users are held captive to the service they are using and had no other option but to pay more if a PT service became more expensive. This suggests a relatively poor perception and desire for these services, and thus a significant resistance to pay more if the service becomes more expensive.

### *6.2.2 Initial HCD Principle 3 - Centralise People's Needs, Desires and Feedback in the Design Process*

SQs 13, 16, 18, 19, 20 and 22 tested the applicability of this initial principle, producing **WCPS<sub>average</sub> = 58.6%**, revealing that most of Gauteng's commuters support the applicability of this initial principle and would like their needs, desires and feedback to be centralised and prioritised in the PT design process. This could also indicate that the poor



quality and reliability of South Africa's infrastructure is a result of a lack of human-centric service delivery (HCDE1:16) and that increased human-centric service delivery in their PT services would improve the quality and reliability of these services. Being heard and considered during the PT design process supports the notion of human-centred mobility (Mitchell et al., 2016) and the smart city concept (Ballas, 2013) – the foundation of which is human-centric service delivery in the GP. This offers the GP the associated benefits of human-centred mobility and smart city design, including swift transfers between different travel modes, seamless door-to-door trips via integrated ticketing systems and real-time travel information, a highly independent and economically sustainability city (Yigitcanlar et al., 2014) and an overall positive transformation in the way a city operates as a collective whole (Lara et al., 2016).

#### *6.2.3 Initial HCD Principle 6 - Collaboration and Consultation with Stakeholders*

SQs 12, 13, 22 and 23 tested the applicability of this initial principle, producing **WCPS<sub>average</sub> = 58.3%**. As such, the bulk of Gauteng's commuters support this principle and HCDE2's view that incorporating authentic, collaborative stakeholder consultation into South Africa's PT design model is one means of enhancing customer satisfaction in South African transportation (HCDE2:142). This strong weighting score also indicates that Gauteng commuters want to be involved in the PT design from its onset (PTE3:137; Herriott, 2011) and want to be consulted throughout a PT design process (HCDE2:112). As such, the provision of negotiating forums (where authorities and commuters can have a regular engagement) (HCDE2:110) is also supported by Gauteng commuters, in addition to building stakeholder consultation into the PT design model (HCDE2:142). Regularly consulting civilians during PT design contributes to making a city and community "smart", requiring that initiatives comprise of an iterative, user-centric process where the community is involved in design and development (Lara et al., 2016) and citizens are encouraged to participate in the joint design of infrastructure and services within the city. Meanwhile, feedback on its effectiveness in meeting their needs is iteratively gathered and utilised (Rizzo et al., 2013). Lara et al. (2016) asserts the importance of citizens and institutions knowledgeable of the city's history, culture and probable future working together to design for its unique characteristics. The "special purpose transport agency" mentioned Mostert (2011) could lead such interactions, facilitating regular stakeholder consultation sessions grounded in their holistic perspective on local PT services.

#### *6.2.4 Initial PT Principle 5: Aligning Institutional Priorities with PT Development*

SQs 14 and 16 tested the applicability of this initial principle. Omitting the weighting score of Question 14, a value of **WCPS<sub>16</sub> = 38.61%** was observed. While this may be a low weighting score, the findings of Question 16 are strongly supported by literature as well as the views of experts interviewed in Phase 1. Additionally, **218** participants (69%) agreed that "some transport decisions are based on politics instead of what people [being citizens or commuters] might want", indicating that most Gauteng commuters feel politics are prioritised above their needs as a customer; one participant even declared that "everything is about politics!". Moreover, nearly a **third** (32%) of the sample say transport officials do not make an effort to understand their travel needs and how they can help them. Considering these concerns and the extensive concerns shown in literature regarding impure, selfish motives of South African transport leaders, initial PT Principle 5 provides an antidote to this context, encouraging transport institutions and leaders to align their plans and priorities with the PT development truly desired by commuters. Moreover, in context of the above-mentioned HCD principles, the Principle proposes collaboration amongst transport leaders to harmonise their collective policies, plans and focus to serve the transport needs of local commuters, and offer real, meaningful PT development that customers desire and approve of.

In Question 14, over a quarter of the sample disagree that transport officials try to understand their travel needs and how they can help them (32%), while half the sample (47.1%) agreed. Because these responses were evenly spread, providing accurate, reliable insights from Question 14's findings does not seem plausible, as the results would not be representative of the sample. The findings of Question 16 align well with the view of PTE3, explaining that "commuter operation is a political problem", as the "commuter is politically very sensitive and abused by individuals in communities" (PTE3:15).

HCDE2 explains that municipalities effectively applying public consultation "don't always last that long" due to the ulterior motives, differing priorities, and selfish political agendas of those who come into power at that time (HCDE2:124), believing the "mindset changes of people in power" is a key issue that is going to come to light (HCDE2:140). HCDE1 supports this view, claiming that service providers are going about design thinking in the wrong way and only focussing on achieving organisational goals instead of asking how the design process itself can be optimised (HCDE1:123). Overall, the term "political will" appeared three times in Phase 1, illustrating awareness on the part of experts that political will and leadership is central to developing South Africa's PT system. In support, both PTE2 and PTE3 claim that political will is the primary means of addressing unmet commuter needs in South Africa (PTE2:18), being one of the main reasons for limited growth and development of South Africa's PT system (PTE3:112). Therefore, the experts interviewed in Phase 1 made it clear that political gain resulting from PT development is often prioritised over providing commuters with a good PT service. Given the views of South African experts, one could ask whether the South African government prioritises the development of its PT system to serve *commuters*, or if PT is only developed to serve their own political agendas.

In context of the Gautrain™ project, the only reason its fundamentally flawed plans went ahead is because the government at the time desired to leave behind a legacy, this while the need to provide safer, more reliable transport to dependent citizens was a far greater national priority (Thomas, 2016). Furthermore, a lack of strong, synergistic and holistic leadership is the primary reason behind the lack of modal integration, policy/plan implementation and meeting commuter needs in South Africa (Van der Westhuizen, 2007; Mostert, 2011; Poliak et al., 2017; Land Transport Authority, 1996; PTE3:112). Effective, well-operated PT systems can be offered only once the political will of government officials and national leaders is aligned with suggested plans and policies (Mthimkulu, 2017).

It must be noted that almost **half** the sample (47.1%) believe Gauteng transport officials *do* try to understand their travel needs and how they can help them. This is a fascinating anomaly, as 69% of the sample conversely believe that some transport decisions are based on politics instead of what people might want. On the one hand, most of the sample aren't educated and may just be novices at being polled; this is also a unique type of study that has just scratched the surface of quantifying average commuter perceptions of PT services. On the other hand, this anomaly poses the question, "From where these perceptions originate?". Either Gauteng transport authorities are satisfying their commuters, or the sample isn't willing to speak out against the government. Considering this and the fact that only one survey question was used to assess this initial principle, this topic warrants further qualitative investigation and explanation to understand what is influencing commuter perceptions and gather greater context and clarity on the applicability of this principle.

### 6.2.5 Initial PT Principle 6: Developing Local Management Structures for PT Operations

SQs 18 - 20 produced **WCPS<sub>average</sub> = 63.9%**, implying far over half the sample found this principle perfectly applicable and approve of the integrated PT control centre proposed by PTE3. Nearly 64% of Gauteng's commuters would like local management structures for PT operations to be established on a regional and municipal level, as it would have the potential to inform them of late arrivals (Question 18), give them the option to select another travel mode if their service is running unsatisfactorily late (Question 19) and allow any report, query or form of self-expression regarding their PT service quality to be posted on the proposed application (Question 20). The proposed application can be used as means to maintain constant communication between the users and control centre, which monitors, manages and communicates with all PT vehicles in the network (PTE3:I39). However, for the purpose of such an application to be even conceivable, PT operations must be first be managed by local transport authorities on a regional, municipal level to create a foundation for local network efficiency, development and management (PTE3:I39).

Scholars strongly support the instantiation of local, regional transport authorities, explaining that these regional structures are imperative (Colin Buchanan & Partners, 2003; ECMT, 2002) for allowing operator behaviour to be managed at a city level (ITDP, 2004). This requires a pro-active approach for local governments to intervene in the provision of infrastructure, regulate private operators, and monitor service provision (Shaw, 2006). Executive power to manage a competitive transport environment must also be assigned to local authorities (Chen et al., 2016), while the instantiation of a special purpose transport agency must monitor and manage the movement of all formal transport service operators (Mostert, 2011). PTE2 support the latter view, believing that setting up a "transport authority that's independent of the government changes" is one way of countering fragmented transport provision (PTE2:I9). South Africa can achieve the same level of inclusive transport management as developed countries by establishing local transport authorities as greater means of modal support and regulation, allowing transport operations to be coordinated locally so the travel needs of citizens can be met more specifically (Thomas, 2016). One solution to this is the instantiation of the integrated PT control centre on a municipal level, linked to an integrated PT application which enables direct, real-time communication between customers and service providers regarding trips, locations and available trips, as well as real-time recommendations and decision-making in the event of late arrivals. Herein, busses and MBTs feed into the rail feeder service, and timings between the rail and feeder services are synchronised.

### 6.2.6 Initial PT Principle 8 – Promote Collaboration and Interaction Between Various Stakeholders

SQs 12, 13, 22 and 23 were used to test the applicability of this initial principle amongst Gauteng commuters, producing **WCPS<sub>average</sub> = 58.3%**. These findings demonstrate that most of Gauteng's commuters would like to be involved in the PT design process through regular public stakeholder consultation (HCDE2:I42) and monthly negotiating forums (HCDE2:I32), while being able to express their concerns and needs to human-centric professionals on a PT design team (PTE2:I26). In Question 12, most of the sample (79.9%) agreed that they would like the opportunity to give their ideas and create the transport service they use, while in Question 13, over three-quarters (82.9%) of the sample agreed that they would be more interested in using PT if their inputs were used to improve the service they use. These findings clearly illustrate that Gauteng commuters *want* to be included in the design of PT services and offer their ideas and feedback, thus supporting HCDE2's view that elevated customer satisfaction in South African transport can be offered by building in stakeholder's consultation into the PT design model (HCDE2:I42).

These findings also support the view that authorities should “set up negotiating forums, some sort of space where the authorities and the people they are making decisions on behalf of have a regular engagement” (HCDE2:I32), linking to the context of initial HCD Principle 6.

In Question 22, most of the sample (84.5%) responded positively to the idea of transport officials making a regular effort to understand their travel needs and how they can help them. Moreover, in Question 23, 81.3% of the sample responded positively to transport officials involving them when creating a PT service. As such, the sample responded positively to the concept of monthly negotiating forums (HCDE2:I32), stakeholder consultation in the PT design model (HCDE2:I42) and being able to express themselves to a human-centric professional that is trained to understand customer needs and address them (PTE2:I26).

Literature supports the benefits of public consultation in a PT design process, allowing cities to reach smart city standards by working together with citizens and institutions knowledgeable of the history, culture and probable future of the city (Lara et al., 2016) and involving citizens in the joint design and implementation of services within the city. This encourages citizens to participate in the construction of infrastructure while gathering and utilising continual feedback on its effectiveness in meeting their needs (Rizzo, et al. 2013). A city and community can only be “smart” when all initiatives involve an iterative, user-centric process where the community is involved in design and development (Lara et al., 2016). Thus, literature- and expert insights assert that incorporating stakeholder consultation into South Africa’s PT model is crucial for its current development, allowing a spectrum of different stakeholders to contribute their unique perspectives to designing a PT system with the central goal of serving the needs of the city and its people (Pillay, 2001; Zellner, 2008; Yigitcanlar et al., 2014; PTE2:I26; HCDE2:I32; HCDE2:I42).

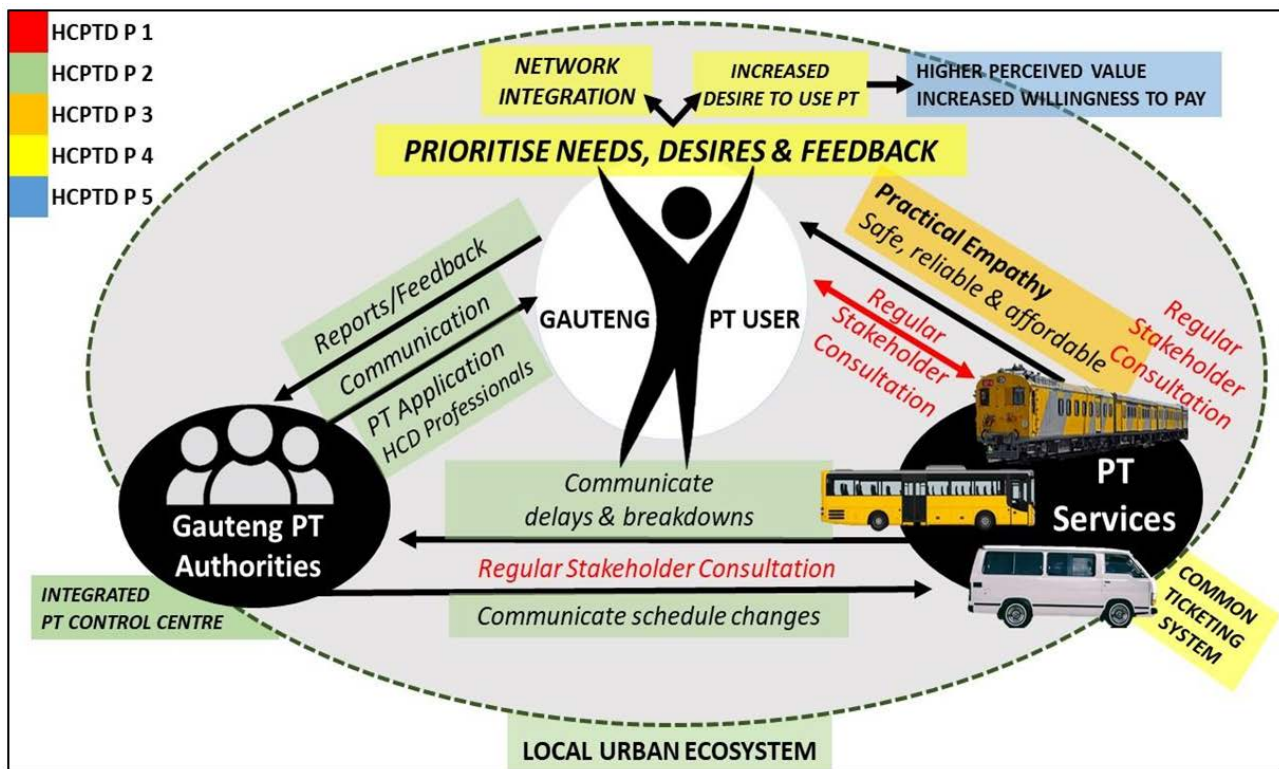
### 6.3 Minibus Taxi Industry Discussion

Both Gauteng experts and global literature have stressed the importance of addressing MBT violence and lack of regulation, due to the way it adversely affects the health and development of Gauteng’s PT system. As such, proper enforcement and regulation of the MBT industry is necessary in the GP in order for its PT systems to become more developed and promote modal network integration. By resolving issues relating to the MBT industry, HCDE2 believes the demand for transport can be “more freely distributed across the different kinds of transport”, likely offering a change in the transport system where “taxis have a different role” to play. This type of balance can only be created through negotiations between the different transport parties (HCDE2:I43). Thus, one primary way of addressing the MBT issue is effectively applying HCPTD Principle 1 to Gauteng’s transport context. PTE3 says that the taxi industry needs more exposure, training and understanding of business moving forward to form part of the upcoming integrated PT system (PTE3:I19). Question 8’s findings show that 13.6% of the sample requested better customer service, asking taxi drivers to be politer and more respectful to their passengers. One participant even said that “taxi drivers need training with respect to customer service”. Effective application of HCPTD Principle 3, 4 and 5 is recommended to aid the MBT industry in providing more human-centric service provision.

### 6.4 Final HCPTD Principles

After an in-depth discussion on applicability of each initial principle, the top five principles from either study construct were selected, related principles from either study construct

matched together, and the context thereof combined to yield the five final HCPTD Principles offered by this study, shown in Table 2 and collectively illustrated in Figure 3.



**Figure 3: An illustration of the five HCPTD principles developed from the study's findings, and their relationships**

**Table 2: Final HCPTD Principles**

<b>HCPTD Principle 1</b> – <i>Promote collaboration and consultation between various transport stakeholders</i>
Incorporating authentic, collaborative stakeholder consultation into Gauteng’s PT design model enhances commuter satisfaction. Provide monthly negotiating forums where authorities and commuters can have a regular engagement. Include human-centric professionals on PT design teams to listen to customer needs and understand what is important to them.
<b>HCPTD Principle 2</b> – <i>Consider the entire transport ecosystem and develop local management structures for public transport operations</i>
Consider the entire ecosystem around PT services during design.  Establish integrated PT control centres at a local, municipal, or regional level: <ul style="list-style-type: none"> <li>➤ Promotes network integration.</li> <li>➤ Linked to an integrated mobile PT application for commuters.</li> <li>➤ MBTs and BRT act as feeder services for rail transport with synchronised timings</li> <li>➤ Electronically monitors, manages, and communicates with PT vehicles in the network.</li> <li>➤ Drivers communicate with the centre in the event of breakdowns or late arrivals.</li> <li>➤ Commuters are informed swiftly of any service exceptions.</li> </ul> Setting up a transport authority that is independent of government changes can counter fragmented transport provision

**Table 2: Cont'd**

<b>HCPTD Principle 3</b> – <i>Practically empathise with commuters and prioritising safe, reliable, and affordable transport services</i>
Practical empathy for commuter travel experiences develops excellent transport designs that are desirable to commuters. Access to safe, affordable, and reliable transport is currently Gauteng's highest transport priority.
<b>HCPTD Principle 4</b> – <i>Transport network integration involves centralising people's needs and feedback in the design process</i>
Centralise human needs, desires, and feedback in Gauteng's PT design process. A greater desire to use PT services results from listening and acting on commuter's concerns and suggestions. Establish integrated PT control centres, integrated PT applications and common modal ticketing systems.
<b>HCPTD Principle 5</b> – <i>Enhance a commuter's perceived value by providing for core travel needs</i>
Perception (emotion) $\propto$ Desire (enjoyment) $\propto$ Value (willingness to pay). Improved PT availability, access, safety and reliability improves the perceived value of these service.

## 7. CONCLUSIONS

Literature, local experts and dissatisfied commuters have made it clear that PT services in Gauteng are falling short in meeting the core travel needs and desires of their customers. Issues like unsafe, unreliable and expensive services, fragmented service provision, and political will out of harmony with suggested policies and plans have left the core customer – the dependant commuter – feeling frustrated, unheard and often spiteful in an attempt to express their concerns and locate a PT service capable of meeting their travel needs.

By combining the contexts of global literature-based principles with initial principles validated and approved by these commuters, this study has offered five HCPTD principles that have been proven to enhance a commuter's perception of Gauteng PT services and in turn their satisfaction with that service. This, in turn, improves the support for local PT services and boosts their operational success due to increase patronage. The findings also indicate that increased human-centric service provision in GP PT services would establish a customer-orientated transport culture, fulfil the specific travel needs and desires of commuters that local transport authorities are currently unable to, and offer customers a desirable service.

While the research has addressed certain areas of this multi-faceted problem, it has also highlighted where the potential of Gauteng PT service provision remains diluted. Effective, well-organised services can only be provided once the political will of national leaders are aligned with suggested transport policies and plans, while the issue of MBT violence and lack of regulation must urgently be addressed in order for Gauteng PT services to become more developed and hold space for modal integration, due to the way it adverse way it affects the health of the PT system. Research on these, and other anomalies highlighted in the study, are required to shed light on more specific topic warranting further investigation.

## 8. RECOMMENDATIONS FOR FURTHER RESEARCH

Further research is recommended on how to optimise the MBT fare payment system by making it touchless and electronic. Half (45.7%) of the sample supported the idea of paying for all their PT services using one smart card instead of carrying cash, displaying an interest in more convenient fare payment. The possibility of training MBT (and even



BRT) operators on offering better customer service to their passengers is also recommended, as the findings of this study have shown that a commuter's willingness to pay for PT is related to their perception of that service. Since the correct type of survey data could not be collected to investigate the potential impact of assigning clear, effective roles and functions to each travel mode, it is recommended that further studies are conducted to create a framework of roles and functions for each mode in an integrated PT system, as this may offer great guidance for other parts of South Africa that plan to integrate their PT network. Investigating the impact of MBT and BRT services acting as feeder services to the rail service in Gauteng is also recommended. Since the study did not go in-depth on the functionality, characteristics and capabilities of the proposed integrated PT control centre, further research is recommended on this matter to investigate the potential of this concept and how it can be practically developed in South Africa's local municipalities.

## 9. ACKNOWLEDGEMENTS

This research was done in part fulfilment of a master's degree in civil engineering at the University of Stellenbosch. I would like to acknowledge my study supervisor, Prof. M. Sinclair, as well as Dr MB Wolfswinkel for their continued support, guidance, and inspiration during this research project. Each of you added a great deal of value to my study and helped induce the determination to finish my study through your passion for academia. Ethical clearance was granted by the secretary of the Social, Behavioural and Education Research (SBER) committee of Stellenbosch University, Cape Town, South Africa under the project number *REC-2021-21661*.

## 10. REFERENCES

Banister, D. 2005. *Unsustainable transport: city transport in the new century*. Taylor & Francis. Retrieved from Google Books.

Bold, M. 2001. *Research Survey on Correlation Studies*. Referenced in Williams, C. (2007). *Research methods. Journal of Business & Economics Research (JBER)*, 5(3). Retrieved from Google Scholar.

Cohen, Y, Makri, S, Reymann, S & Kaparias, I. 2017. *User-centred design in public transport: Discovering mobile user needs*. Retrieved from Google Scholar.

Conserve Energy Future 2021. *What is public transportation?* Available at: [https://www.conserve-energy-future.com/benefits\\_of\\_public\\_transportation.php](https://www.conserve-energy-future.com/benefits_of_public_transportation.php)

Cooper, DR & Schindler, PS. 2001. *Business Research Methods*. New York: McGraw-Hill Companies. Retrieved from Google Books.

Creswell, JW. 2009. *Research Design - Qualitative, Quantitative, and Mixed Methods Approaches* (3rd ed.). SAGE Publications. Retrieved from Google Books.

DC Design. 2017. *What is Human-Centered Design?* Available at: <https://medium.com/dc-design/what-is-human-centered-design-6711c09e277>

Design Kit. 2021. *What is Human-Centered Design?* Available at: <https://www.designkit.org/human-centered-design>

- Fourie, LJ. 2005. *Rethinking the formalisation of the minibus-taxi industry in South Africa* (Doctoral dissertation, University of Pretoria). Retrieved from Google Scholar.
- Gnap, J, Konečný, V & Poliak, M. 2006. Elasticity of demand in public passenger transport. *Journal of Economics*, 54(7):668-684. Retrieved from Google Scholar.
- Innovation Team, A. 2015. *Retrospective ticket pricing, SPARK*. The Rail Knowledge Hub. Referenced in Cohen, Y, Makri, S, Reymann, S & Kaparias, I. 2017. User-centred design in public transport: Discovering mobile user needs. Retrieved from Google Scholar.
- Khosa, MM. 1995. Transport and popular struggles in South Africa. *Antipode*, 27(2):167-188. Retrieved from Google Scholar.
- Khosa, MM. 1998. 'The travail of travelling': urban transport in South Africa, 1930-1996. *Transport Reviews*, 18(1):17-33. Retrieved from Google Scholar.
- Khosa, MM. 2001. Public transport in the changing South Africa, 1994-2000. Retrieved from Google Scholar.
- Kitchin, R & Thrift, N. 2009. *International encyclopedia of human geography*. Elsevier. Retrieved from Google Books.
- Lombard, P & Coetzer, L. 2007. Guidelines For Human Settlement Planning And Design: Public Transport. *International Seminar on Sustainable Road Financing & Investment*, 1, 29. Retrieved from:  
<http://www.nwpg.gov.za/HumanSettlements/site/documents/Guidelines1.pdf>
- Mabhena, T. 2019. *Minister Mbalula confirms that the Moloto Railway Corridor is a pipe dream*. DA. Available at: <https://www.da.org.za/2019/12/minister-mbalula-confirms-that-the-moloto-railway-corridor-is-a-pipe-dream/>
- Mertens, DM. 2003. Mixed methods and the politics of human research: The transformative-emancipatory perspective. *Handbook of mixed methods in social and behavioral research*, 135-164. Retrieved from Google Scholar.
- Mitchell, D, Claris, S & Edge, D. 2016. Human-Centered Mobility: A New Approach to Designing and Improving Our Urban Transport Infrastructure. *Engineering*, 2(1):33-36. Available at: <https://doi.org/10.1016/J.ENG.2016.01.030>
- Mthimkulu, N. 2015. Evaluating the Effects of Spatial Politics of Public Transportation in Johannesburg: A Focus on Bus Systems. Retrieved from Google Scholar.
- Mthimkulu, N. 2017. *Southern African Solutions To Public Transport Challenges*. 36th Southern African Transport Conference (SATC 2017). Available at: [https://repository.up.ac.za/bitstream/handle/2263/62764/Mthimkulu\\_Southern\\_2017.pdf?sequence=1&isAllowed=y](https://repository.up.ac.za/bitstream/handle/2263/62764/Mthimkulu_Southern_2017.pdf?sequence=1&isAllowed=y)
- Pillay, K. 2001. The South African public transportation professional. *SATC 2001*. Retrieved from Google Scholar.
- Poliak, M, Poliakova, A, Mrnikova, M, Šimurková, P, Jaśkiewicz, M & Jurecki, R. 2017. The competitiveness of public transport. *Journal of Competitiveness*. Retrieved from Google Scholar.



- Rizzo, F, Concilio, G, Marsh, J & Molinari, F. 2013. The living lab approach to co-design solutions for human smart cities: lessons learnt from Periphèria Project. *Proceedings of the CO-CREATE Conference 2015, Aalto University, Espoo, Finland* (pp. 16-19). Retrieved from Google Scholar.
- Saunders, MN. 2012. Choosing research participants. *Qualitative organizational research: Core methods and current challenges*, 35-52. Retrieved from Google Scholar.
- Schoeman, CB. 2014. Intermodal transportation perspectives in South Africa: a case study of its application within the Gauteng Province and lessons learned for other metropolitan areas. *Urban Transport XX*, 138(3). Retrieved from Google Scholar.
- Shaw, A. 2006. Achieving a pro-public transport agenda in South Africa—the challenge for middle income countries. *WIT Transactions on the Built Environment*, 89. Retrieved from Google Scholar.
- STATS SA. 2018. *Statistical Release PO318: General Household Survey 2018*. Available at: <http://www.statssa.gov.za/publications/P0318/P03182018.pdf>
- Terrell, SR. 2012. Mixed-methods research methodologies. *Qualitative report*, 17(1):254-280. Retrieved from Google Scholar.
- Thomas, DP. 2016. Public transportation in South Africa: Challenges and opportunities. *World*, 3(3). Retrieved from Google Scholar.
- Thomsen, D. 2018. Why Human-Centered Design Matters. *Wired*. Available at: <https://www.wired.com/insights/2013/12/human-centered-design-matters/>
- Turok, I & Watson, V. 2001. Divergent development in South African cities: strategic challenges facing Cape Town. *In Urban Forum* (Vol. 12, No. 2, pp. 119-138). Springer-Verlag. Retrieved from Google Scholar.
- Van de Velde, DM & Sleuwaegen, LIE. 1997. Public Transport Service Contracts: Searching For The Optimum. *International Journal of Transport Economics*, 24(1):53-74. Retrieved from Google Scholar.
- Walters, J. 2014. Public transport policy implementation in South Africa: Quo vadis? *Journal of Transport and Supply Chain Management*, 8(1):10. Retrieved from Google Scholar.
- World Population Review. 2021. *South Africa Population 2021 (Live)*. Available at: <https://worldpopulationreview.com/countries/south-africa-population>
- Yigitcanlar, T & Lee, SH. 2014. Korean ubiquitous-eco-city: a smart-sustainable urban form or a branding hoax? *Technological Forecasting and Social Change*, 89(1):100-114. Retrieved from Google Scholar.
- Zellner, ML. 2008. Embracing complexity and uncertainty: the potential of agent-based modeling for environmental planning and policy. *Planning Theory & Practice*, 9(4):437-457. Retrieved from Google Scholar.