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Over 30,000 bike trips a day are made over this bike path in central Copenhagen, where over half of all cyclists are women.

Cover photographs courtesy of: Susan Handy

A VISION FOR BUS NETWORK DEVELOPMENT AND BUS PRIORITY IN CENTRAL LONDON

The Best Solution We Never Tried: Cycling and Transport Policy in Melbourne

World Bank financed bicycle track project in Accra, Ghana

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Editorial

We can sort out our transport problems!

Everyone knows that transport is a mess. The UK has some of the worst public transport in Europe, the highest fares, the worst congestion, the highest car dependency, rising greenhouse gases from transport and a decline in walking and cycling. We claim to be one of the best in the world in road safety but we have one of the worst records in Europe for child pedestrian death and injury. A child in a so-called "lower socio-economic group" has a 3-5 times greater chance of being killed or seriously injured in a road crash than a child from a wealthier background. We have more than 150 air quality management areas in our cities where air quality is bad enough to damage health and we are very reluctant indeed to tackle the bulk of this poor air quality and its source (the exhaust pipes of 26 million cars and hundreds and thousands of dirty buses and taxis).

We have had over 30 years of transport policy documents and transport policy ideas but the only practical thing that anyone has done to make things better is the London congestion charge and its 30% reduction in congestion, 80% increase in bike use and 16% decrease in carbon emissions. Outside of London most politicians are very reluctant indeed to get to grips with the inevitability of gridlock and disease associated with the use of the car for short journeys and for taking kids to school.

The tragedy of all this is that we could transform our urban and rural landscape and install a wonderful, world best transport system to produce an absolute decline in car use and a trebling (or better) of walking and cycling. The list of things that need to be done is not that long and is easy to implement and finance. The only thing lacking is intelligence and the guts to get on with the job. So what needs to happen? The list includes:

- A rural public transport system that is as good as rural Switzerland with frequent bus and rail services; unified ticketing (only one ticket is required for any number of buses and trains); and high standards of reliability, cleanliness and security.

- A system-wide 20mph speed limit in all urban areas to improve conditions for pedestrians and cyclists and stop the tragic loss of life in car crashes. The science is very clear and speeds should be set at 20mph.

What are your chances of surviving a collision if you are struck by a car while walking or cycling?

Vehicle Speed	% chances of Surviving	% of vehicles exceeding that speed in built-up areas	
		Cars	Heavy Goods Vehicles
20 mph (app. 32km/h)	95	95	91
30 mph (app. 48km/h)	45	72	55
40 mph (app. 65km/h)	5	12	5

Source: Parliamentary Advisory Council on Transport Safety (1996) Taking Action on Speeding

- We need to stop rat-running in all urban areas so that residential streets can be enjoyed by old and young alike. This can be achieved very quickly through rising bollards i.e. bollards that remain in a raised position for most of the time but lower when residents use their access swipe card to get into or out of their street. This would transform the lives of millions and produce peace, neighbourliness and an end to health damaging pollution outside our homes.

- We need at least 500kms of segregated cycle routes in every city connecting all residential areas with all schools, GP surgeries, hospitals, employment sites etc. We take space away from the car to do this.

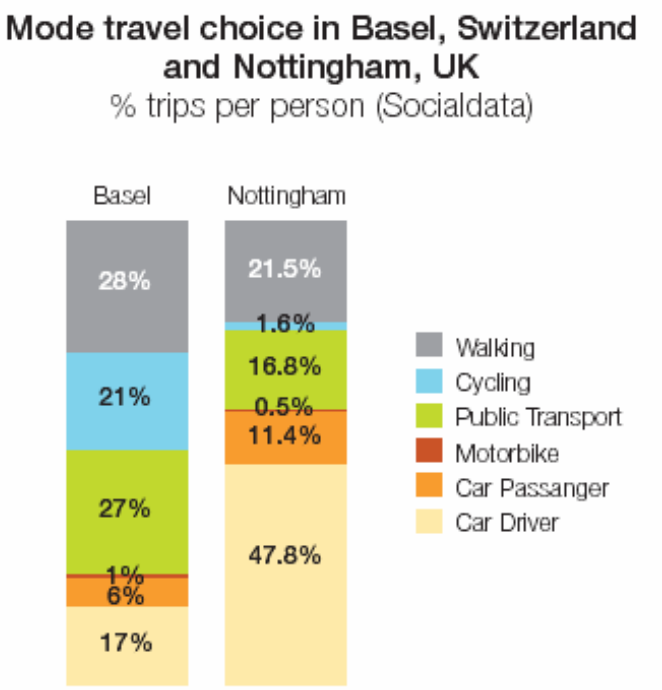
- We need wider pedestrian pavements with no car parking on pavements.

- We need traffic lights that include an all-red phase (every light on red for vehicles) so that cyclists and pedestrians can cross diagonally or in any way they wish whilst all traffic is stationary.

- We need an urban public transport system as good as Basel and Zurich in Switzerland.

- We need a train system as good as the Berlin train system which can take thousands of bikes on the trains for recreational and leisure pursuits.

- We need a black box in every vehicle (just like the aircraft version) so that in any crash we can establish the speed, direction etc. of the vehicle and then deal with criminality in an appropriate manner.



We should task all our urban areas to achieve the Basel solution:

In Basel only 23% of trips are by car and 49% are by walking and cycling. This is the desirable objective of transport policies.

All licence and insurance payments from cars should be collected at the petrol pump through an addition to the cost of fuel so that there can be no evasion from paying these dues.

There should be strict duty imposed on police forces to police speed limits and other car crimes that threaten public safety. If the police cannot handle speed enforcement it should be dealt with through another organisational entity and funded through fines.

There should be a target of no school age pupils at all going to school by car except in the case of specific disabilities. Walking, cycling and school buses can do the job. This will ease congestion and help to solve the obesity crisis in the UK.

There shall be a policy of encouraging local facilities in all our communities (e.g. local post offices, dentists, GP surgeries, shops) and national policies should deliver service density that is sufficient to reduce the need for a car in urban areas.

What next?

We need strong visionary policies and should start with the Swedish Vision Zero road safety policy that commits Sweden to achieving zero deaths and zero serious injuries in the road traffic environment. We also need the Swedish "oil-free by 2020" policy to eliminate our oil dependency. We need to re-engineer streets so that they are quiet, pleasant, peaceful, child-friendly and socially nurturing place rather than traffic sewers.

We are now living out the dying days of a fossil fuel-rich world. Climate change problems and peak oil problems are combining to present us with some of the severest challenges ever faced by our species. We can chart a course towards a safe, healthy, low carbon society and low carbon transport system but the problem is our politicians. They lack courage and they lack vision. The answer is to change the politicians.

John Whitelegg
Editor

Abstracts & Keywords

The best solution we never tried: Cycling and Transport Policy in Melbourne

Robin Goodman and Russell Degnan

The advantages of cycling, compared to other modes of transport, have been well established. While many cities in northern Europe have achieved significant cycling mode share, in Melbourne, cycling mode share has remained very low. This paper investigates why this might be the case through an analysis of the place of cycling in transport policy. The research was undertaken through review of policy documents and interviews with prominent transport advocates, planners and academics. Five factors are found to be significant: a 'predict and provide' approach to transport planning; political expediency; an aspirational rather than transformative approach to cycling policy; a lack of quantitative data for the construction of cost-benefit analyses; and the perception of cyclists in the community. We conclude that planning for cycling needs to be better integrated into transport planning decision making process with stronger leadership and direction.

Keywords: cycling, transport planning, Melbourne, transport policy.

Performance evaluation of the 1998–2000 World Bank financed bicycle track project in Accra, Ghana

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Between 1998 and 2000 a number of bicycle tracks were constructed in Accra, Ghana, as part of a World Bank financed urban transport project. At the time it was included as a pro-poor project component, to enhance cycling as a mode of travel offering low-cost and non-polluting urban travel. It was initiated against the background of the existence of a small, but relevant, cycling culture in the city, mainly introduced by migrants from the north of the country. Unfortunately, only around 20% of the bicycle infrastructure initially envisaged was constructed, reflecting a lower interest in urban cycling at the implementation stage than during the earlier project planning and appraisal. The evaluation reported in this paper was carried out in 2004, with an update in November 2007. The overall conclusion is that, in their marginalised form, the few bicycle paths provided were unable to trigger an increase in urban cycling. It appears that all-in-all the project produced a negative effect on urban cycling due to the suggestion that urban cycling in Accra cannot be enhanced successfully, while in practice the reason for the lack of success was the marginal size and poor quality plan of the initiative. No conclusions can be drawn from this project experience about the potential of urban cycling in Accra. The same low-level cycling continues to exist despite a bicycle traffic environment characterised by the lack of road space for cycling and high risk of traffic accident. To find out whether cycling can make a useful long-term contribution to sustainable urban travel in Accra a much more substantial effort is required and one which is well integrated into the city's overall transport policy.

Keywords: urban transport, urban cycling in Africa, Accra, bicycle infrastructure performance, low-cost urban mobility.

An Integrated approach to bus priority: A vision for bus network development and bus priority in central London

Tam Parry

In large urban areas buses can experience delays due to bus on bus congestion. Traditional bus priority measures can have limited benefit as buses themselves cause congestion and delays to other buses. In such cases bus priority can only be provided by first reviewing the bus network, and then by implementing bus priority schemes on a revised bus network. Central London is used as an example to illustrate how a new bus network could be implemented, to give significant improvements to bus journey time and delay. The existing bus network in Central London results in severe delays to buses due to bus on bus congestion, affecting most bus routes in Central London. There are several proposals which represent an opportunity and necessity for the bus network to be reviewed. These include proposals for a tram for Oxford Street and the Olympics in 2012. A practical example of a new bus route network for Central London is proposed, along with methodology for how this network could be developed in stages. With a new route network bus on bus congestion would be significantly reduced, and the network improved to cater for a developing and changing city. Buses would have much reduced and reliable journey times with a network that could be marketed and provide an alternative to the tube network.

Keywords: bus priority, bus network, bus congestion, journey times

The Best Solution We Never Tried: Cycling and Transport Policy in Melbourne

Robin Goodman and Russell Degnan

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For the past three decades transport planners in Melbourne have struggled with the frequently conflicting goals of accessibility and environmental sustainability. The benefits of cycling for achieving these goals are well established. At an individual level, cycling is a low cost, convenient, efficient mode of transport (Whitelegg 2006), often faster than competing means, particularly for short trips (Hudson 1978:4-5). It is healthy, notwithstanding safety concerns, and contributes to fitness in the broader community (City of Copenhagen 2002:15-16). It is an efficient user of urban space, both for parking and for road space (Hudson 1978:5), and after walking, the most environmentally friendly mode of transport (BTRE 2002:43-44). Potentially, cycling is an excellent replacement for substantial numbers of small trips currently done by automobile, simultaneously reducing congestion and improving the local and global environment (BTRE 2002:44). In theory, it should be "at the heart of every government (national and local) policy to achieve climate change objectives, traffic reduction and congestion-busting objectives" (Whitelegg 2006:3).

In the cities of northern Europe, cycling is both a significant mode of transport for many people, and an important aspect of their transport policies. By contrast, cycling in Melbourne plays only a small part in achieving broader transport goals. Melbourne has had neither a large number of cyclists - the overall mode share is below two percent (ABS 2001, Lucas 2007) - nor a strong commitment to achieving higher cycling rates, despite widespread ownership of bicycles - there are an average of 1.2 per household (Vicroads 1999). As Whitelegg (2006:3) has pointed out, the car dependence of Australian cities and the lack of priority given to sustainable alternatives by transport ministers make them vulnerable to the problem of peak oil and the social and economic crisis that this will bring. He estimates that Australian cities have the potential to easily achieve cycling rates of 10%.

At first glance, it might be considered unrealistic for Australian cities to aspire to European cycling rates. The difference between Melbourne and the cities of northern Europe are stark. Melbourne is large, sprawling, dispersed and automobile dependent; northern European cities are typically small, dense and easily walked or cycled. However, not all of Melbourne is sprawling and dispersed, the older inner suburbs of Melbourne, have conditions that are favourable to walking and cycling (DOI 2006:7), and compare well with cities such as Copenhagen which can boast cycling mode shares of over 30%. All of Melbourne, but particularly the more densely settled inner areas, have potential for a substantially higher cycling mode share.

This paper investigates some of the reasons why cycling in Melbourne has not reached its full potential. It focuses on the role of cycling within transport policy and explores attitudes to cycling within policy documents and transport planning bodies over the last 50 years in Melbourne. The research was undertaken through both an analytical review of the content and style of policy documents and a series of semi-structured interviews with individuals considered to have had a significant role in transport policy over this period. Interviewees included public transport advocates, cycling lobbyists, public sector transport planners in local and state government bodies, and academics involved in either the analysis or the promotion of cycling in Melbourne over this period.

Cycling in Melbourne

The merits of cycling, as outlined briefly above, have long been recognised in many countries, including Australia. The oil crisis in the 1970s generated a number of pro-cycling books, each extolling the benefits of cycling and marvelling at its remarkable growth in the previous few years (Hawley 1975:xi, Bendixson 1977:53-87, Hudson 1978:ix, 4-13). Australian transport policy documents have mentioned cycling in much the same terms ever since (cf. Austroads 2005:4-11 and Hudson 1978: 4-13). Australian cycling mode share however, has remained very low, usually considered to be between one and three percent (Austroads 2005:9; ABS 2001; Vicroads 1999). In the most recent census conducted in 2006, cycling mode share in the entire metropolitan area of Melbourne was only 1.3% (ABS 2007).

The mode share in inner Melbourne is somewhat higher with 4.6% of workers commuting via bicycle in 2006. However, this figure hides some substantial variations in cycling mode share between areas, ranging from less than one per cent up to a height of 9.5% in suburbs with a higher student population, (9.5% in Yarra-North, 8.6% in Brunswick, 6.6% in Northcote (ABS 2007)). Rissel and Garrard (2006:51) note that cycling rates for journeys to work are likely to be underestimated as they come from the national census conducted on a single day in August, during the Australian winter, when rates are likely to be at their lowest. They cite the Victorian Activity and Travel Survey (VATS) conducted from 1997 to 1999 as indicating a 30% variation between cycling rates in autumn and winter. These figures indicate that cycling is slowly re-emerging as a part of the Melbourne transport mix, and one increasing in importance. Bicycle Victoria (2007) report a 42.6% increase in journeys in Melbourne between 2001 and 2006, up from 14,443 to 20,592 riders, primarily focused in inner and middle suburbs.

The role of cycling in Melbourne transport policy has been both varied and constant. The consideration given to cycling has slowly improved within the institutional and professional cultures of engineers and planners, and amongst the broader community; yet cycling's role as a potential solution has remained largely unchanged. Through an analysis of transport planning documents we suggest that four periods can be identified as being distinct, though their boundaries are at times blurred. Within each of those periods, it would seem that cycling has occupied a different place in the minds of policy makers. By looking at policy documents, it is possible to trace those changes, and assess where cycling has placed itself, within the discourse that characterise Melbourne transport policy.

Pre 1960s:
The rise of the automobile

Prior to the intervention of the motor vehicle, the street was a markedly different place, and the cyclist, an important, if not always loved part of it. Brown-May (1998:37) describes cycling as a "popular means of transport" in Melbourne from the 1880s through to the Second World War. But, whereas cycling brought forth a range of regulations to prevent travelling at speed, the automobile rewrote the rules, to prevent access to the street itself (Brown-May 1998:xvi-xvii, 39-41, Davison 2004:131-132). The pedestrian was specifically identified as an encumbrance to traffic flow in Melbourne's first planning scheme produced by the Melbourne and Metropolitan Board of Works (MMBW) in 1953 (MMBW 1953:120). The growth of traffic produced another response that has remained central to transport planning ever since. The streets, particularly those in congested inner city areas, were considered too narrow, they needed to be widened, and others constructed to allow the "free movement of traffic" (Stapley 1935:1800-181). Inner city congestion and the need to relieve it became a constant refrain in the immediate post-war years, as traffic levels increased markedly (Davison 2004:130-140). As this occurred, so levels of cycling dropped, from 12.8 %

commuter mode share in 1954 - though, like today, just 1.8 % of trips to the city (MMBW 1954:192) - to a negligible amount by 1964 (Mees 2000:265). That year, 1964, the eminent Professor Buchanan visited Melbourne, to discuss the future of its transport system. The idea that Melbourne could follow a European model was viewed dubitatively by the assembled experts (Davison 2004:140-142); shortly after, increased road traffic became a planned certainty.

The 1960-80s:
An absence of cycling

The role of cycling in 1970s transport documents is easily described: it had none. The Metropolitan Transportation Study (MTC 1969) makes no mention of cycling, nor does the City of Melbourne Strategy Plan (1974); both focus exclusively on railways, trams and road capacity planning. Both plans fit into what Low et al (2005:399) describe as the “predict and provide” story line, projecting past trends into the future and providing infrastructure for them.

Cycling, like walking, was not in need of infrastructure, but perceived as something we do without assistance (Goodman & Tolley 2003:78), or as a recreational mode (Vuchic 1999:206); the mode share consistently underestimated (MMBW 1981:93) or not measured. Even critics of the planning regime of the 1970s ignored walking and cycling, reflecting a strict dichotomy between public transport and road transport (Crow & Crow 1970:37-66). Smerk (1968:148) exemplifies this dichotomy in his textbook summary of the “urban transportation problem” the answer to which lay “in providing public highways for private automobiles while also creating a greatly invigorated public transportation system”.

It was not until the oil crisis of the 1970s that alternatives to this dichotomy were considered in Melbourne transport planning.

The 1980-90s:
Cycling as an alternative

In a manner that resonates with today's policy context, the oil crisis, and the expectation that it would soon worsen, led a number of authors to promote cycling as the best alternative (Hudson 1978:4, Bendixson 1977:54). The trepidation with which planners faced the 1980s, is reflected in the MMBW review of the 1969 transport plan, in which several pages are devoted to environmental issues not mentioned in previous reports (MMBW 1980:23-24). The plan that came from the review was typical of many that followed, but more forthright in its reasoning. In the context of cycling, it was acknowledged that "most people when they think of transport tend to think in terms of motor vehicles" (MMBW 1981:93), and that “more use of bicycle can be encouraged by minor changes to existing roads" (MMBW 1981:93).

However, the priorities remained clear. No actual plans were put in place to encourage cycling, nor money allocated, even if the tones used to justify continued road construction were defensive:

> The car's dominance of our transport system is not something that will change in the short term..... There will still be a need for roads, for movement of goods and for both private and public transport. Road planning and construction should continue, (MMBW 1981:92).

The election of a state Labour government in Victoria, led by John Cain, in March 1982 began a process of change that has continued for the past two decades. At the behest of the state government, the State Bicycle Committee was formed and the Country Roads Board (CRB) given responsibility for developing guidelines for the creation of cycling lanes. At a policy level, transport plans began to include bicycle networks in their plans, beginning with the City of Melbourne (1984:240), and then at the state level in the planning strategy *Shaping*

Melbourne's Future (Government of Victoria 1987:43). A pattern was established during the 1980s, reinforced during the 1990s, of providing rhetorical, rather than practical, support for cycling. Transport documents emphasised cycling as a "low cost, efficient, convenient and pollution free alternative", that was "growing in popularity" (City of Melbourne 1984:243). The role of cycling was to be "emphasised" (DOI 1996:15), cycling was to be "encouraged" (City of Melbourne 1992:34), and the Principal Bicycle Network was to be expanded (DOI 1996:75). However, the structure of the policy documents - like the structure of the departments and indeed the structure of the road space - was for cycling to have a minority part in transport policy. The emphasis in the policy documents continued to be on improvements to the existing road and public transport networks (City of Melbourne 1992:11-12, Government of Victoria 1995:25-31, DOI 1996:6). Sustainable transport officers, as the new breed of transport planners in local government are often now called, were not seen as having any specific responsibilities and were often isolated from the actual decision-making process. Bicycle lanes remained an after-thought, acceptable only where there was spare road capacity for the introduction of a cycling lane without conflict (Gehl 2004:59, interviews).

The present: cycling as a serious transport mode?

The role of cycling appears to have changed again in the past year or two. Several interviewees expressed the idea that a "quantum shift" had occurred in the offices of state and local government. They suggested that, as in previous years, the impetus for change is coming from political pressure. However, it is not clear at this early stage, whether this shift represents a significant change, or merely a change in the discourse. As always, there are several competing narratives that indicate different policy priorities.

Significantly, some local governments, in particular the inner municipality of Yarra, have, according to some interviewees, begun to encourage cycling at the expense of other modes. A transport planner noted that "it was possible for Yarra to do that", whereas the state body VicRoads "had other obligations" - particularly freight transport. Installing cycling lanes on state arterial roads and at intersections - which remain the major concern of cyclists according to cycling lobbyists interviewed - continues to be possible only where competing interests have no stake. One analyst interviewed expressed the view that cycling was being promoted because it is a cheap solution, but also an ineffective one, and therefore provides political cover for a lack of commitment to a "genuinely sustainable solution" in the form of public transport. However one of the cycling lobbyists gave the opposite view: that public transport initiatives were pushing cycling off the roads. A fight over road space is, in itself, an indication that cycling is taken seriously as an option, however it is too early to judge whether it will win any battles.

Several state government departments are involved in cycling promotion, a situation which perhaps overstates the commitment to cycling. Many small policies create a lot of words, but may in fact lead to little action. The lead agency remains the Victorian Department of Infrastructure (DOI), where a recent restructure to provide a strategic focus for walking and cycling, and a slower generational change away from traditional "predict and provide" engineers, has enhanced certain policy narratives of sustainability and traffic management. The latest transport policy document, *Meeting Our Transport Challenges*, partially reflects this change, with substantial sections on demand management, and changing travel behaviour for short trips (DOI 2006:17, 55-57). However, the major infrastructure projects and priorities continue to be the priority items that require substantial investment (DOI 2006:23-29, 33-54).

Funding may be the best indicator of seriousness. The Victorian state government has doubled funding from 2004-05 to 2006-07, but the total amount remains just $13.6 million per year (Bicycle Victoria 2006a:44-45). By comparison, the proposed spending in *Meeting Our Transport Challenges* was $10.5 billion over ten years (DOI 2006:iv).

Change and stasis

The role of cycling in Melbourne's transport policy has shifted, from nothing, to a curio, to a small, but noticeable part of planning policies. For the most part, the policies have been more prominent than the implementation, although a steady improvement has occurred in both the quality, and the quantity of on and off-road cycling paths. It is a role, however, that has never been well defined. Although the benefits of cycling are stated, targets for cycling are never established, or even suggested. Nor is it clearly identified who the policies are aimed at, apart from the occasional reference to school children. The Bureau of Transport and Regional Economics (2002:xiv) succinctly states the likely reason for this attitude:

> Even if large gains (in walking and cycling mode share) were achieved, because they would originate from such a small base (...) they appear unlikely to make a noticeable shift in VKT (Vehicle Kilometres Travelled)

Although the role of cycling within Melbourne's transport policy documents has advanced somewhat in the past two decades, the mode share of cycling in Melbourne has, at least until recently, not increased. All those interviewed for this research acknowledged two things: that the potential of cycling is much greater than what has been achieved; and that cycling has not been taken seriously in the policy context. Instead, policies have continued to reflect a transport modelling approach, focusing on the provision of infrastructure to meet perceived needs. Cycling policy has lain on top of that; an attractive 'alternative' means of transport, but one unable to 'solve' the problem of urban mobility.

We suggest that five main rational, and mutually supportive, reasons underlie the lack of commitment to cycling as a serious transport mode, which will be discussed in turn.

A predict and provide approach

While the outcomes of the transport modelling process have been criticised, the 'predict and provide' approach that it supports has not disappeared from the institutional culture of VicRoads nor the professional culture that it supports. Within this context, cycling is viewed as a minority pursuit on which infrastructure would be wasted. Interviews with transport planners involved with cycling over the past 30 years described a long process before the institutional culture supported the inclusion of cycling in road infrastructure projects. But this change in approach, when it occurred, was not contrary to the principles of predict and provide planning. Limited expenditure on cycling infrastructure, provided under political pressure, was just successful enough to support a process of providing for the small cycling community initiated.

However, encouragement and prioritisation of cycling was never placed on the agenda, a problem enhanced by the lack of a single body responsible for cycling in Victoria. Because the state government made cycling provision an auxiliary function of both VicRoads and Parks Victoria, those organisations have had little incentive to try and increase cycling rates. Often it was only cyclists within the organisation, (who according to interviewees were isolated voices), promoting the idea that cyclists, although not measured, did exist on the roads, and needed some minimal infrastructure. However as cycling continues to record low mode share even the provision of a Principle Bicycle Network is predicated on the need to provide infrastructure only where sufficient road space is available, and at minimal cost. It is to achieve no more than a

minimum service level for the low number of predicted cyclists.

Political expediency

Priorities for road space are in part determined by political expediency. Both planners and especially politicians are sensitive to alienating the car driving majority. Outer suburban commuters are, for example, the most significant users of inner suburban roads, and some commentators suggested that they will be vocal in demanding priority. Major arterials that criss-cross inner Melbourne are under the control of VicRoads, which, as one transport planner put it "cannot afford to favour bicycles over freight". This implies a greater role for local roads, which could be slowed, and managed, though even here, Brindle (1992a:330) claims that "there is still strong opposition to even modest speed control measures" in local areas. While this attitude may be less prevalent in inner areas with a more pedestrian friendly street culture, local opposition to traffic reduction measures may stymie a substantial increase in cycling in inner Melbourne. Cycling infrastructure has generally been submissive to other road uses where conflict may arise. Several interviewees cited the existence of cycling lanes that end before intersections, or that double as car parks. The implication is that cyclists, while seemingly provided for by cycling lanes marked on maps of on-road cycling networks, are actually limited in how they may use the road. While planning policies support on-road cycling, politically, cyclists are outsiders to a street culture that emphasises traffic throughput.

An Aspirational Non-transformative Policy Approach

Within Melbourne's transport policy documents, there are obvious differences in both style and substance between the sections detailing necessary, but expensive infrastructure, and those related to cycling. New infrastructure is approached rationally, detailing the costs and benefits, the likely time frames, and their role in broader transport policy. While cycling is framed positively, and as a theoretical alternative to a majority of trips made that are shorter than three kilometres (DOI 1996:74, BTRE 2002:43-44), neither a theoretical justification for the Principle Bicycle Network, nor a plan for achieving a mode shift towards the friendly cycling alternative has been proposed. The unstated message is that cycling is a not to be taken seriously. Cycling, as written into Melbourne's transport policies, is not a solution to any particular problem, it does not have targets, nor does it fill a role in the broader transport context. While it may be too harsh to argue that cycling policies have merely acted as window dressing, in the absence of targets for safety, mode share or network coverage, Melbourne's policy approach looks very superficial.

Lack of Quantitative Data

Just as the lack of quantifiable goals limits the effectiveness of policy, the lack of empirical measurements limits the ability of planners to justify the policies chosen. This deficiency operates in three areas. Firstly, until quite recently, the number of cyclists was largely unknown. A number of transport strategies conflate walking and cycling statistically, and in the policy guidelines. As walking normally has a much higher mode share (ABS 2001), this both over-states cycling's current role, and under-states its potential to travel longer distances. The invisibility of cycling in the broader transport context made it harder to justify under 'predict and provide' transport models, thus perpetuating its minor role. By corollary, this means infrastructure that may have encouraged higher cycling rates has not been built.

Secondly, several interviewees cited the lack of cost-benefit analyses available to justify cycling infrastructure. The view was expressed that, while transport engineers can show the value of road improvements, in safety, or automobile throughput; sustainable transport officers in local councils have limited means to justify monetary expenditure. Similarly, state

government planners interviewed argued that the Department of Treasury, under whose auspices all major infrastructure is built, expect to see financial justifications that are not available. Importantly, as the existing space for cycling is used, and road allocation becomes an issue, the lack of data limits the ability of cyclists to argue for more space. A study of road allocation for motorised uses showed that public transport priority lanes were only justifiable with high levels of public transport usage (Currie et al 2005:92). While theoretically, both public transport and cyclists should be more efficient users of the road space than automobiles (Bicycle Victoria 2006b), it could be argued that it depends on the exact number of different road users, and bicycle lanes cannot necessarily be justified over alternative modes in this way.

Thirdly, there is considerable controversy over whether on-road bicycle lanes - and on-road cycling without lanes - are more cost effective and safer than off-road cycling lanes. Forester (1994:1-16) argues in favour of travelling on the road and changing street culture to support cycling, citing numerous studies that show that cyclists are safer remaining in traffic, than to integrate only at intersections. Godefrooij (2003:492-499) and several interviewees argue that although integration should be preferred, segregation gives the impression of safety that encourages less confident cyclists. An absence of empirical research means that traffic planners are unable to rationally assess which of a range of solutions - traffic calming, on-road cycling lanes, off-road cycling lanes - provides the best outcomes.

Perceptions of Cyclists

While perhaps a lesser reason than the others, the prevailing perception of who cycles, and by corollary, who might cycle, has exerted an influence over cycling policy, somewhat to its detriment. The difficulties associated with cycling during the 1980s, when it was considered highly unsafe (City of Melbourne 1984:239), meant that only the foolhardy, driven by environmental or fitness concerns were tempted into traffic (McClintock 2003). This perception of lycra wearing, environmentally friendly, fit, inner suburban males, has had a dual effect. Firstly, the take up of new cyclists has been hindered by the view that cycling is dangerous and difficult. All of the interviewees, if asked, argued that improvements in infrastructure would induce both female, and less fitness-orientated cyclists to begin riding. McClintock's (2003) research into attitudes towards cycling shows that they are often formed without a justifiable basis. Combined with the view of several interviewees that excuses for not cycling are easy to make, the implication is that overcoming non-cycling inertia requires a level of individual motivation that is not as prevalent for other transport modes.

Secondly, a focus on the most visible form of cycling creates an impression amongst policy makers that cycling is for a small minority, and therefore only their needs must be provided for. While all interviewees agreed that cycling was well below its potential, at least in inner Melbourne, some recognised it as a transport solution for a relatively small minority. While it is obvious that cycling is more appropriate for some trips than others, or for some groups of people than others, the experience of other cities particularly in Europe, suggests that many transport planners underestimate cycling potential by focusing on specific user groups who already cycle, when the potential is much greater outside the existing user base.

Each of these factors, we suggest, have played some role in marginalising cycling as an alternative transport mode within policy. The relative importance of each is difficult to determine. Each factor feeds upon the other, creating a self-reinforcing rationale for promoting other transport modes at cycling's expense. Melbourne is not unique in encountering these barriers to cycling. While they may vary in form, many cities will have

encountered them, and a few have overcome them through sound and strong policies.

Conclusions

The problems of urban transportation have never, and probably will never, diminish. The need to travel goes hand in hand with the adverse effects of having large numbers of people travelling - notably pollution and congestion. Cycling presents itself as one way to aid in the reduction of congestion and pollution, while providing significant positive externalities: health, fitness and an improvement of the public realm. This article has focussed on the policy processes which have in part led to the current low rates of cycling in Melbourne. However, to increase cycling levels we suggest that a number of actions need to be taken.

Firstly, a clearer role for cycling within a broader transportation framework needs to be identified with targets for mode share, safety and network coverage, and strategies to achieve them. These strategies must be enforced across the various departments and government bodies that control the road and park space being used. These targets will vary according to area and need to be both aspirational and achievable. Improvements in infrastructure and changes in the local demographics have pushed cycling rates for the journey to work in parts of inner Melbourne close to 10%. A target of 15-20% across inner Melbourne would seem to be realistic. However many outer areas, which may be as far as 50 kilometres from the CBD with very dispersed activity centres, lag well behind in cycling development with rates below 1%. Achieving 5% mode share in those areas would be a significant beginning, but will take time. This article has deliberately focussed on the inner areas of Melbourne as it would appear to have far greater potential for cycling rate increases. Average distances travelled in the journey to work for outer suburban residents are much greater, with employment more dispersed than for inner city residents, many of whom work in the central city. The emphasis in reducing car dependency in the outer suburbs of Melbourne must remain on improving the currently very poor public transport services, whilst continuing to address ways to improve cycling rates.

Secondly, a great deal more research needs to be conducted into cycling levels and usage patterns including demographic profiles of current and potential cyclists. This should be done in order to understand what the barriers to cycling are for those who do not cycle, which could then assist in the creation of policies to overcome these obstacles. Areas with the highest cycling rates show a smaller disparity between genders, (61% of commuting cyclists are male in the inner north where there is a 9.5% cycling mode share, compared to 91% male in the outer eastern suburbs with an overall share of 0.6%, (ABS 2207)) where in the indicating that campaigns to overcome barriers to cycling amongst females may achieve the greatest benefit for outlay. The obvious barriers, the perception danger and the degree of physical fitness required to cycle, are often exaggerated. However without knowledge of what the target demographic believes, it is not clear whether it is better to create more, or better bike lanes with a greater degree of separation; to introduce traffic calming measures or to fund public education campaigns for driver and cyclist education; or to actively promote cycling as a reliable, cheap and fitness enhancing alternative to other modes.

Thirdly, the street culture of Melbourne roads, long dominated by the automobile, should be modified to favour pedestrians and cyclists. In many areas of the central city traffic speeds and flow need to be reduced to create a better and safer environment for alternative means of travel. In order to achieve this, the problem of commuting automobiles from the outer suburbs must be addressed, through improved public transport services. Cycling should not be given priority over mass forms of public

transport, but both of these need to be given priority over cars. This could be done through the application of better urban design, with changes to paving, traffic lights and car parking, and with a reduction in the emphasis on traffic throughput at the expense of cycling lanes at intersections. Bike lanes need to be continuous not placed only where convenient. The high cycling rates in Northcote and Brunswick in the inner north are as much the result of the quality infrastructure in the municipalities of Yarra and Melbourne to the south, as of the efforts of Moreland and Darebin council. A public education and promotional campaign may also be needed in order to enforce new road rules and behavioural expectations. Undoubtedly some of the infrastructure measures would be expensive however the provision of far greater funds towards reducing car dependency and domination is becoming ever more necessary and indeed urgent.

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Performance evaluation of the 1998–2000 World Bank financed bicycle track project in Accra, Ghana

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Performance evaluation of bicycle tracks in Accra

The Accra bicycle path project was prepared and carried out as part of the Accra Urban Transport Infrastructure project (1993-2000), which was initiated, financed and guided by the Worldbank (Worldbank 1993, 2003; ADB 2003). The bicycle paths were constructed in 2000. They were the first of their kind in Accra.

According to the initial set-up, the aim of the project was to enhance urban cycling through the construction of, around 50km of bicycle paths (Kwablah 1994). These were to connect some low and middle-income residential areas to commercial and business districts. The paths were meant to form the initial phase of a larger integrated bicycle path network for Accra. However, out of the proposed 50km only 9.7km were eventually constructed, due to funding difficulties – reflecting the low priority given to cycling facilities during project implementation.

A performance evaluation of the bicycle tracks was carried out by Moses Tefe (Tefe 2004), to assess the success or failure of the Accra bicycle path project. The study included: a household survey in the community of Nima, a low-income city district served by the paths (the only one remaining after the reduction in network size); an inventory of the network infrastructure as-built; interviews with cyclists and pedestrians using the paths; interviews with other stakeholders; and traffic counts.

The Accra bicycle paths project 1998 -2000

The project was carried out as the Non Motorised Transport (NMT) component of the larger Urban Transport Project (UTP). The NMT component consisted of the construction of cycle paths only. The cost was around 1.7% of the overall project amount.

The cycle paths were to serve as a pilot project and to form the initial phase of an integrated bicycle path network for Accra. The sections that were eventually constructed consisted of 4 short lengths as shown in the maps below:

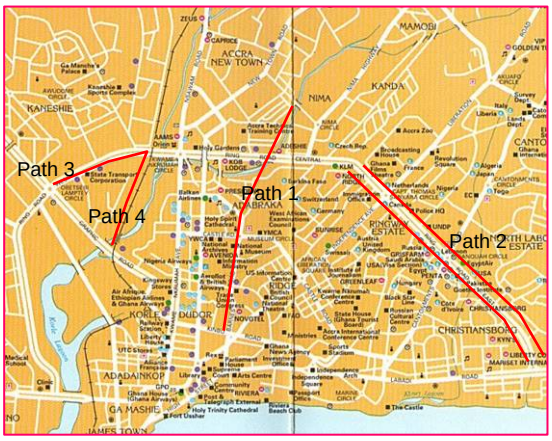


Fig1. Project Paths 1, 2, 3 and 4

1. Nima – CBD (3.5km; first 1.5 km from Nima are NMT only)
2. Sankara- Labadi Road Junction (Ring Road East) (3.5km)

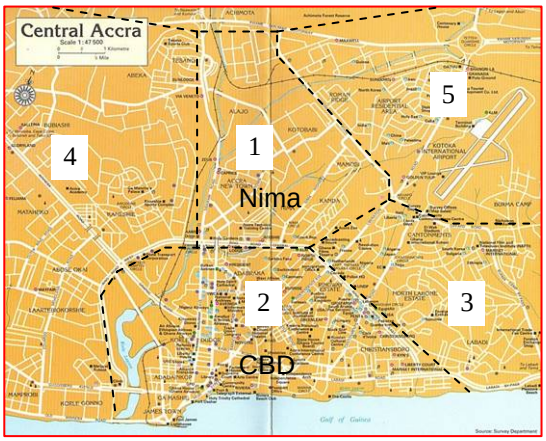


Fig2. Travel zones

3. Ring Road Central-West (1.5km)
4. North-South Industrial Area (1.2km)

Since 2001, some additional bicycle tracks/lanes have been provided near the city centre as part of road construction/rehabilitation works, e.g. along Graphic road (extension path 3) and Sankara interchange (extension path 2). This has at some points improved the situation for cyclists, however, so far without creating coherent cycling routes that really enhance cycling.

Utilisation of the bicycle tracks

Table 1: Track Utilisation (Cycle traffic counts)

bicycle track:	Observed ADT bicycles/day two-way	Observed Peak Flow bicycles/hr one-way (2)	Capacity as built (1) bicycles/day (sections, two-way)	Capacity utilisation
Nima - CBD, NMT - only section (3)	500	40 (38)	16,000	3%
Ring Road East	76	8 (12)	32,000	0.2%
Ring Road Central - West	166	17 (18)	16,000	1%
North/South Industrial Path	154	17 (13)	16,000	1%
Graphic Road	160 (4)		Non-usable	0

1. Capacity estimate based on path cross-section width, assuming no pedestrians or obstacles. Capacities listed above are based on the narrowest sections, a maximum of 1000 bicycles/hr in one direction per single cycle-lane (1.2-1.5m), and an Average Daily Traffic (ADT) of 8x the hourly maximum. In practice the capacity of an urban cycle route is mainly determined by the bicycle capacity of the intersections. In this project, specific attention was neither given to the intersections, nor to the crossing of the Nima - CBD route with the Ring Road.
2. First count: February 2004; second count (in brackets) November 2007. Both: weather conditions: fair
3. Counting point: just south of the ring road – where the bicycle traffic volume on the route was highest.
4. These were counted on the carriageway and not on the path.

Traffic counts were carried out in 2004 (MSc research) and 2007 (update for this paper). The 2007 counts show that the bicycle traffic volume on the selected paths is quite constant. This is in line with casual general observations about bicycle use in the city: in recent years it is more or less constant, not growing, but not disappearing either.

The most utilised path, Nima - CBD, has a peak flow of 40 bicycles per hour. It also has a section of 700m (20% of its length) where cyclists don't use the "bicycle path" that was constructed, but use the carriageway. This is the result of serious flaws in the design of this section.

The relatively higher utilisation of the Nima - CBD path, compared to the other bicycle paths, is likely to be due to the fact that the path serves a logical route (origin–destination link). Moreover, it connects a low-income community known to have significant bicycle ownership, which in part is related to the fact that many inhabitants originate from the North of Ghana where there is a wide-spread cycling culture.

The Ring Road East path, the least utilised one, lies between middle-income residential areas and does not serve any clear direct origin-destination link.

All in all, the bicycle traffic capacity utilisation of the paths is very low. The maximum cycle-track capacity shown in Table 1 is the maximum that applies in the case of well-designed tracks and intersections where appropriate traffic behaviour of both cyclists and motor vehicles applies. There were many design flaws in the Accra case (see Figures 3 & 6), which reduced the capacity and even rendered the track useless (with cyclists abandoning sections and using the motor traffic carriageway).

Figure 3: Unused Nime - CBD cycle path section (2004). *Slab cover of blocked drain. This, together with the adjacent strip of bitumen surface dressing, constitute the cycle track. Brick pavement to the left meant as walkway*

Yet, the difference between the theoretical and practical track capacity, doesn't affect the conclusion:
Utilisation of the tracks by cyclists is low.

Figure 4: Ring Road Central – West (Path 3)

Figure 5: Later extension of Path 2 near Sankara interchange (Nov. 2007)

The concept of designing the bicycle track as a combination with a service road is good. However, the pavement used wasn't strong enough and suffers rapid deterioration. The choice of pavement was probably made on the premise that motor vehicles were to be kept off the track (see the poles meant as barriers). This is an unnecessary reduction of the usefulness of the track and inevitably bound to fail.

Modal choice, trip destinations and trip purposes of Nima inhabitants

The mode of travel used by most residents of the Nima community is the minibus, which accounts for 65% of all trips made outside their direct neighbourhood. The modal share for walking is 17%; cycling 13%, and 4% for the private car. Trip destinations and mode of travel are shown in Table 2 below, and the corresponding trip purposes in Table 3.

Table 2: Trip destinations and mode of travel of Nima inhabitants

	Destination and mode of travel of the first trip of the day					
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total
Walk	14% (51)	3% (9)	--	-- (1)	--	16.9% (61)
Cycle	5% (19)	7% (25)	1% (2)	1% (2)	--	13.3% (48)
Minibus	5% (17)	39% (140)	7% (25)	13% (47)	2% (6)	65.3% (235)
Car	1% (3)	3% (10)	1% (2)	-- (1)	--	4.4% (16)
Total	25% (90)	51% (184)	8% (29)	14% (51)	2% (6)	100% (360)

In brackets: number of respondents (of 15 year or older); source: household survey; short trips (<500m) on foot inside the direct neighbourhood are not included.

Table 3: Trip purpose and mode of travel of Nima inhabitants

	Work	School	Services	Other	Total
Walk	4	2	6	5	17
Cycle	5	2	3	4	13
Minibus	39	3	19	5	65
Car	3	--	1	1	4
Total	51	6	29	13	100%

(Source: household survey)

If 13% of the Nima adult population (15 years and older) make their first trip of the day by bicycle, just over half of them (7%) to the CBD, one would expect a higher volume of bicycle traffic on the Nima - CBD path than the recorded volume of about 500cyclists/day. With an estimated 10,000 adults living in Nima within easy reach of the bicycle path, 7% would mean 700 cyclists per day, one-way. Since only 40% of the bicycle trips are to/from work many are likely to be made later in the day, so the expected morning peak would be around 120 bicycles per hour. The observed peak flow is only 1/3 of this. The difference can have several causes:

- Cyclists travel to parts of the CBD not served by the route (just south of the ring road or the eastern/western parts of the CBD).
- Crossing the ring road from Nima to the NMT-only section of the route is difficult and dangerous, cyclists prefer to cross at intersections where cars are also crossing, since this provides them with some “cover”, and use other streets into the CBD.
- The comparative advantage of using the bicycle track that was constructed is small, given that a large proportion of the track into the CBD is useless, forcing cyclists onto the carriageway.
- Respondents report more bicycle trips in the survey than they actually make (although the number of bicycle trips found in the survey is consistent with bicycle ownership of 19% with an estimated 1.4 trips per bicycle/day).

No women were seen cycling during the traffic counting. In the household survey only 1% of the women reported using a bicycle. This means the modal share of cycling among males of the Nima population is in fact quite high. 17% of trips made by men older than 25 years are by bicycle and 32% by young men (15 to 25 years).

Reasons for cycling

Cyclists using the cycle tracks were asked why they made their trip by bicycle, rather than on foot or by minibus. For cycling instead of walking a single reason was given: cycling is much faster (70% said it is faster, 30% said the distance is too long to walk at all). Preference for cycling over the use of a minibus was mainly determined by cost (65% said cycling is cheaper). 25% of the cyclists said the main reason is that they travel faster by bicycle than by minibus. Around 5% mention transport of goods as the main reason. Calculations indicate that the financial costs of cycling are indeed much lower: 5 days a week Nima - CBD by minibus costs around 80 USD/year, cycling the same costs around 35 USD/year (assuming 2,600 km/year, or 10 km/day on working days only; in the case where more bicycle-kms are made per year, the cost per km decreases).

To investigate the reasons for not cycling, a broader study would have been required than the current one. However, the perception of bicycle traffic accident risk found in the Nima household survey showed fear of accident as the main reason not to cycle: over 90% of all respondents consider cycling in Accra on a mixed traffic carriageway to be dangerous. Another deterrent for cycling is that the majority of inhabitants at this point in time appear to have a negative perception of cycling. Even in the Nima community, where the percentage of cyclists is high, around 60% have negative perceptions of cycling, while as high as 87% of cyclists that were interviewed say that motor vehicle drivers have a negative attitude and traffic behaviour towards cyclist.

Significance of the new bicycle tracks for those cycling.

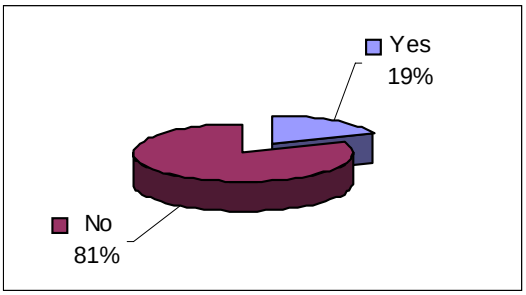
Cyclists using the cycle tracks were asked what part of their trip was made using the track(s). On average, more than half of the total distance cycled was not made on the tracks but on mixed traffic carriageways. Those who used the path still made substantial portions of their journey on other roads, without a cycle path (Note: it is likely that had cyclists also been interviewed elsewhere –on mixed traffic roads-, the average distance of their trips served by the new bicycle tracks would have turned out to be much lower).

It appears that the new bicycle tracks do not have a significant effect on the decision to cycle or not. The tracks do not attract a significant volume of cyclists, and even for those using them they only serve less than half of their trip distance. It is also unlikely that the tracks significantly encouraged bicycle ownership (see below).

Bicycle Ownership

Data on bicycle ownership in Accra as a whole are not available. In the Nima community, 19% of the inhabitants (older than 15 years) report that they own a bicycle. Since only 13% report using the bicycle for their most important trip of the day, it appears that roughly 1/3 of the bicycles are used infrequently and as a supplementary mode of travel for less important trips (and probably only to those destinations that are considered safe enough to cycle to, or for recreational purposes). The variation in bicycle ownership between different income groups in the community was

very small, the lower income group reporting around 18% and the higher 20% (higher, in the Nima community, means lower-middle income at the overall city scale).



Graph 1: Bicycle Ownership in the Nima Community

The household survey indicates that bicycle ownership in the Nima community is about stable. It is not decreasing, e.g. as would be the case if migrants from the North were taking their bicycle along to Accra and not replacing it in case it breaks down. Around 60% of the bicycle owners reported (in 2004) that they bought their bicycle *after* the bicycle tracks had been constructed (in 2000). Taking into account that bicycle purchases are a mix between new and second-hand, and assuming an average remaining life-time of the bicycle of 8-6 years after buying it, one would in a situation of unchanged ownership rates expect a replacement rate between 12% and 16% per year (50% to 65% in four years). There is thus even the possibility of a slight increase in bicycle ownership, which would be consistent with the fact that 22% of the respondents buying a bicycle after 2000 say that the fact that the tracks were constructed positively influenced their decision. Against the overall background of the low capacity utilisation of the tracks that were constructed it is unlikely that bicycle ownership in the Nima community is increasing. The above-mentioned small increase might rather be a short-lived effect of optimism about future cycling conditions. This may have been triggered by the construction of the tracks and quickly disappeared again in view of the continued inadequacy of cycling infrastructure in the city and the high risk to cyclists of traffic accidents (which has essentially remained unchanged despite the few bicycle tracks constructed).

Technical assessment of the bicycle tracks

Function of the tracks

The practical function of the tracks as constructed is unclear. The tracks that were constructed are not interconnected (see Figure 1) and do not support a sensible network of high-potential bicycle routes.

This outcome was generated by the combination of lack of high-level political interest in urban cycling, and a corresponding low priority in practice, together with a weak planning process. The lack of priority can most clearly be seen from the fact that only 10 out of an initially planned 50km of bicycle routes were constructed. This is coupled with the fact that urban cycling was dealt with as a completely isolated issue – the logical integration of bicycle traffic requirements into overall urban road design was not considered.

On the project planning side, several weaknesses catch the eye:

- No clear vision was articulated on prospects for cycling in the city.

- No accurate analysis was made of what routes in the city had a high potential of attracting a significant number of users (once provided in a proper manner), and on how these routes could be combined into a coherent network. A preliminary report had been made before the start of the project, broadly sketching

a possible overall network of 200km of bicycle routes and an initial phase of 50km, but this was not refined afterwards or linked to clear estimates of the expected bicycle traffic volume.

- Plans were not verified against the views and experience of the people that were actually cycling in the city, or even developed in consultation with them.

- No clear requirements were articulated concerning what criteria cycle routes were to fulfill (safety, capacity, directness, attractiveness and comfort) and how these were to be effectuated through the designs, such as where would separate bicycle tracks be suitable; where cycling in mixed traffic with appropriate traffic calming measures would be encouraged; and how to deal with cycling on intersections).

Shape of the tracks

The shape of the tracks (as constructed) reveals a number of design flaws. The designers appear to have lacked sufficient specialised knowledge. Some obvious ones:

- Drop-kerbs between the track and the motor vehicle carriageway at intersections and entrances (Figure 6).
- Narrow sections where a pedestrian walkway and a cycle track were squeezed in, creating conflicts between pedestrians and cyclists that cannot be solved –in which the pedestrians prevail and make cycling impossible, as well as an insufficient and dangerous separation with the carriageway (single drop kerb towards the carriageway, Figures 7 & 3). As shown in Figure 8, recently a fence was constructed at one similar section constructed later, to eliminate this danger.

- No appropriate clear space allocation to cyclists at intersections, and radii of even minor intersections that are so wide that cars can turn right or left without significantly reducing speed –resulting in high traffic accident risk for both cyclists and crossing pedestrians.

- Most traffic lights at intersections on the Nima to CBD route have pedestrian and bicycle lights. However, these are not respected by all vehicle-drivers, in particular at times the traffic volume is low. Therefore, the effect is fake safety rather than real safety.

Figure 6: Drop-kerb across path
Surface-dressed strip along the kerb meant as cycle track. Brick pavement to the right meant as walkway.

The bicycle tracks along the eastern part of the ring road (track 2) are 3-4m wide, with a wide verge separating them for the dual carriageway, shaded by trees and –apart from the crossing difficulties at junctions- comfortable to cycle on.

Figure 7: Walkway between carriageway and cycle track
No separation between walkway (brick pavement) and cycle track (surface dressed strip along wall), impact of wall on space for cycling ignored, drop-kerb to carriageway.

In 2004, after four years, pavements were still in good condition where a combined pedestrian walkway and cycle track was constructed (2m walkway, brick pavement; 1.5m cycle track, 12 cm compacted gravel base with surface dressing, side restraints). End 2007 these pavements were still in fair shape. However, where cycle tracks were built with surface dressing without side restraints, first cracks and small potholes already started to develop in 2004, and had pavements deteriorated severely at many points in 2007. Most likely this was the combined effect of a weaker construction and a stronger abuse by car traffic.

Figure 9: Crossing of path 1 (Nima-CBD) with ring road (2007)
Arrow: pedestrian/bicycle crossing traffic lights (false safety

Often these sections have a service road character along the ring road – paths 2 and 3 (see Figure 4) - without being constructed strong enough for combined use for cycling and as service road accessible for motor vehicles.

Figure 8: Combined walkway/cycle track, separated from carriageway by a fence. Between Circle and Obetsebi Circle, path 3 (2007)

Use of the tracks

Bicycle traffic volumes on the tracks have been shown above. Pedestrian volume counts on the tracks and adjacent walkways have not been carried out. Casual observation indicates that pedestrian volumes on the tracks are higher than the bicycle volumes. As was to be expected, the pedestrians use the paved cycle track where paved parallel walkways do not exist. Where a combined walkway/cycle track was constructed (only pavement type indicating which was meant to be which), the pedestrians use whatever space they need, and by doing so make cycling difficult or even at times impossible (Figure 7).

A lesson to be learned is that in practice (a) a too narrow combined pedestrian/bicycle track will be used as a pedestrian track only, and that (b) differentiating the type of pavement in order to create 'lane discipline' is ineffective.

It is interesting to note that the majority of respondents in the Nima household survey are of the opinion that the tracks are meant as a pedestrian facility.

Most of the bicycle track sections are at locations where roadside activities are rather low (in particular along the ring road east track, but also along most of the other tracks), so abuse of the track by street trading and kiosks is limited. However, at some points encroachment combined with pedestrian clients of the street vendors almost blocks the tracks. Unfortunately, where this happens at one or two points, cycling on the track becomes unattractive and cyclists just use the carriageway as before.

Abuse of the tracks for vehicle parking was in general low, although this appears to reflect low parking pressure around their location rather than the degree of respect shown by vehicle drivers towards cycling and cycling tracks.

Impacts of the bicycle tracks

Although, as documented above, the bicycle traffic volume on the tracks is low to very low, there are still a number of impacts that can be noted:

- At some sections petty traders benefit from the existence of the tracks, in particular along NMT only sections which are not along a motor-vehicle road, but create a short-cut for pedestrians and cyclists (part of the Nima-to-CBD route, and of the N-S industrial area path). The reason is that these tracks –being a short cut- are attractive to pedestrians and thus have a large number of potential customers passing by, and are well paved (convenient in all weather conditions), and quiet (in the absence of car traffic).

- Travel time savings of the users of the paths (both cyclists and pedestrians). The travel time Nima-CBD by bicycle is 25-30 minutes (O-D distance 5km), the same trip by minibus requires at least 45 minutes, including walking to/from the stop and waiting for the bus (and can be much longer in peak times due to high waiting times).

- Travel cost savings: Where the track enables a bicycle trip instead of a trip by minibus, there is also a cost saving for cyclists. A rough breakdown of the bicycle trip for the Nima - CBD trip is estimated as follows: The market value of an old bicycle is around 300,000 Cedi (all costs and the Cedi/USD exchange rate here are as at mid 2004); we estimate a 3 year life-time with one tire replacement and some minor repairs. Cost per year: around 130,000 Cedi (USD 15). The cost of making 200 mini-bus trips in a year to and from the CBD is 200x2x1300= 520,000 Cedi (60 USD). Hence, cycling is 4 times cheaper than travelling by mini-bus, even with as little as 2,000 bicycle-km per year (200x two trips of 5 km). Looking at these numbers, the risk of having a traffic accident in Accra becomes clear: an annual benefit of USD 45 isn't enough (in a community with an existing cycling culture) to attract more people to cycling, given the risk of traffic accident.

- From a questionnaire among cyclists using the paths there was no evidence of a modal shift towards cycling (those interviewed used to cycle before as well). However, it is possible that the construction of the tracks convinced some cyclists to keep cycling (see section on bicycle ownership).

- On the NMT-only shortcut routes, the tracks provide a noticeable improvement of the pavements and make the routes (which existed in an informal manner and were not well maintained) attractive under all weather conditions.

- At certain points, motorcycles use the tracks (the NMT shortcuts in particular) and some drive at high speed. This presents significant accident hazards. The lesson to be learned is that on NMT shortcut routes and bicycle tracks design features must be included to force motorcycles to reduce their speed (e.g. small humps or inverted block drains across the path), since it is impossible to prevent that they use these routes/tracks.

Costs and benefits

The total investment in the cycle tracks was 980,000 USD (excluding access-road sections, of path 1, and excluding the cost of design and supervision, cost level 1999/2000) (Associated Consultants 1998, 1999, 2000)). The total length of the tracks was around 9.7km (5 km on both sides of the road; 2km mixed traffic access road; around 55,000 m^2 bicycle track/walkway pavement (including simultaneously constructed walkways, excluding covered block drain (Figure 3), path 1). Minor drainage facilities were also included at certain points. A detailed breakdown of the costs was not available for this study, so firm conclusions about the cost effectiveness of the investment are not possible. Yet, it appears that had the money been applied in a different manner, a higher value for money in favour of bicycle traffic would have been possible (e.g. by traffic calming on mixed traffic roads suitable as bicycle route).

For comparison, the investment totals (as built) for other components of the same Accra Urban Transport Rehabilitation Project are: road reconstruction 43 million (34km of road, mainly dual carriageway), traffic management 0.6 million, bus terminal rehabilitation 1.6 million, access roads 10.1 million (41km of road) (Ghana Ministry of Roads and Transport 2000).

A rough estimate of the cost benefit ratio for the 3.5km long Nima-CBD path considering bicycle traffic only, leads to a B/C ratio (see note 1) in the order of 0.2.

Note 1: Annuity cost of capital investment 128,000 USD/year – assuming an interest rate of 10%, and a life time of 10 years, without maintenance (no maintenance has been carried out in the 1999-2004 period, although in the bitumen pavement a few potholes start to appear).
Annual travel cost savings by cyclists (from using bicycle instead of mini bus): 500 (bicycle ADT) x 250 (days/year) x 10 (km/day) x 2 (USD cent/km) = 25,000 USD/year (cost per bicycle-km: around 1 USD cent/km, cost per mini bus-km: around 3 USD cent/km). So B/C=25,000/128,000 = 0.2

However, the overall benefit/cost ratio isn't as bleak as that because there are also benefits to pedestrians (non-priced time savings), benefits from improved drainage (along parts of the path its construction was combined with improved/new drains (cost not included in NMT package cost)), and benefits for street vendors and kiosks operating along the path.

For the investment to break even in terms of benefits (travel cost savings) for cyclists alone, the ADT ought to be 2,500 rather than the observed 500. It should be noted that this would mean a capacity utilisation of around 25% (of the

theoretical maximum capacity if it were well designed over its entire length).

Concluding remarks

The study on which this paper is based only assesses the actual utilisation of the bicycle facilities built under the Accra Urban Transport Rehabilitation Project that was implemented between 1996 and 2000. Therefore, it is not possible to draw firm conclusions about cycling in Accra in general. Yet, the following concluding remarks can be made:

1. It is a pity that the bicycle traffic related (NMV) part of the project was dealt with in isolation rather than as an integral part of road network improvements, and wasn't carried out with more vision and competence. Better value for money would have been possible.

2. The negative service done to urban cyclists in Accra is considerable. The impression that has been created is that tangible investment in bicycle infrastructure is unable to enhance urban cycling to the point that it becomes an important and positive segment of the urban travel market. Yet, the key reason for this outcome is that the bicycle infrastructure which has been provided is so marginal and has so many flaws that it couldn't possibly generate a significant positive effect.

3. Looking at the performance of the current transport system in Accra and the cost of travel of the different modes of travel, the economic and environmental attractiveness of cycling is undisputed. At the same time, a nucleus of urban cycling continues to exist in the city, despite the very adverse traffic and terrain conditions cyclists endure.

4. The only way to create a significant market share for urban cycling is to fundamentally reduce the risk of traffic accident. This is a vital issue for all modes of travel, not just for bicycle traffic, and for the urban economy as a whole. A fundamental reduction in traffic accident risk is possible through a wide-scale application of traffic calming measures (de Langen and Tembele 2001.). This has the effect of making bicycle traffic safe in mixed traffic on access and local collector roads, as well as crossing arterial roads.

5. The second step in creating a master plan for sustainable urban traffic (not a separate bicycle master plan) is to determine how routes and basic bicycle route networks created along access and collector roads should be further strengthened, providing either additional bicycle lanes with light lane separation along minor arterials and/or separated bicycle tracks or wide enough service roads along major arterials.

6. The lesson to be learned from the Accra experience is that providing a few inconsistent bicycle tracks pays useless lip service to urban cycling. This has an overall negative effect on the credibility of urban cycling as a valid element in a sustainable urban transport strategy.

At this moment in time, a new Accra urban transport project is underway (Worldbank 2006, 2007). Although lessons learned from the previous project (of which the NMT component was evaluated above) are not mentioned explicitly in the project documents, it appears that the experience of the cycle tracks may have led to the decision to make no further attempts to enhance city-wide urban cycling. This seems to

confirm remark 2 above. The main emphasis in the new project is on Bus Rapid Transit (BRT), a 9km long pilot line with new dedicated bus-lanes (in an unspecified way, pedestrian facilities, bicycle lanes and parking facilities are mentioned as a way of improving access/egress to and from BRT stations).

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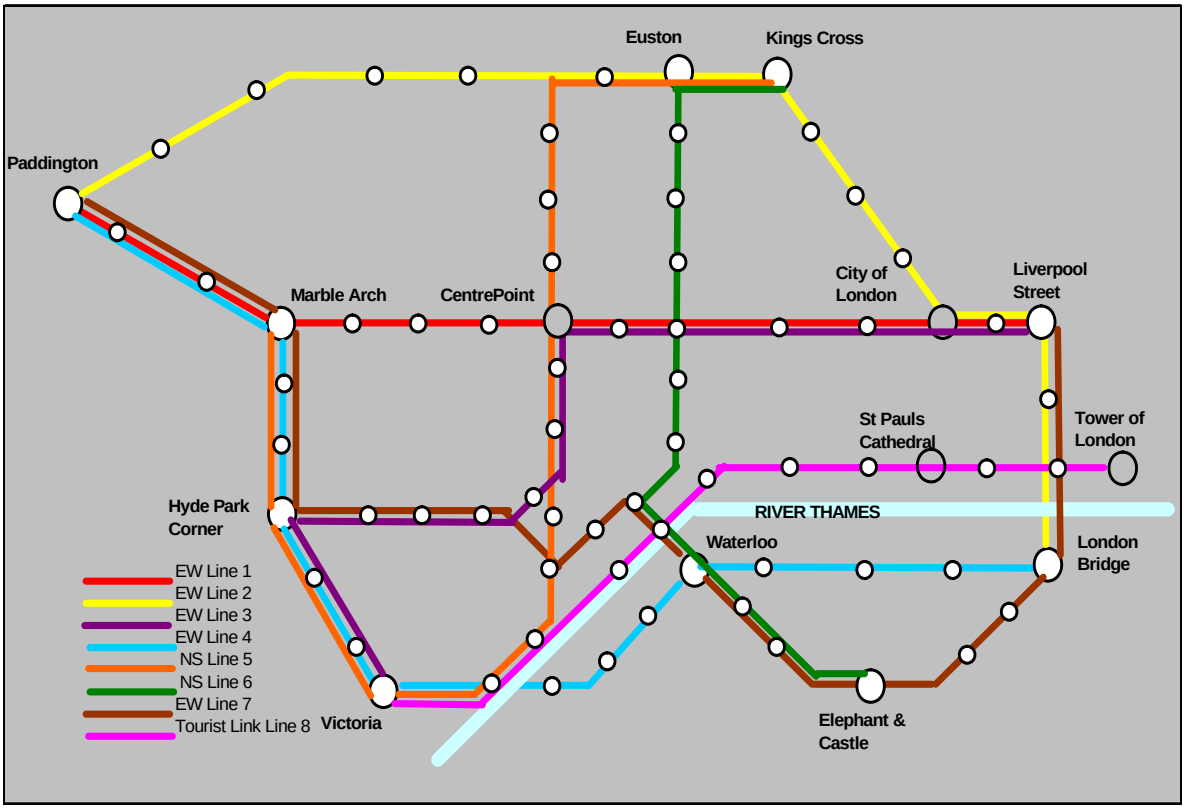
AN INTEGRATED APPROACH TO BUS PRIORITY

A vision for bus network development and bus priority in Central London

Tamsyn Parry



Introduction

Traditional forms of bus priority are sometimes not possible where high volumes of buses result in bus on bus congestion. This paper proposes that where this is the case in the central part of a large urban area or City, that it is still possible to achieve a reduction in the delay to existing bus services. This is by reviewing the route structure of the bus network, before implementing bus priority measures, and is demonstrated by using Central London as a case study.

Within Central London there are several other reasons why the bus network would need to be reviewed. These reasons and the existing bus priority initiatives and policies are reviewed, in the context of unique challenges facing Central London. A potential new bus network is then outlined in detail, along with a staged process of implementation of this network.

Central London

Within Central London there is substantial bus on bus congestion on some key roads. This is due to a bus network where many routes follow a small number of roads.

Present bus congestion in Oxford Street (The UK's prime shopping street) is shown in Figure 1 below.

Figure 1: Bus on Bus Congestion in Oxford Street

For a passenger travelling from the suburbs to Central London, the tube or train system is much more efficient and faster than any bus route. Within Central London the bus, bicycle and walking are better for shorter journeys than the tube system, e.g., from Euston Station to Holborn. This avoids short hop on hop off journeys being taken on the tube. A reliable bus network should make short trips by bus faster and more efficient.

The Case for Change

As well as the bus on bus congestion, there will be a future need within Central London to increase the capacity of the 'public transport network', particularly during the Olympics in 2012. The tube network is at capacity. Any significant increase in passenger demand will result in a need to increase the capacity of surface transport alternatives.

To accommodate any future growth in passenger numbers, the present haphazard bus network needs to be disposed of and redrawn along new lines that provide short, reliable transfers across Central London. These new routes offer clear, attractive links between the principle commuter and long distance hubs, and the major business, retail and tourist centres of the capital.

There are many proposals within Central London that will each place much pressure on the existing bus network. Each of these challenges highlights the need for a new bus network within Central London and their combined effect is to make it impossible for the existing bus network to remain as it is, even if some and not all of the proposals are implemented.

Many of the proposals within Central London are well known and are listed below:

- Reconstruction of Tottenham Court Road LUL (London Underground Limited) Station;
- Crossrail Station construction at Tottenham Court Road;
- Tram along Oxford Street;
- Cross River Tram;
- Renewal of the tube system with line closures for extended periods;
- Developments to many underground and mainline rail stations;
- Proposals for a tram in Regent Street;

- Forecast growth in Central London workforce; and
- The 2012 Olympics.

The existing bus network serves both Greater and Central London. Bus services cross Central London and disperse in all directions to the suburbs. In general a route from the suburbs will terminate on the opposite side of Central London. Good examples of this are the number 68 from West Norwood which terminates at Euston station, or the number 73 from Seven Sisters which terminates at Victoria. Many of these services have remained unchanged for several decades and continue to use Oxford Street.

The provision for pedestrians in Oxford Street is very poor with narrow and crowded footways. Between Oxford Circus and Tottenham Court Road the footways are particularly narrow with a carriageway that is wider than necessary. Buses can tail back the whole length of Oxford Street particularly in the westbound direction.

Proposals for a tram to operate the full length of Oxford Street are being investigated by Transport for London. If a tram is to be introduced into Oxford Street, then alternative routes will need to be found for all of the 24 bus routes that serve Oxford Street. This would result in Oxford Street being used by trams and pedestrians only, and would be an opportunity to modernise this prime shopping location. The tram proposals are supported by Ken Livingstone (Mayor of London) as well as the New West End Company, who have recently secured significant funding for improvements to be made to Bond Street, Regent Street and Oxford Street, in conjunction with the Crown Estate who own many of the buildings in the area.
Improvements for pedestrians would benefit shoppers but would require the removal of buses from Oxford Street. This could pose problems for buses as it is a vital link in the current bus network for Greater London.

Amongst the biggest change to face London within the next decade is the Olympics in 2012. This will have profound demands on the existing transport network. The number of visitors that will arrive in Central and Greater London will be much higher than is normally experienced in a good summer. There will be many more visitors travelling from Central London to the Olympic site, as well as within Central London itself, when they are not at the Olympic venues.

In the immediate future the redevelopment of Tottenham Court Road LUL station, and the construction of a Crossrail station in the same area, will result in major disruption until at least 2014. Located east of Oxford Street, this junction has some of the highest flows of buses within Central London. When the station is under construction it will be impossible for the existing bus network to operate as it does at the moment without delays and disruptions to services. Construction will begin in 2008.

London Buses have experienced significant passenger number increases in recent years, and in many ways is one of most successful bus networks within the United Kingdom. However, in the context of increasing passenger numbers and complex demands, the existing network is becoming less able to meet current demand, and to meet future developments.

Existing Bus Priority in London

There are many existing proposals to improve bus services within Central London. These are nearly all forms of bus priority based on existing bus services. The main initiatives are listed below:

- The London Bus Priority Network;
- The London Bus Initiative;
- Flagships; and
- Third Generation Bus Priority (3G).

Each of the LBPN, LBI, Flagship and 3G approaches to bus priority share a similar set of inherent difficulties. The proposals are as follows:

- require the cooperation of London Boroughs at an officer level. Most bus routes operate on roads where London Boroughs are the highway authority;

- must gain support within London Boroughs at a political level, if they are not to be watered down to minor 'LBPN' type schemes from more 'radical' schemes;

- should consider other local needs which may conflict with the need to reduce bus journey times;

- need to take into consideration the needs of traffic flow, pedestrians, cyclists and highway capacity through the Traffic Management Act process;

- need to be implemented on a highway network that is not wide enough for significant segregation of buses from other traffic;

- are along a whole bus route, and not just within one 'performing' Borough only;
- are restricted to the existing bus route.

The effect of these constraints can be highly disabling, preventing the implementation of measures, sometimes severely curtailing the benefits of a scheme. In some Boroughs, even simple schemes to improve bus stops, (which are not even bus priority based) can take several years to implement.

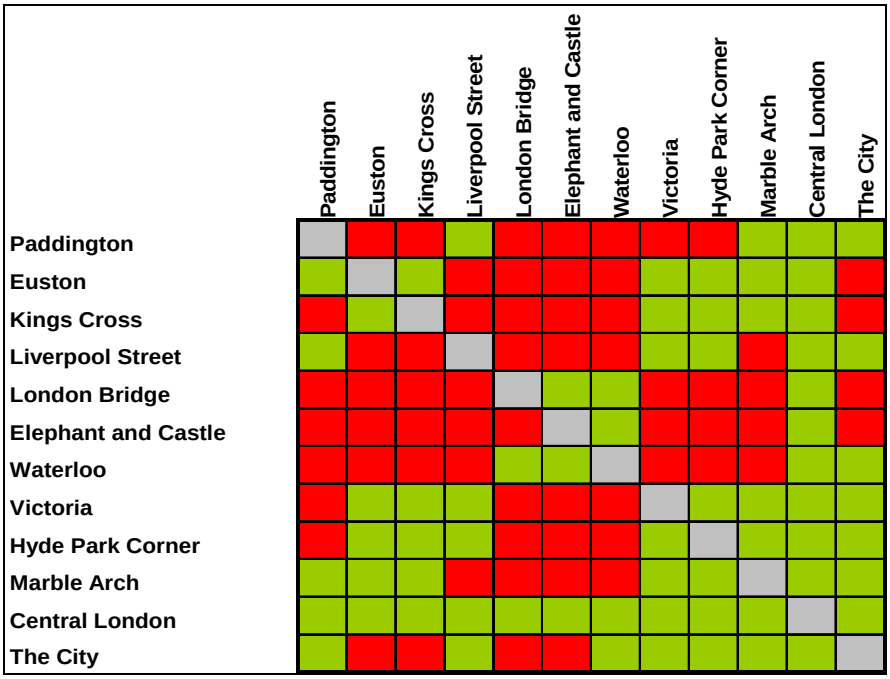
The single greatest obstacle that prevents improvements to bus passengers and journey times is the existing network itself. Removing the existing network and replacing it with a new bus network in Central London is the key to enabling bus priority to deliver passenger benefits on a huge scale.

A Vision for a New Bus Network in Central London

The principle of the new bus network for Central London is to separate existing bus routes into suburban bus routes and Central London bus routes. Bus services that currently pass through the centre of London and into the suburbs will start on the edge of the central area, at designated major interchange points. The Central section will be replaced with a network of short and frequent services. Each individual bus route will have the capacity of several existing services put together, and will operate like a tram, and be marketed like the tube network, making it much easier for people to understand.

Figure 2 below shows that the bus network for Central London is extremely limited. Connections advertised to tourists between key locations in London are shown below in green.

Figure 2: The Extend of the Bus Network Advertised To A Tourist



Travelling Around: Your Tube and bus map TfL

For any new bus network to appeal to non bus users, tourists and people who may otherwise use the tube, then the frequency of all routes on the network should be with a bus every five minutes or less. This is also the frequency of many tube services in Central London.

The Central London bus network proposal is modelled on the following four principles.

- A core Central London network which serves within a two mile radius from Oxford Circus;
- A suburban route network that serves up to a two mile radius of Oxford Circus;
- The cross Central London services terminate at hubs where suburban services (for a region of Greater London) meet the Central London services; and
- Passenger interchange from one route to another is provided with well designed 'state of the art' bus interchanges at each hub.

Eight bus routes have been created that cross Central London from one hub to another. These eight routes are one possible suggestion for the new network. The hubs are defined by the destinations used in Figure 2 above. From each hub it would be possible to go to every other hub, and destination between hubs. For example, the new network would allow for trips from a hub at Paddington to one at Liverpool Street to the east, London Bridge to the south east or Victoria to the south west of Central London. The routes would also pass through key areas like Oxford Street, Covent Garden and the City of London.

Each of the hubs would be the termination point for both the suburban and Central London bus routes. The hubs would be within a small geographical area at many of the locations listed in Figure 2. They would enable a quick and easy transfer between suburban and Central London bus services.

There is a huge potential market for passengers within Central London to make use of this available capacity on buses. However, it is very difficult for potential bus users to understand the current bus network in Central London, deterring them from using it. A new bus network for Central London offers an opportunity to develop a tube based bus route map. This would be much easier for passengers to understand.

The new network for Central London as it could be is shown in Figure 3.

Figure 3: The New Central London Bus Network

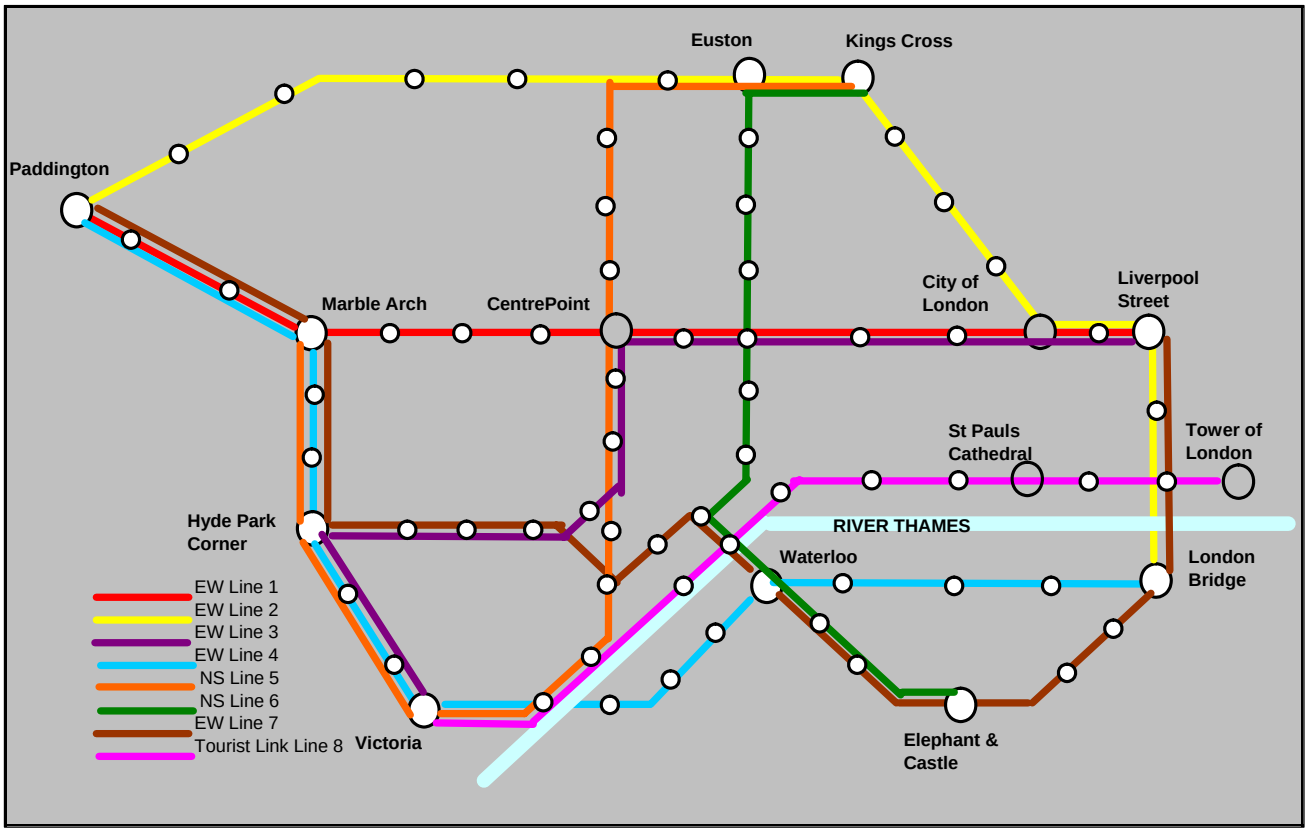


Figure 4 below shows the coverage of the new Central London bus network. Of all the 66 possible route choices, only three would not be possible with this bus route network. All of these destinations would be served by a bus every 5 minutes or less. One other route choice is presently served by an articulated bus route, (shown in orange). If this service was retained it would form part of the renewed bus network.

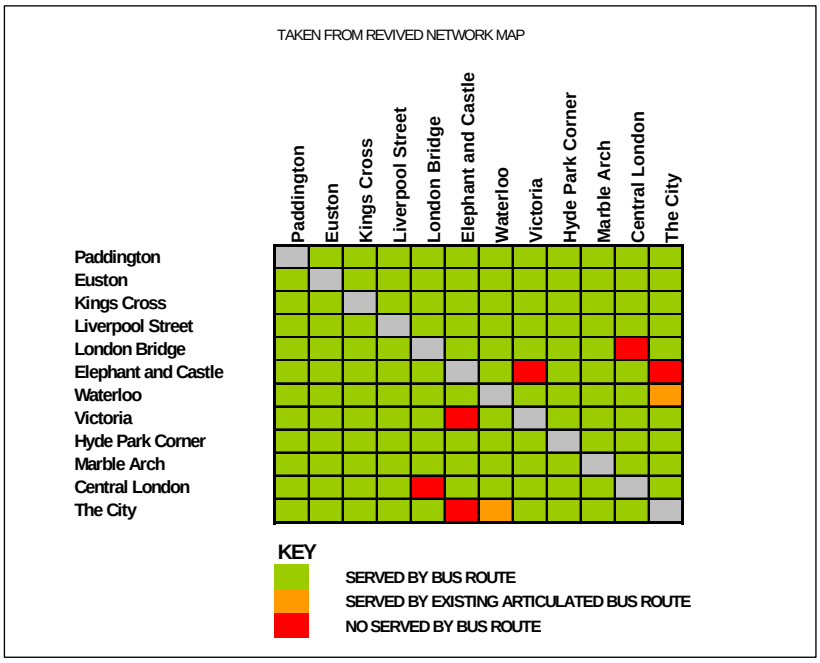


Figure 4: New Bus Route Network Performance

Buses would operate like trams on routes, which like the tube network, would be easy for passengers to understand. Buses and each route would be colour coded e.g. the red bus route runs between Paddington and Liverpool Street. This follows the Central Line which is also coloured red on the tube map. This gives the bus network synergy with the tube network, making bus routes easier for passengers to remember.

With the new Central London bus network it is possible to reduce the amount of bus services in New Oxford Street from 17 to only 3. These would be Line 1, Line 3, and route 38. The amount of buses on New Oxford Street would be reduced substantially from approximately 120 buses per peak hour westbound at present to approximately 60 buses, (with a 3 minute frequency on each route).

Are There Examples in Other Cities?

Each city develops in its own way, and is defined by its geography, the locations of railway stations, bus interchanges, and areas where people wish to travel from and to. London's road network and transport system has evolved over many centuries. The current bus network is a reflection of the tram and trolley bus network before it, as well as the evolution of bus routes and demand, that has taken place over the last fifty years.

Consequently it is very difficult to use other Cities across the world as examples to reflect both London's current transport network, as well as the future bus network as suggested in this paper.

There are examples of how other world Cities have developed tram networks or bus networks, but neither can fully reflect what could evolve in Central London. The suggestions put forward in this paper are, to the author's best knowledge, a unique solution to a unique City.

Integrating a New Bus Network into Central London

The vision outlined above for a new bus network in Central London would in practice be very difficult to implement. Like most cities the factors influencing London are very complex and can interact in many ways. A method of implementing a new bus network is proposed in several stages given the changes in Central London which are outlined above. These stages are outlined in Table 1 below.

The first stage would be the replacement of several bus routes, with the routes to form the new Central London Bus Network. These bus routes would be terminated on the edge of Central London at key interchanges.

The routes used through Central London would in some cases be different to the routes previously used by the each bus route. This is to facilitate the connections and routes required for the new Central London bus network.

Table 1: Stages of Implementation for a New Bus Network in Central London

Stage	Proposals	Bus Network Development
1	Revisions to the existing bus network to create the proposed bus network	Replacing existing bus routes with new routes through Central London
2	Development of Tottenham Court Road LUL station and Crossrail station nearby	Removal of infrequent services through Central London
3	Development of a Tram in Oxford Street	Creation of a new bus station at Marble Arch
4	Development Kings Cross, St Pancreas, Euston, Paddington, Victoria and London Bridge railway stations	Creation of improved bus stations at each railway station to facilitate improved interchange between rail and bus
5	Completion of bus network in Central London	Installation of bus priority measures on the revised bus network

At this stage a key part of the proposals would be to retain key bus routes that have a high passenger demand. These would be complemented by the new Central London bus routes. Further analysis of the bus routes and passenger demand would be required using data obtained on bus stop passenger boarding and alighting demand.

An example of the bus routes which could be altered to facilitate the new bus network for Central London is given below in Figure 5.

Figure 5: Bus Routes which could be altered to facilitate the New Central London Bus Network

New Central London Bus Route	Revised Central London Bus Route Origin and Destination	Existing Bus Route No to be Changed	Existing Bus Route to be Changed	Revised Suburban Bus Route Origin and Destination	Revisions to Bus Route	Bus Route Terminus requirements
Yellow	**Liverpool St to Paddington**	205	Paddington to Mile End	Liverpool Street to Mile End	Move terminus from Paddington to Liverpool Street	Liverpool St for 205 and Yellow route
Blue	**Paddington to London Bridge**	15	Paddington to Blackwall	London Bridge to Blackwall	Blue route via Hyde Park Corner and Victoria and Waterloo. Terminates at London Bridge.	London Bridge for 15 and Blue route
Brown	**Paddington to Liverpool Street**	436	Paddington to Lewisham	Victoria to Lewisham	Brown route serves Waterloo and Piccadilly. Route shortened to Victoria.	Terminate at Victoria for 436.
Red	**Paddington to Liverpool Street**	23	Liverpool Street to Westbourne Park	Paddington to Westbourne Park	Move terminus from Liverpool St to Paddington	Paddington for 23 and Red route. Use existing 23 terminus at Liverpool St for Red route
Orange	**Marble Arch to Kings Cross**	390	Notting Hill Gate to Archway Station	Kings Cross to Archway Station	Move terminus from Notting Hill Gate to Kings Cross. Orange route serves Victoria and Charing Cross Road.	Kings Cross for 390 and Orange route
Purple	**Victoria to Liverpool Street**	25	Oxford Circus to Ilford	Liverpool Street to Ilford	Move terminus from Oxford Circus to Liverpool Street	Victoria and Liverpool Street for Purple route and Liverpool St for 25
Green	**Kings Cross to Elephant and Castle**	68	Euston to West Norwood Station	Elephant and Castle to West Norwood Station	Move terminus from Euston to Elephant and Castle	Euston for Green route and Elephant and Castle for 68
Pink	**Victoria to Tower Hill**	RV1	Covent Garden to Tower Gateway Station	Victoria to Tower Hill	Move terminus from Covent Garden to Victoria. Route follows the northern side of the Thames (St Paul's Cathedral) and not the south side.	Victoria station for Pink route and existing stand at Tower Gateway Station

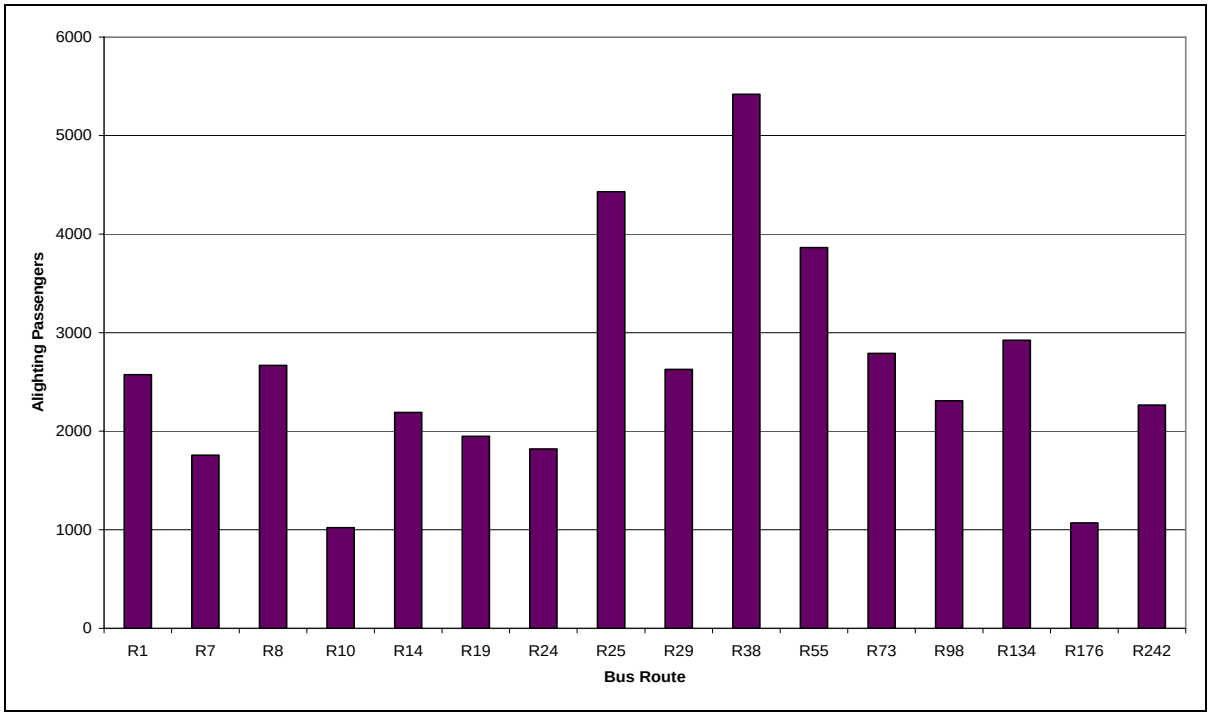
The second stage would be for the removal of infrequent bus services from Central London. Many bus routes within Central London have a frequency of less than five minutes. This can worsen existing bus on bus congestion on key bus corridors like Oxford Street and Regent Street.

The construction of a new LUL station at Tottenham Court Road and Crossrail station nearby will result in a loss of capacity at its junction with Oxford Street, New Oxford Street and Charing Cross Road between 2008 and 2014. At this time, it will be particularly necessary to reduce the number of buses at this junction, to reduce delays to the most frequent and key bus routes in this area.

The less frequent services carry the least amount of passengers. This can be seen in Figure 6 below, which illustrates the passenger numbers alighting at bus stops in the Tottenham Court Road LUL station area.

The most utilised bus routes (where total demand for alighting per day is greater than 2,500 passengers) includes bus routes 1, 8, 25, 29, 38, 55, 73 and 134. Of these, bus routes 25, 73 and 38 operate using articulated buses. The bus routes with the lowest passenger demand for alighting are Routes 7, 10, 24, and 176. These services could be terminated before they enter Central London, to help reduce bus on bus congestion.

Figure 6: Alighting Passengers in Bus Stops Surrounding Tottenham Court Road LUL Station by Bus Route per Day



The future development of a tram in Oxford Street would facilitate its closure to all vehicles and allow for much needed improvement for pedestrians. Bus routes that serve Oxford Street from the western part of London could be terminated at a new bus station at Marble Arch at the western end of Oxford Street.

Bus routes approaching Oxford Street from north and eastern London (using New Oxford Street) could be diverted away from Oxford Street onto

Shaftesbury Avenue or Kingsway and to other routes avoiding Oxford Street.

The new bus station at Marble Arch would become one of the interchanges for the new Central London bus network. This stage represents the third stage in the development of the new Central London bus network.

The fourth stage in the development of the new Central London bus network is the reconstruction of many of London's railway termini. There are currently proposals that would affect Kings Cross, St Pancreas (recently completed), Euston, Paddington, Victoria and London Bridge railway stations.

At several of these stations, proposals are already being developed to improve the interchange for buses with rail in the station concourse area. New bus interchanges will need to be constructed at each of these stations, to allow for busses standing, and to enable the full development of the new bus network for Central London.

It is only with new interchanges at these key locations (with or without new railway stations) that the proposals for a new bus network in Central London could be fully realised. Without new bus stands at these locations it would be difficult to implement the proposals fully.

This leads to the final stage in the development of the new bus network. This stage is the completion of bus priority measures on each corridor to maintain a reliable and short journey time for each route in each direction, and allow for consistent bus stop facilities for passengers. The improvements will realise the full potential of the new network for Central London. Improvements to each route on the new network would include:

- Bus priority along the full length of each bus route;
- Bus priority on suburban bus routes to the hubs;
- Creation of 'super bus stops' at every bus stop along each Central London bus route;
- IBus and SVD technology;
- Replacement of double deck buses with articulated buses; and
- Replacement of the Central London bus network with a Central London tram network using the same interchanges and routes.

Bus priority schemes on a route basis have been implemented on the Route 38 in London. This can take a long time to install and requires much cooperation from the Boroughs.

A bus route is only able to achieve its potential when it has less congestion due to the removal of other buses, delays from traffic and other factors. Bus priority can then be used to remove all other delays due to other traffic on the bus route. This is the kind of bus priority that is currently being developed along the Route 38 corridor from Victoria to Hackney.

Conclusion

This paper demonstrates that the focus of bus priority, where there is bus on bus congestion, should be on the bus network first. Central London is used as an example, where there is significant bus on bus congestion, and many pressures on the bus network. From here once the network is improved (without generating bus on bus congestion), then bus priority schemes on an individual route can be implemented. This technique can be applied to other cities where bus on bus congestion hinders traditional bus priority measures.

Developing a new bus network for any metropolitan area requires planning over

several decades. The process needs to take account of developments that have been and are likely to be approved. All of these factors need to be judged together to enable forward planning.

Where there is bus on bus congestion the renewal of the bus network has huge potential to improve bus services and reduce bus on bus congestion. This is particularly the case in Central London. The bus could become a mode of travel that passengers could use in greater numbers to travel around Central London, and would enable the bus to compete with the tube network for short journeys.

A tram network within Central London connected to hubs, linked to a suburban bus network is attainable. This would require 20 years of investment and planning. The new bus network would be completed in five years, be established within ten years, with the tram network taking the remaining ten years to complete.

Whilst buses are the focus of this paper, it should be noted that TfL's policy is to encourage more people to use a bicycle to travel short journeys. This would help to address rising levels of obesity, and create a road network in Central London that is more adapted to the bicycle and for more cycle journeys. Any policy to encourage cycling could compliment a policy to encourage bus use, as it would help remove pressure from the tube network. In 2006/7 there were 297 million underground journeys within zone 1. Those who are unwilling or able to cycle would be able to use the improved bus network instead. This would include commuters to Central London who are unable to travel with a bicycle who could travel across Central London using the bus. Along with developing a culture of using the bus for short journeys, Central London would also benefit from a cultural shift to generate a much greater level of cycle use. TfL could develop the use of both modes within Central London without compromising its own policies. This can be achieved by directed marketing, to target socio economic groups who are most likely to respond to initiatives to increase cycle or bus use within Central London.

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