# CYCLING TO PUBLIC TRANSPORT STATIONS: THE MOST SUSTAINABLE TRANSPORT MODE COMBINATION

**P ONDERWATER and E DA SILVA**

Hatch Africa, 25 Richefond Circle, Ridgeside Office Park, Umhlanga, Durban
Tel: +27 73 041 8294; Email: pieter.onderwater@hatch.com
Tel: 011 231 6524; Email: erin.dasilva@hatch.com

## ABSTRACT

The Netherlands is regarded as one of the most prominent cycling countries in the world. It also has one of the best railway systems in the world. Interestingly, the combination of 'cycling to railway stations' has a very good mode share, as it has many advantages: it expands the catchment area of stations and is often faster than congested road traffic. In this paper the authors will explore if and how we can use this transport mode combination for the South African context.

In a project to optimise Gautrain services, the authors have explored what could be done to promote a mode shift in the access/egress to/from Gautrain stations, with Hatfield Station as a pilot. We suggested a cycling network with dedicated lanes along major arterials and mixed-traffic on quieter streets, and secured bicycle parking at the Gautrain station (and elsewhere in town); as well as a bicycle-share facility for 'the Last-Mile' in combination with an already existing bicycle-share programme for the University of Pretoria.

In this paper, the authors have explored some other conditions that need to be fulfilled, to implement this for public transport stations such as the Gautrain, Metrorail, BRT, bus and taxi ranks. Ideally, over-time, this could facilitate cycling as a preferred transport mode in South Africa.

## 1. INTRODUCTION

### 1.1 Background

The Netherlands is regarded as one of the most prominent cycling countries in the world, together with Denmark. The Netherlands also has one of the best railway systems in the world, together with Japan and Switzerland. Interestingly, in the Netherlands the combination of 'cycling to railway stations' has a very good mode share. The combination is also emerging in other countries like Denmark, Germany and the United Kingdom, and in the United States and Canada (Shelat *et al.*, 2018).

According to the National Household Travel Survey (NHTS) 2020, cycling in South Africa is not a common transport mode and accounts for less than 1% of all mobility trips in the country (Stats SA, 2021); however, it is used more as a leisure activity. Public transport however is very well used and is mostly accessed by walking.

The potential of cycling is recognised in national and local transport policies as a healthy and environmentally-friendly mode of transport. This paper aims to explore another reason to promote cycling, namely as a potential access mode to public transport.

### 1.2 Objective of This Paper

The objective of this paper is to explore the combination of cycling to/from public transport stations, and how to make it applicable to the South African context. The paper can be seen as a discussion paper, not based on quantitative research, but exploring some opportunities qualitatively. The authors do not have the aspiration that their conclusions can be achieved in the short term, as the required culture change would probably take decades. However, some of the recommendation could be implemented to start a shift in planning for public transport (PT) and non-motorised transport (NMT).

The current cycling to station situation in South Africa is described in section 2. As a contrast, cycling to stations in the Netherlands is presented in section 3.

From understanding the Netherlands context, in section 4 a discussion follows on the benefits of the cycling–train combination, as well as some additional quality aspects that need attention in order for South Africans to pick up cycling to PT stations.

Next, in section 5, the lessons learned are applied as a pilot plan for Hatfield Gautrain Station, as well as a discussion how this could be implemented at other PT stations.
Section 6 concludes with some recommendations.

## 2. CYCLING TO STATIONS IN SOUTH AFRICA

According to the NHTS 2020, less than 1% of the daily trips are made by cycling (Stats SA, 2021). This includes cycling to education institutions (0.2% modal split) and work (approximately 1%). Cape Town is seen as one of the most bicycle-friendly cities in South Africa and has a relatively higher cycling share; however, this only constitutes merely 1% (rounded) of all trips (CoCT, 2017). The situation for cycling to PT stations has not been assessed separately but is assumed to be negligible.

There have been few papers that studied the combination of cycling and PT for the South African context.

Venter (2020) found that walking and cycling accounts for 6% of all Gautrain access at the home-side of the trip; the majority came by private car: 52% parking and 19% drop-off, 14% by taxi/shuttle and 7% by feeder bus. Gautrain has a few bicycle parking racks at stations, used by on average a dozen of cyclists per station (with Centurion and Midrand mostly used); just over 100 on a daily basis. This would total to approximately 0.4% of all Gautrain home-side trips.

Wently and Hitge (2013) studied Park&Ride facilities at 5 selected Metrorail stations in Cape Town. They found that less than 0.2% of passengers came to these stations by cycling, as the majority walked (67%), 19% came by PT and 13% by car, either parking or drop-off.

Jennings (2015) has made an inventory on the ability to take bicycles on PT vehicles in Cape Town. Since 2011, bicycles are permitted, free, on MyCiTi buses, and since 2013 on the Metrorail southern rail line at an additional ticket cost. Eight rail stations across the

city have unsecured parking racks to which users are able to lock bicycles: Monte Vista, Brackenfell, Kraaifontein, Retreat, Fish Hoek, Oosterzee, Lansdowne and Eerste River, but all with very limited volumes.

Bechstein (2010) has surveyed commuter cycling in Pretoria and concluded that cycling can be an option on trips where no train connectivity is available and minibus-taxi transport is too expensive or lacking. Additionally, she indicated that cycling as a feeder to train stations could be a competitive option versus the minibus-taxi, or to replace long walking to the train station, but that the bicycle–train combination is still a long way off.

## 3. EXPERIENCE OVERSEAS – THE NETHERLANDS

The bicycle-PT combination is well studied and documented in the Netherlands, by the University teams of Marco te Brommelstroet (Amsterdam) and Niels Van Oort (Delft), amongst others. In this paper, the authors made use of a brief selection of their work.

Most of the information in this section comes from the Annual Report of the Dutch Railway Company (NS, 2020), and their website.

### 3.1 Bicycle Access to Stations

The 17 million population of the Netherlands make a total of 1.3 million train trips per day, equalling about 400 million train trips per year (pre-Covid). More than 40% of the train passengers – at the home-side of the journey – come to the station by bicycle (NS, 2020; confirmed by many other sources). The roughly 400 railway stations have a total of almost half a million bicycle parking spots:

- 311,000 unsecured/free racks.
- 173,000 secured/paid parking spots, at €1.25 (R25) per day or €105 (R2000) per year; many bicycle parking facilities include a service and repair workshop.
- 12,000 bicycle lockers, at €130 (R2500) per year, at smaller stations where a secured parking facility was not viable.

This would equate to more than 1,200 bicycle parking spots per station on average. The busiest railway station in the Netherlands, Utrecht Central Station, recently opened a new bicycle parking facility with 12,500 parking spots (the biggest in the world), with an additional +/- 10,000 parking spots spread elsewhere around the station.

### 3.2 Bicycle Egress from Stations

The bicycle is also used in 10-15% of the egress trips – at the destination-side of the journey (Jonkeren *et al*., 2019). Many passengers have a second bicycle at their destination station to reach their workplace or university.

With this, the stations' bicycle parking spots can be used twice per day.

### 3.3 Taking a Bicycle on the Train

It is possible to take a bicycle on the train, at an additional €7.50 (R140) per trip, but this is prohibited in the peak hours to avail more space for passengers. This facility is mostly used for weekend leisure trips.

Folded bicycles are permitted on the train as hand luggage, and a few (approximately 3%) commuters do so. This would combine the benefit of cycling to and from the station, without the need and associated costs to park a first and/or second bicycle. One would, however, need a special foldable bicycle.

### 3.4 Shared Bicycle Rental at Stations

It is possible to rent a bicycle at the destination station. The *OV-Fiets* (PT-Bicycle) is a special form of a 'Last-Mile' bicycle-sharing scheme, linked mainly to train stations.

In 2019, 20,000 bicycles were available at 300 facilities (out of 400 stations). Annually, 5.3 million *OV-Fiets* trips are made (with a 25% annual growth); this equates to approximately 3% of the train trips. One can pay for renting an *OV-Fiets* with the same PT-smartcard as one uses for the train trip, at almost €4 (R70) per day. Theft of this bicycle will be charged €350, presumably the applicable purchase cost of the bicycle.

Only in recent years, other bicycle-share initiatives have become available in the Netherlands. It must be stated that the development of bicycle-sharing in the Netherlands is slower than in other parts of the world. Generally, bicycle-sharing is used where people have no bicycle available, including accommodating First/Last-Mile transport for PT. In the Netherlands almost everybody owns a bicycle (the Netherlands is alleged to have more bicycles than people), which can also be used for the First-Mile. This makes bicycle-share less viable, and mostly applicable for the Last-Mile only. Train users do see the advantage of sharing a bicycle for the Last-Mile egress from train stations, hence the popularity of the *OV-Fiets*.

### 3.5 Cycling to Local PT Stops

The majority (85%) of cycling-PT trips in the Netherlands is linked to train trips, with the remainder for bus, tram or metro trips. It is found that cycling to PT is mostly used for somewhat longer commuter trips, with a median trip length of 40 km (Shelat *et al.*, 2018).

Cycling is hardly used to access local urban bus and tram systems (Rijsman *et al.*, 2019). It would indeed increase the access catchment, but in general, bus and tram routes are dense, and a PT stop would be available within walking distance. Cycling is used in a few cases where it would avail a more convenient PT stop or more direct PT route, avoiding a transfer. However, the volumes are low, and secure bicycle parking at local PT stops remains an issue.

Cycling is used to access metro / Light Rail systems in the bigger cities, as these networks (comparable to train systems) are less dense and much faster than close-by available bus routes.

Cycling is also used to access rural bus systems, as the access distance from remote farms is often larger.

### 3.6 User Profile

Different studies indicate the trip purpose of bicycle–train users (Shelat *et al.*, 2018, Jonkeren *et al*., 2019, Mil *et al*., 2020). The groups that make use of the bicycle-PT combination are workers (50-65%), students (25-35%), and secondary school learners (0-15%). All of these groups indicate that they make use of this mode combination almost

daily in peak periods, although the bicycle–train combination is also often used by these groups in their social and leisure trips (30% of the trips). For the younger groups, it can be expected that a car is not available (PT Captives) or too expensive to use. However, the majority of workers generally have a reasonable income to afford car travel, do have a car available (Choice Users), and make the bicycle–train trip as it is more convenient and efficient than congested car travel.

Interestingly, bicycle–train travellers are on average more physically fit, which on the one hand removes a barrier to use the bicycle–train travel combination, and on the other hand can even provide an incentive for this combination: a light workout as a daily routine (Jonkeren *et al.*, 2019).

## 4. THEORETICAL DISCUSSION

The bicycle and train are two completely different modes of transport, although both seen as a sustainable competitor to the private car. The train is fast between two stations without any congestion, but one would need to access / egress the stations which will cost time. The bicycle on the other hand is extremely flexible, faster than walking, but is limited in range. The combination, however, is an ideal alternative to car use: a fast and flexible access to a fast and uncongested PT service, cheaper and often more convenient than using a private car.

In this section, some theoretical aspects of this mode combination will be discussed, not based on quantitative research, but exploring some qualitative opportunities.

### 4.1 Cycling Increases the Station's Catchment Area

With cycling (at 15 km/h on average) being roughly 3 times faster than walking (5 km/h), cycling can theoretically cover a distance that is three times longer. Within the same access time, cycling can cover a nine-fold larger catchment area, increasing the potential use of stations (Jonkeren *et al.*, 2019).

In the Netherlands, the median distance for walking to PT is in the order of magnitude of 500 m (with a wide range indicated in different studies), while the median cycling access is 2 km, both representing a similar access time (Shelat *et al.*, 2018).

In South Africa, the NHTS 2020 (Stats SA, 2021) reports that just over 50% of workers walk less than 5 minutes to their PT stop, 25% between 5 and 10 minutes, and almost 25% more than 10 minutes. This indicates a median walking distance of 500 m.

However, the situation at train stations is worse: 40% of workers walk more than 15 minutes. This would indicate a median walking distance of 1 to 1.5 km, with many train passengers walking farther. This situation has worsened in recent years because of the decline in train quality due to vandalism amongst others.

### 4.2 Train Speed Dependent on Station Spacing

To understand the potential of the bicycle-train combination, let us compare the railway systems of the Netherlands (NL) and South Africa (SA).

In the Netherlands, the railway system has some 400 stations for the population of 17 million. Rail stations are approximately 3 to 5 km apart, larger in rural areas. This results in

a relatively high average speed at 50-60 km/h for the all-stop trains. 1 in 5 people live within 1 km of a station (walking distance), 4 in 5 live within 5 km (cycling distance). Therefore, all metros, most urban areas, and even some parts of the rural areas are covered by the railway system.

The Intercity Express train system has station spacing of generally 20 km, resulting in an average speed of 90-100 km/h. A quarter of the population lives within a 5 km radius of the approximately 40 Intercity stations.

Additional to the train system, in the biggest metros, a metro / light-rail system is available, with station spacing of 0.5-1.5 km. This system operates at an average speed of 30-35 km/h and is mostly accessed by walking and some cycling.

The population in the main South African metropolitan areas (Gauteng, Cape Town, Durban, and both Eastern Cape metros) is approximately 24 million people and is serviced by the PRASA Metrorail which has some 500 stations. The rail network in Gauteng and Cape Town is fairly dense, whereas Durban and the two EC metros have a much lower catchment.

Access to stations is mainly by walking, resulting in a preference of short station spacings to make the system accessible. As a result, Metrorail has station spacings of 1.5 to 3 km, resulting in average speeds of 35-40 km/h (in the 'pre-vandalism' period). Despite the fact that the rail network is fairly dense, the majority of population lives outside a 1 or 2 km walking catchment area.

The Gautrain has a station spacing of 10 km which is accessed mostly by car, and has an average speed of 80-90 km/h.

Table 1 below summarises the train systems, with their average station spacing and their general average speed as running time including stations' dwell time on different corridors. From this data it can be seen that a clear relation exists between station spacing and average train speeds.

**Table 1: Station spacing and corresponding average train speed**

| Train System | Main Access Modes | Station Spacing | Average Speed |
|---|---|---|---|
| NL: Metro Light-Rail | Walking | 0.5 – 1.5 km | 30 – 35 km/h |
| SA: Metrorail * | Walking | 1.5 – 3 km | 35 – 40 (40 – 45) km/h * |
| NL: All-Stop train | Cycling, Walking | 3 – 5 km | 50 – 60 km/h |
| SA: Gautrain | Car, Feeder PT | 5 – 15 km | 80 – 90 km/h |
| NL: Intercity Express | Other PT, Cycling | 15 – 50 km | 90 – 100 km/h |
| EU: High Speed Rail | Other train, Car | 50+ km | 150 – 200 km/h |

* Metrorail infrastructure and rolling stock is in a poor state; the average speed was for the 'pre-vandalism' situation; after modernisation a somewhat higher average speed is deemed possible.

From the above it could also be suggested that a rich cycling culture can have a positive impact on the service characteristics of the train system.

## 4.3 More Travel Flexibility

Many people in South Africa have only a few PT options available within walking distance. Cycling could make more PT options available such as a slow (mini)bus route close-by, a BRT / train station somewhat further away, or even a fast Express train station further way. The latter might require a slightly longer cycling access trip but would avail faster PT options. Since PT is a multimodal trip by definition (a passenger is an NMT user at some point in the journey), any additional transfers are valued more negatively. Thus, stations with a more direct service are more attractive. A Dutch stated preference survey indicated that people are prepared to cycle 6 minutes farther to avoid a transfer (Mil *et al.*, 2020).

Cycling would further increase travel reliability in the event of planned or unplanned disruptions at one of these PT systems (Jonkeren *et al.*, 2019).

Because of the flexibility of cycling, many bicycle–train travellers combine other activities with their commute trip, like visiting the supermarket or shop, going to a restaurant or bar, and other chores (Jonkeren *et al.*, 2019).

## 4.4 Changing Urban Patterns

As more people tend to move to cities, these cities struggle to accommodate the growing car traffic and demand for parking areas. PT is a much better option, with cycling applicable for shorter distances. As mentioned above, cycling could further enhance the catchment area of the PT system, making them more attractive and viable.

Currently in South Africa, the metropolitan areas are getting too big to be accommodated by minibus-taxi, and it requires higher-capacity and faster BRT and train systems. Unfortunately, South African metros have a fairly low density, where a dense BRT/rail network seems to be somewhat less viable. However, both cycling and minibus-taxi systems can feeder and further optimise these systems (Verkade, 2017).

In small towns and rural areas: PT by minibus-taxi seems to be adequate, with cycling a good alternative.

Cycling could be accommodated by further reducing facilities for car traffic such as providing fewer parking spots, which in turn would avail land for development of other uses and would promote a better urban realm quality. Also, the maximum speed on streets can be reduced (ideally 30 km/h), making these streets safer and better places to live, further enhancing walking and cycling. This all could facilitate denser localities for shops and facilities and introduce the necessary aspects of the ideal ‘15-Minute City’.

Furthermore, cycling will influence the choice of residence areas of ‘train–cyclists’ (within cycling distance of a station), where they work (ideally near a station, or use a 2$^{nd}$ bicycle), and where they meet people (near stations, as those places are accessible for all). Consequently, the more train–cyclists, the more the urban pattern will be adjusted to accommodate cycling and promote improved and sustainable cities (Verkade, 2017).

## 4.5 Required Quality Aspects

There are many reasons why people in South Africa do not cycle, and various measures are required to get them to cycle. Da Silva *et al.* (2022) surveyed leisure cyclists and identified a set of measures required to get leisure cyclists to cycle to work, school and

shops as well. It is assumed that implementing similar (or even more prevalent) measures would be required for other commuters to make use of cycling. These quality aspects are also mentioned in many other studies on cycling in South Africa: Bechstein (2010), Jennings (2015), CoCT (2017), amongst others.

In this section these measures are applied to the cycling access / egress to PT stations.

### *4.5.1 Secure Bicycle Parking Facilities*

Cycling is a low-cost mode of transport. However, there are costs associated with owning a bicycle (and replacing a stolen bicycle), as well as maintenance and services.

Therefore, at the applicable PT stations, secured parking facilities need to be provided (at a small fee) to limit the risk of bicycle theft. This would be a task for the Transport Authority, in combination with the PT Operator such as PRASA or the Gautrain.

As long as the cycling volumes are still low, these facilities will need to be subsidised. The viability could increase if these facilities are also used for bicycle parking for visits to nearby local facilities (shops, work). Furthermore, a service workshop for small repairs (e.g. punctures) could be included, not only for 'train–cyclists' but also for the local community. Additionally, where applicable, it could include a rental facility for bicycles to be used for the Last-Mile egress.

For passengers' convenience, an integrated payment system, using the same smartcard as for train use, could be applied (Mil *et al.*, 2020).

Although 'cycling to work' might require shower facilities at the destination (da Silva *et al.*, 2022), this would not be required (or even be feasible) for train stations, as the cycling trip is generally limited to 2-5 km, which is generally less exhausting than walking 1-2 km.

### *4.5.2 Safe and Convenient Cycling Networks*

Generally, in South Africa, cycling on the road is perceived to be very unsafe. Improving traffic safety would require the provision of a cycling network to stations (and town centres), with dedicated cycling lanes along major arterials, and lower traffic speeds on quiet residential roads (da Silva *et al.*, 2022). Additionally, the provision of streetlights is required. This is a task for local municipalities, not just for cycling to stations, but for promoting cycling in general.

Research has shown that the integration of bicycle and public transport assists in creating safer biking communities which motivates more riders to cycle and further strengthens the transport system. Additionally, the increase in cyclist numbers can improve vehicle behaviour as they become more aware of the cyclists (Jacobsen, 2015). Therefore, in terms of the South African context, improving the modal share for the access/egress to public transport stations will assist in improving the safety of cycling and the sustainability of the wider transport system.

Another addition for cycling convenience is the use of electric bicycles. Cycling involves some physical effort, especially in hilly areas such as Durban and Gauteng. Electric bicycles could enhance cycling by alleviating the physicality and enable more enjoyable commutes. This could even increase the cycling distance and associated catchment area of stations. However, electric bicycles are more expensive which could make them more targeted for crime activities; therefore, secured parking facilities are even more required (possibly even with a charging facility).

*4.5.3 Supportive Policies and Attitudes*

National and most municipal governments have an NMT policy in place, but this is hardly being implemented due to various reasons. This is withholding commuters to cycle. Similarly, Transport Authorities have a PT policy in place, albeit slowly being implemented. Therefore, cycling to PT has a long way to go. Probable reason is that the volumes are low, therefore priorities are low as well. However, without pro-active measures, volumes will remain low, and would-be cyclists will remain feeling neglected.

Another setback is the fact that both PT and cycling are seen as "poor-man's transport", which further withholds many to use either of these modes. There is some movement away from this image where the Gautrain attracts higher-income commuters, with Metrorail modernisation and BRT also aiming for a similar market. Also, leisure cycling is mostly a middle/higher-income activity; thus, it should be possible to attract them to become commuter cyclists (da Silva *et al.*, 2022)?

The benefits of cycling, and cycling to PT stations, are multiple. They include (but not limited to) the reduction in traffic congestion, improvement in urban realm, reduced environmental impact, healthy communities, social and economic benefits, etc., all good reasons to implement the cycling policies.

Implementing the cycling-to-stations policy would require multiple stakeholders (Transport Authority, PT Operator, multiple municipal departments, etc.). Current policy implementation is segregated and therefore not effective. A more holistic approach would require integrated implementation. The City of Cape Town's Cycling Strategy (CoCT, 2017) is such an example, although it is awaiting sufficient budgets and subsequent implementation.

## 5. HOW TO APPLY IN THE SOUTH AFRICAN CONTEXT?

The authors have applied above lessons to the access / egress of the Gautrain system with Hatfield Station as pilot. From this, additionally, cycling to Metrorail, BRT and minibus-taxi is explored.

### 5.1 Cycling to Gautrain

The Gautrain system has large station spacings and hence stations' catchment areas of more than 5 km, currently mostly accessed by car. This would be ideal to promote cycling to the station and reduce the pressure on parking facilities.

It was assumed that bicycle access to the station could mainly make use of an own bicycle, but safety of the cycling trip should be improved. This would require dedicated cycling lanes on main busy arterials; however, shared use of quiet residential roads should be possible, ideally with lower traffic speeds.

At the Gautrain station, secured bicycle parking would be required. The Hatfield Parking has some spare capacity, and a portion of the ground floor could be reserved for bicycle parking, including a service facility.

For egress to various local destinations, often 1-2 km away, a shared bicycle programme could be introduced. Such programme already exists for the University of Pretoria, with 2 hubs at the Hatfield main campus and the LC de Villiers Sports Ground. This programme

could be expanded to Gautrain use, with an additional hub in the Hatfield Gautrain Parking. Such shared bicycle programme could include additional hubs elsewhere in Hatfield, near shops and main work destinations.

Payment of bicycle parking and using the shared bicycles should then be made possible via the Gautrain smartcard, similar to Gautrain's bus and car parking use.

It was found that the above measures would not only accommodate train-cyclists but should also enhance cycling to the local CBD facilities, the University, and other work opportunities. Promoting cycling has to be an all-encompassing policy, not aimed at one trip purpose only. Therefore, implementation should be done in collaboration by the Municipality, Gautrain, and main local institutions. The coordinating role could be at the Transport Authority of Gauteng.

### 5.2 Cycling to Metrorail

Metrorail has a shorter station spacing than the Gautrain system, but many passengers still walk 2-3 km or access the stations by minibus-taxi. Similar to Gautrain use, access to Metrorail stations could be made more convenient by facilitating cycling.

The safety of the cycling network would require similar measures as mentioned before: dedicated cycling lanes and/or shared use of quiet roads.

Selected Metrorail stations, especially those stations with a (future planned) Express train service, would require bicycle parking facilities, including a service facility. Parking fares should remain low, owing to the predominantly lower-income users of Metrorail.

Shared bicycle facilities might not be viable, as the additional user costs for such service is often not competitive against using a minibus-taxi or walking the Last-Mile.

### 5.3 Cycling to Bus and Minibus-Taxi Ranks

For local PT, access by bicycle seems to add little value. Bus and minibus-taxi stops are often abundant, and cycling doesn't decrease access time. There might be a few occasions where cycling could be used to access a BRT station, to avoid a transfer from a feeder PT route. However, secure parking would be required at those BRT stations, which for the low cycling volumes would be unviable.

There might be an opportunity to avail bicycle parking at taxi ranks, as there the access distance is often larger. However, the taxi system is operating quite ambiguously. It is often only possible to access a taxi vehicle at a rank (where it leaves when full, hence no access possible en-route); this would indicate a long access distance / time, suitable for cycling access. But it is often possible to exit a vehicle en-route, possibly closer to the destination with shorter egress. This would also count for the return trip, where you could exit the taxi close to home, but your bicycle would still be parked at the taxi rank.

However, owing to the fact that taxi ranks are known to have safety and security issues (NHTS, 2021), secure bicycle parking facilities and safe cycling routes are required. This is a major task for the Transport Authority / Municipality. The taxi industry, however, might be reluctant to support such an initiative as it might take away feeder trips currently served by other taxis.

## 6. CONCLUSIONS AND RECOMMENDATIONS

Currently in South Africa, there is hardly a commuter cycling culture to cycle to work, school and shops; and cycling is unused to access the PT systems. This can be attributed to the unsafe road conditions, the lack of facilities and infrastructure to support this modal combination, and generally a stigmatism around the mode.

However, cycling can improve access to PT systems, especially train systems, and will increase the stations' catchment area. The cycling access to the stations has less effort than walking long distances, and is cheaper than a feeder trip by other PT.

To enable more people to cycle to access PT systems, will require secure bicycle parking facilities, possibly including a service workshop and/or rental of bicycles, to be organised by the Transport Authority and/or PT Operator. It will also require a safe cycling network, to be organised by local municipalities, not just for 'cycling to stations', but for promoting cycling in general.

In theory, it would be possible to re-design the PT network, with a less dense catchment, as people who live further away could come to the PT station cycling – similar as the current BRT system is designed for people to access with feeder PT. However, this is not advised, as the majority of passengers would not have a bicycle available or are not capable / willing to cycle (nor willing to pay for feeder PT); the majority would still access the system by walking. Therefore, a short access is required with short station spacing.

Cycling, however, could avail better PT options at stations a bit further away (e.g. Express services). It can also reduce the amount of access trips made by car to Gautrain stations (and future Metrorail Express stations), reducing required parking space, congestion, and improving the public realm and environment.

This paper used the Netherlands as an example of what is possible with such a modal combination. The authors realise that this is not comparable to the South African situation, and hardly comparable to other countries. However, other countries are slowly seeing increasing bicycle–train use; many of these countries were in recent past largely car dominated. Therefore, it is not impossible for South Africa to make the shift. The paper shows a different way of thinking.

These developments will take a long time to materialise, but it is advised to start now, in order to introduce a better cycling culture in South Africa and improve the wider transport network. Additionally, there are various actors that are required to work together to realise this: collaboration in implementation is key.

## 7. REFERENCES


Bechstein, E, 2010. *Cycling as a supplementary mode to public transport.* 29th Southern African Transport Conference (SATC 2010), pp.33-41, Pretoria.

City of Cape Town (CoCT), 2017. *Cycling Strategy.* TDA, Cape Town.

Da Silva, E & Onderwater, P, 2022. *Harnessing leisure cyclists to promote commuter cycling*. Southern African Transport Conference (SATC 2022), Pretoria.

Jacobsen, PL, 2015. *Safety in numbers: more walkers and bicyclists, safer walking and bicycling*. Injury Prevention, 21:271-275. (2015)

Jennings, G, 2015. *A bicycling renaissance in South Africa? Policies, programmes & trends in Cape Town*. 34th Southern African Transport Conference (SATC 2015), pp.486-498, Pretoria.

Jonkeren, OR, Kager, L, Harms & te Brommelstroet, M, 2019. *The bicycle-train travellers in the Netherlands: Personal profiles and travel choices*. Transportation (2021), 48:455-476. Springer.

Nederlandse Spoorwegen (NS, Dutch Railways), 2020. *NS Jaarverslag (Annual Report) 2019*. Utrecht, the Netherlands.

Rijsman, L & Van Oort N, *et al.*, 2019. *Walking and bicycle catchment areas of tram stops: Factors and insights*. IEEE, the Netherlands.

Shelat, S, Huisman, R & Van Oort, N 2018. *Analysing the trip and user characteristics of the combined bicycle and transit mode*. Research in Transport Economics, 69:68-76. (2018). The Netherlands.

Statistics South Africa (Stats SA), 2021. *National Household Travel Survey (NHTS) 2020*. Statistical release P0320, Pretoria.

van Mil, JFP, Leferink, TS, Annema, JA & van Oort N, 2020. *Insights into factors affecting the combined bicycle-transit mode*. Public Transport (2021), 13:649-673. Springer.

Venter, C, 2020. *Measuring the quality of the first/last mile connection to public transport*. Research in Transportation Economics.

Verkade, T, 2017. *De Treinfietser (the train-cyclist)*. De Correspondent, Amsterdam.

Wentley, O & Hitge, G, 2013. *Understanding the Utilisation of Park and Ride Facilities*. 32nd Southern African Transport Conference (SATC 2013), pp.15-24, Pretoria.