A word on the street

Alan James

Pedestrianization and traffic calming schemes can achieve more than merely practical results if designers keep them simple

Introduction

The city street plays a vital role in the quality of urban life. In the present age, the trends of society are towards what Sir Richard Rogers recently highlighted as "single-minded space" (BBC 1995 Reith Lectures), in which most places have a single predominant purpose in the name of efficient living. The street is one of the last bastions of "open-minded space" in which a multiplicity of functions and behavioural patterns interact. The significance of this is that single-minded space invariably acts as an agent of sterility and anonymity; whereas it is open-minded space which shapes the qualities of place – character, diversity, identity, community, vitality – on which the quality of urban life depends.

Over the past few decades the open-mindedness of the street has been increasingly threatened by the dominance of one user – the motor vehicle – and its environmental consequences – noise, danger, pollution, overcrowding, pedestrian severance. Pedestrianization and traffic calming are widely seen as policies which redress the balance and, therefore, "a good thing". They are all about returning the streets to people, eliminating or reducing the adverse effects of traffic, lessening the tensions between street users with very different demands and capabilities. They are about using the space to meet more vital and human needs and aspirations such as those for trees, seats, fountains, art, information and meeting places. They constitute, in planning and urban-design terms, a "*success story*".

Of course all these positive aspects must be acknowledged; but there is another side, which has generally been ignored or underestimated amid the enthusiasm for such projects. Pedestrianization and traffic calming have introduced a whole vocabulary of forms and materials alien to the established patterns of streetscape and potentially very destructive of the visual qualities of the street, especially in the historic context of many town centres.

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The photograph of a street in the centre of Lancaster (Plate 1) shows a typical, and not even unusually bad, example. Pavement blisters, lopsided pavement widths, slab strips across the road, a confusion of paving materials and slab orientation, a lone tree (probably shoe-horned into the only available space between underground services), and a forest of overbearing cast iron bollards in visually random disorder, all destroy the simple shaft of space between varied façades which is the essence of the street. The eye is distracted from, instead of led to, the natural focus of the street at the classical portico of the town hall. Compare this with the effect of the avenue beyond the portico, which simultaneously closes the general vista yet, even at a distance, strongly expresses the continuing line of the street, inviting exploration towards the mysterious spire rising beyond the town hall.

In spite of more than 25 years' experience in the design of pedestrianization schemes, urban designers have largely failed to tackle the basic issues thrown up by the introduction of urban forms that are largely without historical precedent. It has been too easy, in the context of a generally positive initiative, to gloss over the deficiencies in detail which have marred and continue to mar such schemes. These design considerations are not simply a matter of professional pride: they are, arguably, as important in determining the qualities of place and living environment as the concepts themselves.

This short article can do no more than introduce the subject, identifying the problems and some of their causes, and suggesting general ways of reconciling the competing demands on street space with the equally legitimate and vital demands of streetscape.

Pedestrianization – a load of old bollards?

Pedestrianization of town-centre streets removes the functional basis on which street layouts evolved historically: namely, the differentiation between space for vehicles and space for other uses. This simple functional requirement had a simple structural expression in three elements – pavement, kerb line and roadway – reinforced by two further distinctions – materials and levels.

Plate 1. *Brock Street, Lancaster: pedestrianization meets traffic-calming, with disastrous results!*

Plate 2. *Penny Street, Lancaster: The road is dead, long live the road (and if the kerb line on the left didn't need protecting with bollards, why did the one on the right?)*

Plate 3. *Penny Street, Lancaster: Most of the mess on the left is designer clutter rather than highway clutter; more importantly, this design blocks a view along the street to the river and open countryside from the heart of the city, to the detriment of one of Lancaster's most significant townscape qualities*

Footways required materials to be good walking surfaces, whereas roadways needed, first and foremost, to bear heavy loads. Raised kerbs kept vehicles in their part of the street, preventing them from going on to the weaker footways, protecting pedestrians and building frontages. Drainage naturally followed the base of the kerb, and all levels sloped towards the gutters.

The redesign of a street as purely pedestrian space instantly removes the functional imperative which kept streets simple, leaving an uncomfortable vacuum in which the purpose of any given space is less clearly defined and frequently ambiguous. Many of the design problems of pedestrian precincts stem from this uncertain starting point, the foremost of which are:

- *How to lose the roadway*. Although the functional differentiation of areas is no longer relevant, a remarkable number of pedestrian schemes fail to lose the roadway, retaining surface differentiation, crossfalls and even kerb lines from the old street (Plate 2). Even though most pedestrian streets retain limited access for delivery and emergency vehicles, this design treatment surely sends the wrong signals to pedestrians about the relative dominance of vehicles in what should be their space.
- *How to fill the space*. Historically, the space between buildings had to be left clear simply to fulfil its functions. In the absence of such constraints, many designers of pedestrian schemes in Britain appear to have been incapable of leaving space alone, but choose instead to fill streets with all manner of signs, columns, seats, litter bins, "heritage" statements, trees, and cast iron bollards (Plate 3). All such artefacts set the trap of having a specific function to justify their use, but in most cases this is undoubtedly secondary to their use as space "definers" or "enliveners", and the street suffers fragmentation as a consequence.
- *Floorscape*. This is perhaps the most seductive aspect of streetscape treatment, embodying the desire to express a conscious design input through surface patterning (Plate 4), rather than letting the space between buildings speak for itself. Such attempts are almost by definition contrived (although sometimes a spurious "functional" relationship is invoked between pattern and use) and more often distract from than harmonize with the essential qualities of the street.
- *Materials*. The onset of pedestrianization coincided with the decline in use of natural

Plate 4. *New Street, Birmingham: Meaningless geometric games, and a serious overdose of different paving materials*

materials, and the introduction of new, artificial and universally available materials such as concrete paviors. The new materials were even to some extent developed to meet the new needs, for example to meet the combined load-bearing and walking surface requirements of pedestrian streets. However, the combination of new streetscape forms and new materials had enormous townscape consequences especially in the context of historic town centres in which much pedestrianization took place. The variety of colours, shapes and sizes, and the removal of the constraint of local availability, led to a period of largely undisciplined design, using a large number of materials at once (Plate 4) and introducing new paving types into areas with neither a tradition of nor an affinity with the new material.

Traffic calming or townscape chaos?

Traffic calming gives rise to an even broader and in many ways more difficult spectrum of townscape problems, mainly because it works within existing street functions but seeks to modify them, across a much wider range of urban contexts. The same may also be said of policy makers, who are having to modify long-standing approaches to traffic management, based on assisting vehicle flows, towards policies to restrict vehicle flow. Perhaps understandably there is some difficulty in making this strategic adjustment, and in consequence many traffic calming measures are relatively minor and incremental. It is however inevitable that this somewhat tentative current basis of traffic calming in Britain finds expression in the townscape effects of implemented schemes, the most significant of which are as follows:

- *The pavement blister*. This is a very widespread feature, creating a section of constricted roadway width, slowing traffic down, providing a shorter, safer pedestrian crossing point, and often defining parking bays. In townscape terms, the blister interrupts the flow of the street every bit as effectively as it does the flow of traffic. Invariably a blister stands out as an intrusive afterthought to the street layout, often being one-sided, constructed of different materials, and with the old kerb line strongly expressed or even still in place (Plate 1).
- *Pavement cross-falls*. Pavement widening into an existing roadway, either generally or as a pavement blister, usually results in paving levels riding up the roadway camber, with a back-fall to the former kerb line (Plate 1). The resulting kink at the old kerb line, often emphasised by a drainage channel, is visually uncomfortable and upsets the simple visual correlation between levels and materials in the traditional roadway-footway-kerb-line pattern.
- *Speed humps, paved crossovers, raised tables*. This array of techniques uses level and material changes to slow down traffic and to promote easier pedestrian crossing points at footway level. They are invariably accompanied by signs and either bright materials or road markings to warn motorists of their presence, which inevitably draws attention to them as streetscape elements. Their prominence as transverse interruptions to a basically linear space is generally visually disturbing, unless a regular rhythm is established.
- *Materials*. Where traffic calming devices are inserted into existing streets without otherwise altering existing features, this is very often done in completely different materials, thus proclaiming the intrusion. The comments on new materials discussed under pedestrianization are equally applicable to traffic calming.
- *Signs and street furniture*. There is an apparently inevitable proliferation of signs and markings, guard-rails and bollards associated with almost all

traffic calming to date in Britain, perhaps because of concerns that such schemes are still relatively untypical and unfamiliar to motorists. The resultant visual clutter, especially when each element is provided without reference to all other elements, is already recognized as one of the most obviously detrimental visual consequences of traffic calming schemes.

The results of indifferent schemes of both types are to been seen throughout Britain. The remedy is difficult to identify, as there can never be a single prescription which is viable for all circumstances, but a few guiding principles can be suggested:

- A "twin spearhead" approach is essential, in which townscape objectives are given equal status with traffic management objectives, and the two are designed integrally.
- Design quality in urban spaces requires more attention from the design professions, which have tended to be complacent about their own role in such schemes. It is fairly commonplace to hear urban designers bemoan that townscape considerations are submerged by either unsympathetic highway authorities or inflexible highway design regulations, when in fact many of the shortcomings discussed above can be laid directly at the designer's door.
- Traffic management policy has to progress, to allow more radical treatments which will not only have a greater traffic calming impact but should also allow a more unified and less compromised townscape treatment.

It is fair to say that in all these aspects progress is being made and co-operation between highway authorities and urban designers is producing results, occasionally in particular schemes but also in specific subject areas such as the rationalization of road signs and poles. However, while co-operation is essential to open the way to better streetscape treatment, it does not in itself guarantee good results, and many schemes still under-achieve.

If there is any one, overriding reason for this, it is the designer's failure to understand the simple relationships within the street, and that simple relationships benefit from simple treatments.

The following section looks at two places where integrated design has been very much in evidence, and from where there is much to learn.

Streetscape design in practice – a tale of two cities

Birmingham and Edinburgh are two cities with diametrically opposite development histories since the Second World War, yet which have in different ways made radical strides in recent years in response to the issues of traffic management and the pedestrian environment.

Birmingham went probably further than any other British city in the direction of city centre highway construction and promotion of the motor vehicle in the 1960s and 1970s; yet in the past few years it has embraced city centre pedestrianization more comprehensively than anywhere else. In complete contrast, Edinburgh was the only large British city to avoid major urban road construction programmes at that time, but has achieved least by way of city centre pedestrianization, preferring instead, in recent years, a significant initiative on central area traffic calming.

Both cities demonstrate some of the positive aspects of integration of environmental design and traffic management objectives, but both display some of the pitfalls which beset even the most well-intentioned urban design.

Birmingham has created, in a matter of a few years, an almost wholly pedestrian central area around a spinal route along New Street, through Victoria Square, Chamberlain Square and Centenary Square, to the new Concert Hall complex, a distance of around 1km. This is an enormous achievement, at a scale comparable with many leading European cities in the field of pedestrianization, and its success as a concept speaks for itself in the vitality of the streets and squares (except for Centenary Square) as places for people.

Unfortunately, the design detail is very variable, and occasionally awful. New Street exemplifies most of what is bad about the design of pedestrian streets (Plate 4):

- a floorspace of contrived geometric patterns, with a serious overdose of different paving materials, mostly brick – in a street with few brick buildings in a city with little tradition in brick paving;
- failure to break away from the original street levels, resulting in ungainly visual kinks on the old kerb lines, emphasized by the prominent transverse bands of yellow paving;
- serried ranks of seats, used by some people but failing to provide attractive, positive lingering spaces;
- trees, large and splendid in themselves, but planted in a way which unbalances the street and already beginning to destroy the important vista along New Street to the classical town hall;
- a profusion of largely unnecessary street furniture.

This scheme, far from augmenting the bold concept of the pedestrian spine, has created a restless and distracting jumble of small-scale incident in what might otherwise

have been one of the noteworthy pedestrian streets of Europe.

Victoria Square, by contrast, is much calmer and more unified in spite of its irregular shape, complex levels, and diverse building frontages (Plate 5). Although the judgement is inevitably fine, the scheme has on the whole achieved a balance in which a simple piazza allows the buildings and space to be read together while incorporating several features – steps, water, sculpture, trees and subdued patterning – to avoid sterility without fragmenting the overall space.

Centenary Square and Chamberlain Square form a further interesting contrast. The former exhibits a strong design consistency (Plate 6), demonstrating especially the possibility of diversity within unity by using different coloured paving bricks to form a cohesive pattern rather than a meaningless geometric exercise: and yet the space is sterile, in scale, proportion, enclosure and function. On the other hand, Chamberlain Square (Plate 7) has several design idiosyncrasies yet manages to attract and hold people by a few simple means – a south-facing amphitheatre of steps, lots of casual sitting places (not a formal seat in sight), a sense of place, and above all the operation of space at several different scales. In an indefinable way, Chamberlain Square is a space which works through its open-space treatment, in spite of its unpromising backdrop of buildings and leaking corners.

Birmingham's central pedestrian spine offers a fascinating journey through the good, the bad, and the odd of current practice in pedestrianization. Edinburgh's equivalent achievements in central area traffic calming have been more recent and less comprehensive to date, but two important schemes have reached partial fruition in the historic Old Town. Both of these have, significantly,

Plate 5. *Victoria Square, Birmingham: calm surface treatments allow full expression to the more interesting contributors to space and place (love or loathe them as you will)!*

Plate 6. *Centenary Square, Birmingham: surface pattern used to unify rather than fragment – but a place for pigeons not people (and did the occasional vehicle route across the concert hall really need 38 bollards to define it?)*

Plate 7. *Chamberlain Square, Birmingham: a place for people*

given townscape objectives at least equal status with traffic management objectives, and both offer insights of potential relevance to the general practice of traffic calming.

The higher profile scheme of the two is the work to the High Street, part of Edinburgh Old Town's most important historic street and therefore among the most significant historic streets in Europe. The scheme involved reducing a variable but generally very wide stone setted roadway to a standard 7.3-metre carriageway, and repaving the footways to new kerb lines. Three especially important principles are evident in the scheme design:

(1) The street was completely redesigned and repaved to new levels over the whole area between the street frontages, so there is no sense of the new layout as tacked-on to the previous street form.

(2) The scheme has been executed entirely in traditional natural materials, befitting the exceptional conservation status of the High Street, and with almost obsessive attention to detail.

(3) The design generally avoids small-scale detail and distracting space-fillers, to allow the extremely high-quality relationship between buildings and the spaces of the street full expression.

At its best, the High Street scheme works well as townscape design. It achieves the simple relationships between roadway, footway and kerb lines described earlier, while altering the balance between pedestrian space and vehicle space. Yet, even in this carefully considered, high-quality, high-cost scheme, doubts remain. The roadway, through its constant width and gently curving line, fails to respond to the very irregular and variable spaces and thereby still dominates the street, especially in the most important section alongside St Giles' Cathedral (Plate 8). Here, roadway and footway are flush paved, and vehicles contained within two rows of stone bollards following the gently meandering roadway. These intrude into the simple space, conflict with the scale of the cathedral and emphasize the roadway as a kind of toboggan run through an essentially pedestrian space.

This in turn raises the more fundamental question of the extent to which the High Street actually performs traffic-calming functions. The retention of a uniform 7.3-metre carriageway allows the previous two-way one-lane traffic flows to operate unchanged, and the strong definition of vehicle space does little to reduce traffic speeds. Could not the High Street have been more successful as a more radical shared-surface street with greater restriction on traffic movement, especially given that it is largely unnecessary as a through-route? That said, the townscape improvement, in spite of the number of criticisms which can be made, is undeniable.

Plate 8. *High Street, Edinburgh: a model of restraint, clarity and precision (almost too much of the latter, which arguably stifles the essential variability of natural materials); but the spaces of the street would speak even more strongly without the bollards, and with a less uniform, less dominant roadway*

The second Old Town scheme to date has been a first phase of the "pedestrian pilot route" project, which was proposed as a demonstration of the principles established in a central area pedestrian study for improving the pedestrian environment of the city centre.

This differs from the High Street scheme in several respects, being along a major vehicle route across the Old Town and being more specifically directed at pedestrian-oriented objectives, over a larger and more diffuse area and at considerably lower cost. Again, though, streetscape objectives were at the fore of the design proposals, and the study objectives were met within this context in several interesting ways, especially on Forrest Road (Plate 9):

- The basic layout principle was to extend an existing avenue of trees along the line of Forrest Road, thereby also maintaining the balance of the street while reducing the roadway width by two lanes.
- The avenue is placed within a continuous stone-set strip, which accommodates the roadway camber backfall without a visual kink, and absorbs all the unavoidable visual clutter – sign poles, rails, bollards, bus shelters in the subordinating line of the trees.
- The area of footway usable by pedestrians has been slightly increased, by removing this clutter without actually widening the pavement, but the perceptual effect is much more significant through the creation of the avenue buffer zone between the pedestrian and vehicle zones of the street.

In many other ways this scheme achieves simple traffic calming and pedestrian area enhancement by simple

Plate 9. *Forrest Road, Edinburgh: design based on contextual reference and functional requirements; vehicle space halved and pedestrian space improved in quality while maintaining the simple form of the street*

means, without intruding on the essential qualities of the street, generally by taking its design cues from townscape reference points and simplifying surfaces and spaces as far as possible. Although it is sometimes let down by detailing and workmanship – and there still seem to be too many bollards – this scheme points to a direction in which traffic calming can go with integrated design processes and a basic empathy with the underlying principles of the street.

Conclusion

The central theme of this article is that much streetscape treatment of pedestrianization and traffic-calming schemes in Britain to date has been unsatisfactory mainly because the essential qualities of the street have either not been considered or not been understood. This begs two questions. First, is it right? Second, does it matter?

The first question is the more difficult, involving as it does matters of taste. One person's pleasing simplicity may be another's numbing blandness; some may regard Birmingham's New Street as cheerful, colourful and lively rather than irritatingly fussy; and the designer should always be wary of high ideals which are not shared by the population at large. Clearly, there can be no easy answer to this question; but it is still fair to argue that, without being too dogmatic about the end product, a scheme which starts from an understanding of context stands a better chance of achieving a basic harmony with place than one which starts from some arbitrary, ill-conceived or simply mindless point.

The second question – does it matter – is equally interesting. If the concept of pedestrianization is right, and somewhere like New Street is thronged and bustling with all human life, does the detail matter and do people even notice? This is a complex issue, but the short answer must be "yes". Most people are capable of liking or disliking the feel of a space or place, without necessarily articulating or even consciously thinking about what it is that evokes the feeling. The designer's role is to analyse, understand, articulate and, ultimately, to translate these unspoken criteria into tangible expressions on the ground. It is in this way that the execution of schemes such as the pedestrianization and traffic calming of city streets can produce places which are not merely practical or acceptable, but special.

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A future for air transport?

Arie N. Bleijenberg

Achieving targets of reduced environmental pollution in cost-effective ways need not be incompatible with less governmental control of the air transport sector

Slump in air transport

The European air transport sector is going through a major economic crisis. This picture was convincingly painted by a *Comité des Sages* ("Committee of Wise Men") from the sector itself (*Comité des Sages*, 1994). In 1992, 11 of the 15 European airline companies running scheduled services operated at a loss. Their aggregate loss that year amounted to some 2 billion ECU. There are a number of different reasons for this slump. First, the economy is (still) flagging. In itself, however, this headwind is by no means sufficient explanation. A second important factor is that the production costs of the European air transport sector are far higher than are those of competitors on other continents – by a factor of almost two. The main causes of this cost-price differential are the higher cost of infrastructure and substantial overcapacity. Both factors are directly related to the fragmented European market, protectionism by national governments and extensive government subsidies. In a recent policy study, for example, the European Commission states that current government subsidies form a serious obstacle to reducing overcapacity (European Commission, 1994). Recently, though, the same European Commission approved major new funding for Air France. The picture that emerges is one of a sector that is in the midst of a painful streamlining operation, with countries endeavouring to save their national pride by pumping in considerable sums of public money. At the same time, by advocating liberalization of the European air transport market, the sector has itself opted for increasing competition, with all the reorganization that this implies.

Against this background, the aforementioned *Comité des Sages* was created to chart a course out of the economic slump. The committee was made up solely of people from the aviation sector itself. The Netherlands, for example, was represented by the president of KLM, the Dutch national airline. Expertise in the environmental field was not apparently deemed necessary for drawing up a plan for revitalizing the sector. The committee made a number of recommendations for achieving further growth in the air transport market while at the same time ensuring a recovery of profitability. The recommendations can be summarized as follows:

(1) further liberalization of the European air transport market;

(2) expansion of the capacity of airports and air traffic lanes;

(3) reduction of costs.

Cost reduction can be achieved by substantially improving the efficiency of air traffic control. At the same time, though, the committee fervently opposes any kind of fiscal or environmental measures that could lead to an increase in costs. In addition, the committee takes no clear stand on the structural government support given to the aviation sector. The interests of the companies gathered around the table were probably too conflicting for them to make any comment of substance on this issue. In the view of the committee, as the economy continues to pick up implementation of the three recommendations above will once more make the European air transport sector profitable.

Air transport and the environment

It is remarkable that the environment features only in the margins of the committee's report. After all, the pollution caused by air transport is so intense as to make it irresponsible to present a plan for the future without taking into account any environmental constraints. Today, the aviation sector is responsible for 3 per cent of global CO_2 emissions, a share that will in all likelihood have risen to about 8 per cent by the year 2025 (Bleijenberg and Moor, 1993). Emissions of nitrogen oxides and water vapour at flight altitude moreover constitute a significant risk to the earth's climate (Fransen and Peper, 1994). In addition, air traffic causes local nuisance around airports. All in all, in any study on the future of air transport there is every good reason to give a prominent place to the environment. The fact that the committee has omitted to do so makes its recommendations rather unrealistic. As a result, the necessary and predictable tightening up of environmental policy looks set to lead to a permanent slump in the air transport sector.

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Environmental policy for the air transport sector

At the moment the main thrust of environmental policy for the air transport sector is to curb nuisance in the vicinity of airports. This is clearly reflected in the decision-making process concerning the expansion of Schiphol Airport. The situation is comparable in other European countries. The air pollution that occurs at flight altitude still remains outside the scope of environmental policy. As an initial step, the directorate-general for the environment of the European Commission intends to tighten the emission standards for aircraft beyond current internationally-agreed levels. However, this plan has met with major opposition from the aviation industry, and particularly from Rolls Royce, the only engine manufacturer still not producing according to the scheduled tighter standards. In the Netherlands, too, several steps have been taken towards developing an integrated environmental policy for the aviation sector. In the Schiphol decision-making process, the Dutch government has declared itself in favour of introducing a tax on kerosine for flights within Europe (Project Mainport and Milieu Schiphol, 1991). From the environmental point of view, this is a first-rate plan. However, The Netherlands has made little or no effort to give concrete shape to such a policy at the European level. This raises suspicions that no more than lip service is being paid to the introduction of a kerosene tax. At the same time, the national Government is working on a policy paper on air pollution by the air transport sector which is scheduled for parliamentary debate in the autumn. The expectations are that this paper will focus on problem definition and will contain few, if any, actual policy measures.

Development of an integrated environmental policy for the aviation sector is thus still in its infancy. Below, we present some suggestions for such a policy, based largely on a literature study undertaken by our institute (Bleijenberg and Moor, 1993). In this effort, we are concerned not only with developing a sound environmental policy but also with overcoming the economic slump facing the sector. The latter was also the point of departure of the *Comité des Sages*; we have simply added the dimension of an environmental policy. Our recommendations are as follows:

A European ban on any form of direct or indirect financial support to the aviation sector

A ban of this kind is required to create a level economic playing field and is fully in line with the objective of liberalizing the European air transport market. At the same time such a ban would be good for the environment, since it constitutes a cut in public funding of the most polluting mode of transport. The ban would apply to both airports and airline companies. The European Commission is currently working on a Directive on airport dues which proceeds from the principle of full cost allocation.

Abolition of all tax benefits for the air transport sector

At the moment the zero rate set for VAT on tickets for air flights constitutes an exception to the fiscal regime in Europe. Abolition of this exemption would mean air tickets being subject to the low or high VAT rate. This would result in an immediate rise in the price of flights in the European Economic Area. In addition to the VAT exemption for air tickets, there is also an exemption in force for duty and VAT on "tax-free" goods sold at airports and on air flights. According to calculations made by the IOO (Bangma and Boneschansker, 1993), abolition of this arrangement for flights within Europe would lead to a 2.7 per cent rise in the price of air tickets.

Tightening of aircraft emission standards

At the moment, international standards have been set for maximum NO_x emissions and for noise generation. However, these standards should be tightened up to bring them more in line with the best available technology (BAT). In addition, supplementary standards are required to set a ceiling on permissible CO_2 emissions.

Internalization of environmental costs

To this end, it is desirable to introduce a kerosene tax. At first this could apply to European flights, preferably being extended later to the global level. In addition, an environmental tax component should be included in airport dues, at a rate governed by the type of aircraft (noise and emission characteristics). A surcharge could possibly be introduced for shorter flights, since these are disproportionately polluting (see Appendix 1).

Creation of a fund to reduce current overcapacity in the aviation sector in a socially responsible fashion

This fund would be fed by the new kerosene tax for domestic European flights. This approach is parallel for example to that adopted by the European Union for streamlining overcapacity in the steel industry.

This policy is "greener" and at the same time more "liberal" than that proposed by the *Comité des Sages*. It is more "liberal" because it creates fairer competition and does away with the exceptional fiscal position currently enjoyed by the air transport sector. It is also "greener", since a very approximate estimate indicates that it would stabilize aircraft emissions of CO_2, H_2O and NO_x (Bleijenberg and Moor, 1993). This can be achieved through a pronounced improvement in fuel efficiency, higher occupancy levels and a shift from short flights to rail journeys. In addition, the annual growth of the aviation sector would be halved, from 6 per cent to 3 per cent.

Opposition

The policy outlined here will undoubtedly meet with resistance. After all, it means that air travel and transport will become more expensive and that growth in the sector will be less pronounced than currently envisaged. Both aircraft manufacturers and airline companies will see their sales grow more slowly than planned. Obviously, they will defend their financial interests, asserting, for example, that reduced growth in the aviation sector is bad for the economy as well as for employment. Even today, this kind of pronouncement is already being made. Nevertheless, this picture of the situation is an irresponsible oversimplification. Of course less air traffic will mean fewer jobs in the aviation sector. On the other hand, though, consumers who spend less on air travel will spend more on other goods and services and as a result, there will be a growth of employment in other sectors of the economy. In addition, the extra tax income generated by the aviation sector can be used to reduce taxes in other areas. On balance, a reduction in air travel may even result in greater employment. This is, at any rate the conclusion that can be cautiously drawn from a study not aimed specifically at air transport (de Wit, 1994).

Reduced growth in the aviation sector is thus not necessarily bad for the economy as a whole. At the same time, though, less air travel means less mobility, and is this not an undesirable side-effect? No, because infinite mobility is not infinitely good. As with any other economic activity, for mobility, too, the benefits should outweigh the costs. It is precisely for this reason that economic theory states that the price should be in line with the costs. In the case of traffic, there is friction here, for the price of traffic and transport does not reflect the full costs. (Bleijenberg *et al.*, 1994). As a result, the volume of traffic exceeds the economic optimum. The policy recommendations presented above are designed precisely to internalize all the costs of air traffic. This then leads to an optimum volume of air traffic: neither too much nor too little.

Airport expansion

Reduced growth in the air transport sector does not conflict with the objective of developing Schiphol into a European mainport. Under the projected conditions, there would be less growth in the overall volume of air traffic and Schiphol could still remain one of the top five European airports and continue to be an important hub for intercontinental air travel. In essence, the mainport objective for Schiphol boils down to acquiring a certain share of the market. The same market share can be attained under conditions of reduced air traffic growth; there will merely be fewer incoming and outgoing flights at Schiphol. If our environmental policy suggestions for the aviation sector were implemented, the double objective set for Schiphol – to become a mainport and to improve environment quality – would become more readily attainable.

The other side of the coin is that Schiphol and the other major airports may come to suffer from overcapacity; for, if due allowance is made for environmental constraints, there will be less growth of air traffic than originally envisaged.

This risk of overcapacity is in fact even greater, because the international airports – and the countries in which they are located – are engaged in fierce competition to retain or expand their market share. Schiphol is not the only airport that wants to become a mainport. Will the competitors merely stand on the sidelines watching Schiphol increase its market share at the expense of their own expansion?

These market forces can readily lead to overcapacity – consider the cases of the steel industry, airlines and aircraft manufacturers, for example – which would lead to a new call for government support. Now, while there is still no overcapacity, is the time to introduce a European ban on government funding for airports. Every airport would then have to weigh up all the risks itself: reduced growth in the aviation sector, and the response of competing airports. In the case of Schiphol, because the airport is owned by the Dutch government, these entrepreneurial risks are still being passed on to Dutch tax-payers (van Soest and Bleijenberg, 1994).

Three scenarios

The above appraisal clearly points to a field of tension between the economic interests of the aviation sector, on the one hand, and the environment, on the other. It is in this area of tension that environmental policy for air traffic will be shaped further, as has been the case with road traffic and industry, for example. Since development of an integrated environmental policy for the aviation sector is still at an early stage, there is scope for learning from previous mistakes. To illustrate this position, I would like to present three scenarios for the future of air transport.

No integrated environmental policy

The first scenario assumes that the power held by the industry is so great as to preclude development of any international environmental policy of substance. This is presumably the target scenario of the aviation sector. Although other polluting activities are being tackled, aviation is let off the hook. This may seem unlikely, but the unbelievably slow pace at which European and international policy is developed gives this scenario a fair chance. International environmental policy continues to be frustrated by subordinate national interests: every man to himself, and ecological disruption for us all.

Traditional environmental policy

The second scenario is based on historical developments in other policy areas. Step by step, the government gets more and more grip on the industry's operations. With each new calamity or alarming study, or under popular pressure, new rules and regulations are created. In the case of aviation, these might include a ban on short flights, a statutory minimum-occupancy level, regulations on flight altitudes and routes, and on the number of flights per route, detailed technical stipulations and ultimately quota for the number of flight-kilometres per capita of the population.

At first sight, this scenario might again seem fairly unrealistic. However, all the examples quoted are already to be found in the literature. This kind of scenario also shows great similarity to the development of an environmental policy for the agricultural sector, for instance. Such a scenario requires legions of officials to draw up and enforce all the rules and regulations. The sector will be hampered in its freedom to optimize the complex business of managing its operations and reducing its environmental impact at least cost. In this scenario there are therefore two losers: the aviation branch and the tax-payer.

This traditional environmental policy will be the inevitable outcome if the aviation sector continues to set its sights on the first scenario – no environmental policy at all – but proves unable nonetheless to keep government off its back.

"Hands-off" environmental policy

This third scenario can be termed ideal. Government steers developments from a distance, leaving the air transport branch maximum scope for achieving environmental targets in the most cost-effective manner. Aviation, with such a wide range of possibilities for improving environmental efficiency, is the branch *par excellence* for this generic approach to regulation. Government restricts itself to adhering to international obligations to pass on the costs of all infrastructure and consistent taxation of environmental costs by way of a substantial tax on kerosene and an environmental surcharge on airport dues. Under these new constraints, the international aviation market can continue to operate unhindered.

Although this third scenario is the most attractive, it is at the same time also the least probable, for it implies the aviation branch renouncing the objective of the first scenario: no environmental policy at all. Given the lack of environmental expertise in the *Comité des Sages*, this is far from likely. And, on the other hand, politicians and government would have to renounce any desire for obtaining direct control of society. This would seem almost unnatural.

References

Bangma, K.L. and Boneschansker, E. (1993), *Public Financial Support to Civil Aviation*, Instituut voor Onderzoek van Overheidsuitgaven, The Hague.

Bleijenberg, A.N. and Moor, R. (1993), *Air Pollution by Air Traffic,* Centre for Energy Conservation and Environmental Technology, Delft.

Bleijenberg, A.N., van der Berg, W.J. and de Wit, G. (1994), *Maatschappelijke kosten van het verkeer (Social Costs of Transport),* Centre for Energy Conservation and Environmental Technology, Delft.

CEC (1992), *The Impact of Transport on the Environment*, Green Paper COM (92 46), Commission of European Communities, Brussels.

Comité des Sages (1994), *Expanding Horizons*, January 1994.

de Wit, G. (1994), *The Effects in Employment of a Shift in Taxation from Labour to the Environment*, Centre for Energy Conservation and Environmental Technology, Delft, April.

European Commission (1994), *The Way Forward for Civil Aviation in Europe,* Brussels.

Fransen, W. and Peper, J. (1994), *Atmospheric Effects of Aircraft Emissions,* Directorate General of Civil Aviation, The Hague.

Hofstetter, P. (1992), *Persönliche Energie – und CO_2 – Bilanz*, Greenpeace Schweiz and VCS, Zurich.

Hofstetter, P. and Meienberg, F. (1992), *Ein Ökologischer und ökenomischer Vergleich versciedene Verkehusträges anhand von Städtereisen in Europa*, Buro für Analyse & Okologie and VCS, Zurich, October.

IFEU (1992), *Vergleich von Personenverkehrs-systemen*, Institut für Energie und Umwelt, Heidelberg, July.

Kågeson, P. (1993), *Getting the Prices Right*, European Federation for Transport and Environment, Stockholm.

Pavaux, J., Colomb da Daunant, L., Lisio, F. and Rault, N., *Rail/Air Complementarity in Europe*, Institute of Air Transport, Paris, December.

Project Mainport and Milieu Schiphol (1991), *Integrale versie Plan van Aanpak Schiphol en Omgeving*, The Hague.

van Soest, J.P. and Bleijenberg, A.N., *Distributieland of subsidieland? (Distribution or subsidies ?)*, Centre for Energy Conservation and Environmental Technology, Delft.

Appendix 1. The energy consumption of individual modes of transport

Passenger-kilometre for passenger-kilometre, the amount of energy required for air travel is markedly higher than it is for any other mode of transport. Table AI provides an overview of the results of several comparative studies (Bleijenberg and Moor, 1993). What the table does not reflect, however, is that energy consumption may differ significantly from (type of) aircraft to aircraft – and from car to car. The data in the table are averages, and this holds for occupancy rates too. Under specific circumstances these may also diverge widely from the mean, which is of influence in any comparison between modes of transport. It is surprising how much the specific energy consumption of air travel depends on flight distance. Per passenger-kilometre, short flights cause far more pollution

Table AI. *Primary energy requirements of various modes of transport for various distances (aircraft, 500km = 100)*

Modes of transport	Kilometres 200	500	1,000	2,000
Aircraft				
Pavaux *et al.* (1991)[a]		100	79-83	
Hofstetter (1992)[b]	190	100	70	56
IFEU	154	100	76	
High-speed train				
Pavaux *et al.* (1991)[a]	20-43	20-43	20-43	20-43
CEC (1992)[ac]	24-35	24-35	24-35	24-35
Train				
IFEU (1992)	24	22	21	
CEC (1992) [ac]	11-14	11-14	11-14	11-14
Hofstetter and Meienberg (1992)[d]	20-31	20-31	20-31	20-31
Private car[e]				
IFEU (1992)	67	70	71	
CEC (1992a) [c f]	44-55	44-55	44-55	44-55
Kageson (1993) [c g]	43-54	43-54	43-54	43-54

Notes:

[a] Occupancy level: 65 per cent

[b] Average of eight types of aircraft

[c] A primary energy consumption benchmark of 3.2 to 4.0 MJ/pkm has been assumed for a 500-km air flight (Hofstetter, 1992; Kageson, 1993; Ifeu, 1992)

[d] An average of 0.8-1.0 MJ/pkm has been assumed

[e] Petrol, 3-way catalytic convertor

[f] Cylinder capacity 1.4-2.0 litre and occupancy level 1.7 persons

[g] Fuel consumption 8.5/100 km and occupancy level 1.7 gives 1.74 MJ/pkm

than do long-distance flights. The question can thus be posed whether there is a future for short-distance flights from regional airports.

Appendix 2. HST and air travel

It is sometimes suggested that the high speed train (HST) offers a solution for the environmental problems of air travel. In particular, it is suggested that this will do away with the need for the shortest, most polluting flights. A shift from the car to the HST also benefits the environment. On the other hand, though, the HST also generates additional mobility. An evaluation of ten international HST links points to an average growth in mobility of 10 per cent. On balance, then, the "net environmental benefit" of the additional mobility and the substitution towards cleaner means of transport is almost zero. At the same time, however, it is true that the situation differs widely from project to project.

Studies carried out for the Dutch HST (Amsterdam-Rotterdam-Paris) indicate that of all international journeys, 33 per cent are new journeys. An additional 22 per cent of international HST journeys are made by passengers who would otherwise have gone by traditional train. For more than half the passengers, then, the net environmental impact is negative. The other passengers first travelled by car or by air, and for these the switch obviously generates a net environmental benefit. Using the energy consumption figures of Appendix 1, we estimate that for international journeys there will still be a net reduction in environmental impact.

For domestic passengers travelling by HST between Amsterdam and Rotterdam the opposite is true. Of these passengers, 65 per cent are traditional rail passengers, while 25 per cent constitute new journeys. As an estimate, it seems very likely that the new environmental impact will not measure up against the environmental benefits of the reduction in car traffic. Only 10 per cent of the domestic passengers using the HST service will have left their cars at home.

It can thus be concluded that the HST is not an unambiguously fitting response to the environmental problems caused by the aviation sector. As environmental policy for air transport becomes tighter, though, the HST will gain in importance and, in this wider context, might fulfil a useful purpose. A rough estimate indicates that the energy consumption of air transport could conceivably be cut by 5 to 15 per cent by wide-scale introduction of high speed trains (Bleijenberg and Moor, 1993).

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The role of parking in traffic calming

Hartmutt H. Topp

Car traffic balances are essential to parking schemes and the lessening of traffic in urban centres

Some impacts of parking

Parking spaces attract cars; so they generate car traffic. Parking needs space, which is not available for other street uses. Nothing else has changed the traditional streetscape as dramatically as parked cars have done during the last few decades. Accordingly, the role of parking in traffic calming and streetscaping is significant in several respects.

Parking in the pull-and-push approach

With the growth of traffic calming from isolated streetwide applications in the 1970s to a general principle of citywide approaches today, parking policies have gained even more weight. Parking is a key issue in the push-and-pull approach towards better urban transport with fewer cars (see Figure 1). Parking policies are supposed to support the change from car trips to the more city-compatible means of transportation, such as walking, cycling, public transport, park-and-ride and car pooling, and to relieve the open space of driven and parked cars thereby securing the street for other uses.

Priorities according to user groups

At the same time, parking management intends a more effective use of limited public parking space by car traffic which is considered to be essential for the city's functioning. Among the parking demands of five different user groups, priorities are usually set for deliveries and services, for residents, customers and visitors – varying according to the specific functions of a city district – whereas, on-street parking for employees should not be available at all. Employees who rely on their cars because of handicaps, business needs or lack of reasonable public transport alternatives can usually be provided with parking spaces by their firms, since 40 to 50 per cent of the total parking volume in German cities is privately owned and privately used.

Traffic generation

The amount of car traffic generated by a parking space depends on parking duration and parking turnover (see Table I) as well as on search traffic. So, for instance, 10 per cent of the residents' cars parked on-street in a Frankfurt inner city district are not moved during a weekday. In Munich's inner city districts, this share of unmoved cars rises to 30 per cent. Residential parking spaces used in this way generate no car traffic during the day at all. On the other hand, a parking space with an enforced one-hour parking limit from 8.00 a.m. to 6.00 p.m. which is enforced may be occupied ten times, thus generating that number of car arrivals and departures.

Rough balances are often based on the assumption that a short-duration parking space for customers and visitors is occupied five-fold compared with a resident's or an employee's parking space. That means a five-fold car traffic generation if a parking space is transformed from long-duration use by residents or employees to short-duration by customers, as is often said in discussing parking concepts. Additionally, the imbalance of the demand for public transport services during the day will increase with the effect of growing operating costs.

Two contradictory objectives

If parking management results – according to one of its objectives – in increased parking turnover (which happens to be the case with most of the inner-city parking schemes), it can work against the other objective, which is to mitigate car traffic by a push-and-pull strategy.

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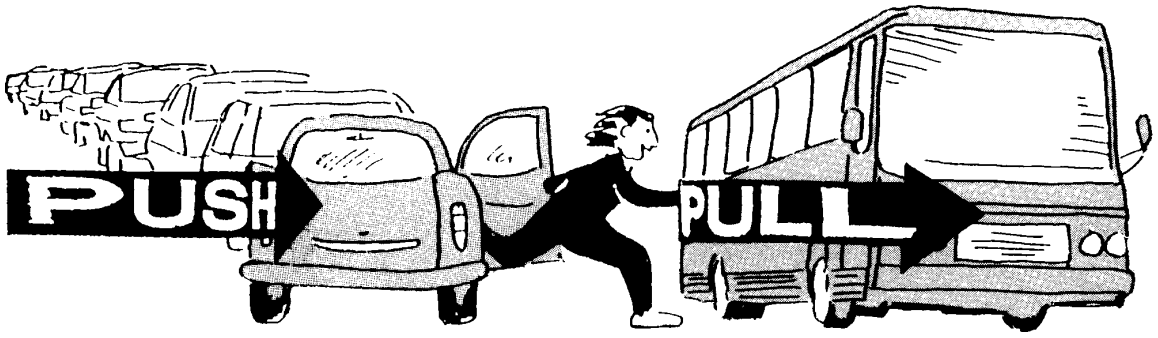
This is a speech the author gave to the Conference on Car Free Cities of the European Union in co-operation with Eurocities in Amsterdam/The Netherlands in March 1994.

Figure 1. *The push-and-pull approach towards less car traffic in urban areas*

Measures with push-effects
Area-wide parking management, parking space restrictions in zoning ordinances, car limited zones, permanent or time-of-day car bans, congestion management, speed reductions, road pricing...

Measures with pull-effects
Priority for buses and trams, high service frequency, passenger friendly stops and surroundings, more comfort, park-and-ride, bike-and-ride..., area-wide cycle-networks, attractive pedestrian connections...



Measures with push- and pull-effects
Redistribution of carriageway space to provide cycle lanes, broader sidewalks, planting strips, bus lanes..., redistribution of time-cycles at traffic lights in favour of public transport and non-motorized modes, public-awareness-concepts, citizens' participation and marketing, enforcement and penalizing...

Source: Müller *et al.* (1992)

Table I. *Parking turnover according to specific types of spaces in Berlin and Sulzbach-Rosenberg*

City and zones	Percentage
Berlin City West (6 a.m.-11 p.m.)	
On-street residential area: unlimited/no fees	
Legally	2.9
Illegally	6.6
On-street mixed area: unlimited/no fees	
Legally	4.5
Illegally	8.9
On-street inner city: parking card 2 hours/no fees	
Legally	3.2
Illegally	6
Sulzbach Altstadt (9 a.m.-6 p.m.)	
City centre	
Parking card 1 hour	15
Illegally	20
Outside city centre	
Parking card 1-2 hours	11
Unlimited/no fees	6
Illegally	17
Side streets	
Parking card 1-2 hours	8
Unlimited/no fees	2.5
Illegally	1.2
Private spaces for customers	6
Exclusively private spaces	1.2

Source: IVU *et al.* (1993); Lappe and Monheim (1992)

Freezing or even reducing car traffic under such circumstances can only be achieved by abandoning illegal parking and some of the existing legal spaces to equalize the effects of increased turnover. In practice, this is feasible in so far as bus lanes or bike lanes are needed at the expense of parking spaces. In other cases, lower numbers of spaces are hardly likely to be achieved. And finally, where it is achieved a parallel augmentation of private spaces is often to be observed.

Two important specifications for parking management can be derived from this:

(1) no scheme should be established without a car traffic balance added to the common parking space balance;

(2) private spaces have to be included into those balances, although they are not directly subject of parking schemes.

Car traffic balances

It is only by car traffic balances that the extent of the conflict between the objectives of "more effective use of parking spaces" – which usually means more short-duration parking for customers and visitors – and of "less car traffic" becomes obvious. Car traffic balances are therefore indispensable for the decision makers, who usually establish the goal of achieving less car traffic through a parking scheme and then wonder why there is the same or an even greater amount of car traffic afterwards. The formula of one-to-one conversion of non-

regulated spaces into short-duration spaces must be extended. So, for instance, five non-regulated spaces should be transformed to one short-duration space for customers and one long-duration space for residents, with the rest changed into sidewalk, cycle lane, bus lane or space for a tree.

Search traffic

Search traffic is repeatedly quoted as reaching peaks of about 50 per cent of the total car traffic in a city centre. Apart from the difficulty of identifying search traffic – each drive finally ends with parking – to measure it and therefore to verify such high shares, search traffic is obviously a problem in most cities. This is the result of the concentration of parking demand for the most favourable and cheapest spaces, while less conveniently located parking garages are hardly accepted. With the high proportion of search traffic in mind, it is common to have exaggerated expectations of the effectiveness of parking guidance systems.

More effectively than by parking guidance, search traffic can be reduced by an area-wide parking plan. Such a plan has to be clear and comprehensible. This means, for instance, that a car driver knows definitely that there is no space for him or her within a residential parking zone. Necessary short duration parking spaces should therefore be concentrated on the streets peripheral to a residential area. Even a few short-duration spaces within a zone can produce much search traffic.

Public parking control and enforcement

Public on-street parking is controlled by the amount of parking supply, parking fees, parking-period limitations with or without fees, and the privileges for certain user groups – such as, for instance, deliveries, residents and handicapped drivers. The success of all parking regulations depends strongly on their enforcement.

It is generally agreed that intensified enforcement is self-financing through improved willingness to pay at meters and ticket machines and through income by fines. The financial balance for Kaiserslautern (Germany; 100,000 inhabitants) for instance, proves this: theoretically, all on-street spaces throughout the whole city should be enforced, but actually only 2,650 within 85 hectares (the first stage of the parking scheme) of the inner city are enforced from 9 a.m. to 7 p.m. by 20 half-time and 5 full-time municipal employees in the field. In 1991 130,000 fines and 700 tow-aways occurred. The enforcement costs were DM1,860,000 of which DM900,000 were costs for personnel including administration, and DM870,000 for equipment such as computer services, mailing, service dress and off-writing of portable computers and walky-talkies. The income from fines during the same time was DM2,000,000. That means a positive balance even though the parking fees, which are increased through enforcement, are not included.

There is evidence from Mainz (Germany; 180,000 inhabitants) that the average income per parking meter was increased through enforcement from DM400 in 1987 to DM1,210 in 1991 without changing the level of fees. Similar experience is given from other cities.

Staggering of parking fees

Very recently some German cities raised their parking fees considerably up to DM4 (Düsseldorf, Hamburg, Hannover, Karlsruhe, Lübeck, Osnabrück, Stuttgart) or even DM5 per hour (Nuremburg, Munich). Beside the trend to increased parking fees, more often fees are differentiated according to demand. Whereas in the past this applied to areas of different demand, now different fees are also employed according to time of day and duration of parking. So, for instance, in Weimar (Germany; 60,000 inhabitants) you pay, progressively, for the first half-hour DM0.50, for the second half-hour DM1.00, third half-hour DM1.50, fourth half-hour DM2.00. In a neighbouring district to the centre of Würzburg (130,000 inhabitants), you pay, linearly, for the first four hours DM0.50 each, and DM5 for the entire day. Sometimes a kind of diminishing tariff is considered: for instance, for the centre of Berlin, to charge DM3 for one parking occurrence of up to three hours, rather than for a certain time (IVU *et al.*, 1993). That means that, whether you park for ten minutes or three hours, you pay the same amount.

These different approaches to parking fees are not just arbitrary: behind each policy, there are different objectives. Progressive tariffs tend to increase parking turnover, the aims being to achieve optimum use of the limited number of spaces and also to accomodate more car traffic. Diminishing tariffs encourage longer parking periods, with less turnover resulting in less car traffic.

With parking fees of over DM3 or 4, the false fee differential between parking garages and the more convenient on-street spaces can be corrected, in that on-street spaces become more expensive. So the acceptance of garages can be improved, while neighbouring streets might be relieved of some search traffic.

Effects of parking schemes

Many studies deal with potential reactions – or stated preferences – on parking schemes because occasions to investigate actual reactions – or revealed preferences – are lacking or were missed. In this article I refer exclusively to revealed preferences – even if the studies are not brand new or sometimes the statistical basis should be broader. Obviously reporting past and present

behaviour is closer to real life than is giving ideas about future intentions, though stated preference is an indispensable source where revealed preferences cannot be investigated.

Munich

A before-and-after study in the same year (ADAC, 1982) showed the effects of residential parking permits on the modal choice of employees. The share of car solo-drivers dropped from 44 to 32 per cent and the traffic peaks and search traffic during the day were reduced. Spillover parking in neighbouring streets was not observed, though it can usually be avoided by extending the area of a parking management concept.

Salzburg

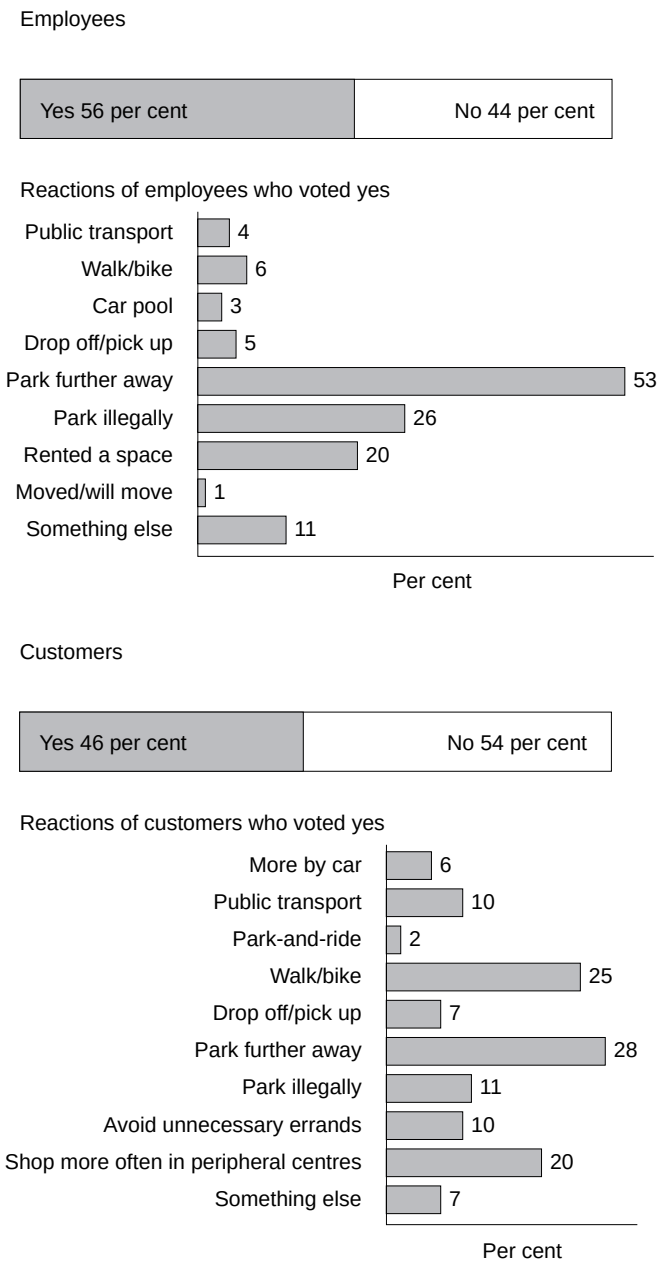
In Salzburg (Austria; 140,000 inhabitants), comprehensive before-and-after studies (Koch, 1991) were conducted to clarify whether car traffic reductions and easier parking for the essential share of car traffic were achieved. All on-street parking spaces – without any regulations until then within the expanded inner city (3,400 before and 2,000 after; besides these there are 7,100 off-street spaces) – were in 1989 converted into short-duration spaces for 90-180 minutes between 8 a.m. and 6 p.m. with fees collected through a parking ticket machine. The new regulations (there are exemptions for residents) are enforced by 13 employees. The average occupancy decreased from 85 to 76 per cent, the average parking duration from 169 to 124 minutes; 50 per cent of all parked cars have residential permits. Average turnover during 13 hours increased from 6 to 8.5. In areas with high demand for short-duration parking, this resulted in more car traffic despite an average decrease of the number of spaces by 23 per cent. But in total, car traffic in the city's core area decreased by 5.5 per cent which is assumed to result from less search traffic.

Kaiserslautern

Parking management in Kaiserslautern (Germany; 100,000 inhabitants) covers an inner-city area of about 250 hectares. Parking duration is limited to 2 hours; the fees are DM2 per hour without staggering according time-of-day or area. Residents' cars which display a permit are exempted from these regulations ("soft" privileging); only a few spaces outside (about 10 per cent) the main shopping area are exclusively reserved for residents' cars ("hard" privileging). The scheme was introduced in two steps in 1990 and 1992. The number of spaces before and after is about the same.

Derived from an interview survey in Kaiserslautern about 3.7 per cent of all employees within the scheme area or about 6.4 per cent of all solo car driving employees changed to a different mode because of the parking management. During the same time, however, some switched to car driving for other reasons, which had nothing to do with parking management, such as moving to another home or having a car available. So the net effect – comparing the after-situation without and with parking management – is a decrease from 62 per cent solo car-driving employees to 58 per cent. Figure 2 shows the reactions of employees and customers. About half of each group were affected by the parking scheme in one way or another. The non-affected employees were those who used modes other than the car before or who parked on private spaces; the non-affected customers usually use other modes. The most frequent reaction of both groups was to park farther away, followed by parking illegally more often, in the case of the employees renting a space, and

Figure 2. *Reactions of employees and customers to the inner-city parking scheme in Kaiserslautern*



Source: Strey (1992)

using alternative modes more often and shopping in peripheral outlets, in the case of customers. The customers' response gave rise to some problems which need to be interpreted, because the modal choice of customers is less steady and because the chance to get a vacant space was improved by the scheme, although parking became more expensive.

Zoning ordinances for private parking

All approaches towards less car traffic fail if parking management in public areas is faced by an increasing number of private parking spaces which are not included in a management scheme. In some cities – for instance, Saarbrücken (Germany; 190,000 inhabitants), where a decrease of on-street spaces was achieved with difficulty – this was equalled or even increased by new public or private off-street spaces. This is a success in terms of streetscape; but, to achieve less car traffic, parking policies have to include zoning ordinances to restrict an increase of private spaces. Usually, in German cities, about half of all parking spaces are private.

Some 20 cities in Germany now have zoning ordinances to restrict the building of new private parking spaces (see the seven examples in Table II). Basically, the parking-space obligation – which is formulated by building Acts of the States – is maintained, but only a certain percentage of it can be realized through parking-space provisions and the rest must be paid off. The pay-off amount is limited to 60 to 80 per cent of the real costs of building a space in the area concerned. It has to be paid by the builder to the city when the building permit is granted.

Until recently the use of the pay-off amounts was limited to parking facilities including park-and-ride. Amended Building Acts in Berlin, Hessen and Sachsen now allow public transport and bicycle facilities to be financed out of this money. In Hessen and Sachsen, a delay for the pay-offs can be granted, if the owner reduces the demand for parking spaces by special means, as for instance through job-tickets for public transport for employees.

Extending the schemes

From the experience to date with parking concepts in cities, it can be concluded that city-wide parking concepts and parallel improvements of public transport have key roles in a push-and-pull approach to mitigate the

Table II. *Restrictions on building new private parking spaces in large cities*

Cities	Districts with parking space restrictions	Approximate restriction (per cent) for offices	Pay-off amount (DM)	Use of pay-offs
Hamburg 1976	Inner-city areas with heavy traffic	40 60	11,600	Park-and-ride; public and residents' garages
Stuttgart 1985	Inner city areas I and II	40 50	None	
Nuremberg 1988	Zone along the underground	10	15,000 maximum	Park-and-ride
Wiesbaden 1991	City south	40	60,000 maximum	Park-and-ride
Dresden 1992	Inner city extended city	10 30	15,000 10,000	Park-and-ride public transport
Frankfurt am Main 1992	Four zones according to public transport quality	10 30 50 70	15,000 maximim or jobticket	Regional park-and-ride; public transport; bike facilities
Kassel 1992	Three zones according to public transport/ parking quality	0 10-30 30-60	Actual costs of space; jobticket	Park-and-ride; public transport; bike facilities

problems of car traffic. Most cities in Germany have introduced parking schemes, at least in their inner cities, but only a few continued to extend these schemes into the neighbouring city districts. In most medium-sized cities, public transport lacks the quality needed to bring about a major shifts from use of cars. Finally, most parking schemes do not have the necessary intensity in terms of decreasing the number of spaces and their turnover. In cases where parking schemes are limited to inner cities, shifts to park further away are more frequent than are modal shifts.

Conclusions

Under the circumstances discussed in this article, the effect of parking schemes in lessening car traffic are limited to employees, with shifts in the modal split balance of between 5 and 10 per cent. The parking conditions for residents, customers and visitors were improved. It became easier to find a parking space through considerably higher fees, improved enforcement and a corrected relation to fees in parking garages. These effects obviously contributed to the reduction of search traffic, though there are no quantified proofs available.

Only city-wide parking concepts are an effective measure towards traffic calming in so far as they are integrated in a broad approach of pull-and-push measures. Every city needs its specific approach.

References and further reading

ADAC (1982), *Verkehrsuntersuchung Modellversuch zur Parklizenzierung im Stadtteil München-Lehel*, ADAC, Munich.

Apel, D. and Lehmbrock, M. (1990), *Stadtverträgliche Verkehrsplanung – Chancen zur Steuerung des Autoverkehrs durch Parkraumkonzepte und-bewirtschaftung*, German Institute for Urban Studies, Berlin.

Appel, H.P., Baier, R. and Wagner, A. (1993), "Leitfaden für die Erstellung von Parkraumkonzepten in Mittelstädten", Contributions of the Federal Office for Roads, No. V 1, Bergisch Gladbach.

IVU/SNV/Heusch-Boesefeldt/Topp (1993): *City-Konzept Berlin – Teilbericht Parkraum*, Senate for Traffic and Transportation, Berlin.

Koch, H. (1991), *Parkraumbewirtschaftung Salzburg - Vorher/ Nachher-Untersuchung*, Gmunden/Salzburg.

Körntgen, S. (1994), "Wirksamkeit von Parkleitsystemen und Entwicklung eines einheitlichen Parkleitkonzepts", Contributions of the Federal Office for Roads, No. V 13, Bergisch Gladbach.

Lappe, T. and Monheim, R. (1992), "Verkehr in der Altstadt von Sulzbach-Rosenberg – Analyse und Planungskonzepte", Arbeitsmaterialien zur Raumordnung und Raumplanung der Universität Bayreuth No. 98.

Müller, P., Schleicher-Jester, F., Schmidt, M-P. and Topp, H.H. (1992), "Konzepte flächenhafter Verkehrsberuhigung in 16 Städten", Grüne Reihe des Fachgebiets Verkehrswesen der Universität Kaiserslautern No. 24.

Stadt Frankfurt am Main (Frankfurt am Main Ordinance) (1990), "Parken in Frankfurt am Main – Einschränkungssatzung, Stellplatza blösung und Verwendung der Ablösebeträge" ("Parking in Frankfurt am Main: parking ordinances and parking restrictions"), Part 1, March: Part 2, September, Frankfurt am Main.

Strey, K. (1992), "Verkehrliche Auswirkungen der Parkraumbewirtschaftung am Beispiel Kaiserslautern", Diplomarbeit am Fachgebiet Verkehrswesen der Universität Kaiserslautern.

Topp, H.H. (1993), "Parking policies to reduce car traffic". *Transport Reviews,* Vol. 13 No. 1.

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The throttling of a transport system: Calcutta tramways

Debasish Bhattacharyya

More than just a transport system will perish if CTC is abandoned

A history of mismanagement

Once considered as the centre for advancement, Calcutta is now sinking. The attitude of indifference on the part of the authorities to providing fundamental civic facilities have made the city almost uninhabitable. The worst part of it is probably the automobile nuisance. Choked with standstill traffic and poisonous fumes in the air, it is hard to believe how a city like Calcutta still survives and its citizens remain productive.

Calcutta has 567,973 registered motor vehicles in addition to 60,000 non-motorized vehicles. This figure is astronomically high for a city of 104 sq.km, where less than 6 per cent of road space is allotted to traffic movement. Thus, in the name of people's mobility, cars have virtually ruined the city. They are parked everywhere day and night: on the green boulevards, on the pedestrians' footpaths, next to one's bedroom. They even occupy the tree shades in the scorching sun which are intended for passenger shelters. Apart from that, all open spaces, which are mostly public property, have been converted to car repair/ maintenance shops. As the city authorities are concerned with the revenue collection from these automobiles, it is the citizens who are actually paying the cost. An environmental report, based on air and noise pollution data, says that the average life span of a citizen has been reduced by 15 years (see also Tables I-III).

Calcutta would not have been converted to a gas chamber if proper planning had been undertaken and if the political will was there. The city is surrounded by several broad-gauge train lines; it has a major waterway alongside; the construction of its underground Metro is near completion and it has a variety of buslines. Moreover, the city proper is blessed with the 70-km network of Calcutta Tramways Company (CTC), together with a workshop capable of the complete overhaul and manufacture of rolling stock. All major railway stations, hospitals, schools, universities, offices and tourist spots are within the tramway network. Service rendered by CTC was so pleasant that Calcuttans retained it with full fanfare when the rest of the world largely abandoned tramways in the 1950s. It is unanimously considered to be an asset to the city.

Science and technology notwithstanding, the city has a deep-rooted relationship with its tramways. We inherited CTC from British management in 1882. After initial setbacks lines were electrified in 1902. Then it became a popular profit-making concern. It has an unparalleled history in Bengal's freedom movement. After independence in 1947, for obvious reasons, British shareholders did not invest adequately in the tramway system. The State Government nationalized the system in 1969.

Replacing tramcars with buses

In the modern era, when tramcars are being restored to prominence throughout the world, the State Transport Ministry of West Bengal has suddenly described tramcars as "obsolete". In their view, emphasis must be given to private vehicular traffic. Therefore, regarding CTC, their policy can be summarized as:

- the tram service will be gradually phased out; and
- CTC will be converted to a bus operating corporation.

It sharply contradicted their earlier view as under the same management, CTC procured 75 new cars; renovated some 180 cars; updated tracks and even extended its service area with the assistance of a huge amount of World Bank loan just a few years ago. In fact the last car was delivered in 1989. Earlier they promised to ply 500 tramcars in Calcutta during the mid-1970s when CTC once again received substantial assistance under CMDA to renovate 365 cars and replace various components of its structure. In the meantime, vehicular traffic in Calcutta has increased exponentially, causing unbearable suffering to its people (see Tables I-III).

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Table I. *Uncontrolled growth of suspended particulated matter (SPM) in the air at Bhowanipore, a residential area of Calcutta over a ten-year period (ug/m^3)*

Year	SPM concentration
1983	600
1985	700
1986	850
1987	1,600
1993[a]	3,000

Note:
[a] Peak hour

Sources: United Nations Environmental Programme (Kenya) publication *Megacity Calcutta*, and School of Environmental Studies, Jadavpore University, Calcutta

Table II. *Comparison of polycyclic aromatic hydrocarbon (PAH) concentration in the air of Calcutta with New Jersey,USA, in 1984. Concentrations were recorded during peak periods of traffic and are expected in ng/m^3*

Compounds (physiological role)	Calcutta	New Jersey
Benz (a) anthracene (potent carcinogen)	65.6	0.85
Benz (b) fluoranthene (potent carcinogen)	200.0	1.09
Benz (j) fluoranthene (potent carcinogen)	66.1	1.04
Benz (e) pyrene (carcinogen)	182	1.83
Benz (a) pyrene (extremely carcinogenic)	120.2	1.06
Dibenz anthracene	40.9	0.75

Notes:
The present status compared with 1984 data should account for a 2.6-fold increase of vehicular traffic compounded with corresponding drop in vehicle speed (incomplete fuel combustion)

This list is partial: there are 25 PAHs reported in the environmental report

Data were recorded in residential and business areas of Calcutta and thus exclude industrial pollution

The episode emerged as CTC failed to earn sufficient income in spite of 200-300 per cent overcrowding of the tramcars. Another controversial issue was raised when CTC planned to sell the "excess" land of its 23 depots and sub-depots to real-estate promoters. These lands were purchased by CTC in the early 1940s with a view to expanding its service in future. Valuation of these prime sites situated in the city centre has been fixed by government sources at Rs300 Cr. and through trade union

Wood-framed tramcars made in the 1940s by English Electric

figures at Rs700 Cr. Surprisingly, CTC authorities remain silent on how they are going to use the money for the benefit of the tramways or for how long they can survive on a one-off windfall.

Some modification of the attitude of the CTC authority in running tramcars has become apparent. It remains a mystery how they decided that hundreds of running tramcars should be condemned and destroyed. The spaces previously occupied by these roadworthy trams in depots are now used for parking CTC buses. CTC public works department has been kept idle and, as a result, track and traction repair and preventive maintenance work have virtually come to a halt. The lion's share of what CTC gets as subsidy goes for purchase of buses, leaving a microscopic amount for trams. Trams are now kept running by cannibalizing spare parts. Several trunk routes have been closed; early-morning and late-night services have been practically withdrawn. Desperate attempts are openly made to cripple the system beyond repair.

It is difficult to ascertain the reasons for the withdrawal of tramcars and their replacement by buses, as the arguments put forward by CTC are neither clear nor well defined. Some of the reasoning is summarized in the Appendix. This decision is endorsed by the trade-union wing of the ruling party, by some car owners and, superficially, by a few intellectuals apparently ignorant of public transport systems.

The decision to replace tramcars with buses is opposed by most of the environmental and scientific bodies, social welfare organizations, learned societies and concerned individuals, as well as by all political parties, no matter whether they are in opposition or in coalition with the ruling party. It has been criticized by many regional and UK newspapers. It has been condemned by many global environmental and welfare agencies and experts from

Table III. *Noise pollution in Calcutta in decibels against legal set limits*

Category of area	Place	Maximum Set limit [a] Day	Night	Observed noise [b] intensity Day	Night
Industrial area		75	70	–	–
Commercial area	BBD Bag	65	55	91-83	(Peak hr)
Residential area	Shyambazar	55	45	94-83	(Peak hr)
	Gariahat			91-82	(Peak hr)
Silence zone	Hospitals	50	40	79	65
	NRS Medical College and Hospital			100[c]	
	Calcutta Medical College and Hospital			100	

Sources:
[a] Survey of Environment in *The Hindu Publication*, Madras, 1992, p. 75
[b] School of Environmental Studies, Jadavpore University, Calcutta
[c] Publicity folder of PUBLIC, on Earth Day, 1994

varied fields. Anxiety has been expressed from such distant countries as Canada, the USA, the UK, Australia, New Zealand, etc. People affiliated with the World Bank (India), UNEP, WHO and UNICEF have also pointed out the mistake. Expecting a disaster, a Danish businessman has warned the citizens of Calcutta through repeated advertisements in newspapers about this suicidal drive.

Dangers and consequences

There are several points worth mentioning here:

(1) Unlike other cities of India, most mass transport in Calcutta is run by private operators who very often formulate rules according to their own interests, flouting all motor vehicle and safety acts. If trams are withdrawn, a bulk volume of passengers will have to depend on overcrowded buses which are by no means cheap.

(2) If disciplined trams are replaced by unruly buses, passenger misery will invariably increase.

(3) Most importantly, it is a planned decision that city transport will receive subsidy for various reasons. In Calcutta, subsidy is synonymous with inefficiency and corruption; the question of accountability never arises. As a result, transport

Car no. 347 (English Electric, 1931) negotiating a curve. Pre-war trams still provide the backbone of the system

Car no. 274 made in India in 1983. Trams are the only public vehicle whereby operations are done according to rule of conduct

First class. Reserved for ladies only. Made in India in 1989. Overcrowded cars prove to be the utility and economic viability of Calcutta's tramways. There are 40 bus routes parallel to this tramline – yet passengers prefer the trams

offices are concerned only with balance sheets. Phrases such as "social benefit", "users and non-users benefits", or "environmental damage" are not in their vocabulary. Even if we assume such a simplistic formulation of urban transport, CTC stands well ahead of CSTC (Calcutta State Transport Corporation): cumulative loss of CSTC up to 1990-1991 is Rs342 Cr.; for CTC it is Rs121 Cr.; subsidy per passenger journey in CSTC is 72P, in CTC it is 69[1]. Of course the costs of journey-diesel subsidy or road maintenance are not disclosed.

The effects of the withdrawal of tramcars will be multi-directional:

- passenger movement will be restricted;
- environmental damage will be greater;
- there will be a higher risk of corruption; and
- the city will lose confidence in itself.

As the number of tramcars has been reduced, a large number of people have already been immobilized or have restricted their journeys. In the ruined landscape of the city, the worst affected are the poor and physically weaker people, particularly the women and school-children. This is compounded by intolerable traffic congestion, because any type of car or bus substituting for tramcars offers higher road-space occupancy per passenger. Calcutta's environmental degradation as of 1984 has been briefly described earlier (Table I).

Concluding reflections

Tramways are less susceptible to corruption than are busways. This is a serious consideration for developing countries. If CTC is converted to a state transport corporation, it will buy and discard a large fleet of buses in perpetuity, leaving enough scope for unfair dealings. Unlike buses, tramway spares have no parallel market.

It should be emphasized that Calcutta is a compact city; its residents are accustomed to a simple lifestyle. Except for midday in summer, its temperature remains at a comfortable level. It remains unclear why the city has no pedestrian, cyclist or cycle rickshaw plazas. Surprisingly, while the municipality has no fund to paint zebra crossings, it has plans for an underground car parking garage and a multi-storey bus terminal. This is maturing at a time when 95 per cent of Calcutta's road space is occupied by private cars catering for only 5 per cent of the commuters. Since a car owner enjoys his journey at the cost of non-car users, state patronage to the former sharply divides the society in two, leading to greater inequality.

Finally, one question remains unanswered. How come Calcuttans remain inert to this issue? It is because of the combination of a number of factors:

- Tram services have been degraded over several years, with constant publicity given to its non-viability.
- The average social consciousness of the citizens is very poor.
- The state administration had never had resistance due to its absolute majority in assembly.
- People started believing that protests would have no effect.

In the uncertain journey of Calcutta's trams towards a trackless destination, an honest traffic planner sees "the seeds of a future light-rail system, as it is much easier to build upon an existing system and convert bit by bit to something new, than it is to start from the ground up with a new system that is very expensive". It remains to be seen whether the protests against the abolition of the CTC will succeed or whether the city will follow the CTC towards a "natural death".

Note

1. Rs = Rupees; Cr = Crores = Rs10,000,000; P = Piasa (100 Piasa = 1 Rupee); lakh = Rs100,000.

References and further reading

Armstrong-Wright, A., (1993), "Public transport in Third World cities", *State of the Art Review*, Vol. 10.

Calcutta Metropolitan Development Authority Publication (1974), *Calcutta's Traffic and Transport: Yesterday, Today, Tomorrow.*

Chakrabary, D., Van Vaeck, L. and Van Espen, P. (1988), *International Journal of Environmental Anal. Chem.,* Vol. 32, pp. 109-120.

CTC (1992), "CTC are running buses, why?", advertisement issued by the Calcultta Tramways Company in all leading newspapers, 4 November.

Daily Jugantar (1993), 4 November.

Finck, N. (1994), Community affairs: San Francisco Municipal Railways, personal communication, September.

The Statesman (1992), 10 August.

The Telegraph (1993), 26 December.

Walmsley, D.A. and Perpett, K.E. (1992), "The effects of rapid transit on public transport and urban development", *State of the Art Review,* Vol. 6, HMSO, London, p. 117.

Appendix. Arguments forwarded by CTC (1992) for abandonment of tramcars (responses in italics)

- Revenue loss from tramcar operation is so high that any further subsidy could not be provided.

  The reasons for CTC's low revenue are well known. Unless tramcar use is intensified and run on volume based timing, how does one expect a rise of ridership and earning?

- Cost of running tramcars per km is unusually high; 85 per cent of total expenditure goes to staff salaries. This situation is intolerable.

  CTC network and infrastructure is meant for 500-600 tramcars and not for the 100 tramcars it is operating now. Recruitment has matched potential rather than actual operation.

- Tramcars as well as spares are too expensive.

  Exceptionally long service life of tramcars and durability of its spares far outweigh the expense in the long run.

- Tramcars are for rich, affluent societies.

  Use of tramways in third world cities refutes this point.

- Tramcars cause traffic congestion in narrower streets.

  Trams are extremely efficient in use of space. Cars are not.

- Phasing out of 100-120 tramcars against 5-6 lakhs[1] vehicular traffic could hardly alter the environmental status of Calcutta.

  The city used to have 500 two-coach tramcars with 90 per cent in regular use. Moreover, other than trams and trolley buses, what measures will reduce air pollution?

- One-way traffic could not be properly introduced for bi-directional tramlines.

  Calcutta is not suitable for one-way traffic as the road alignments do not form a "grid system".

- Since the Government does not have adequate funds for total revival of CTC, the system will naturally decline.

  Money wasted so far through subsidy is more than sufficient for its revival. Currently under the state administration, there has been little effort to boost CTC ridership, nor has the CTC requested funds for new investment.

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The association between health and residential traffic densities

John Whitelegg and Anthony C. Gatrell

A statistically significant relationship exists between traffic volume in residential areas and reports of symptoms of poor health

Introduction

Traffic has been associated with a large number of adverse health effects especially through air pollution from exhaust emissions (Mage and Zalie, 1992). In addition to air pollution large numbers of vehicles are also associated with:

- noise;
- vibration;
- road-traffic accidents;
- disruption of community activities and
- lack of exercise on the part of both vehicle users and residents deterred from walking and cycling.

The effects of increased traffic volume include a significant loss of freedom on the part of school children who used to walk to school and visit friends unaccompanied (Hillman *et al.*,1991)and sterile and useless spaces in cities that contribute to crime and vandalism (Whitelegg, 1993). All these consequences of higher levels of motorized traffic might be expected to have an adverse impact on health.

This is an important public health issue and has been recognized as such by CEST (1993) and Dockery *et al.* (1994). Much of the current interest in transport and health can be traced back to the work of Mayer Hillman who gave evidence to a House of Commons Select Committee on preventive medicine (Hillman, 1976).

Air pollution has received most attention in the catalogue of health-damaging factors. Vehicles are a major source of health-damaging air pollutants. Evidence on the health impact of transport emissions is widespread, though pollution from cars and lorries is not yet perceived as a serious public health hazard. Schmidt *et al.* (1987) have reviewed the health damaging effects of traffic air pollutants.

Air pollution from traffic is growing in line with increases in traffic and poses significant problems for any attempt to work towards sustainable objectives. Air pollution in Britain has risen by 35 per cent in five years, with one-third of the UK population living in places where EC air quality guidelines are not met for nitrogen dioxides (Campbell, 1992).

A number of community-based studies have looked at cancer incidence. Blumer *et al.* (1989) carried out a comparison of two groups of subjects in Netstal, Switzerland. One group lived in the vicinity of a heavily trafficked road and the other 400m away from the main road with no through traffic.

At the end of 1958, in the houses located within 25m of the main road, 25 of the 232 adults in the group had died of malignant tumours (11 per cent). In the control area three of the 259 residents had died of cancer (1.2 per cent). The study linked the higher mortality on the heavily trafficked road to higher concentrations of particulates (*Teerstaub*), mainly heavy polycyclic hydrocarbons.

In an epidemiological study carried out in Hamburg, Ippen *et al.* (1989) observed a 12 per cent increase in cancer incidence in men on "heavily trafficked" streets as compared to lightly trafficked streets. Heavy traffic was defined as >30,000 vehicles per day. Taking their data from the Hamburg cancer registry, they calculated rates for heavily trafficked areas and compared them against Hamburg-wide rates. Lung cancer rates in the heavily trafficked areas were 34 per cent higher than expected and colon cancer 68 per cent higher. There was no attempt to control for cigarette smoking or dietary factors.

Ackerman *et al.* (1987) undertook a community-based study in the cantons of Basel and Zurich in Switzerland. This study targeted 0-5 year-olds and demonstrated a relationship between the severity of respiratory symptoms and air quality.

A California study (American Lung Association, 1990) reviewed nearly 1,000 health-effect reports to identify those pollutants of greatest interest for human health studies. The report focused on morbidity effects from

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ozone and on mortality and morbidity effects from particulate matter. Five morbidity effects were analysed for exposure to ozone pollution: mild cough; eye irritation; sore throat; headaches; and chest discomfort. Using dose-response coefficients from the scientific literature, the study predicted that reducing ozone pollution to meet the federal public-health standard would eliminate, annually, 121.7 million occurrences of mild cough, 191.6 million eye irritations, 179.0 million sore throats, 107.4 million headaches and 64.5 million cases of chest discomfort.

The same study estimated that in the United States as a whole "an upper bound of about 120000 excess deaths attributable to air pollution in 1985 is reasonable and that a lower bound of approximately equal likelihood is about 50000". Vehicles produced 40.5 per cent of the total discharge of the pollutants examined, but the authors concluded conservatively that vehicles were responsible for 15-25 per cent of the total health costs from air pollution. They were, in effect, concluding that vehicle emissions prematurely killed between 10,000 and 24,000 people each year. This assumes a 20 per cent apportionment of air pollution to vehicles, which is very conservative indeed when, in the US, automobile exhausts contribute 66 per cent of the nation's total carbon monoxide pollution, 43 per cent of the nitrogen oxide pollution and 34 per cent of the reactive hydrocarbon pollution.

Measuring the impact of traffic on human health

The study documented in this article had three main objectives:

(1) to test the hypothesis that reported incidents of poor health would rise as traffic volumes in residential areas rose;

(2) to identify the direction and quantify the strength of any relationship established;

(3) to filter out confounding variables (in particular, social class) so as to identify a "traffic effect" in isolation from other factors.

Previous work in this area has not attempted to control for confounding factors and has not used high-quality, continuous traffic-count data as an indicator of the strength of the environmental impact of traffic.

Traffic counts were obtained from the local authorities and health data from a self-administered questionnaire mailed to 1,916 addresses in 57 streets in 15 local authority areas. Full details of the study can be found in Whitelegg *et al.* (1993). The study areas are identified in Figure 1.

Figure 1. *Study areas*

A statistical analysis of the questionnaire results was carried out using the traffic counts as an independent variable and the health outcomes as a dependent variable. The statistical analysis is described in detail in Whitelegg *et al.* (1993).

The streets finally selected for the study were chosen to reflect the range of traffic volumes and social/economic status types, and to exclude locations where a point source of pollution might disturb the estimation of a "traffic effect". Every street was visited and the presence of industrial activities, power plants, stacks, etc. noted. All those streets with a potential source of pollution other than road-traffic were excluded. The reasons for exclusion included the presence of crematoria, incinerators, gas-flare sites, lead recycling plant, concrete plant and a foundry.

Daily vehicle flows in selected streets were in the range 157-67,589 capturing a large proportion of the daily range in values to be found in UK urban areas.

The selection of streets was carried out to ensure a representative sample of heavily trafficked and lightly trafficked streets across all social strata. The questionnaire contained questions relevant to the designation of social class for the analysis (e.g. occupation), enabling social class to be controlled for in the estimation of a traffic effect independently of a social class factor.

The statistical analysis used was generalized linear modelling which allows the probability of a respondent reporting an illness to be modelled as a function of a large number of variables including social class, housing quality, amount of exercise and daily volume of traffic passing the respondent's home. Each of these independent variables can be held constant in the analysis to estimate the probability of illness as a function of any other variable. This allows a traffic effect to be determined.

Seven symptoms of illness were evaluated:

(1) runny or blocked nose;

(2) red or sore eyes;

(3) sore throat;

(4) dry cough or cough with phlegm;

(5) breathing difficulties or wheezing;

(6) headache;

(7) lack of energy.

Five of the seven symptoms of illness produce a statistically significant association with traffic volume. As the traffic volume rises so the probability of a particular symptom illness reported rises. The two symptoms that do not show this statistically significant relationship are headache and breathing difficulties.

The analysis shows a clear link between traffic volume and health and has shown this independently of other variables. The statistical analysis permits the effects of housing quality, income and smoking to be filtered out. This is a considerable improvement on previous studies in which such effects were not controlled for. The traffic effect has a significant impact for five of the seven symptoms studied, and this effect is still present when "confounding" factors are eliminated.

Conclusion

This study has shown that living in proximity to traffic damages health. Traffic is one of the most pervasive components of everyday life in Britain and is forecast to double. The combination of a large expected growth of an activity with significant environmental impacts when there is a proven link between that activity and health, merits a much higher level of interest on the part of clinicians and public health professionals than is currently the case.

As air quality deteriorates, and if as seems likely new technologies (e.g. catalytic converters) fail to stem the tide of health-damaging pollution, the case for reducing our dependence on cars and lorries, converting large parts of cities into car-free areas and planning for a dramatic increase in walking and cycling, grows ever stronger.

References

Ackermann, V., Rapp, R. and Conzelmann, C. (1987) "Luftverschmutzung und Gesundheit. erste Ergebnisse der Studie uber Atemwegs-erkrankungen bei Kleinkindern in den Kantonen basel-Stadt und Zurich", Abteilung fur Sozial- und Praventativmedizin der Universitat Bern.

American Lung Association (1990), *The Health Costs of Air Pollution: A Survey of Studies Published 1984-1989*, Washington, DC.

Blumer, W., Blumer, L. and Scherrer, L. (1989), "Messungen von feinstem teerstaub an einer autostrasse mit hoher krebsmortalitat", *Medicina Generalis Helvetic*, Vol. 9 No. 1, pp. 19-21.

Campbell, G.W. (1992), *A Survey of Nitrogen Dioxide Levels in the UK Using Diffusion Tubes*, Warren Springs Laboratory, Stevenage.

CEST (1993), *The UK Environmental Foresight Project. Road Transport and the Environment: The Future Agenda in the UK*, Centre for Exploitation and Technology, London.

Dockery, W.D., Pope, C.A., Xu, X., Spengler, J.D., Ware, J., Fay, M., Ferris, B.G. and Speizer, F.E. (1993), "An association between air and pollution and mortality in six US cities", *The New England Journal of Medicine,* Vol. 329, pp. 1,753-9.

Hillman, M. (1976), "Some implications of transport and planning policies for preventive medicine", evidence to House of Commons Select Committee Inquiry into Preventive Medicine, minutes of evidence, Appendix 58.

Hillman, H., Adams, J. and Whitelegg, J. (1991), *One False Move – A Study of Children's Independent Mobility*, Policy Studies Institute, London.

Ippen, M., Fehr, R. and Krasemann, E.O. (1989), "Krebs bei anwohnern verkehrsreicher strassen", *Versicherungs-medizin*, Vol. 2 No. 1, pp. 39-42.

Mage, D. and Zalie, O. (1992), *Motor Vehicle Air Pollution. Public Health Impact and Control Measures*, World Health Organisation, Geneva.

Schmidt, M., Mampel, U. and Neumann, U. (1987), *Gesundheitschaden durch Luftverschmutzung*, Wunderhorn, Heidelberg.

Whitelegg, J. (1993), *Transport for a Sustainable Future: The Case for Europe*, Belhaven, London.

Whitelegg, J., Gatrell, A. and Naumann, P. (1993), *Traffic and Health*, Environmental Epidemiology Research Unit, Department of Geography, Lancaster University, Lancaster.

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Automobile dependence in Bangkok:
an international comparison with implications for planning policies

Jeff Kenworthy

International comparison reveals the need for important and major policy changes to address Bangkok's traffic-related problems

Introduction

Any discussion of automobile dependence today will usually involve some reference to Los Angeles. As an archetype for cities that have tried to build their transport systems almost totally around freeways – and failed – it is almost unparalleled. However, the Asian region is rapidly developing its own archetype of urban traffic dysfunction: the Bangkok metropolitan region. Interestingly, by a perverse coincidence, the similarities between Los Angeles and Bangkok, today, also have some deeper historical significance.

In 1781, the Spanish Governor of California, Felipe de Neve, established the community that we know today as Los Angeles or "the City of Angels". In 1782, in an almost prophetic leap that would seal a strange connection between the two places, King Rama I of Thailand established a new capital for his country, the original name of which translates to "the Great City of the Angels."

Whether we want to read any more into this coincidence depends a little on our penchant for intrigue. But for those who once knew Bangkok as the "Venice of the East" with its serpentine river and network of canals, the unfortunate reality is that it is fast becoming the Los Angeles of the East. Most canals have been paved over with roads (which are now congested). Elevated freeways and spaghetti junctions punctuate the urban landscape. The air is so laden with automotive air and noise emissions that walking outside is an ordeal; and, in true Los Angelino style, there are plans to turn the Chao Phraya River into a floating freeway. Bangkok presently adds about 600 new cars daily to the traffic stream, which equates to an extra 3km of bumper-to-bumper traffic. At this rate, in less than four years, enough cars are added to fill the entire road system with one lane of traffic.

Bangkok's traffic predicament raises some interesting questions about how a city can descend into such chaos and what factors underlie the situation. Importantly, it raises questions about what policies and strategies are best for relieving the situation, irrespective of the present political likelihood of realizing them. An effective way of providing the perspectives needed to answer these questions is to compare Bangkok to other cities around the world, especially other Asian cities in the region.

This article provides a detailed comparison of Bangkok's land use and transport system characteristics with cities in North America, Europe, and Australia and, in particular, other Asian cities such as Kuala Lumpur, Jakarta, Manila, Seoul, Surabaya, Singapore, Hong Kong and Tokyo. The data on the developing Asian cities other than Bangkok are taken from Barter *et al.* (1994), and Bangkok data come from Poboon *et al.* (1994). On the basis of this investigation, the article highlights those areas of planning policy that need attention and suggests a suite of policies that are likely to improve the present transport situation in Bangkok.

Land use patterns

One of the most important factors in determining a city's level of car use and the viability of public transport, walking and cycling is urban density (Newman and

The research by PhD students Chamlong Poboon and Paul Barter in developing the data on Bangkok and Asian cities in newly-industrializing countries is gratefully acknowledged. The data in this article on the less-developed Asian cities represent the best available to date from studies and government sources. They may be subject to some revision if better information bases come to light.

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Kenworthy, 1989). Higher densities, and the mixed land uses which are associated with them, shorten the length of trips by all modes, make walking and cycling possible for more trips and create sufficent concentrations of activities for an effective, frequent public transport service. Figure 1 depicts the relationship between urban density, energy use per capita and the percentage of workers using public transport across a global sample of cities. As can be seen from the graph, higher urban densities, particularly those characteristic of Asian cities such as Tokyo, have much lower energy use per capita for transport and much higher use of public transport for work trips.

Figure 2 provides average urban densities for cities in the USA, Australia, Europe and a selection of Asian cities. The Bangkok metropolitan area, with 6 million people living at 162 persons per ha, is clearly a densely-settled city in an international context, and is a little above average for an Asian city. Examining densities within Bangkok we find that the inner zone of three million people has a density of 257 persons per ha (virtually the same as Manhattan and central Paris), the middle zone of two million people is settled at 138 per ha and the outer zone of one million people has 74 persons per ha, which is still some five times denser than the average metropolitan area in the US and Australia (Poboon *et al.*, 1994). Bangkok therefore fulfils one of the chief criteria for minimizing automobile dependence.

Provision for the automobile

Another key factor in automobile dependence is how well the automobile is catered for in basic infrastructure. The length of road per person and the amount of parking in the central business district (CBD) are indicative of this factor. Figure 3 summarizes the length of road per person in cities and shows that the Asian cities are extremely low in this factor when compared with all other cities around the world (0.7 metres per person compared to as high as 8.7 in Australian cities). Bangkok is about average for an Asian city, but this relatively low road provision only partly helps to explain the congested traffic, as shown later. Figure 4 provides the number of parking spaces per 1,000 jobs and shows that Bangkok with 338 exceeds the average Australian city and is only a little less than the average US city with 380. By contrast, Singapore, Tokyo and Hong Kong average a mere 67 spaces per 1,000 CBD jobs.

Figure 1. *Urban density, energy use and public transport for the journey to work in a global sample of cities*

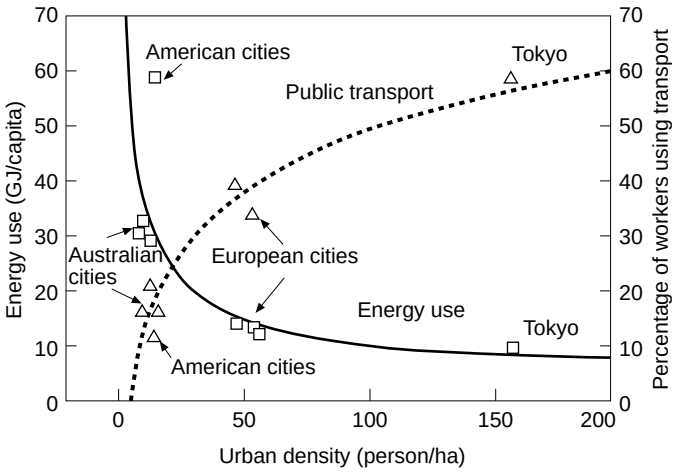
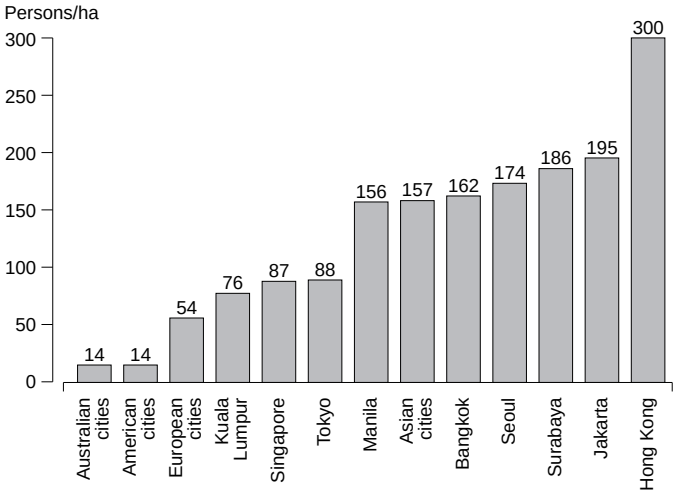
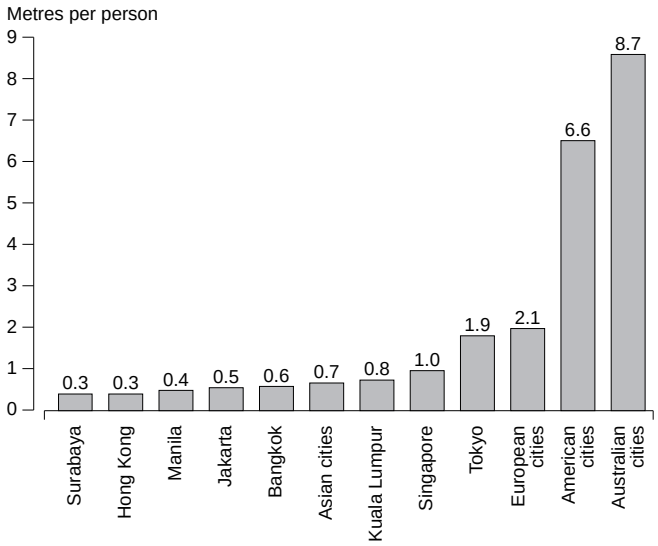


Figure 2. *Urban density in American, Australian, European and Asian cities*



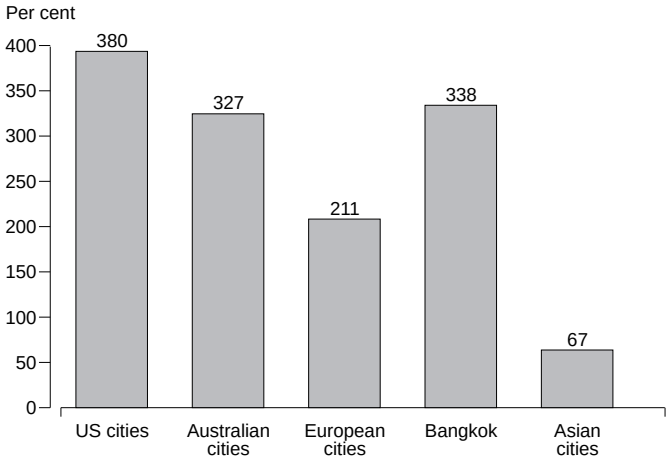
Source: Sustainable Urban Transport Systems Project (ISTP)

Figure 3. *Length of road per person in American, Australian, European and Asian cities*



Source: Sustainable Urban Transport Systems Project (ISTP)

Figure 4. *Parking spaces (per 1,000 jobs) in the CBD in Bangkok compared with American, Australian, European and other Asian cities (Singapore, Tokyo and Hong Kong)*

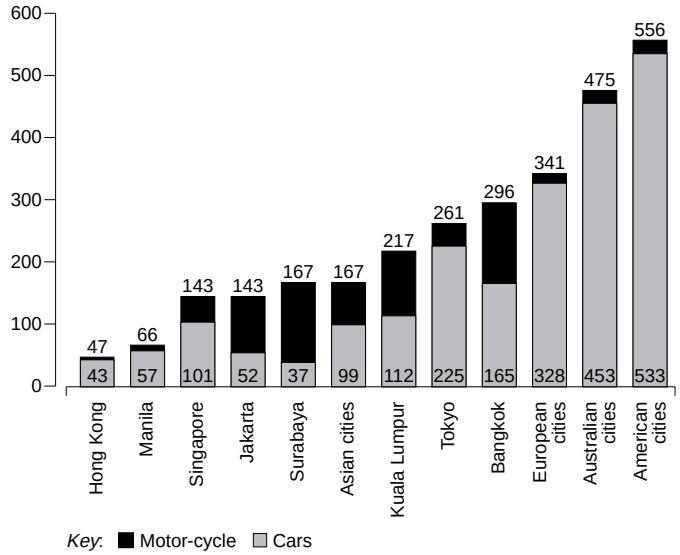


Source: Sustainable Urban Transport Systems Project (ISTP)

Vehicle ownership

Vehicle ownership varies considerably in cities around the world as shown in Figure 5 which summarizes car and motor-cycle ownership. US and Australian cities are clear leaders in car ownership, but they have very low motor cycle ownership (95 per cent of the combined car and motor-cycle ownership consists of cars). At the other end of the spectrum Hong Kong has only 47 vehicles per 1,000 people and, again, these are mainly cars (91 per cent). Bangkok is the highest of the Asian cities in total vehicle ownership (296 per 1,000 people) and is only a little behind the European average of 341. However, only 56 per cent are cars in Bangkok, unlike in European cities with 96 per cent cars. Motor-cycles are popular in Bangkok and other Asian cities such as Jakarta and Surabaya, where they dominate vehicle ownership. This is because they are cheaper, smaller and easier to park, and can cut a path through congested streets and negotiate the narrow streets of the urban kampongs.

Figure 5. *Car and motor-cycle ownership (per 1,000 people) in American, Australian, European and Asian cities*



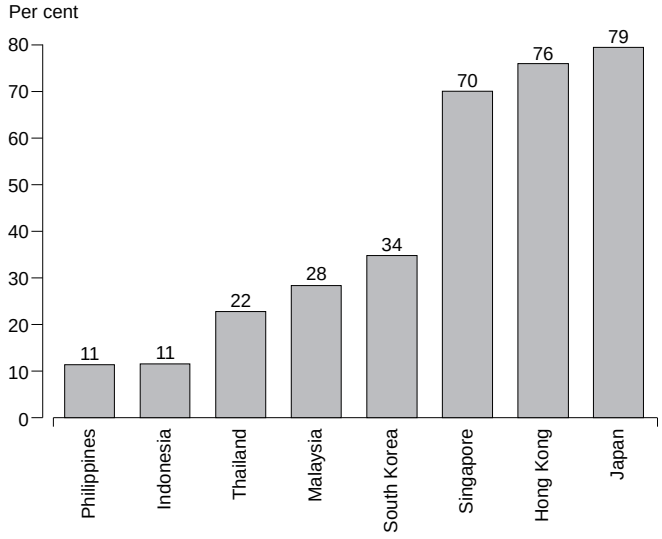
Note: Asian cities' figures are from 1990, the others are from 1980
Source: Sustainable Urban Transport Systems Project (ISTP)

Los Angeles-style freeway development punctuates the landscape of Bangkok

Bangkok is very much higher in total vehicle ownership than is the average Asian city (296 per 1,000 people compared to 167). It has double the level of the much wealthier Singapore which has only 143 vehicles per 1,000, and is even higher than Tokyo with 261 vehicles per 1,000 people (although Tokyo's ownership is 86 per cent cars).

Figure 6 shows the paradox associated with such high levels of vehicle ownership in Bangkok by comparing

Figure 6. *National purchasing power per capita in Asian countries compared with the USA (1990)*



Source: Sustainable Urban Transport Systems Project (ISTP)

national purchasing power per capita in various nations in 1990. For example, Thailand had only 29 per cent of the purchasing power of Hong Kong, but Bangkok in 1990 had some six times more vehicles (cars and motorcycles) per capita. Similarly, Bangkok's car ownership is 63 per cent higher than Singapore, but Thailand's purchasing power is only one-third that of Singapore. Wealth levels alone are clearly not the only determinants of vehicle ownership. This factor is returned to later in the article. What kind of transport patterns are associated with these basic land use and transport features?

Transport patterns

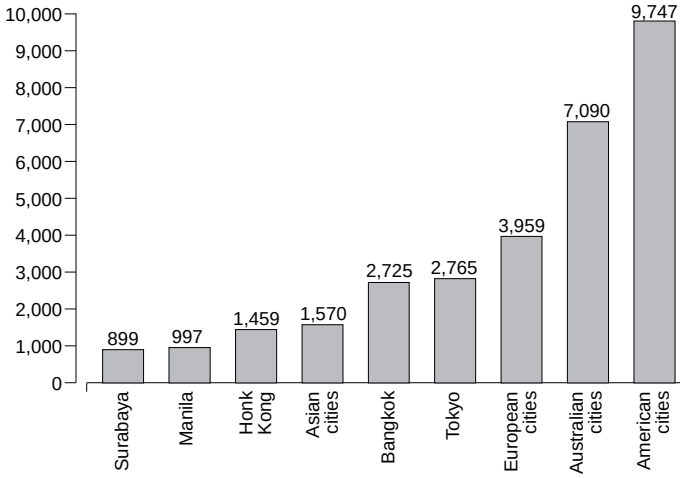
Private transport

Figure 7 provides the total vehicle kilometres of travel per person in the various cities. As expected, the US and Australian cities are clear leaders (9,747 and 7,090km respectively), followed by the European cities with much lower levels (3,959km). Bangkok however is heavily motorized for its physical characteristics, being 74 per cent higher in vehicle use than the average Asian city. It has almost the same level of private vehicle use as in Tokyo which, based on national figures in 1990, had 3.5 times more purchasing power than did Bangkok. Again, there are clearly more factors than wealth at work in urban automobile dependence.

Figure 8 shows the modal split to private transport (including motorcycles) for all trips in a variety of Asian cities. Bangkok stands out as a leader in the Asian cities with 51 per cent of all trips by private means, compared with an overall average for these Asian cities of 33 per cent, and Manila as low as 21 per cent.

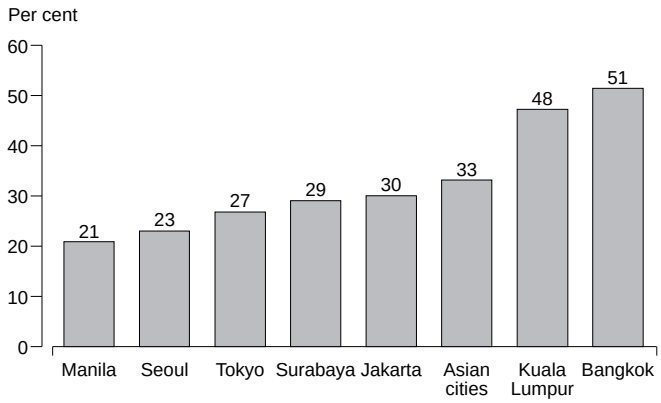
Los Angeles-style freeway development punctuates the landscape of Bangkok

Figure 7. *Total private vehicle travel (kms per person) in American, Australian, European and Asian cities*



Source: Sustainable Urban Transport Systems Project (ISTP)

Figure 8. *The proportion of all daily trips by private transport in Asian cities*



Source: Sustainable Urban Transport Systems Project (ISTP)

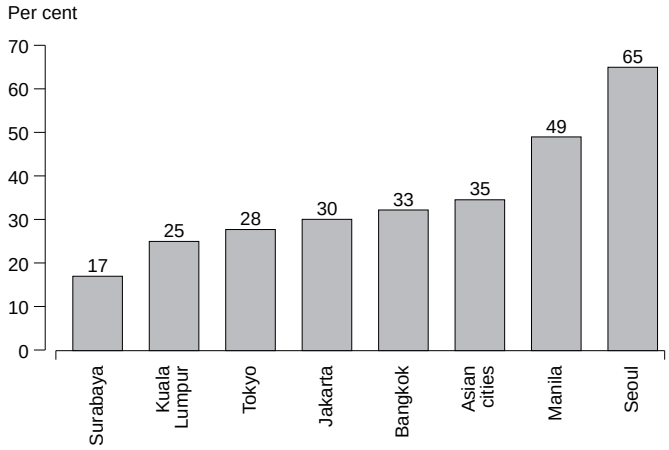
Public transport

Figure 9 shows that the use of public transport, expressed as transit's share of total annual passenger kilometres, is very low in US and Australian cities (4 per cent and 8 per cent respectively), while in Europe it is 25 per cent. The Asian cities in this graph are Singapore, Tokyo and Hong Kong only, which have 64 per cent of all passenger travel by public transport and which, today, are heavily dependent on rail-based transit. By comparison, Bangkok – with its gridlocked bus-only transit system – has only half this level of public transport use. Although this is quite high on an international scale, it is too low for a city of Bangkok's type, with its low road provision and a dense urban fabric unsuited to accommodating automobiles. This aspect is also developed further in the article.

Figure 10 provides public transport's share of all trips for a wider range of Asian cities, and shows that Bangkok does moderately well with its basic bus system and other collective modes (33 per cent compared to an average for Asian cities of 35 per cent). Nevertheless, Manila and Seoul have much higher levels of public transport (49 per cent and 65 per cent of all trips). Figure 11 shows the proportion of motorized work trips on public transport for an even larger sample of cities. This is very revealing as it shows that for those trips undertaken in the peak when road space is at a premium, Bangkok has rather low use of public transport (only 31 per cent compared with an average for the Asian cities of 55 per cent and, more particularly, between 62 per cent and 89 per cent in Tokyo, Singapore, Manila and Hong Kong).

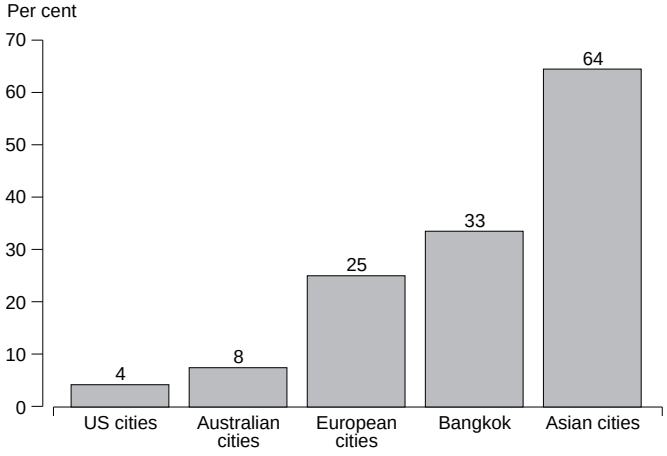
Congestion on the middle ring road of Bangkok

Figure 10. *The proportion of daily trips on public transport in Asian cities*



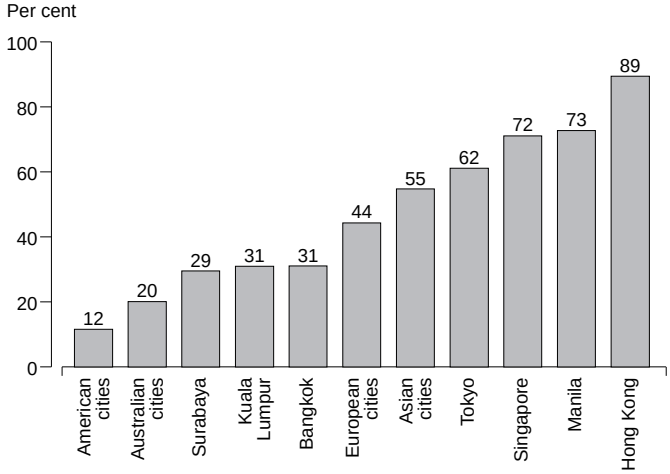
Source: Sustainable Urban Transport Systems Project (ISTP)

Figure 9. *The proportion of total annual passenger travel by public transport in Bangkok compared with proportions for American, Australian, European and other Asian cities (Singapore, Tokyo and Hong Kong)*



Source: Sustainable Urban Transport Systems Project (ISTP)

Figure 11. *The proportion of motorized works trips on public transport in American, Australian, European and Asian cities*



Source: Sustainable Urban Transport Systems Project (ISTP)

Non-motorized modes

Figure 12 shows the use of walking and cycling for the journey to work in cities around the world and reveals that US and Australian cities with their low densities, heavily-zoned land uses and long trips, have only 5 per cent of workers walking or cycling; European and Asian cities have 21 per cent and 25 per cent respectively, while Bangkok is very low with only 10 per cent. Figure 13 shows that, as a percentage of all daily trips, walking and cycling in Bangkok is about as low as it gets in Asian cities (14 per cent, or less than half of the Asian city average of 32 per cent). Tokyo, on the other hand, has a massive 45 per cent of all trips on foot and by bicycle, exceeded in this sample only by Surabaya, with 53 per cent.

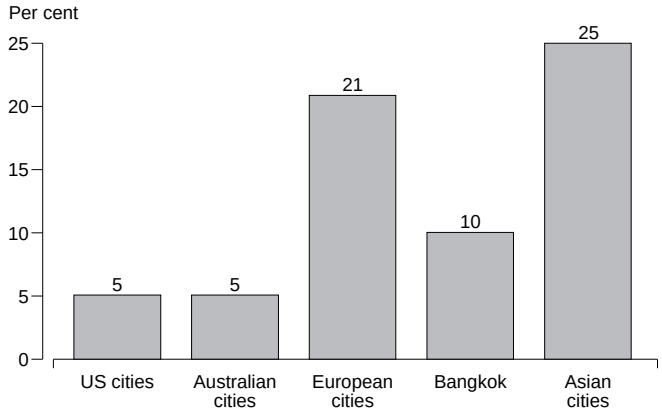
Implications of the international comparisons

The foregoing has provided some useful examples of differences in the land use and transport patterns of cities across the globe. What are the implications of these comparisons for Bangkok?

Vehicle ownership

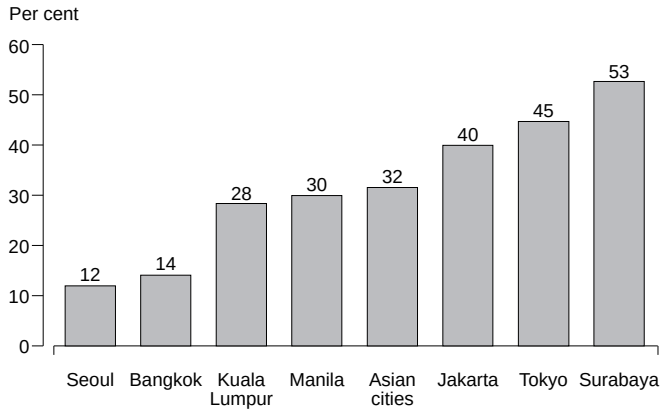
Bangkok clearly has a burgeoning vehicle population which is higher than is to be expected if wealth were the only factor involved. It can be argued that the absence of a real public transport alternative together with the serious problems associated with walking and cycling are helping to fuel exponential growth in vehicles, particularly since 1980 (Poboon *et al.*, 1994). There is also nothing in government policy which would help to curtail the trend. On the contrary, close ties with Japanese car and motor-cycle manufacturers, financial aid from Japan and other financial institutions for road projects, plus low tariffs and other government charges associated with vehicle ownership, suggest that high vehicle growth will continue (Kenworthy, 1994; Mallet, 1994).

Figure 12. *The proportion of workers using walking and cycling for the journey to work in Bangkok compared with proportions for American, Australian, European and other Asian cities (Singapore, Tokyo and Hong Kong)*



Source: Sustainable Urban Transport Systems Project (ISTP)

Figure 13. *The proportion of all daily trips by non-motorized modes in Asian cities*



Source: Sustainable Urban Transport Systems Project (ISTP)

Bangkok buses stuck in a gridlock – this is not a viable transit alternative for the growing middle classes

Singapore highlights Bangkok's need to establish some policy constraints on motor vehicles. The suppression of vehicle ownership in Singapore compared with Bangkok can be seen in Figure 5. Singapore's tough economic and physical planning disincentives against cars and its excellent public transport explain this picture, especially in the light of the city's economic capacity to purchase cars, as depicted in Figure 6 (Kenworthy *et al.,* 1994). Singapore's policies include the Area Licensing Scheme which now provides all day (7.30 a.m.-6.30 p.m.) restrictions and high charges for vehicles entering the CBD, and the certificate of entitlement (COE) system which requires purchase of the right simply to buy a car (costs depend on vehicle size and the time that the vehicle will be operated, but range from S$28,150, for a weekend-only car, through to S$63,000, for big cars.

Public transport

Bangkok's dense urban fabric, combined with intensively-mixed land uses throughout a major part of the city, make it potentially an ideal environment for public transport and particularly for walking and cycling. This is especially true because of the linear nature of the city in which residential areas and commercial/retail strips are densely built up along road corridors. This is well-suited to a fixed-route, segregated transit system, whereas buses attempting to ply these corridors find themselves at a standstill with other traffic. As we have seen, public transport use in Bangkok is correspondingly low for an Asian city because only occasionally do buses operate on effective bus lanes (in particular contraflow lanes). Moreover, the crowded, mostly non-air-conditioned buses are unable to provide an acceptable transport alternative for the growing middle class, who are fuelling the demand for car travel. The Asian cities which *do* have high levels of public transport use are those with effective rail systems that have been able to capture middle-class travellers on attractive, air-conditioned fast trains (e.g. Hong Kong and Singapore). The existence of a viable alternative to cars, combined with disincentives to car ownership, has kept a lid on car travel and congestion in these cities.

An effective rail-based public transport system would appear to be a priority for Bangkok if it is to ever compete with cars.

Walking and cycling

Bangkok's level of walking and cycling is atypically low for an Asian urban environment. This appears to be related to the general hostility of the pedestrian environment and the dangers of riding a bike – there are no bike lanes or other facilities. Most main roads have poor footpaths, and where they have been widened and perhaps planted with trees – to relieve the hot climate – there is so much noise and so many fumes that walking is an ordeal.

The *sois*, or residential roads, on which most of Bangkok is built, are narrow, and those that connect the *sois* with

Motor cycles are large contributors to the suspended particle pollution of Bangkok – but they are popular for avoiding the queues of traffic

People sitting in non-air conditioned buses are subjected to unacceptable levels of air pollution

The residential sois *of Bangkok are jammed with traffic and there are few places to walk or ride safely*

The residential sois *of Bangkok are jammed with traffic and there are few places to walk or ride safely*

major roads are particularly crowded with traffic and speeding motor bikes. The narrowness of the *sois,* combined with the high walls which surround the houses, create a very unattractive environment for pedestrians and cyclists, and there is almost nowhere to walk or cycle safely. However, in smaller *sois* with lower traffic volumes, it is common to find people walking to street vendors, local businesses and schools. For trips to the shopping areas on main roads or to catch buses, many people use hired motor-cycles.

Many of Bangkok's canals have been filled in for roads and water transport remains a neglected but effective form of transport

It can be concluded that if priority were to be given to improving pedestrian environments and facilities for walking and creating a shaded cycleway system, people would naturally choose non-motorized modes for short trips because they are the most convenient modes in dense environments with fine-grained, mixed land uses; Tokyo strongly demonstrates this point.

Waterways

Water transport is an attractive, fast way to travel in Bangkok. It provides passengers with relief from the hot climate and separation from the fumes and noise of the roads. However, many canals have been filled in for roads, and even the river is the focus of an attempt to build a floating freeway. Water transport's present contribution to passenger transport is thus very low; but, with more and better boats, improved jetties and effective feeder services, waterway transport could be further developed.

Paratransit

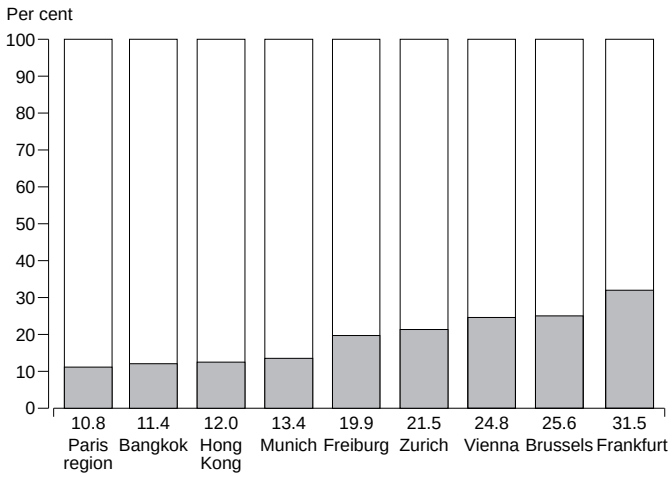
Bangkok's *tuk-tuks, silor-leks* and hired motor-cycles currently fill an important transport niche and offer cheap fares. Their overall contribution to daily trips is very small when compared with buses and other modes, but could be improved by using them as formal feeder services to bus stops, piers and railway stations, and through improved shelters and government regulation to maintain vehicle standards and safety.

Roads

The big issue in Bangkok is roads. The greater part of capital investment in transport goes into large road projects (see Poboon and Kenworthy, 1995), and the dominant perception of the root of Bangkok's traffic problems is simply that there are not enough roads. Much is made of the fact that Bangkok has only 11 per cent of its urbanized area devoted to roads whereas other cities have upwards of 20 per cent (Tanaboriboon, 1993).

As shown in Figure 3, however, Bangkok is not atypical of Asian cities in the length of roads it provides per person. Indeed, Jakarta, Manila, Hong Kong and Surabaya provide less. To compare Bangkok's road area with those of other cities is more difficult because of data availability problems. However, it is worth doing because this parameter incorporates road widths. Figure 14 draws together data on a number of cities and shows that Bangkok is not so unusually low (e.g. Paris, Hong Kong and Munich are almost identical to Bangkok in this respect). The crux of the issue is that cities which have a low proportion of urbanized land under roads also have extremely good public transport services – in particular, very good rail systems. They also have high levels of walking and cycling because of better infrastructure

Figure 14. *The percentage of urbanized land in Bangkok occupied by roads compared with percentages for a selection of global cities*



Source: Sustainable Urban Transport Systems Project (ISTP)

provision and environments more conducive to these modes.

The important conclusion about policy to be drawn from this analysis is that Bangkok is suffering not so much from a lack of road space, as from a poorly-developed transit system and a very low level of walking and cycling. Bangkok's public transport system and low level of non-motorized mode use do not sufficiently complement its small road provision. In other cities, these factors are better matched and although there is still congestion, there is no traffic crisis.

There is another very important point to stress in relation to Bangkok's tightly-woven urban fabric which, like many other Asian cities, has not been built for the automobile: non-motorized modes, especially waterway transport, were the basis of Bangkok's early development, followed by trams and buses. It is only since about 1980 that vehicle ownership, and thus congestion, have gone out of control (Poboon *et al.*, 1994). It is certainly possible to try to accommodate Bangkok's growth in vehicles with an aggressive road-building programme, but not without tearing apart the urban fabric.

Figure 15 estimates the results of trying to expand Bangkok's proportion of urban land devoted to roads from its present 11 per cent up to 20 per cent. Based on present average population and job densities, the new roads would displace the equivalent of a city the size of Chiang Mai. Resettling these people, and the necessary employment enterprises at densities typical of the outer zone of Bangkok, would require new land equivalent to 10 per cent of Bangkok's present urbanized area. Moreover, because they would be in automobile-dependent areas distant from public transport, they would themselves generate huge new volumes of traffic.

Bangkok's CBD has American levels of parking, mostly on-street

Policy conclusions

Based on the analysis presented here, there appears to be a range of essential policies which Bangkok needs to consider in order to begin resolving its desperate traffic situation. They are summarized briefly in what follows. A

Figure 15. *The implications of increasing the percentage of urbanised land under roads in Bangkok to 20 per cent*

		Equals....
Existing road space	3,844 ha	
Extra land needed for roads	2,888 ha	Lat Pro district
Displaced residents	469,000	City
Displaced jobs	145,800	of
Total activities displaced	615,100	Chiang Mai
Land required to resettle	14,598 ha	10 per cent BMA

Source: Sustainable Urban Transport Systems Project (ISTP)

more detailed discussion of these policies can be found in Poboon *et al.* (1994), Poboon and Kenworthy (1995), Kenworthy *et al.* (1994) and Barter *et al.* (1994).

Restraints on cars

This requires an economic approach in the form of increased vehicle taxes, registration duty and fuel tax and perhaps even a Singapore-style COE for car ownership. It also requires physical restraint in the form of an area licensing scheme which has already been outlined in a major air-pollution study (Boontherawara *et al.*, 1994). The level of CBD parking also needs to be controlled as it is excessively high. Designating particular parts of inner Bangkok as pedestrian and public transport priority zones and at least some full scale pedestrianization in central Bangkok would be appropriate.

Public transport development, especially rail

In order to make restraint on private transport politically feasible, public transport would need to improve greatly. A first and absolute priority is the establishment of a mass rapid-transit system, notwithstanding the enormous technical, institutional and political complexities which currently need to be overcome. Buses need to be given effective, enforceable priority in the traffic system in the form of bus-only lanes and bus-actuated signal priority. Waterway transport and paratransit modes need to be greatly improved.

Walking and cycling environments

In addition to pedestrianization in central locations, there needs to be a comprehensive programme to improve walking and cycling environments at both local and regional levels. Shaded routes, continuous footpaths and cycling routes, separation from dangerous traffic, noise abatement and bike facilities at destinations all need to be considered. If Tokyo can achieve 45 per cent of daily trips on foot and bicycle, Bangkok must set its sights on more than its present 14 per cent.

Transit-oriented, mixed use development

Although much of Bangkok is already ideally suited to mass transit, there is an enormous number of high density apartments and dispersed townhouse and condominium developments being built, with huge parking facilities and without any thought for public transport. They are all being built and sold on the assumption of car travel. In Europe and North America automobile dependence is being reduced through urban village-style developments located around rail stations. These are high-density, mixed land-use areas with minimal parking, and have pedestrianized or traffic-calmed environments to encourage walking and cycling for local trips (Newman *et al.,* 1992). Without controls on the form and location of future development in Bangkok and the integration of effective public transport, every improvement through other measures will be wiped out.

Institutional reform

Bangkok's quest to build a rail system has, up to now, been thwarted by the plethora of agencies responsible for transport planning and implementation, causing overlapping in mandates and many conflicts. There should be a much smaller number of agencies and each should have a clear-cut function. A single committee should have decisive power to oversee and co-ordinate such agencies with the authority for recommending decision making to the government.

A final word

Bangkok is increasingly referred to as the "Los Angeles of the East". Although its present problems can be analysed and understood in a technical way using the data in this article, its problems extend deeper, as do those of Los Angeles itself. In a very real sense, the transport problems in these two cities stem from a lack of effective public planning for the "common good" over many years. Los Angeles has attempted to function almost totally on automobiles and has been reluctant to develop a public transport system of any significance or to control land use. The notion has been that if individuals are allowed to maximize their private good, then the sum of these decisions will be a good city. This has not happened, and Los Angeles is now one of the most problematic environments in the western world. Bangkok, too, runs the risk of allowing itself to be plundered by private interests associated with road transport systems. Unless public planning for the common good can gain a foothold, as it is beginning to do now in Los Angeles – with the development of an extensive rail system, integration of some development around stations, and land use controls to minimize new travel – there is little hope that any of the policies outlined here can be implemented.

References

Barter, P., Kenworthy, J., Poboon, C. and Newman, P. (1994), "The challenge of Southeast Asia's rapid motorisation: Kuala Lumpur, Jakarta, Surabaya and Manila in an international perspective", paper presented to the Asian Studies Association of Australia Biennial Conference, Environment State and Society in Asia: the Legacy of the Twentieth Century, 13-16 July, 1994, Asia Research Centre, Murdoch University, Perth, Western Australia.

Boontherawara, N., Paisarnutpong, O., Panich, S., Phiu-Nual, K. and Wangwongwatana, S. (1994), "Traffic crisis and air pollution in Bangkok", *TEI Quarterly Environment Journal*, Vol. 2 No. 3, pp. 4-37.

Kenworthy, J. (1994), "Exit to Eden or highway to hell?", *The Australian*, 5 December, p. 9.

Kenworthy, J., Barter, P., Newman, P. and Poboon, C. (1994), "Resisting automobile dependence in booming economies: a case study of Singapore, Tokyo and Hong Kong within a global sample of cities", paper presented to Asian Studies Association of Australia Biennial Conference, Environment, State and Society in Asia: The Legacy of the Twentieth Century, 13-16 July, 1994, Asia Research Centre, Murdoch University, Perth, Western Australia.

Mallet, V. (1994), "Thailand in driver's seat of Asia's accelerating car industry", *The Australian*, 10 November, p. 39.

Newman, P. and Kenworthy, J. (1989), *Cities and Automobile Dependence: An International Sourcebook*, Gower, Aldershot.

Newman, P., Kenworthy, J. and Robinson, L. (1992), *Winning Back the Cities*, Australian Consumers Association/Pluto Press, Sydney.

Poboon, C. and Kenworthy, J. (1995), "Bangkok: towards a sustainable traffic solution", paper presented to Urban Habitat Conference, Delft, 15-17 February.

Poboon, C., Kenworthy, J. Newman, P. and Barter, P. (1994), "Bangkok: anatomy of a traffic disaster", paper presented to Asian Studies Association of Australia Biennial Conference, Environment, State and Society in Asia: the Legacy of the Twentieth Century, 13-16 July, 1994, Asia Research Centre, Murdoch University, Perth,Western Australia.

Tanaboriboon, Y. (1993), "Bangkok traffic," *Journal of International Association of Traffic and Safety Sciences*, Vol. 17 No. 1, pp. 14-23.

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The changing role of cycling within Chinese transport policy

Matthew Smith

Forsaking the bicycle for the automobile in a hugely populated country like China will require much thought from policy makers

Introduction

When "green" transport planners, cyclists and environmentalists consider the role of cycling in transport policy, many of them often look to cycling provision in China with a mixture of jealousy and encouragement and as an example to hold up to less enlightened, more doubting individuals. However, while it might be true that Europe can learn from studying the role of cycling in China with regard to the state of European policy (Smith, 1994), the situation is perhaps not as exemplary as one might think.

Government support of cycling

Lowe (1989) points out that studies in North America and Western Europe have shown that wide variations in people's transport decisions are not chiefly influenced by levels of income, technology or urbanization. The difference, however, lies in enlightened public policy and strong government support. This certainly applies in China, where the government traditionally has been an advocate of cycling. Decades ago, it began investing in bicycle production when most people were too poor to own one and improvements to infrastructure were made to facilitate non-motorized travel. City governments in China have used bicycles to relieve pressure on overcrowded buses by paying commuters a monthly allowance for cycling to work. China has thus provided high-quality transport to large numbers of people while postponing the need for heavy public transport investments (Lowe, 1989).

In noting these facts, however, one should not fail to consider the political reasons behind the support.

Political rationale

Cycling, in China, more than in any other country, has benefited from, rather than suffered because of, its image of utility. Whereas, in the ex-Soviet Union, the doctrines of Communism focused more on urban areas and on industrial development, in China the doctrine has focused on the rural peasant classes. As they comprised the most prevalent and poorest group, Communist leaders pointed up their importance as the backbone of China. Thus, while it was recognized that development for these people was needed, much of Maoist thought sought to educate others in what could be learned from these peasants. This strand of Chinese communism reached its absurd extreme in the Cultural Revolution when education and status were seen as negative traits and the role of the peasant revered. Millions suffered, and many "re-educated" by being sent to the country to learn from rural peasant living and hard labour.

While not attempting to explore the doctrine of Chinese communism, it ought to be recognized that, if one extols the virtues of the peasant class, one can achieve equality more readily by lowering the standards of the upper, middle and even working classes than by raising that of the peasant class. In this political situation, the bicycle is well placed as some kind of "vehicle for the people". It is not a machine of luxury or status, but a practical workhorse, able to bring benefits to the population at large.

Pragmatic factors

For pragmatic reasons also the bicycle was an attractive choice for China's politicians. When first promoted, even cycles were beyond the reach of most people. The Chinese Government, however, obviously needed to show some tangible evidence of development, both to its own population and to the outside world, and the bicycle was perhaps the only way to do this. Promotion of car ownership by public subsidy would have made China vulnerable because of financial constraints and because China had set itself against the world and was therefore unable to use the technology of other countries, or to invite car manufacturers in.

Geographical and demographical factors

The bicycle has also been effective in tackling problems that stem from China's geographical status and its

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population size and density. Over 45 per cent of the population live in cities of half a million, and the remainder in rural or semi-rural areas (World Bank, 1986). Despite China's huge size, there is enormous pressure on almost all of its land, and despite having only 7 per cent of the world's available farmland, it manages to feed 22 per cent of its population (*China Daily,* 1993).

In the urban areas, population densities are very high, people living in cramped conditions without the expectation of space and privacy seen as necessary in the West. In Shanghai, for example, there are 22.7 million people (almost half the total population of England) making it one of the largest cities in the world (World Bank, 1984).

The popular appeal of bicycles

The size of China and its population certainly provide the opportunity to offer up fascinating statistics. There are 1.2 billion people in China (Brown, 1994) and over 300 million cycles, i.e. about 1 per 3 people. This, however is a much lower ratio than that of many western European countries (in The Netherlands, for example, there are 8 bikes to every 10 people). The major difference, however, is the reliance of the Chinese on cycles. In China, there is no other private alternative – there being one car per 74,000 people (Lowe, 1989).

Limited alternatives

Most of the remainder, then, have to rely on walking or public transport; but public transport is unreliable and overcrowded. The levels of crowding on buses would be unacceptable in the West, but in China are suffered daily by millions of commuters. To board and disembark often requires a physical struggle, and being unable to get on or off a bus is not uncommon because of the numbers of people crammed on board. Maximum capacity is determined not by the law, but by the physical impossibility of any more people cramming on board.

Chinese-built buses are old, under-maintained, dirty inside and out and heavily polluting, emitting black diesel smoke. Many are fitted for the use of electric overhead wires, though their actual use seems rare, perhaps because of power shortages. These buses also seem to be everywhere, yet are often snarled up in congested streets along with other buses, lorries and taxis.

Given the problems with the buses, it is unsurprising that people attempt to do without them. The cycle is their alternative, and is the eastern equivalent of the western automobile. While many in the West own a car because of a perceived need and importantly, a related perception of personal liberty, many in China buy bicycles for the same reason. That they are cheap to run is also important, but that they are an environmentally-sound mode of transport is irrelevant. Plate 1 shows cyclists in Shanghai at rush hour who must fight with the many buses for space in the crowded streets. In the centre buses often grind to a halt through sheer weight of numbers, and only the cyclists have a chance to keep moving.

Affordability

A new bicycle is equivalent to two or three months' wages of an average Chinese worker, so still represents a major purchase; but given increasing economic prosperity, cycle ownership has tripled since the early 1980s. In 1987, domestic bicycle sales in China reached 35 million – meaning that more people bought cycles in China than purchased cars world-wide (Lowe, 1989).

With so many bicycles now present, they have perhaps become a victim of their own success, and in many cities cycle predominance is the major cause of congestion. In Tianjin, for example, traffic monitoring at one intersection counted more than 50,000 cycles passing in one hour, which is a rate of 14 per second. Plate 2 shows a traffic junction in Shanghai. In order to regulate cycle

Plate 1. *Cyclists in Shanghai at rush hour*

Plate 2. *A traffic junction in Shanghai*

members, the authorities employ guards, seen standing in the foreground with a flag and armband at key junctions to ensure that cyclists do not overwhelm the road system.

Controls on cycles

With such high levels, cycle management is obviously necessary. Special roads are set aside in most cities for cyclists; but, to prevent cycles taking over all roads, cycling is banned on some roads either permanently or at rush hour. In an attempt to maintain some control, most city authorities make having a licence compulsory, and in Beijing the authorities have gone so far as to require that all cycles carry a small yellow number plate.

Furthermore, to stop cycles taking over all the space available, parking is allowed only in designated cycle parks which are found at intervals along the roadside. Here, cyclists must pay an attendant a small parking fee and, in return, can be fairly sure their bikes will be safe: an important factor in a country where cycle theft is a growing problem and where reliable cycle locks are the exception rather than the rule. Plate 3 shows a cycle park in old Shanghai. The government-employed attendant can just be seen sitting among the cycles. Those cyclists who do not use these parks may return to find their cycle has been removed by the police – the Chinese equivalent of towing – and must pay a fine to have it returned. Chinese police, moreover, are not renowned for their equal treatment of all citizens.

A question of space and motion

The general impression gained from visiting China is of a transport system that is working, but only just. In many cities, the majority of trips are made by cycling, so obviously people are moving while taking up a relatively small amount of space and producing no pollution. However, western research about how much space people take up when using different transport modes (Navarro *et al.,* 1985) does not translate easily to China. Whereas, in the West, walking, cycling and metro systems are seen as the most efficient forms of moving people in terms of space usage, in China this accolade almost certainly belongs to the buses. They achieve this through being overcrowded and unpleasant – a transport strategy which should not be recommended. Given better public transport, people might be able to travel in greater comfort, and there are some positive signs of better infrastructure development. In Guangdong in the Special Economic Zone of South China, modern economic development has given the city much-needed capital, and a metro system is being planned, which will hopefully relieve some transport problems there.

Plate 3. *A cycle park in old Shanghai*

Zoning

Even with public transport investment, the sheer volume of private transport – in this case cycles – still leaves city planners with a headache. Zoning of transport into separate streets helps, but unfortunately there is not enough space to cope with the demand. Most worrying, though pragmatists might suggest ongoing encouragement of cycling, there are signs that cycling is falling out of political favour. As Zuckermann (1991) notes:

> Even the Chinese are beginning to worship the private car and disdain the bicycle which is their transport mainstay.

Changing political priorities

As already noted, cycling provision in China benefited because it fitted the political mandate of the time. Now however, China has moved on. Whereas previously the goal was achieving some kind of social stability and the promotion of communism, the goal now is greater economic development *and* the survival of the Communist Party. Desperate to raise living standards without letting go of power, under Deng Xioping the Government has come up with its peculiar doctrine of "Free Market Socialism", which provides for the lifting of economic controls while maintaining political and social controls. Over the last few years, shops, markets and roadside vendors have proliferated, making many things available that bureaucracy (and not just affluence) once denied.

Growth of capitalism

In certain areas, such as the Special Economic Zones of the South and South West, controls have been almost totally withdrawn, with capitalism developing almost unfettered. The Government is using these zones to modernize China through the provision of capital for development. At the same time, however, people are being offered not increased civil rights, but greater affluence (which is, however, the traditional Chinese means of achieving power, influence and access to civil servants and government).

Presence of Western automobile manufacturers

Foreign companies are being invited into the country, and are bringing with them sophisticated marketing techniques and western models. Among them are the Volkswagen-Audi Group, Fiat, BMW, Mercedes and Ferrari. In February 1994 Ferrari opened a showroom in Beijing and within three days had sold three model 348s (US$ 350,00) and one Testarossa at double the price. These companies have been quick to work out the potential in a country with a huge population, and now embracing market forces. With cars being a "traditional" demonstration of affluence, and when only a tiny proportion of the country needs to buy a car for China to become a core marketplace, the potential gains for these car manufacturers are immense. To the cynical, it seems that having eaten their way through one sinking ship the rats are now happily inhabiting another.

Tempering industrial development with caution

Politically, it is now important to allow successful Chinese citizens to display their success: this is a part of the reward. Therefore cars are being given more space and cycles are being marginalized. Furthermore, cycling is now being seen as projecting the wrong image. Since the western world has large-scale car ownership, Chinese transport planners are asking, why not us? Some have suggested controlling cycle traffic with the ultimate intention of reducing it to an auxiliary mode of travel (Zuckermann, 1991). Plate 4 shows cyclists crossing Nanjing Douglu, Shanghai's main street and site of its most prestigious shopping area. In 1993 cyclists were banned from Nanjing Donglu and have been allocated side streets and must now weave along back streets to cross the city out of sight of tourists and wealthy Chinese shoppers. Cars, however, are still free to use Nanjing Donglu, and the almost continuous traffic congestion is not perceived as a problem.

Plate 4. *Cyclists crossing Nanjing Douglu, Shanghai's main street*

Warning signs from neighbouring countries

In Taiwan, which is diametrically opposed to China, the free market has ruled for a long time and just as its industry is more advanced, so too are its traffic problems. In Taipei, the capital of Taiwan, traffic density is ten times higher than that of Los Angeles – a city often used as an example of auto-infestation.

Similarly, in Jakarta, Indonesia, thousands of cycle rickshaws have been confiscated and thrown into the sea to "reduce congestion". This policy is illogical, because motor vehicles cannot effectively replace the services provided by those rickshaws (Wright, 1992). In reality, the rickshaw drivers have suffered through owning a vehicle with the wrong image.

Enter the road-builder

Such moves are being encouraged by the West. Foreign "experts" have, among other things, produced a report on Chinese transportation for the World Bank without ever mentioning the word bicycle. As Wright (1992) notes, these experts

> who take great pride in being hard-headed realists, provide a notable demonstration of how great effort and long years of training may ultimately enable one to overlook the obvious.

Instead the World Bank is encouraging large-scale infrastructure development, a term which usually means road building and which brings little gain to the general population.

Turning boulevards into motorways

In Beijing the problems of road building are all too obvious. There the streets teem with lorries, diplomatic cars, buses and scores of small, yellow taxi vans which have infected the city since licensing laws were relaxed. These taxis spend much of their time empty cruising the streets looking for paying fares while doing their bit to contribute to congestion and air pollution. Plate 5 shows traffic queueing outside the Forbidden City while policemen cycle freely down a separate cycle lane. Much of the urban traffic consists of taxis, but growing car ownership will add to the problem.

Through planning for city centre motor traffic, the old wide boulevards of Beijing are slowly developing into inner city motorways, while on the urban fringes large-scale road building is carving up the city (Sun-Yinshe, 1992) in a manner rivalling the excesses of the West in the 1960s and 1970s. What city planners did to Birmingham, England – which is now an unsightly sprawl of concrete, dual carriageways and drab pedestrianization subways – the Beijing authorities are attempting in their own city. Given half a chance, they may succeed in turning the Forbidden City into an island surrounded by a sea of car

Plate 5. *Traffic queuing outside the Forbidden City*

infested concrete. It is rather ironic that this is being done at a time when Birmingham is attempting to undo past mistakes. The City Council has now embarked on a scheme to take motor vehicles out of the city and encourage people to walk and cycle. The city's affair with the motor car is apparently over. Now the city centre ring roads are being viewed as a "noose around the city core" (City of Birmingham, 1988) and the intention is to "give the City Centre back to the people" by taking it away from the car (Sparks, forthcoming).

Conclusion

China is facing a wealth of environmental problems most of which stem from having a large population that is, perhaps nearing its carrying capacity (Meadows *et al.,* 1992), yet simultaneously attempting to speed up its industrial development. Development is certainly needed, but at present is being conducted in a manner that is unsustainable. Whereas in the West governments are only just beginning to realize the scale of their mistakes in transport planning, in China politicians and planners are seeking to emulate them.

China, though, has neither the space nor the economic security to be able to make these mistakes and recover. Given its population size and density, it will not take a large rise in the number of vehicles to bring urban China to a halt; and, if this happens development itself may grind to a standstill. In the rural areas, cropland is too valuable to be sacrificed to large-scale road building which, in any case, will provide only dubious benefits.

Perhaps, then, what is needed is a new way forward. To an old problem, China must attempt to find a new solution to an old problem and use transport planning in a new, more sustainable manner to bring about development. The use of cycles by the majority of its population may be causing problems. If, however, government support is withdrawn from promoting this method and motorized transport encouraged in its place, then China could be investing in problems from which it cannot escape.

References

Brown, L.R. (1994), *State of the World*, Norton, London.

China Daily (1993), 10 December.

City of Birmingham (1988), *Pedestrian Movement and Open Space Framework*, LDR/HLN Consultancy.

Lowe, M.D. (1989), *The Bicycle: Vehicle for a Small Planet*, Worldwatch Institute Paper 90, Washington, DC.

Meadows, D.H., Meadows, D.L. and Randers, J. (1992), *Beyond the Limits*, Chelsea Green, VT.

Navarro, R.A., Heierli, U. and Beck, V. (1985) *Alternativas de Transporte en America Latina: la bicicleta y los triciclos,* SKAT, Centro Suizo de Technologia Apropiada, St Gallen, Switzerland in Whitelegg, J. (Ed) (1993), *Transport for a Sustainable Future,* Belhaven, London.

Smith, M. (1994), "Cycling in China", *Atlantis,* Vol. 2, April.

Sparks, L. (forthcoming), *City Centre Strategy*, Birmingham City Council Department of Planning and Architecture.

Sun-Yinshe (1992), "Forming mechanism and delinutation of metropolitan areas in China – a case study for Beijing", *Acta Geographica-Sinica*, Vol. 47 No. 6, pp. 552-60.

World Bank (1984), *World Development Report*, in Dimitriou, H. (Ed.), (1990), *Transport Planning for Third World Cities,* Routledge, London.

World Bank (1986), *World Development Report*, in Dimitriou, H. (Ed.), (1990), *Transport Planning for Third World Cities,* Routledge, London.

Wright, C.L. (1992), *Fast Wheels Slow Traffic,* Temple University Press, Philadelphia, PA.

Zuckermann, W. (1991), *End of the Road*, Lutterworth Press, Chelsea Green, VT.

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