

Public transport service design requirements for the changing face of the South African customer

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Abstract

The philosophy of a design user is often used in the design of infrastructure in order to facilitate its effective utilisation by the majority of its target population. Within the services sector, however, the science of the design of services has only recently been gaining momentum and literature is increasingly making available theoretical frameworks for service design such as Quality Function Deployment and the Kano model. The extension of such a knowledge base to the design of public transport services is conceptually appealing and holds promising prospects. Nonetheless, the basic design requirement in all these theoretical frameworks is the identification of the voice of the customer and how this is carried through the entire design process.

Based on the life cycle dynamics of the South African population, the paper investigates the implications of such dynamics on the design requirements of public transport services. The life cycle dynamics considered in the paper refer specifically changing circumstances related to travel patterns, demographics and some social reforms. Several household surveys that include the National Census and the National Household Travel Survey are used for analytical purposes, and therefore, the paper is limited to the dimensions of the respective surveys. The paper attempts to identify the design customer or group of customers and associated design implications. The findings are especially relevant to the refinement of passenger transport design standards.

1. Introduction

South Africa, with a reported population of 46 888 200 in 2005, made a transition to a democratically governed country in 1994. Prior to that, the country was governed along racial lines in which statutory provisions were explicitly designed to offer privileges to white people at the expense of black people (generally grouped as Indian, Coloured and Africans). Even after the adoption of what is considered one of the most liberal constitutions in the world, the legacy of racial segregation still defines much of the daily lives of South Africans. Nonetheless, the South African society is fast adopting a newer identity characterised by the quest to improve the quality of life of all citizens, as well as to successfully compete globally. The transport system is considered to be at the heart of the societal transformation process, and it is generally accepted that its performance contributes significantly to improving the competitiveness of the country.

Of interest in this paper is to illustrate the implications of emerging societal trends on the design of the operations of passenger transport systems, with emphasis on public transport. In this way the paper attempts to bridge two subjects that have often been treated separately, namely, transport policy and transport operations. The argument presented shows that the customer provides the linkage between these two areas, and it is through the identification of the design customer or groups of customers that more effective designs can be implemented. This philosophy is widely used in the design of infrastructure as well as in manufacturing, and theoretical frameworks such as Quality Function Deployment are deployed for the purpose. The design of passenger transport systems on the other hand have often relied on Newton's laws of motion and capacity analyses where emphasis is placed on the mechanics of the system to facilitate the design of transport infrastructure. The dynamic needs of the customers, however, demand that the passenger transport design processes increasingly become sensitive and responsive to these needs. Reliance on mechanistic design methods, while still important, it becomes far from adequate. In this paper the changing circumstances of the South African population is used as a case study to illustrate the need for improved passenger transport service design methods.

2. Background

The design of public transport services is traditionally focused on the characteristics of the transport system such network configuration, fleet management, right of way options and scheduling, for example, as provided for in Vuchic (2005). While such design techniques are a necessity, they become insufficient on their own when applied in socially diverse societies such as South Africa. Improved understanding of societal dynamics and their implication on system design become critical. The explicit exclusion of such dynamics has often been justified on grounds of decision making frameworks such as 80:20 rule. However, the cumulative exclusion of such societal dynamics, while unknown, appears potentially critical.

Interest in the design of public transport services that are responsive to the dynamic needs of customers is gaining momentum. The strong emergence of the concept of performance-based contracting regimes bear testimony to this, in which techniques such as stated preference modelling have been applied to quantify and design quality contracts (Hensher, Stopher and Bullock, 2003). Tools that combine both quantitative and qualitative approaches such as Quality Deployment and the Kano model (Ramaswamy, 1996; Tan and Shen, 2000; Nilsson-Wittel and Fundin, 2005), however, appear to offer added analytical advantages. The dynamic response surface of the Kano model formulation in particular is conceptually appealing for application in passenger transport service modelling. For example, it relaxes the assumption of linearity of the relationship between customer satisfaction and changes in service attributes levels as well as the ability to model changes of satisfaction levels over time for the same attribute level. Also, approaches such as activity-based modelling have also improved travel behaviour modelling substantially.

In South Africa, market based approaches in the design of public transport services were brought to the fore through Moving South Africa (DOT, 1998) in which specific design markets were identified. The dynamics of a changing society, however, demand that transport systems design tools be reviewed regularly.

3. Societal trends and implications on the design of public transport systems

In this section, selected societal trends in South Africa are highlighted, together with the implications on the design of public transport services. Due to the general lack of good time series data, in some cases, cross-sectional data is used to provide a snapshot of the state of the interaction between the customer and the transport system and relevant inferences are drawn. Indeed, South African time series demographic data has in the past been racially fragmented where coverage of black people has explicitly been excluded (Udjo, 2005; Mfono, 2001), hence the poor time series data. While more research is still required, the findings from both cross-sectional and time series datasets are noteworthy for public transport system designers.

3.1 Trip purpose

On a typical day in South Africa, education trips remain the predominant trip purpose followed by shopping, visiting and work (Table 1). However, the public transport system has historically been designed to cater for the work-based commuter trips. Table 1 further shows that the ratio of the number trips between the male and female members of the population who make trips is generally similar, apart from trip purposes such as work, recreation, and the category “other”. The category “other” is of interest and it is overwhelmingly represented by females. However, given the coding system used in the 2003 national household travel survey (DOT, 2003), from which the analysis is based, it is not explicitly known what is contained in this category. Of interest is also the relatively high number of people who did not travel at all on a typical day (representing about a quarter of the country’s population) irrespective of age. The largest proportion (75%) indicated that they did not need to travel. Therefore, on any given day the estimated capacity utilisation of the transport system taken from physical observation would be a gross underestimation of what it could potentially be, and somewhat challenges the use of average trip generation rates for travel demand estimates in the design of passenger transport operations. The significant number of trip purposes that are considered “non-compulsory” such as visiting and shopping is also indicative of the scope for travel demand management measures, such as private travel surcharges, given their characteristically high demand elasticities.

Table 1. Trip purpose on a normal day in South Africa (Source: Department of Transport, 2003)

Trip purpose	Male	Female	Total number of trips reported
Education	51%	49%	14 302 519
Shops	50%	50%	10 472 047
Visiting	50%	50%	9 992 995
Work	58%	42%	9 952 306
Church	43%	57%	4 024 578
Sport, recreation and entertainment	62%	38%	2 736 570
Medical services	42%	58%	2 550 389
Looking for work	51%	49%	1 853 638
Welfare offices	50%	50%	903 055
Other	17%	83%	500 349
Trip purpose	Male	Female	Number of people
Did not travel at all	27%	20%	11 168 173

Work trip purpose is usually considered the most important trip purpose used to design passenger transport operations. In 2003 when people did travel to work (a total of 9 952 306), private car was the dominant mode of travel (25%), followed by minibus taxis (24%), walking (23%), bus (9%), car as passenger (6%) and train (6%), with the rest made up of a combination of other modes such as cycling, motorcycle, and animal transport. Notably, motorised travel to work was dominant over non-motorised travel (walk, cycle and animal transport), which represents about a quarter of the work trips. There are travel modes whose patronage is skewed in terms of gender. For example, “car as driver” is a male dominant mode of travel (66%), which in itself reflects the historical mobility privileges of the male members of the society. Worth noting also is the gender mode split for train, which is also predominantly used by males (62%). Train travel in South Africa has especially been plagued by security concerns (Page et al, 2001) and therefore women travellers, being relatively more vulnerable, tend to avoid it. Women also tend to avoid cycling to work (5%); partly attributable to safety concerns, in that cyclist infrastructure in the country is generally poor and possibly associated with risk taking behaviour.

3.2 Important service attributes

Respondents were asked in the 2003 national household travel survey to specify what they considered important when using public transport and the overwhelming majority (48%) indicated “safety from accidents” as the most important concern, much more than travel time (15%) and travel cost (14%). Despite this, however, travel time and travel costs remain the most important considerations in the design of public transport services, reflected in many of the algorithms adopted in public transport design frameworks used in the country. Many of the transport modelling tools used widely in the country, such as EmmeTM and TranscadTM, typically engender analysts to focus almost entirely on the generalised costs of travel (as a function of travel time and travel cost) as the main design attributes.

3.3 Car use

While private car is the single most dominant mode of travel, in 2003 many South Africans eligible (over 18 years) to have driver’s license did not own one (only 19% in possession), and this applies particularly to females. A large proportion of the population therefore remains captive to public transport for longer distance trips. Therefore, in South Africa, apart from global concerns about the use of public transport being necessary to address climate change challenges, public transport remains a basic humanitarian service. Access to private owned cars, however, is on the increase, fuelled also by its association with good social class standing. In fact, through a household survey of newly-emerging middle class in a South African urban area, Ungerer (1999) reports that respondents agreed with the statement that a person’s status is reflected by the products he or she uses, and a car was chosen overwhelmingly as the single most important product imparting the most status. Also fuelling the rise in car ownership is a trend that indicates that car prices have been decreasing relative to household incomes, making cars more affordable (Mokonyama and Venter, 2007). From a household car ownership model, Mokonyama and Venter (2007) point to a potentially explosive growth in car ownership to be expected in historically disadvantaged areas (due to segregationist policies) of South African cities as middle-class incomes grow. The design of public transport services is therefore increasingly competing with the service offered by the convenience of a private car. If public transport modes are to retain the high market share, public transport services cannot just be seen as services for the poor members of society.

3.4 Peak and off-peak travel

In 2003 a large proportion of the people travelling to work (90%) use the traditional morning peak period, which is typically between 06:00 and 08:00. A notable proportion (10%), however, travels in the traditional off-peak periods. While this appears little, politically, from the perspective of attracting votes, this proportion of the population is significant. Also, while a policy that promotes higher frequency public transport services in the traditional off peak periods is desirable, the system operational costs could prove to be high given the generally low development densities in the country, even in metropolitan areas. Exacerbating this would be a trend that indicates that the average household size is on the decrease (DBSA, 2006) although offset somewhat by the growing household formations (StatsSA, 2005). Furthermore, data for South Africa do not reveal a simple relationship between development density and car ownership as well as development density and public transport use (Mokonyama and Venter, 2007). Nonetheless, novel public transport systems such as demand responsive public transport could find niche applications in many parts of the country. Actually, the minibus taxis currently provide a service that resembles in many respects a demand responsive system, although recent legislation forces them to operate on fixed routes. The service provided by minibus taxis has grown substantially over the years, and indications are that it is at the expense of scheduled bus services which have drastically lost market share in real terms (DBSA, 2006).

While dominant travel to work trips takes place in the traditional peak periods, indications are that there is a significant amount of peak spreading in the metropolitan areas of the country. Time series traffic counts in many parts of the country, point to the increased phenomenon of peak spreading. Also based on a survey of a large organisation employing about 3 000 employees on the same site, Mokonyama, et al (In press) show that on average at least half the number of employees make an extra car based trip during normal working hours outside work premises, to illustrate the increasing role of off-peak travel in the country. Off-peak travel considerations should therefore increasingly be embraced in the design of public transport systems.

3.5 Mortality

Figure 1 shows mortality trends in South Africa between 1997 and 2004, where a sharp increase in the mortality rate of people in the age groups 0 to 4 years and 30 to 35 years is notable. Such a trend can possibly be associated with the HIV/AIDS pandemic that is affecting significant proportion of the population. From a panel survey in an urban area of South Africa, Naidu and Harris (2006) find that the survival strategies adopted by households directly affected by HIV/AIDS revolve around the following:

- The sick member continues to work for as long as possible.
- Borrowing money and other resources from friends and relatives.
- Receiving money transfers from relatives.
- Taking up social grants.

Implications of these HIV/AIDS trends on the transport system would include the following:

- Loss of earning potential seems to be one of the threats facing such households. Therefore, social grants provided by government need to be holistic and be integrated with the design of transport systems, to improve the mobility of affected households.

- It is essential that institutions such as clinics and hospitals become easily accessible by public transport.
- In the long run, the increased mortality of people in the economically active age groups has the potential of decreasing the travel demand economies of scale and as a result system level transport costs may in turn increase, thus creating a vicious cycle of transport unaffordability.

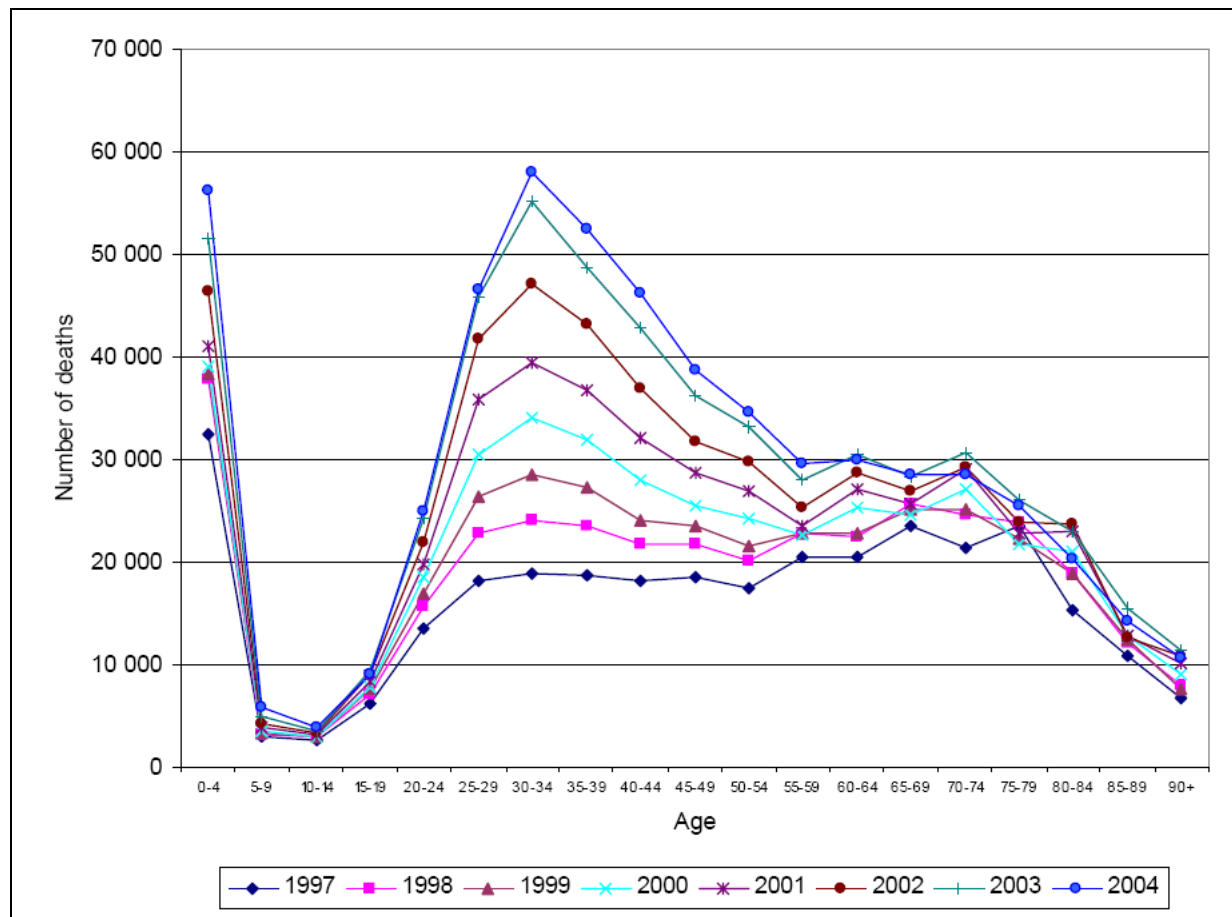


Figure 1. Number of death by age group

(Source: Statistics South Africa, 2006)

3.6 Life-cycle trends

The analysis of the South African population reveals the following cohort trends (StatsSA, 2005), listed together with transport system design implications:

- Only about a third of African infants and children live with both parents in the same household: The special care required by infants and children imply that the single parents (mostly women) have increased atypical travel patterns requiring special consideration.
- Disability tends to increase with increasing age: Apart from losing sources of income due to retirement, elder people have reduced mobility and sensory functions with special demands on the design of public transport system.
- In South Africa, school attendance is compulsory between the ages of 7 and 15 years. As a result, the proportion of less educated people is on the decrease. However, younger people are more likely to be educated than older people, especially in the African communities.

Furthermore, older people are more likely to be in elementary occupations. Therefore older people again will have more intense service design requirements than younger people.

- Household formations are on the increase and the average household size on the decrease: Smaller sized households, especially single person households, potentially have more disposable income and as a result are in a relatively better position to afford to buy and use a private car.
- A trend of children becoming heads of households is noticeable from the age of 10, and also while not prevalent, child labour is notable: Mobility patterns of such children are likely to be atypical of known children movements, for example home-based education trips.
- At 27% in 2005, unemployment is notably high: At any given time, therefore, the numbers of people looking for work, and therefore desires to travel, but without money, is high.
- Employment peaks at late 20s to early 30's: The increased disposable income in this age group has the potential to demand the best transport service matching the convenience of a private car.
- Different racial groups are increasingly living in the same areas, especially in the historically white areas: Public transport can no longer be designed along racial lines.
- The earning gap between high and low income is increasing: Price discrimination of transport service is still necessary to enable increased social inclusion of the poor.
- At any given time there is a significant number of people who live in hospitals, orphanages, police cells, tourist accommodation, homes for disabled, convents/monasteries, as well as homeless people: This challenges the planning of public transport routes which have traditionally had an exclusive home end.
- The annual number of marriages are in the order of 150 000 to 200 000, and the average age of the bridegroom at the time of marriage is reported at 35.7 years and that of the bride 31.2 years. On the other hand the annual number of divorces is in the order of was 32 000, implying that, on average, for every five marriages take place there was one divorce. The peak age group for divorces is generally between 30 and 40. Furthermore, it is marriages that are between 5 and 9 years that exhibit the highest divorce rate, and annually, the number of minor children involved in these divorces is in the order of 30 000. Related to this dynamic, some researchers have found that the breaking of travel habits (for example exclusive reliance on the private car) is most effective and significant when coupled with non-transport related triggers such as getting married, changing household size, buying a first house, moving to a better area and choosing a better job (Del Mistro et al, 2006). The age group 30 to 40 years, therefore, seems to be especially a good target market for breaking of travel habits.

4. Conclusions

The identification of a design customer or group of customers for public transport is not straightforward, and the simplicity of such a concept dilutes the underlying societal complexities. The paper has however identified issues that the public transport design processes need to consider if they are to respond to the changing South African society. Further research would be required to irrefutably quantify service design implications. Nonetheless, the needs of poor-ageing-single mother and an ill-divorced unemployed-poor-single mother in the age group 30 to 40 years, would certainly be of design interest.

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