

# INFLUENCE FACTORS FOR PASSENGER TRAIN USE

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## ABSTRACT

This paper investigates the different influence factors for passenger train use. These factors have been clustered into 3 groups:

1. Socio-economic aspects: population and economic growth;
2. Internal train system aspects: fare price, travel time, comfort service levels, and capacity constraints; and
3. Other transport systems' aspects: fuel price, toll price and parking costs, congestion, and other public and private transport's service levels.

The response to these influence factors are different for the different travel purposes: work / education (peak trips), and social / leisure (mainly off-peak trips). The response also differs based on the type of train users: Choice Users (i.e. the Gautrain market), and Captives (i.e. the Metrorail market), although both systems will eventually attract other markets as well, e.g. via the PRASA Modernisation process.

The socio-economic aspects (population and economic growth) have a positive relationship with the demand of passenger train use. The analyses on the transport systems have considered the financial, time and effort budgets that a passenger has available, to make a decision on the use of Public Transport (PT) and train. It was found that Choice Users are more receptive to time and comfort aspects, while Captives lay relatively more value in cost aspects. However, due to a lack of alternative transport modes, the Captives' response to changes is fairly inelastic.

## 1 INTRODUCTION

### 1.1 Background of Public Transport

#### 1.1.1 PT trip purposes

Transport is not a purpose in itself, but merely a means to get involved in economic and social activities. There are different travel purposes:

- Commuter trips, for work and education (mainly in peak hours). These economic activities are more or less fixed in time and place, and have to be attended, irrespective of the transport service quality.
- Social and leisure trips (mainly in off-peak). These social activities are less fixed. If the quality of transport is not good, one can decide to skip the activity. In economic terms: the total costs of travel are higher than the benefits of the activity.

### **1.1.2 Individual transport budgets**

From a user perspective, transport incurs monetary (financial) costs, utilises time, and requires physical and/or mental effort. Each passenger has these three types of budget available. In order to keep sufficient budget for other activities, one wants to minimise the total burden on these budgets.

The above mentioned activities provide economic benefits (money for work), and social benefits (e.g. socialising, relaxing); it charges your financial and mental effort budgets. Unfortunately the time budget cannot be charged. Travel time, however, can be spent efficiently, by combining trip purposes (e.g. do shopping on your way back from work), or combining activities during travel (e.g. studying, socialising or relaxing while using PT).

In transport planning, there are different groups of PT users:

- PT Captives have no other means of private transport, mainly because they cannot afford a car, and rely on PT. They are mostly lower-income people.
- Choice Users do have private transport / car available, and can make a choice on which travel mode is preferred. They are mostly higher-income people.

All transport users want to minimise the burden on each of their budgets, but with different priorities.

For lower-income captive passengers, the money budget is restricted. This impacts their mode choice, as they would rather spend money on housing and food than on transport. This is also indicated in National policy, which states that households should preferably not spend more than 10 % of their income on transport. Therefore a commuter trip is made with the least financial burden, even if it has to take more time or effort (e.g. some people would rather walk for 3 km than spend R5 on a minibus-taxi). This group also makes limited social and leisure trips, as they cannot afford the activity or the trip.

For higher-income Choice Users, this 10 % share is sufficient transport budget and more travel options are available, including a private car. This group can also permit more social and leisure activities (to increase their social benefits) and will travel more.

For Choice Users, time is a more important budget (“time is money”). This is also indicated by the ‘Value of Time’ (VoT), which for higher-income people is significantly higher than for

lower-income people. With this VoT principle, one can add the money and time factors to one factor: 'Generalised Costs'.

The effort aspects (safety, comfort and convenience) are more difficult to quantify. In many of the generalised costs functions, it is included as a constant factor. Sometimes it is valued via a 'Willingness to Pay' monetary value, or a factor relative to the 'in-vehicle time'.

Choice Users may (subjectively) perceive PT as inconvenient and/or not of satisfactory quality. As they have a choice option, they can decide to use another mode of transport, whereas Captives do not have this option and will use PT no matter its quality, or decide not to travel.

## **1.2 Objective of this paper**

In South Africa, there are two different passenger train systems, each providing different Quality Levels of Service. PRASA's Metrorail currently has a poor Level of Service, mainly due to poor maintenance over the last decades, although it attracts vast numbers of (Captive) passengers. The recently introduced Gautrain is a modern Rapid Rail system, attracting a new market of Choice Users, which previously would not have considered using 'traditional' PT at all.

Both systems will eventually attract other markets as well, e.g. via the PRASA Modernisation process, as discussed in the author's previous SATC paper (Onderwater, 2013). It is, however, uncertain how different groups would respond on the proposed quality improvements. The author's PhD research, intends to close this knowledge gap, and this paper is a first introduction, with literature review, on the topic.

The scope of this paper is to investigate the different influence factors for passenger train use. These factors have been clustered into three groups:

1. Socio-economic aspects: population and economic growth (see section 3);
2. Internal train system aspects: fare price, travel time, comfort service levels, and capacity constraints (see section 4); and
3. Other transport systems' aspects: fuel price, toll and parking costs, congestion, and other public and private transport's service levels (see section 5).

This assessment will be done for price, time and comfort / convenience aspects, referring to the availability of money, time and effort budgets.

The paper uses the method of elasticity to explain the sensitivity to changes in the influence factors (see section 2). The response will be different for Choice Users and Captives, as well as for peak commuter trips and off-peak social trips.

This paper has investigated these influence factors, mostly from a qualitative point of view, by reviewing and analysing international scientific literature on public transport (including train) influence factors, and their elasticity parameters. It must be stated that this literature is mostly available for Western World PT systems, and the South African context could be different. In addition, relevant local transport trends and data have been assessed. Further investigation and quantification of these influence factors and its elasticity parameters is subject to the author's PhD research.

## **2 EXPLAINING TRANSPORT ELASTICITY**

In economics in general, as is the case for transport economics, the most common way to measure the sensitivity of one variable to another is 'elasticity', which specifically is a number that tells the percentage change that will occur in one variable (i.e. passenger demand) in response to a 1-percent increase in another variable (e.g. price, time, etc.). There are different types of elasticity (based on Pindyck, 2009):

Price elasticity of demand is the percentage change in passenger demand of a specific mode, resulting from a 1-percent increase of its price. It is assessed that higher-income (Choice) passengers tend to be less sensitive to pricing, and more sensitive to service quality, like travel time, comfort and convenience.

Quality of transport is often measured in time. In a similar matter to price, an increase in time (slower transport) will lead to a decrease of demand. This is referred to as the time elasticity of demand. Another approach is to 'translate' time in monetary values ('Value of Time'), and then the price elasticity can be used to assess time related elasticities.

Other transport qualities are not measurable, such as safety, comfort, effort, etc. In several Stated Preference studies these factors were 'translated' in either an equivalent in-vehicle time, or into monetary values ('Willingness to Pay'), and a time or price elasticity can be used to assess the impact.

The price and time elasticity is negative: patronage will decrease as fares or trip time increases. When the elasticity is greater than (+/-) 1 (greater in magnitude, absolute value), demand is called elastic: the percentage decline in demand is greater than the percentage increase in price or time. With an elasticity parameter smaller than (+/-) 1, the factor is called inelastic; this is generally the case in transportation. With completely inelastic demand (elasticity = 0), consumers will buy a fixed quantity of a goods (i.e. travel), regardless of its price or quality.

Cross elasticity is the percentage change in the demand of one mode, resulting from a 1-percent increase in the price / time of another mode. Cross-elasticity is made up of the elasticity of the other mode, times the substitution rate, where substitution depends on the relative mode share and diversion factors (Acutt et al., 1996): several studies suggest that roughly half the impact would be diverted transport to/from other modes, the other half

being newly generated or reduced mobility. For that reason, cross elasticities are fairly inelastic.

If transport modes are complementary modes (e.g. feeder services), the increase in the price / time of one mode will result in the associated decrease in demand of the other mode.

Although elasticities are often reported as single estimates, there are actually many factors that can affect the sensitivity, and the actual value will vary widely depending on the trip purpose, income, peak / off-peak, etc. (Litman, 2013).

Generally demand is more elastic in the long run, because it takes time for people to change their transportation habits. Scientific literature review shows that the differences in impact for short term (1 to 2 years) and long term (> 3 to 5 years), can be a factor 2 to 3.

#### *Adjusting prices (Consumer Price Index – Inflation)*

Some of the influence factors are monetary aspects (e.g. fare price, fuel price, toll, etc.). These factors are mostly available as nominal (current) values. To assess the impact over time, these factors need to be adjusted by CPI / inflation rate, to determine the constant (real) value, rather than the nominal value.

In cases where a Value of Time parameter is used, it is noted that this would also increase over time with inflation; and therefore would be fairly constant in real terms.

### **3 SOCIO-ECONOMIC INFLUENCE ASPECTS**

The socio-economic influence factors include aspects such as population, employment, jobs, economic growth and car ownership.

#### **3.1 Population and jobs**

Transportation is a derived demand of economic and social activities. Therefore growth in general mobility, and PT / train use, will be in line with demographic growth.

In peak hours, the majority of passengers are commuters, travelling for work or business. Therefore 'jobs' is the most determinative driver of peak patronage, and the elasticity calculation should be applied to the percentage growth of jobs.

The determinative driver of off-peak demand would be amenities, points of interest and social destinations. Therefore transport growth is mainly determined by the growth of population.

Airport passengers are a specific group, and the number of PT / train passengers to/from an airport is directly proportional to the number of airport passengers, which in its turn is related to GDP economic growth.

The elasticity parameter = +1.0: with 1 % increase of population / jobs, mobility is expected to grow 1 %. Instead of using average growth factors, the population and job growth could

be determined by the actual planned developments within each of the station's catchment areas, using a buffer of 2 to 5 km around the stations.

### **3.2 Economic growth**

The more disposable income people have available, the more activities they can undertake, and the more they will travel (income elasticity). This increase in mobility is expected to impact commuter peak trips, as well as additional off-peak social and leisure trips.

Economic growth is closely related to the increase of jobs. To avoid double counting, it is suggested that increase in the number of jobs in the station influence area be used to determine peak commuter patronage growth.

However, as economic wealth increases, car ownership will also increase, and more people will become Choice Users, and less PT Captives. This can result in a reduction of PT patronage. To assess this impact, it is recommended to split population growth in income groups, for non- / car users, to determine the number of Captives / Choice Users respectively.

## **4 INTERNAL TRAIN SYSTEM ASPECTS**

Passenger demand will respond to 'internal' improvements of the train system, or decrease when quality declines. The key aspects to consider are:

- Fare price, which is the total monetary price of traveling by train, consisting of train fares and the additional cost required for parking or feeder services;
- Travel time, including access and egress time, and waiting time (service frequency);
- Other comfort and convenience aspects.

It should be noted that the assessed passenger growth is 'unconstrained' and would normally be supported by sufficient capacity of all train system components. However, capacity constraints in the system will adversely affect demand, the most important being:

- Train capacity (crowding);
- Parking capacity.

In case where the system cannot provide sufficient capacity, passengers will first deviate to other stations or change their travel time (e.g. peak spreading), and finally change to other travel modes (e.g. private car), or not travel at all. This will limit the assessed growth.

### **4.1 Fare Price**

Fare prices are generally increasing in line with CPI / inflation. Therefore the direct impact on PT / train trips is limited. However, there could be an impact by introducing fare differentiation for different market groups.

#### **4.1.1 Train fare prices**

A review of several international studies (Paulley et al., 2006; Litman, 2013), show a price elasticity for train / PT with a wide variation between -0.1 and -1.0, generally approx. -0.3 to -0.6.

The price elasticity for Captives is reported to be lower than for Choice Users. This might seem in contradiction with the fact that Captives have less money to spend, and therefore be more affected by price fluctuations. On the other hand, Captives have little choice options, apart from using another mode of PT (also see section 5.4), or not travel at all. Therefore the Captive's price elasticity for PT as a whole is low, but is higher per separate PT mode.

The price elasticity for peak trips is generally lower than for off-peak trips. Work trips are relatively fixed in time and space, without much of an alternative. For social trips, there is a wider range of alternatives: other destinations, more convenient other travel modes, or not make the trip at all. The off-peak price elasticity is higher for Captives than for Choice Users, with Airport train passengers even less sensitive to fare price.

#### **4.1.2 Differentiation in peak / off-peak fares**

The impact of introducing top-peak fares or off-peak discounts is hardly studied in literature.

For commuter trips, peak spreading ability is limited, as passengers are bound to relatively fixed working times; this is more the case for lower-income jobs (Captives), than for higher-income jobs (Choice Users). Some peak spreading is expected to be possible from top-peak to the 'peak shoulders', which would result in wider peaks.

For social trip purposes, peak spreading would be more effective and pricing incentives would lead to a shift of such trips to the off-peak. However, as the majority of the peak patronage are commuters, the total impact is limited.

Discounts on off-peak fares, however, will have impact in attracting new social trips.

#### **4.1.3 Parking and Feeder bus fares**

A part of the total trip price is for costs to access and egress the train stations, by feeder PT systems or parking (the latter for Choice Users only). A similar price elasticity as for train fare prices would be used, although the impact would only be applicable to the portion of access / egress using these specific modes, and should be related to the total trip fare. Therefore the elasticity of PT feeder or parking fares is very limited, and would firstly see a shift between different access/egress modes, with little impact on the use of the main train system.

Fare integration between the main train mode and its feeder modes could reduce the total trip price and the general price elasticity can be used to assess the impact.

## **4.2 Trip time and Service Frequency**

The PT trip time consists of access time, waiting time (depending on the service frequency), in-vehicle time, and egress time. Sometimes an additional transfer time may be applicable. On average, the in-vehicle time is approx. half of the total door-to-door trip time.

In international scientific literature (Paulley et al., 2006; Litman, 2013), a wide range of time elasticity is found: -0.4 to -0.9. However, in this literature it is not always clear whether the elasticity parameters are applicable to the in-vehicle time only, the total door-to-door trip time, or even to a subjective time (see section 4.3).

The trip time has an impact on the time budget. The higher the passenger's Value of Time, the more sensitive the passenger is to the trip time. Choice Users (and especially Airport train passengers) are more sensitive to time than Captive users. Commuters are more sensitive to time than passengers travelling for leisure.

### **4.2.1 In-Vehicle time**

For existing train services, the in-vehicle time is fairly constant and few changes have been implemented or are planned. In PRASA's Modernisation programme, the train speeds are to be increased, and Express services be introduced. This will reduce the in-vehicle time significantly, and a patronage growth can be expected.

### **4.2.2 Waiting time and service frequency**

Most changes in train service are related to frequency / waiting time. The direct time impact of a frequency increase is very limited, with a few minutes reduction of the average waiting time, which is only a small portion of the total trip time. This multiplied by the time elasticity would show a very small percentage change of patronage.

### **4.2.3 Access / egress time**

Access and egress to the station is by various modes: walking, feeder PT, or car (pick-up / drop-off, or parking; mainly for Choice Users), with a certain split based on its cost, time and effort aspects. When a station area start to experience traffic congestions, the access / egress time for road-based modes will increase. Poor station access could lead to the use of other access modes (e.g. walking), or in reduced train patronage. Once access is improved, growth can resume unconstrained.

## **4.3 Other Quality Aspects**

### **4.3.1 Availability and punctuality**

A poor availability or punctuality of the PT / train system will impact on the (expectations of) travel time, and has different impact for the different PT users. Choice Users have a higher sensitivity to any delays in the system, as they have the resources to shift to other more reliable modes of transport. Regular occurring delays in the system would cause permanent loss in patronage. Captive users are less sensitive to delays because shifting to a different mode may require more financial budget which they have not available. If delays are frequent, Captive users would first try to allocate more travel time to their



journey to accommodate the possible delays, before seeking another PT mode (bus or minibus-taxi).

Similarly, the reliability of feeder services, would affect the train patronage demand.

This impact is even greater with strikes. On strike days, train passengers would use other access / egress modes in case of a feeder PT strike (parking, drop-off or walking), or make the whole trip by car or car-pooling, or not made the trip at all (e.g. working from home).

There would also be some impact in the short and medium term, due to passengers developing a negative attitude (especially when strikes happen regularly), and re-assessing the best-suited travel option. The medium-term impact of strikes could be a 0.3 to 2.5 % reduction of patronage (literature review by Job et al., 2001).

#### **4.3.2 Train Capacity and Crowding**

Especially in peak period, trains are sometimes crowded, and more passengers need to stand. Crowding is a form of discomfort, and will increase the subjective in-vehicle time. Several 'Value of Travel Time Savings' studies (Li, et al., 2011) show that, compared to comfortably seated (value of in-vehicle time = 1), standing passengers will assess a subjective time multiplier of 1.5 for that part of the trip where they have to stand. With extreme crowding (200 % load factor, or 6 pass/m<sup>2</sup> standing), the time multiplier increases from 1 to 1.6/1.8 for seated passengers, and from 1.5 to 2.0/2.4 for standing passengers.

This can partly be explained by the physical effort of standing, and the fact that passengers are less able to relax, read, or socialize during their trip, which is generally seen as an advantage of PT: spending travel time efficiently (Ettema et al., 2012). This will both impact passenger's mental effort budget (less relaxed) and their time budget (spend time on these activities at other times of the day).

With very crowded PT vehicles, there is a chance that passengers cannot board and are left behind on the platform, increasing their waiting time and discomfort of travel, resulting in unreliability of the service with chances of arriving late at work (Tirachini et al., 2013).

With high levels of crowding, growth will be constrained, and the potential growth (as a result of other aspects) would be reduced / capped. With higher service capacity (e.g. once new rolling stock is available), growth can resume unconstrained and the level of comfort will improve.

Therefore, introducing additional capacity can have a great impact, as it will open up a latent demand market. Scientific literature often shows a very high elasticity on service supply (frequency increase), of 0.6 to 1.0 (Litman, 2013; Wardman, 2004). This is much greater than the direct impact caused by the reduction in waiting time (see section 4.2.2).

#### **4.3.3 Comfort of access, waiting and transfer**

In scientific literature, some notions on the weighting of out-of-vehicle time, compared to in-vehicle time, are made, indicating the comfort or effort of these trip sub-sections:

- Access to stations: weighting = 1.4 to 2.0 times the in-vehicle time;
- Waiting time: weighting = 1.2 for train, to 1.6 for bus;

Other studies show a factor 2 for access and a factor 3 for waiting (Wardman, 2004, citing several studies), although Wardman recommends that it is reasonable to value both walk and waiting time as twice the in-vehicle time.

The fact that the perception of access and waiting time is roughly a factor 2, is partly caused by the physical effort and mental stress of the walk to the station (“will I be in time to catch my train?”); as well as the uncertainty of waiting time until the train would arrive, and assessing the waiting time as ‘useless’.

Several studies have shown that providing real-time information would reduce this uncertainty, and a pleasant environment (by providing sufficient light, back-ground music, TV screens, etc.), can relieve the mental effort of waiting (Hagen, 2011), and a lower subjective waiting time factor can be used.

In case changing between PT services is required, passengers have to undergo the physical effort of changing to another platform, additional waiting time, and effort (with associated stress) to obtain a seat in the next train. In literature, this ‘penalty’ for changing varies widely from 5 min (Guo et al., 2010) to 20-30 min in-vehicle time (Paulley et al., 2006), depending on the service quality of the next service (frequency, scheduling integration) and the station environment.

#### **4.3.4 Parking capacity constraints**

Insufficient Parking capacity at stations will affect Choice Users and impact on AM-peak and off-peak passengers. Commuters may leave home early in order to find parking, which will result in many parking facilities filling up early. When the parking fills up, late-arriving passengers might not find parking, or relatively far away from the station, which results in additional walking time. Others would change to a feeder bus (provided it’s availability), or prefer to use their car for the entire trip. Therefore, parking constraints will cap the growth of passenger demand, partly for peak commuters, and more so for off-peak passengers.

## **5 OTHER TRANSPORT SYSTEMS’ ASPECTS**

Changes in any transport mode aspect (e.g. price, quality, etc.), will impact on that specific mode, and also on its competitors. For PT Choice Users, the main competitor is the private car, and its competitive position is determined by direct car costs (fuel, tolls and parking) and congestion. Current Choice Users show hardly any mode shift to/from other modes of PT (Metrorail, bus and minibus-taxi), as the perceived poor quality does not appeal to the Choice User market. In the future this situation will change, with modernised Metrorail and BRT attracting more Choice Users. For PT Captives, mostly a private car is not available, and the train system has to ‘compete’ with other modes of PT (bus and minibus-taxi).

## 5.1 Fuel Price

Motorists normally assess the car costs mainly as out-of-pocket costs, and fuel price is the most important aspect. In recent history, fuel prices have varied significantly, both up- and down-wards, and this has impacted on Gautrain use by Choice Users.

Scientific literature has extensively studied the cross-elasticity of fuel price to PT / Train use, and elasticities of +0.1 to +0.4 are found (Litman, 2013). This cross-elasticity is made up of the elasticity of the own mode (fuel price – car use), multiplied by the substitution rate (car – PT / train), where substitution depends on the relative mode share and diversion factors (Acutt et al., 1996).

For Captives, there is hardly any substitution between car and train, and the cross-elasticity for Captives is nil. However, fuel price will have a secondary impact for Captives, as it will influence the costs of other PT modes (see section 5.4).

## 5.2 Tolls and Parking

Apart from fuel price, other out-of-pocket costs for driving a car contribute to the total variable car travel cost. These costs include toll and parking fees and would mainly be applicable to Choice Users.

Some of the national roads in South Africa are tolled, either by toll gates or e-toll. The cross elasticity impact for toll will be similar to the fuel price, although with a much lower impact, as toll is only applicable to selected roads (some of the freeways only), and it is a small portion of the total trip cost. For regular commuters, the impact of e-toll is even lower, as it is capped to a max (approx. R5 per trip, when used on a daily basis), and is partly evaded (currently e-toll has approx. 1/3 compliance). The impact of e-toll on incidental social trips can be much higher.

Parking fees are mostly applicable in CBD areas and shopping malls. Many employers, however, have made some provision, e.g. by providing parking on own premises. Therefore, parking costs would not impact all commuters. Parking costs, however, will impact social / leisure trips to such areas, and changes in parking fares could impact car use, and show a shift to PT / train.

The cross elasticity impact for parking will be similar to the fuel price, although with a lower impact, as parking is applicable to certain destinations only, and is a small portion of the total trip costs.

## 5.3 Congestion

With population and economic growth, road traffic volumes will grow, and congestion will increase over time. Government has road expansions planned in certain areas, but in areas where congestion continues to grow, motorists could change their travel behaviour

by avoiding congestion in peak hour (travel before or after the peak), or by changing travel mode (e.g. shift to train / PT). Congestion mostly occurs in the peak period, and therefore will mainly impact on commuter trips.

Similarly to car costs, there is a cross-elasticity for car travel time, the longer the car trip, the more motorists make the shift to PT / Train. Again, this cross-elasticity depends on the own elasticity (congestion – car use), and the substitution rate (car – PT / train), which depends on local circumstances. Scientific literature mentions cross-elasticity parameters of +0.4 (Litman, 2013). Commuter and business trips are more elastic: due to relatively fixed working times, the opportunity to shift to off-peak is limited, and one could decide to change to another mode (if available). Social trips in peak periods have more opportunity to shift to off-peak and avoid congestion.

Airport passengers are more sensitive to time, as the penalty of a delay is much higher (it could cause missing a plane), resulting in a much higher cross-elasticity. This would even be applicable to off-peak (e.g. unexpected congestion caused by accidents or maintenance).

#### **5.4 Competing PT modes**

Train competes with other PT modes, as minibus-taxis and bus, mainly on the Captive market. Although train fares are generally cheaper, road-based PT often provides a faster trip (less in-vehicle time), with higher frequency (less waiting time) and a dense network (less access and egress time). Given current circumstances, there is an equilibrium in train use versus road-based PT. But as soon as circumstances change (e.g. road-based PT fares due to fuel price, or congestion), the situation will change. The total PT use (train plus road-based) might not change much, but there will be a shift between PT modes.

Uber (a form of semi-public transport) is a new player in the mobility market, but due to the high costs, it is mainly used by Choice Users. Uber can be used as a complementary service, to access or egress the train stations, replacing 'traditional' drop-off or pick-up, but with no significant impact on train patronage.

However, Uber can also be seen as a competitor for certain markets. This is not so much the case for commuter trips, as Uber has the same disadvantages as the private car in terms of congestion and higher costs. But Uber has shown to be used for trips to/from the Airport, and will be a new competitor to an Airport train services (e.g. Gautrain). But as Uber is a relatively new player, its impact on PT train use is still unknown and needs to be assessed.

## **6 CONCLUSIONS AND RECOMMENDATIONS**

This paper has investigated the impact on PT train patronage based on 3 groups of aspects (socio-economic, internal train system, and other transport systems). From international scientific literature, elasticity parameters are found, that can be used to

examine this impact. It must, however, be stated that this literature is mostly available for Western World PT systems, and the South African context could be different. Additional analyses and surveys are required to substantiate these parameters for the local South African.

The analyses show a huge variation of factors and elasticity parameters, differently for different trip purposes, income levels, etc. It is therefore recommended, while analysing the impact, to split the trip into different sub-trips (access, waiting, in-vehicle, transfer, egress), as well as to split the passenger market into different sub-markets (Captives vs. Choice Users; commuter peak trips vs. social off-peak trips), and assess the impact of changes in the PT service separately, using different elasticity parameters.

Further investigation and quantification of these influence factors and its elasticity parameters, is subject to the author's PhD research.

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