FUTURE CAPETONIAN IRT STATION AREAS PROFILES EXPLORED

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ABSTRACT

There is a growing interest in station area development across the globe, since the improvement of public transport services at station areas shapes favourable conditions for restructuring the urban fabric. Cape Town is no exception, while the Integrated Rapid Transit (IRT) will introduce new public transport station areas, serviced by high-quality public transport. In order to discuss the additional development potential of these station areas, this paper examines the station area profiles of 323 (partly hypothetical) future IRT trunk station areas. The goal of this exercise is to contribute to the integrated development discourse in Cape Town. What will the city look like after the implementation of the city-wide IRT, and where is the future development potential located?

1. INTRODUCTION

There is an ever-growing interest in station area development. One of the reasons is that improved public transport will shape favourable conditions for new land-use (Wegener & Fürst, 1999). This can be extensively seen in many European and Asian countries where numerous cities are promoting station area development (Bertolini, 1998; Cervero, 1998). Peek, et al. (2006) highlighted several developments that fuel this interest in the station areas.

1. Concerns about urban sprawl and car dependent growth patterns
2. New development opportunities as a result of new transport technologies
3. Competition between cities, large investments are made in grand urban (transport) projects.
4. Growing market-orientation of transport companies (e.g. diminishing operating subsidies)

Some of these developments can also be found in the Capetonian context. Firstly, Cape Town is characterised by urban sprawl and car-dependency; the prime example is the continuing low-density development on the northern fringe of the city (Toruk, 2001).The promotion of denser development around high accessible nodes is a means to offer an alternative to the tendency of sprawl. The second and third point take shape in the form of the Integrated Rapid Transit (IRT) project in Cape Town. The IRT will enhance (future) public transport station areas as the new entrances to high-quality public transport, making them relatively attractive locations for development. Fourthly, market-orientation is an ever-present issue in Cape Town (and South Africa), since public transport subsidies are costly and public funds are finite. For instance, the first phase of the future IRT is expected to run with a cost deficit of R118 million annually (Cape Town, 2010), which suggests that interventions should be explored to improve the viability. Overall, these observations suggest that the fundamentals are in place for an enhanced focus on public transport station areas within Cape Town.

The goal of this paper is to contribute to the integrated development discourse by examining the future IRT station area profiles, and mapping the development potential for additional policy interventions.

Chapter 2 explores the methodology that will be used for station area profiling in Cape Town, elaborating on the node-place model as prime method. Chapter 3 addresses the used input for station area profiling, giving a detailed insight in the choices made. Chapter 4 discusses Capetonian station area profiles, showing a diversity of profiles within the city. Chapter 5 concludes this paper by discussing the goal of this paper.

2. THE STATION AREA AS UNIT OF ANALYSIS

2.1 A perspective for the station areas profiling: station areas as nodes and places

Bertolini (1996, pp.330) has stated that the nature of a station area is dual: station areas are "…*nodes of networks, and places in the city*". In later work, Bertolini (1998) describes the *node* as the potential to physically interact at the station area, and the *place* as the actual interaction taking place within the station area. From a theoretical point of view, the potential should be met by the actual interaction. To analyse station areas from this perspective, Bertolini (1998) designed a model to compare multiple station areas between each other, and to map, among others, the development potential of the node and the place. Figure 1, illustrates the node-place model, which will be further discussed in the next paragraphs.

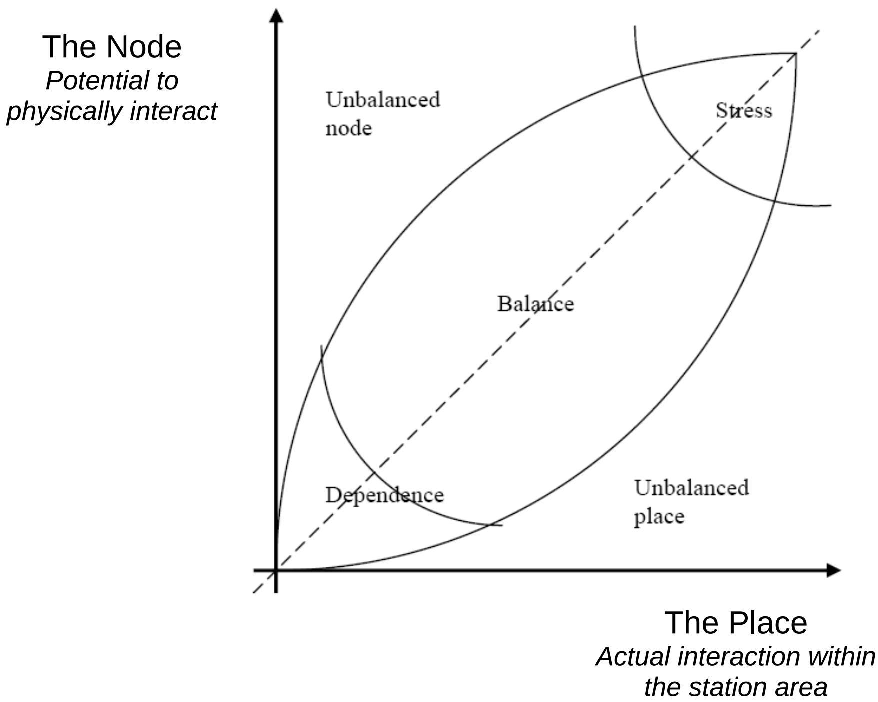

Figure 1: Node-place model as designed by Bertolini (1998)

Depending on their node and place scores, station areas can have different positions within the model. Besides the achievement of balance between the potential interaction and the actual interaction, four characteristic areas could be identified:

- *Stress area*: the potential is met by the actual interaction. These are station areas where excellent public transport characteristics are accompanied by multifunctional, high-density development. Expanding the node or place at these station areas is difficult, since both the node and place have huge spatial implications
- *Unbalanced node*: the potential to interact is not met by the actual interaction. These are station areas with excellent public transport characteristics, but with low-density, monofunctional development.
- *Unbalanced place:* the actual interaction is not met by the potential to interact. These are station area without adequate public transport. Inhabitants and employees are more dependent on non-public transport nodes.
- *Dependent area:* these areas have both a weak node and a weak place. There is no struggle for space. The level of public transport services is low, but so is the demand. Dependent station areas are generally not viable on their own.

The dual nature of station areas is embraced by many authors and governmental bodies across the globe. One recent example is a report of the Dutch advisory council for urban welfare and spatial planning which put emphasis on station area development – the intensification of node and place in a balance matter around railway stations – as means to reach a more sustainable future in the Netherlands (VROM-raad, 2009). This is one of many indications that show increased emphasis on station area development as a node and a place. In international literature, many other authors have put emphasis on this dual nature, among others, Belzer & Autler (2002), Chorus (forthcoming) and Reusser, et al. (2008). In sum, the perspective of node and place is widely accepted to be an adequate perspective for the analysis of station areas.

2.2 Balance and accessibility, sustainability and equity

Literature review suggests that there are several reasons why a match between the potential interaction and the actual interaction should be achieved. The relationship between balance and the issues of accessibility, sustainability, and equity has been briefly explored.

From an accessibility perspective:

- If the actual interaction (place) of the station area increases, the demand for interaction grows as well. A stronger node will be necessary to facilitate new movements that are generated or attracted by the activities (Wegener & Fürst, 1999).
- If the potential to interact increases (node), favourable conditions will be shaped for new land-use (place). From this perspective, the node value is underutilised if the place value is not increased as well (Wegener & Fürst, 1999)

From a sustainability perspective:

- An underutilised node/place could lead to unnecessary transport cost for the community (e.g. overcapacity or congestion) (Wee & Dijst, 2002). The node and place value should fit the characteristics of the station area.

From an equity perspective:

- Relatively low potential to interact (node) could lead to social exclusion (OECD, 2008). In this case, limited options are available and people are restricted to the use of other, more expensive means of transport. This could restrict the financial situations of the poorest communities (Kenyon, et al., 2002).
- From an equity perspective it is positive to offer a considerable potential to interact and a dense and mixed environment. This will allow more lifestyles than are

possible in a low-density, monofunctional, car-oriented environment (Newman & Kenworthy, 1999).

These notions support the fact that focusing on station area, and realising a match between the potential and the actual interaction can to a certain degree address many problems in South African cities. It should be noted that the effect of creating a balance is strongly dependent on the context of the station area itself, since other (local) factors influence accessibility, sustainability and equity as well.

3. SELECTING THE INPUT FOR STATION AREA PROFILING IN CAPE TOWN

3.1. The Capetonian public transport network and the urban fabric in 2030

Because of the high-quality characteristics of the IRT, the IRT trunk stations have been selected for station area profiling. Currently, 72 IRT trunk station areas have been identified for phase 1a, or are addressed in the online city-wide network illustration. While the amount of station areas identified is still limited, the city has a global indication of future routes for trunk and feeder services. Based on the spacing of trunk stations on one of the urban corridors (CBD – Table View; approximately 1000 meter spacing), 251 hypothetical stations have been identified to complete the future IRT city-wide trunk network. The urban fabric that will be analysed together with the city-wide IRT is based on the 2030 transport zone information of Cape Town. Despite the restriction of this data to peak hours and commuter flow, this data offers global insight in the interaction within a transport zone.

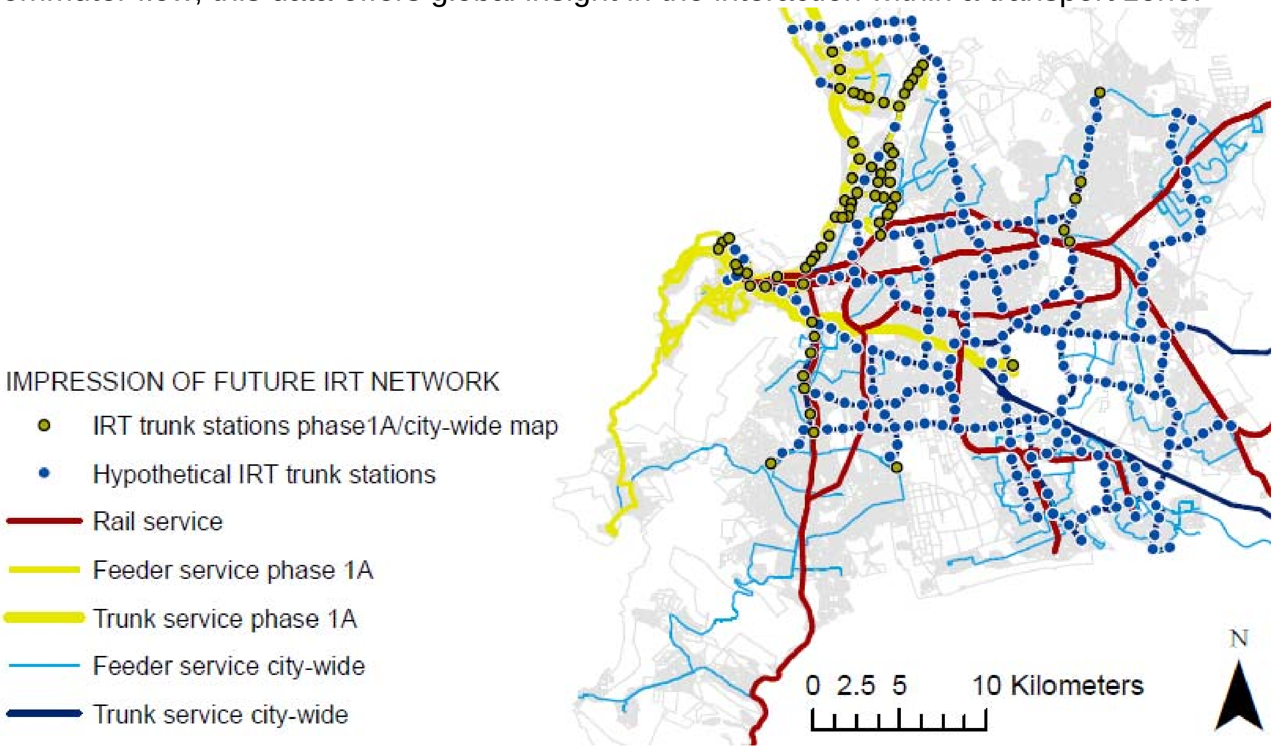

Figure 2: Impression of the future public transport network and the IRT stations

Figure 2 offers an impression of the future public transport network in Cape Town. The public transport network consist of the rail, IRT trunk and IRT feeder services. It is assumed that current scheduled bus services and minibustaxi routes will be incorporated in the feeder routes of the IRT. In this illustration, the currently 72 identified IRT trunk stations and the 251 hypothetical stations are displayed.

3.2. Defining the station area: the pedestrian pocket

The station area is defined as a pedestrian pocket with a radius of 800 meters from the station, which represent a 10 minute walking time. This distance is based on several views. First of all, the guidelines for human settlement planning and design, which supports 800 meter as the pedestrian pocket for railway stations and 400 meter for scheduled bus services (CSIR, 2000). It is assumed that the IRT will offer more quality than the current scheduled bus services, and the impact area of railway services will better suit the IRT. Secondly, the MSDF redraft of 2001 put emphasis on 10 to 12 minutes walking time to public transport stations in the city (Cape Town, 2001). Based on an average walking speed of 4 km/hour, a radius of 800 meter could be perceived as the pedestrian pocket around high quality public transport nodes. However, it should be noted that all future IRT users will go to the closest station unless connections or amenities are unique at station areas on a (slightly) greater distance. Furthermore, the pedestrian pocket of 800 meter is a global indication, since empirics about the acceptable walking distance to IRT are not available yet.

3.3. Input for the node and the place: three examples

To gain insight in the use of the node-place model for station area profiling, three examples have been selected. These examples give insight in the identification of the node and the place indicators. Table 1 shows the diversity of indicators that are used to determine both the node and the place. Nevertheless, these cases also share common ground: both the node and the place have been equipped with quantitative and qualitative indicators.

For both the node and the place, the values of the underlying indicators are standardised in scores between 0 (lowest value) and 1 (highest value) value. Subsequently, these values are joined together to determine the node and the place score of an IRT trunk station area.

Table 1: indicators to determine the node and place value[1]

	Dutch case	Swiss case	Japanese case
Node	• Number of directions served by train • Number of train services • Number of stations within 45 minutes • Number of direction served by bus, tram and underground • Number of bus, tram and underground services • Distance to first motorway access • Parking capacity for car • Number of dedicated bicycle paths • Parking capacity for bicycles	• Number of directions served by train • Number of train services • Number of stations within 20 minutes • Number of directions other public transport • Frequency of other public transport • Distance to first motorway access • Number of dedicated bicycle paths • Number of daily passenger • Type of train service	• Number of train services • Type of train connections • Travel distance to CBD • Number of bus services
Place	• Number of inhabitants • Number of employment opportunities per economic cluster • Degree of functional mix	• Number of inhabitants • Number of employment opportunities per economic sector • Degree of functional mix • Presence of conference rooms and educational facilities • Distance to town centre • Presence of commercial services	• Number of inhabitants • Number of employment opportunities • Degree of functional mix

3.4. Defining the node and the place for Capetonian station areas

It should be taken into account that not every factor has a certain optimum. For example, Belzer & Autler (2002) suggest that there is no optimum for the degree of functional mix at a station area, and that it is strongly context-dependent. For this reason it has been preferred to limit the indicators for node and place to one quantitative and one qualitative factor, while using factors that have a generally agreed optimum (e.g. higher is better).

3.4.1. *Input for the node – the potential interaction*

Two indicators have been selected to determine the node score. Firstly, the amount of employment opportunities that is accessible within 45 minutes[2] travel time from the station. This is perceived as a general indicator to show the potential that can be reached from the station areas, and vice versa. Secondly, the amount of daily IRT feeder, IRT trunk and train services that arrive and depart within the station area, which gives an indication of the quality of this potential.

The amount of employment opportunities accessible within 45 minutes travel time has been calculated with the GIS program Flowmap, which is developed by the University of Utrecht (University Utrecht, 2010). The train, IRT trunk, IRT feeder, non-motorised network

[1] Based on the work of Bertolini (1999; 2007); Chorus (forthcoming), and Reusser, et al. (2008)

[2] This is the average travel distance for all travel modes (DoT, 2003). This value has been used since the IRT is also aimed at current non-public transport users.

have been modelled. The IRT trunk and IRT feeder have been modelled with service intervals of 10 minutes peak, and 20 minutes off-peak[3]. For the rail network, the new Century City railway station has been included, although average service intervals of 2010 have been used due to a lack of detailed information.

In this view, a station area with a large potential for interaction within 45 min travel time and a high amount of public transport trips is characterised by a strong node score.

3.4.2. *Input for the place – the actual interaction*
The indicators to determine the place score are: the sum of origins and destinations within the station area, and the diversity of activities. The latter one consists of the balance between origins and destinations. These indicators show the intensity of station areas – the amount and kind of interaction that is taken place. The place information has been gathered using buffer analysis in ArcMap.

In this view, a station area with many origins which equals the amount of destinations receives a high place score.

4. IRT STATION AREAS PROFILES

4.1 Considerations for interpreting the station area profiles

The results of the station area profiling of IRT trunk station should be interpreted with some consideration, since the analysis is based on future information, which comes with a certain degree of uncertainty. Four considerations should be taken into account.

1. Currently identified routes can be changed, or new routes added
2. The 252 hypothetical stations are merely potential stations, which can somewhat differ from the future identified IRT trunk stations
3. The 2030 zoning information is an indication of future intensity of land-use, not a snapshot of the future.
4. Buffer analysis is used to determine the amount of origins and destinations in station areas, without regard to natural barriers during the allocation process.

4.2 Pattern of station areas profiles

In general, the pattern of station area profiles in Cape Town is characterised by relatively low place scores. In 2030, the highest place score in Cape Town is 0.55, which could be explained by the lack of station areas with both a high density of origins and destinations and a balance between them. The denser station areas tend to have a very mono-functional nature in Cape Town.

On the side of the node, there exists a more diverse pattern. Extremes are IRT station areas in the CBD area, where many IRT services come together, and many destinations are in reach within the average travel time of 45 minutes. Other station areas follow on greater distance, and are often located near the CBD, or near (new) major interchanges in the city.

The station area profiles are displayed in figure 3: In the next section, these results will be discussed in more detail, making the impact of the position in this scatter diagram clearer.

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[3] These characteristics have been discussed with John Spotten (Head: Transport Modeling and Systems Analysis; City of Cape Town)

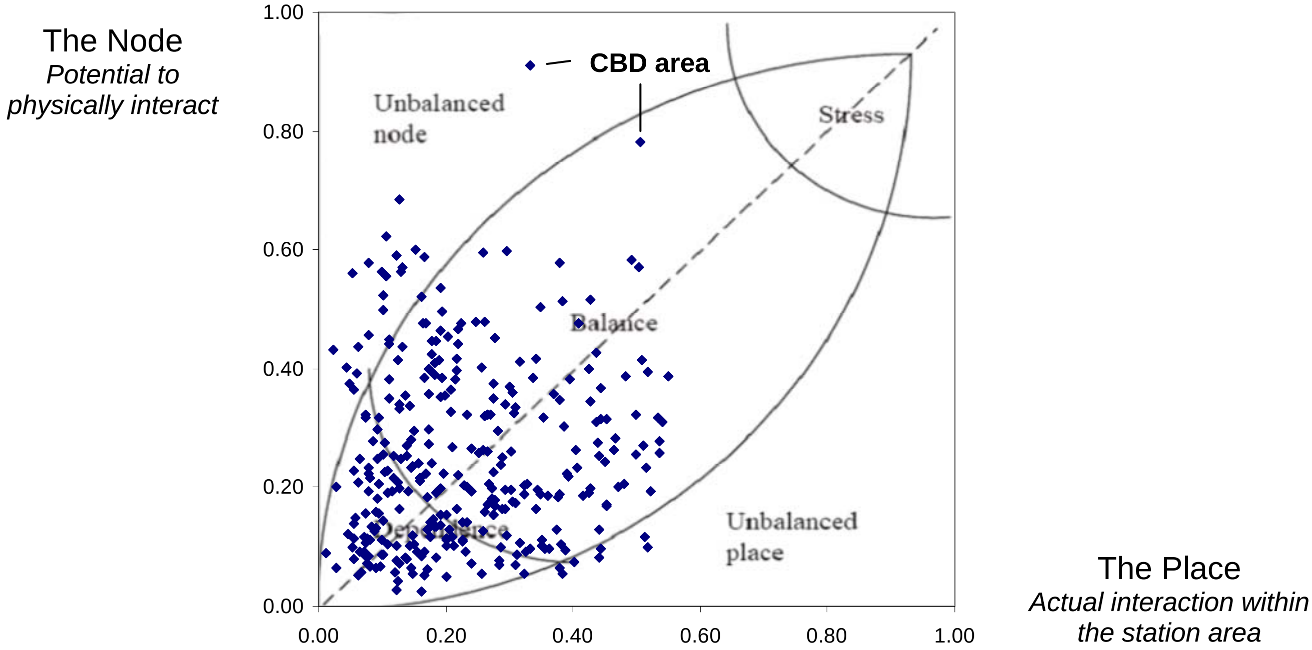

Figure 3: Pattern of station areas profiles

4.3 Station area profiles explored

The distribution of the node and the place has been mapped in figure 4.

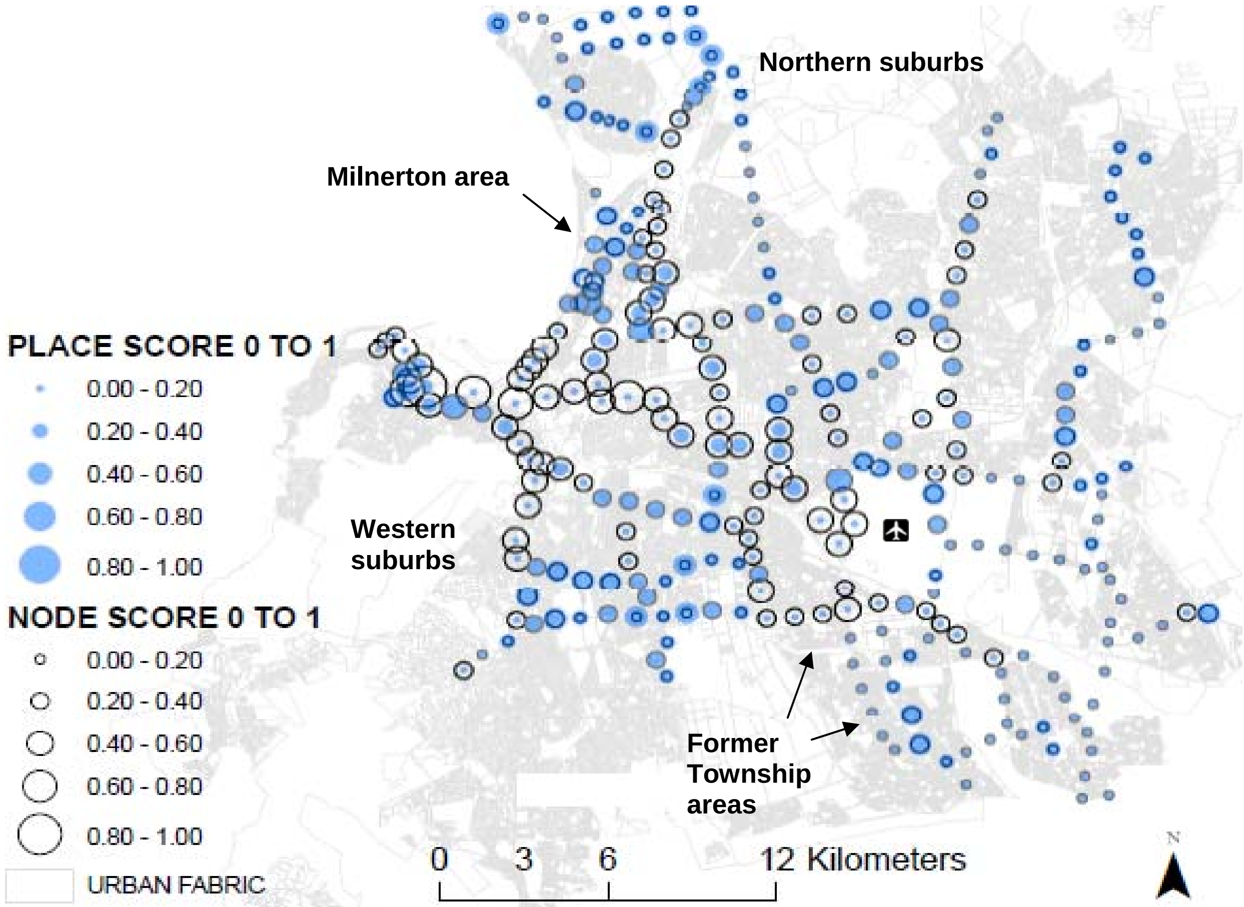

Figure 4: Capetonian station area profiles

A visual inspection of these station area profiles teach us that the CBD and the eastern approach route show a high potential to interact, which is – from a theoretical perspective – not met by actual interaction at the location itself. In general, these locations have a low intensity of activities as well as low degree of balance between origins and destinations. Especially the approach route has both IRT and train services which position the locations relatively well in the network, although their value as places in the city are somewhat limited. A second cluster of station areas that draws attention are the station areas west and southwest of the Airport, just north of the former townships areas. Here multiple public transport services join together and offer good connectivity in many directions.

From a node-place perspective, these station areas are ideal locations for intensification, or diversification of land-use, to better meet the potential to interact at these station areas. The improved utilisation will result in a better viability of the IRT services, but will also result in more vibrant places in the city.

Besides the phenomenon of underutilisation of the potential to interact, there are also station areas that lack the necessary potential for interaction. Examples of this can be found in the northwest of the city where green field development consumes valuable land. These, mainly, mono-functional developments are built on great distance of employment opportunities, resulting in a low potential to interact. A result is that people living in these areas are forced to travel longer than average to reach the same amount of employment opportunities as other station areas. Since it induces unnecessary travel, it could be perceived as unsustainable. At the same time, the weak node score suggests that public transport might not be the fastest travel mode, which results in increased dependency on the car.

From a node-place perspective, increased public transport services can help to increase the potential to interact. This could include more daily public transport trips, or a better alignment within the public transport network. Nevertheless, it should be noted that providing good nodal qualities on a large distance from the city can incur great expense.

The third category consists of the somewhat balanced station areas, where the potential for interaction at the station is met by the actual interaction within the station area. These locations are spread out all over the city. One thing that should be noted is the presence of two balanced station areas in Mitchell's Plain, to the southwest side of the former township areas. Along with rail and IRT services, two economical centres: the former town centre and the parade shopping centre exist within the pedestrian pocket of the two IRT stations. Therefore these station areas have strong place scores that match the nodal qualities.

From a node-place perspective, these locations should be maintained and preserved to keep the balance between the node and the place. A change of the node or the place should be accompanied by appropriate node or place interventions.

Overall, the match between the node and the place should be achieved, and existing matches between the node and the place maintained. The means to cope with these station areas are limited to a few ideas, due to the length restriction of this paper. These ideas for interventions, and many others, deserve further exploration.

- Nodal interventions:- increase connectivity within the public transport network
  - increase daily public transport trips
- Place interventions - zoning bonuses for intensification and differentiation
  - tax-incentives to encourage development

Shaping conditions for enhancing the match between the node and the place can help Cape Town to become a city that is more accessible, sustainable and equitable on the long-term. The window-of-opportunity to act is today.

5. CONCLUSION: STATION AREA PROFILING

Despite the quick-scan characteristics of this approach, station area profiling offers a strategic tool to examine the position of public transport nodes and its station areas within Cape Town, and other South African cities. Many future station areas could be identified that – at least from a theoretical perspective – could be improved with either node or place interventions. At the same time, station area profiling put emphasis on the fact that a public transport improvement is not a stand-alone solution and should form a hand-in glove fit with an urban economic strategy to create a viable public transport and a successful city.

ACKNOWLEDGEMENT

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