Bus design guidelines: Complementing planning with vehicle design.

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ABSTRACT

This research creates a set of design guidelines for route bus vehicles. Transport planning views the bus vehicle as a known-quantity. Aside from a few attributes such as vehicle length and passenger capacity there is little discussion of how bus vehicle design affects public transport performance. Direct results from the literature review method indicate bus transport is a sum of service elements; the utility of the journey, the intangibles such as route design, and the tangibles such as the bus vehicle.

In comparing overall bus 'service' to existing theory on quality, services and motivation, the research adds currency to conventionally avoided 'soft' transport factors. The results describe the application of qualitative factors outside of – but complementary to – transport planning and policy. The literature review identifies that in addition to complementing system needs, bus vehicles must offer passengers a safe, comfortable, enjoyable transport experience, and desirable status and image in order to be conducive to ridership. This research concludes that route bus functions are spread across hard and soft factors, and that the two are not inseparable in the aspiration to provide successful public transport.

Keywords: *bus, design, service, planning, passenger*

1. INTRODUCTION

This research aims to inform guidelines for the design of a route bus interior. Through this task, the research also aims to more clearly distinguish between those elements of the transport system affected by planning, and those in vehicle design. This research is the initial stage of a bus vehicle redesign project and as such the guidelines will be tested by application.

Public transport requires systems thinking to be *complemented* by vehicle design; distinguishing between intangible – non-physical – elements such as schedules, and the tangible elements such as the bus vehicle. This research aims to address the knowledge gap between transport system research and vehicle design by creating guidelines for a bus vehicle that complements system objectives. This research contextualises existing knowledge in the public transport arena by applying it to the specification of a route bus interior, with particular reference to the passenger's journey experience and how this relates to the transport system as a whole.

Part two, the literature review, synthesises information to determine desirable attributes of bus transport. The desires are sourced from system and passenger perspectives, as what serves the system must in turn serve the passenger. Data is collected from primary sources in the form of passenger survey and focus group results. The review identifies individual attributes in part two, under five categories:

1. System operations
2. Safety
3. Comfort
4. Journey experience
5. Status and image

Part three examines the effects of methods and perspectives in the literature review, and how this has affected our approaches to public transport. It also introduces theoretical perspectives to deal with the qualitative approach to transport, which are observed to cause some difficulty. Part four broadens the discussion of the literature review with a vehicle design perspective and summarises the literature review in the form of design guidelines, followed by concluding remarks.

2. LITERATURE REVIEW

2.1 System Operations

System operations are factors related to "*when"* and *"where"* the person is transported. The "*how"* of the transport milieu is determined by the physical environment; separating for the purposes of this study the tangible and intangible elements of the bus system. In a discussion of vehicle design for any mode, the vehicle is implicit in supporting successful system operation. A vehicle is of no value without a system in which to operate, and conversely the system is redundant without vehicles.

The manner in which a bus should complement the transport system are many and varied, but must fundamentally facilitate a reliable supply of capacious, accessible vehicles (Newman & Kenworthy 1991; Booz Allen & Hamilton 2000; Ben-Akiva & Morikawa 2002; Department for Transport 2003; Stradling, Carreno, Rye & Noble 2007; Sweeney Research 2008a, 2008b). Physical access must be complemented by cognitive access to services – the prospective passenger must understand the system (Bus Partnership Forum 2003; Howes & Rye 2005; Nielsen et al. 2005). The cognitive load placed on a passenger conflicts with their desire for a relaxing journey (Stradling et al. 2007) and may be addressed through good design of timetables and maps, and in-vehicle information sources. This point is at odds with the findings of some research, reporting vehicle design as related solely to comfort (Schwartz 1980). Visibility and permanence are constructed through various system attributes – not just vehicle design but their frequency and infrastructure (Newman & Kenworthy 1991; Hensher 1998; Litman 2004), and represent another method for the vehicle to complement the successful operation of the transport system.

2.2 Safety

In the absence of an actual incident, safety is a matter of individual perception, so if a vehicle is physically "safe", then safety is considered an intangible attribute (Sweeney Research 2008a). Vehicular safety is complemented by providing a safe environment at a personal level. Both contribute to the perception of safety for the entire journey. Personal safety is often outside passenger control; rail modes may be perceived as safer at a personal level because passenger densities are higher and spaces generally more activated, although not at all times (Ben-Akiva & Morikawa 2002). Perception of safety is also linked to the time of day, with passengers perceiving bus safety at night as both important and currently inadequate (Sweeney Research 2008a). However, other survey work done in the same metropolitan area shows personal safety is a leading attribute of buses (Department of Transport 2008a, 2008b, 2008c), highlighting that although inadequate, buses may offer more safety than other modes. The need for personal safety prescribes a design encouraging visibility between occupants, staff and the environment of the vehicle.

2.3 Comfort

Passenger comfort is recognised as a source of satisfaction (Stradling, Anable & Carreno 2007), and an uncomfortable ride is sure to provide dissatisfaction. Although often cited as an intangible element of transport, comfort has been determined by seat availability, ride quality such as acceleration characteristics (Oborne 1978), temperature (Ben-Akiva & Morikawa 2002), the intermediate journey, waiting and proxemics (Schwartz 1980). Passenger comfort is regarded by passengers as a good element of bus transport when compared to other parts of the bus experience (Sweeney Research 2008a, 2008b). Clearly some of these attributes are themselves matters of taste, but ideally the bus interior would accommodate personal preferences in seating, while the bus generally should endeavour to provide a journey within comfort ranges for all the senses. Ride comfort is generally regarded as higher in rail-based modes (Howes & Rye 2005) – derived from higher specification in guidance infrastructure and rolling stock.

Some passengers desire disengagement with their immediate surroundings to undertake an activity of their own choice; an advantage of public transport (Stradling et al. 2007) countered by the "driving experience" in the private car (Sheller 2004). Passengers should not be inhibited in their choice of activity or relaxation; and as such an overly stimulating ride or anxiety from the system (Sweeney Research 2008b) is to be avoided. The transit user requires flexibility in the transport system and of personal time, despite the contrast between flexibility and reliability (Newman & Kenworthy 1991).

An unpleasant environment will be perceived as a cost of travel (Taylor, Miller, Iseki & Fink 2009). If we picture the range of choices that may be available to the potential passenger we must account for the private car, which offers a particularly well developed aesthetic experience to the driver and passengers (Sheller 2004). Light rail is perceived to offer better "ambience" (Beirão & Sarsfield Cabral 2007) than bus transport; which suffers from localised emissions, variable infrastructure and vibration from engines. The aesthetic environment created by the bus is represented by attributes in surveys such as lighting, temperature and air quality (Sweeney Research 2008a). Vehicle aesthetics must account for the passengers' perception of the bus through all their senses.

Cleanliness is instrumental in maintaining a pleasant visual, tactile and olfactory environment for the passenger, and is a key part of satisfaction (Stradling et al. 2007; Sweeney Research 2008a). Evidence suggests that passengers will tolerate unclean services, provided the basic service is in place (Commission for Integrated Transport 2002), however cleanliness should be aspired to in these cases. The vehicle must provide a "clean" visual environment, that itself can be easily cleaned.

Design rules (for example; Lloyd 2006) determine minimum spatial requirements, but utility demands some space be provided for personal effects such as shopping. In addition to quantity, the qualities of transit space are of considerable importance, especially when we consider a principle advantage of the car is personal space and comfort (Beirão & Sarsfield Cabral 2007). Although a passenger in public transport cannot hope to influence the nature and proximity of fellow passengers, there is a desire to avoid crowding (Sweeney Research 2008a); somewhat ironically, operators desire full vehicles but passengers prefer them empty. The design should maximise passenger capacity, but balance this in creating an environment whereby the proximity of other passengers minimises interference with personal space. The design should accommodate or encourage the positive aspects of human interaction that if properly managed become a positive aspect of public transport – the social capital explored below. Notably, this is not always desirable, a dislike of public transport may spring from a dislike of the public (Stradling et al. 2007); it would appear that opportunities for both privacy and social contact are desirable attributes for the bus.

2.4 Journey Experience

A positive experience is sought by passengers in any transport situation, which when weighed up against other transport attributes such as cost will affect decisions. Several studies indicate the passenger's desire for this experience, but do not delve further into what a positive experience may consist of. Furthermore, the nature of an experience is difficult to meaningfully quantify. Buses are

associated with captive users; students, the elderly, people on low incomes, and tourists (Stradling et al. 2007). Nothing is inherently wrong with these groups; however a choice user of public transport may not wish to be seen as a captive user; a design problem or a social problem? Comparing bus experiences to those of other modes is one method of assessing differences (Curtis & James 1998), enabling us to see transport as an experience, not just a utility. When comparing public transport modes with the private car, there is a tendency in the literature to suggest that people who choose the car are somehow "wrong". Bunting (2004) suggests that rather than musing what may be 'wrong' with the drivers, we might examine why the car appeals. This suggests that the experience of transport is a key element of desirability. We should offer the passenger a positive experience, whether by association with social indicators or discrete physical elements such as comfortable seats.

Social interaction in public transport adds to the value of the mode, and provides benefits in security, ambience, and the sense of ownership. Public transport is recognised as an important component in reducing social exclusion (Stanley & Stanley 2007). A perceived benefit of public transport is the relaxation and socialisation possible while in transit (Beirão & Sarsfield Cabral 2007) which offers a distinct advantage over the private car – both in a vehicular and urban-form senses. Social interaction in and around the bus is however a personal matter, some passengers may not desire interaction, a possible source of discomfort (Schwartz 1980). However a noted advantage of buses is personal interaction, especially with the driver (Sweeney Research 2008b). A reaction to this requirement in design should enable social interaction within the passenger group as a matter of personal choice.

Mode perception shapes mode choice. Buses are recognised as a rational choice, yet also suffer an inadequacy in attractiveness or appeal (UITP 2006). It is easy to dismiss this "appeal" as a non-operational requirement of any mode, yet it is a crucial element in the passenger decision and therefore directly impacts ridership. These attributes are generally referred to as "Mode Specific Factors" and refer to the qualities of attraction intrinsic to the mode (Booz Allen & Hamilton 2000). Comparatively, light rail is perceived as more attractive than bus with descriptors such as silent, fast and efficient (Beirão & Sarsfield Cabral 2007). Appeal can be created in a variety of ways, bus-rapid-transit (BRT) being one example where appeal is greater than bus (Sislac 2000), despite mechanically similar vehicles. One such "appeal" factor is modernity (Sweeney Research 2008b), where the bus appeals to the potential passengers' sense of what is current, and perhaps therefore the best available. It is useful for design purposes to recognise the dimensions upon which attraction is created in various modes. If an aim of public transport is to attract car users (Bunting 2004), an awareness of all facets of automotive attraction is necessary (Coxon, Napper & Allen 2007).

An advantage of the car is excitement (Sheller 2004). In this case, the excitement is derived from brand association, the sensation of driving coupled with control, and also by association with "exciting" derivatives such as motorsport. Many of these attributes are inappropriate for public transport, and would indeed have a negative effect on its perception – excitement without control or trust is replaced with fear. Brand identity of automotive manufacturers successfully builds association with desirable attributes, a process that could be adopted in public transport.

Speed, although easily measured, is also a matter of perception. Passengers perceive light rail as faster than bus (Howes & Rye 2005; Beirão & Sarsfield Cabral 2007), buses are criticised for being meandering and slow (Sweeney Research 2008b). There are two factors at play; perception of speed, and actual arrival time. Perception of speed is also relative to the mode and distance to destination (Jenkinson, Simkin & Rhodes 1999). The bus should expedite operational realities such as loading/unloading, in tandem with infrastructure. Cars attract riders by offering a kinaesthetically positive experience (Sheller 2004). The approach to kinaesthetics in public transport should focus on the elimination of negative elements, a dissatisfier for public transport. Kinaesthetic impressions are formed from various sensorial inputs, a negative example being that of longitudinal (sideways facing) seats (Oborne 1978; Booz Allen & Hamilton 2000). Further to removing negative sensations, the bus should encourage a positive perception of motion through reference to the outside environment.

Convenience can be the sole reason choosing car over bus, rather than elements of buses that may be left wanting (Howes & Rye 2005). Convenience is also considered an "intangible" – and in this case somewhat inexplicable – benefit of light rail over bus (Beirão & Sarsfield Cabral 2007). Bus passengers perceive other passengers as an inconvenience (Sweeney Research 2008a). In summary, convenience is affected by a variety of factors; permanence, quality and presence of infrastructure, and information.

2.5 Status and Image

In using public transport, the passenger must acknowledge themselves as a member of the general public (Stradling et al. 2007). Public perception of buses also includes notions that they are a last resort for those who cannot afford a car (Bus Partnership Forum 2003) – a notable exception in this UK study is the London case, where choices in transport are rooted in practicality; thus a transit user may be "forgiven" (Bunting 2004). Conversely, the private car is marketed as a symbol of status, affluence, personality (Jensen 1999), success, and freedom (Sheller & Urry 2000); constructs which also work in reverse for non-car users (Jensen 1999). Individual transport choices are demonstrably irrational. The same irrationality exists at planning levels where transit utility may be secondary to the prestige (Litman 2004), status (Mackett & Edwards 1998) or image (Booz Allen & Hamilton 2000) embodied in a mode – especially in the difference between light rail and bus-based modes (Hensher 1999). One view is that the intangible image benefits of light rail should be able to justify the cost difference over BRT (Ben-Akiva & Morikawa 2002). The image of a mode is used in the literature to cover factors that are difficult to quantify, but still significant to ridership (Booz Allen & Hamilton 2000). Exactly what image is desirable for transport will vary in response to social setting.

The social status of cars is derived from ownership; with projected signifiers of affluence and personality (Jensen 1999; Sheller 2004; Beirão & Sarsfield Cabral 2007). In comparison, the very nature of *public* transport yields no element of *personal* ownership similar to that of the car, and therefore passengers feel less association with the mode. Mitchell (2008) suggests that passengers only wish to gain utility from transport, a notion at odds with the practice of car marketing. Passengers do of course require the utility of transport, but this perspective ignores the cultural and personal value of product ownership. Collective ownership or belonging may be used in the public transport arena to counter this, and is already demonstrated by modes such as San Francisco's cable cars or London's Routemaster buses, which have become part of a cultural identity.

Lower emissions are a benefit of bus transport (Beirão & Sarsfield Cabral 2007). However environmental sustainability must account for product life cycle, not just exhaust emissions. Appearance and actual impact are different; buses belching diesel fumes are perceived as unclean, especially when compared to electricity generation in distant places; out of sight in this case is out of mind. The design of the bus should maintain best-practise with regard to complete life cycle impact, but also make the travelling public more aware of the advantages of public transport. The social perspective is valid in this case as members of society become keen to be seen 'doing the right thing', even if by the conspicuous consumption of "green" branded cars or even plastic bags.

There is an improved perception of new modes (ibid). New does not necessarily mean unique; it may be that a new alternative in a particular geographical area also creates this reaction. New solutions such as monorails or personal rapid transit systems may carry an aura of panacea, but are insignificant when compared to effective planning and infrastructure. New modes should be avoided if their significance is one only of novelty not effectiveness (Mees 2000; Vuchic 2005). Novel modes are not hampered by ghosts of past failures. A requirement in this case is not to develop new modes for their own sake, but to be aware that subtle differences may assist the transport operation in changing a poor image, provided the newness is also clearly associated with positive changes in other attributes.

A distinct way to measure social attributes of transport is by political association – namely what will yield votes. The responsibility to spend public money wisely is often overcome by desire for favourable public perception and timing of expenditure, particularly related to political terms and

marginality. This is based on evidence showing overspending on modes that are less effective at producing transport utility but perhaps more effective at garnering votes (Kain 1988; Mackett & Edwards 1998). The discrepancy between spending and transport utility exists because there are implicit attributes not accounted for in the planning approach, as covered above. Image is difficult to measure and cost; nevertheless decisions are made to implement inappropriate modes (Hensher 1999; Griffin et al. 2005; Howes & Rye 2005; UITP 2006). Generally, buses are seen as a politically unpopular mode; they are a lower cost option than rail, thus perceived as cheap. The counter case is Bogota, where buses are a central part of social and urban renewal. There is a requirement for buses to offer the same level of "glamour" (Mackett & Edwards 1998) as rail. Positive perceptions must be based in superior service, but go far beyond the traditional measurements of transport performance in attracting ridership (Litman 2004). Mackett and Edwards (1998) call for a counter argument to the image benefits of light rail resulting in unnecessary overspend. The solution is not necessarily to *argue* against this benefit of light rail, but to *understand* why it is a logical and pervasive phenomenon. Political popularity is based on but not limited to effective service, and must satisfy the public need for an attractive, desirable, pleasant means of conveyance.

There is a perception that because car use is expensive, that car drivers would be willing to pay significantly more for a bus journey if it offered higher quality route service (Bunting 2004). The problem with this statement is that it ignores the benefits – aside from utility – that a car offers its owner. Affordability is an important requirement in the design of the bus, lest high costs be passed on to passengers who cannot afford them. However, it is a balancing act between providing low cost and value for money through improvements – adding to what a customer receives for their fare.

3. DATA OBSERVATIONS AND APPROACHES

3.1 Theoretical Perspectives

In distilling the attributes described above, it has been necessary to draw comparisons between sources of different nature. Primary sources include qualitative data from focus groups and questionnaires, and quantitative data from stated and revealed preference studies. Secondary sources include reports on such data, making inferences on how new data affects historical views and trends. Attributes for desirable bus design were noted in all sources, exhibiting a high degree of circularity. This allowed the listing of attributes directly from the literature – a desire for more route information for example or the need for social status to be satisfied.

The critical difference between data types in transport research is what part of the transport product they form. Across the field, a distinction is quickly drawn between system attributes and "other" (Vuchic 2005) or "soft" (Booz Allen & Hamilton 2000) attributes. The impact of these non-system attributes is recognised, before being put to one side because they are immeasurable (Booz Allen & Hamilton 2000); dealing with quality rather than quantity of service (Ben-Akiva & Morikawa 2002). The treatment continues by grouping non-system attributes as "internal characteristics" of the service (Gallouj & Weinstein 1997), such that they cannot be coherently identified from one another. This research approach is valid for studies dealing strictly with system attributes, but many such studies attempt to equate the overall success of a transport product solely in terms of system attributes, a task that by admission of these very studies is impossible.

Grouping qualitative attributes as "other" will not yield understanding. The difficulty in this area lies in the type of information available; ironically, the intangible elements of transport such as headways are measurable, whereas the tangible elements such as the physical bus environment are somewhat immeasurable. Transport system research needs to be complemented by transport environment research. To completely understand the transport commodity, we must measure what may be measured, but not ignore that which may not.

3.2 Approaches to quality, services and motivation

If we approach the qualitative aspects of transport with Kano's theory of attractive quality (Kano 1984; Löfgren & Witell 2008) we can begin to determine their role in passenger perception. This method distinguishes between expected qualities and those that are above and beyond expectations – attractive qualities. This theory clarifies the difference between a transport service that has nothing wrong, to one that has the power to attract passengers. Removing dissatisfaction does not lead to happy passengers, merely indifferent ones. Moreover, as several transport options may present themselves to a potential passenger, the situation within the transport system becomes competitive.

Taking just two transport choices – the car and public transport, the competitive platform on which transit must compete becomes clearer. Both means provide the transport commodity, yet each offers qualities the other does not. The Kano method enables us to see that the presence of value-enhancing qualities creates attraction towards the car. Conversely, public transport may offer a service that is competitive with the car on the minimum levels of quality – the service of transport – yet provides little in the way of value enhancing qualities. This may go some way to explain the seemingly irrational dominance of the car in many cities.

The quantitative factors of transport are related to the result of the service, whereas the qualitative factors are related to how they are carried out (Gadrey (1992) trans. in Gallouj & Weinstein 1997). The former quantitative attributes are termed the "indirect" product — the change of state in the passenger; this is achieved through the means of the qualitative "direct" product — that which the passenger interacts with. The indirect product is what the passenger seeks to achieve by catching the bus, and is the intrinsic motivator for the journey (Eysenck 1984). The quality of the direct product is related to extrinsic motivation; *how* is the service delivered. By viewing the transport commodity as a collection of smaller products, each with their own relationship to quality, motivation and the service as a whole, it is easier to relate "soft" factors of transport to the traditional "hard" factors. The parallels between these elements of transport are shown in table one. The intrinsic motivators for transport are a cause for dissatisfaction if not present (e.g. a late bus), however to actively satisfy passengers, the transport must satisfy intrinsic motivators, *and* offer extrinsic motivators such as a comfortable ride and pleasant environment.

Area of Study	Aspect of Transport "product"	Quality Type	Product Component	Motivator
Quantitative	Quantity of Journey (time, distance)	Must-Be Quality	Indirect Product (change of state in consumer)	Intrinsic
Qualitative	Quality of Journey (cleanliness, ride)	Attractive Quality	Direct Product (consumer interaction)	Extrinsic

Table One – Comparing Quality and Service elements with the example of bus transport

4. DISCUSSION

The literature describes difficulties of over – or under – estimation in transit system ridership. The difficulties in this area are compounded when comparing modes, in particular the continuing debate between light rail and bus-based transport modes (e.g. Hensher 1999). There is a call for more advanced methods of measurement to deal with notions of quality (Ben-Akiva & Morikawa 2002) while others suggest a method is required to *"...counter arguments about the very expensive "image benefits"..."* (Mackett & Edwards 1998) that light rail may offer over buses. Many of the notions of quality or attractiveness have been gathered under the loose heading of *Mode-Specific-Factors* for the purpose of comparison between modes, somewhat removed from the separate notions of the "soft factors" this research deals with. Our propensity to either measure or ignore the impact of qualitative transport attributes will continue to affect the accuracy of ridership predictions in any mode. Planning methods are quantitative; passengers are not. This knowledge gap requires work,

not exclusively in the form of more measurement. The design of vehicles, and indeed the whole system must be astute to the spectrum of passenger needs (Norman 2004) in order to create a successful, useful transport commodity.

There is an apparent lack of design intent in public transport. A system-centric perspective results in problems such as the "means paradigm" where support is given to a particular mode for its own sake rather than how appropriate it may be (Hensher 1998), and problems with economic modelling of transport (Gärling 1998). The means paradigm is a valid emotional response to transport; albeit one outside our typical realm of understanding. Evidence suggests passenger preference for light rail over bus (Sislac 2000; Bunting 2004; Litman 2004; UITP 2006; Beirão & Sarsfield Cabral 2007). These preferences are not based solely on mathematical reasoning but on a holistic view of transport that cannot be adequately explained through measurable attributes. Existing BRT system can cover more area, more frequently, for less money. The imperative is not to argue on functional grounds, but to demonstrate the importance of the qualitative, emotional, experiential aspect of transport. Rather than being "the competition", light rail may provide design specifications.

Generally, investment in stops/stations increases with passenger numbers. Investment in a railway station is justified by the expected high passenger volumes on trunk routes, as the small investment of a post-in-the-ground bus stop is justified by low volumes. Some sources cite the higher load factors of rail as an advantage over bus (Litman 2004), however this appears to be a circular argument. If passengers are given a high quality, grade separated mode on a trunk route, the technology is immaterial; such as in Bogota where the investment is significantly higher than for normal bus services, but has increased load factors past those for comparable rail systems. This is a clear benefit of understanding transport beyond numeric means.

Another force on quality is the nature of transport system administration, particularly the nature of contract of service. If a contract determines payment based on a number of seats per hour on a route, the natural tendency is for buses to be designed containing the highest possible number of seats. The result is a removal of design from what may result in the best quality transport. The provision of seats is a contentious issue, and relates to journey duration. Evidence suggests cars are often used for remarkably short journeys (Dept. of Infrastructure 2002) and that light rail – especially vehicles with few seats – is seen as a mode appropriate for short journeys (Sweeney Research 2008b). Thus it may be apt for vehicles to have fewer seats in contrast to what may quantitatively constitute 'better' transport as evidenced in many tender documents (e.g. State Transit Authority of New South Wales 2007).

Mitchell (2008) argues that transport utility – the "indirect product" from table one — is the only aspect of transport requiring work. The phrase *"People don't need drills, they need holes."* (ibid) neatly sums up this way of thinking, and at a basic utility level this holds true. However, to continue the analogy, we know that people enjoy purchasing and possessing drills, the drill offers its owner an innate sense of purpose and even identity. In transport, the car has been identified as an ideal model for transport service, suggesting that as car owners pay significantly more for better transport, they would be equally happy to pay more for a better bus service (Bunting 2004). As with the drill, this underestimates the value of car ownership, and ignores extrinsic motivation in transport choice.

In setting out the contributing factors to successful public transport, the question of measurement arises; where appropriate, quantitative measurement may be undertaken as currently practised. The question of measuring the immeasurable in the qualitative attributes is somewhat more difficult. In setting out the guidelines this research aims to inform the design process by introducing requirements of public transport into the design brief. As an integrative discipline, design sets out to meet the requirements of often conflicting constraints (Heskett 1980); and these are no exception. By applying these attributes in a design methodology (Napper, Coxon & Allen 2007) their successful implementation becomes less an issue of measurement, and more an issue of presence. The success of a design applying these methods is far from guaranteed, however it may be more likely that the users *"...are made safer, more comfortable, more eager to purchase, more efficient - or just plain*

happier - by contact with the product..." (Dreyfuss 2003). Application of these findings may then be measured by way of the end user.

The summary of findings from this literature review is presented in table two, with each guideline separated into sub-categories of individual aims. The guidelines to do not dictate the means which may be employed to meet them, as goals may be achieved through different methods, and may be achieved concurrently with others; as such, the guidelines aim to inform the design process.

System Operations	Physical access
	Service visibility
	Capacity for passengers
	Cognitive access
Safety	Vehicular
	Personal
Comfort	Conducive to personal activities
	Sensorially pleasing
	Clean
	Spacious
	Personal space
Journey Experience	Relaxation / Stimulation Balance
	Attractive
	Excite response
	Perceived as fast
	Kinaesthetically positive
	Convenient
Status and Image	Ownership
	Environmentally responsible
	Image of newness
	Conducive to political support

Table Two – Route Bus Design Guidelines.

5. CONCLUSION

By means of literature review, this research set out to determine guidelines for the design of route buses. Rather than treating the route bus as a constant in the equation of service design, the intention was to show how the needs of the system can be represented in the vehicle. The transport system has requirements of the route bus. Similarly, the travelling public have requirements of buses related to their interactions with the vehicle, which the review showed also affects the transport system. This review led to the notion that a bus must accommodate the needs of the transport system while providing a safe, comfortable, enjoyable transport experience with desirable status and image for the passenger. By reviewing theory on motivation and attractive quality, the different elements of buses – physical and non-physical – can be placed in context of one another and their affect on the transport system. This perspective will lead to a better understanding of "soft" factors in transport planning and the pros and cons of different modes which are presently a source of some contention in the field. The design guidelines which form the summary of this research represent a starting point in this direction of research, and as such require testing and refinement by implementation in future route bus design and operation.

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