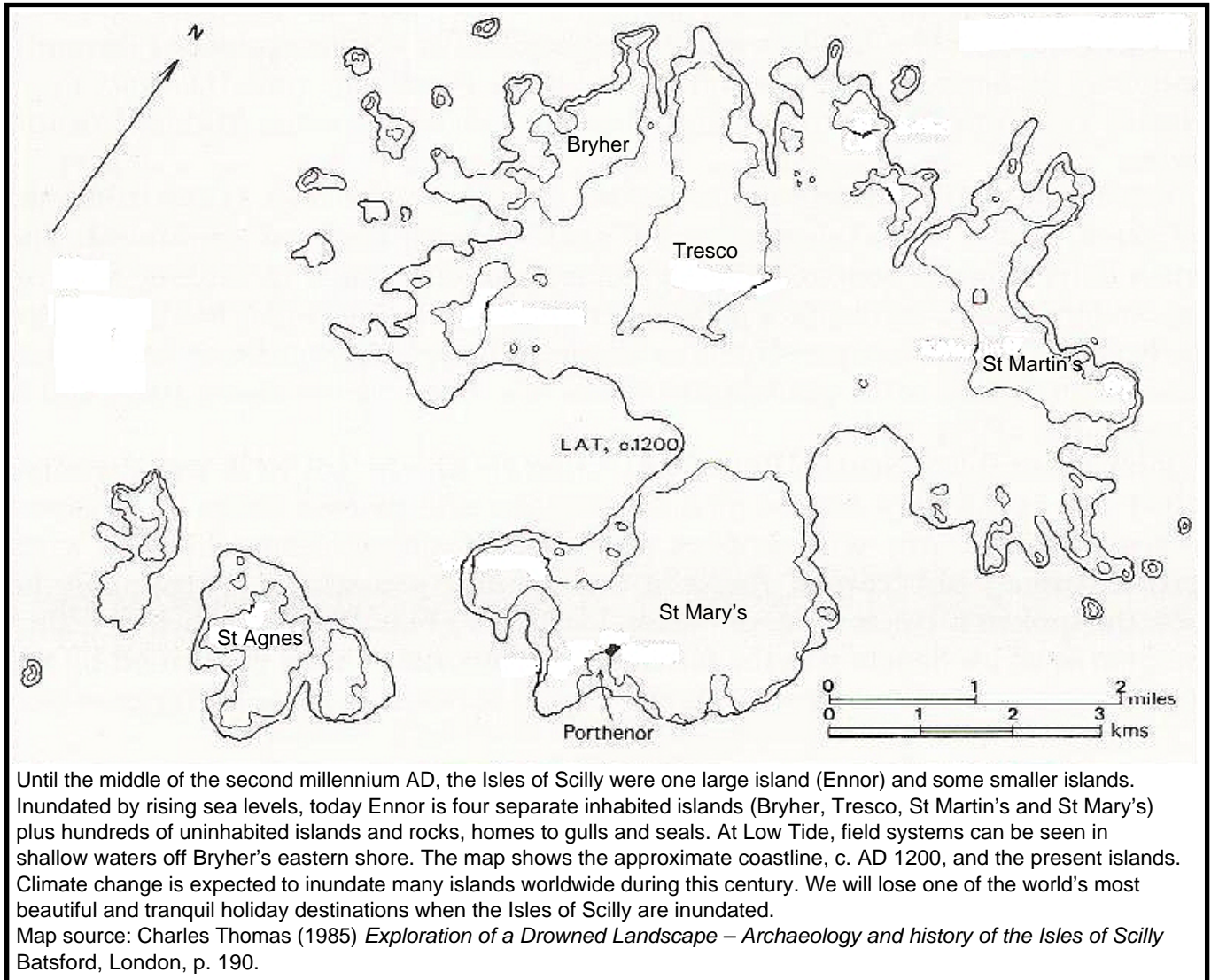


# World Transport Policy & Practice

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**Roadwars – or: Go Extreme. Go MK.***Joachim Allgaier*

Before moving to Milton Keynes in 2003, the author looked at the Milton Keynes council website and was impressed by the information about the ease of cycling in the borough. When he arrived in Milton Keynes, he got a shock. He sent the following text and images to Milton Keynes Council and, other than an e-mail auto-response, heard nothing for a few weeks. Then he was contacted by the Editor of a Milton Keynes promotional website requesting permission to put some of the text and the images on the web. Some of it appeared on <http://www.mkweb.co.uk/transportmk/> but it was rewritten... particularly the Editor of MKWeb praised National Express, something he wouldn't have done were he a regular passenger. Following complaints from the author, the Editor of MKWeb removed it from the website. However, the rewrite can be found here:

[http://66.102.9.104/search?q=cache:fB4j2QSOmnEJ:www.mkweb.co.uk/transportmk/home.asp%3Fr%3D6260+%22go+extreme%22+www.mkweb.co.uk&hl=en&lr=lang\\_en&ie=UTF-8](http://66.102.9.104/search?q=cache:fB4j2QSOmnEJ:www.mkweb.co.uk/transportmk/home.asp%3Fr%3D6260+%22go+extreme%22+www.mkweb.co.uk&hl=en&lr=lang_en&ie=UTF-8)

**An analysis of the regulation & transportation of hazardous waste in the United States of America***Vereda Johnson King & Basil Coley*

This research analyses current practices and trends related to the transportation of hazardous waste materials with special emphasis on the Department of Transportation's guidelines for transporting contaminants. Several major problems associated with hazardous waste are addressed including the following: tracking and documenting of the movement, notification requirements of imports and exports, labelling and placement of safety markers, initial and recurrent records of employee training for handling contaminants, compliance and violations.

Additionally, this study will analyse the impact of the regulations and guidelines for the transport of hazardous materials using the *2001 Penalty Action Report* from the Department of Transportation (OHMS, 2002).

**Keywords**

transportation safety violations, hazardous waste management, transporting environmental waste, USA, business regulation

**Urban road infrastructure policies in Africa: the importance of mainstreaming pedestrian infrastructure and traffic calming facilities***Marius de Langen*

The scale and orientation of urban road infrastructure works that are implemented in Africa usually depend strongly on the financial position of the local and national government. The reality in most cities is that the available budget is small compared to the total volume of works that ought to be carried out and, since that has been the case for the last three decades, a huge backlog of essential infrastructure demands has built up. Given the scarcity of funds it is very understandable that the works that have been carried out have focused largely on increasing the capacity of the main arterial road networks for motor vehicle traffic.

However, looking at the composition of urban travel demand in African cities, at mobility levels, at affordability of travel costs, and at the actual road infrastructure and traffic quality that has in general been achieved, the question must be asked: understandable, yes... but wise? The short answer to this question is: no.

This paper discusses the importance of mainstreaming pedestrian infrastructure and traffic calming facilities as an immediate priority – precisely because of the enormous backlog in infrastructure supply and the low traffic performance quality that most currently adopted road infrastructure designs have led to.

**Keywords**

Africa, Dar es Salaam, pedestrians, traffic calming, non-motorised transport, Sustainable Cities Programme

# Opinion Piece: Roadwars – or: Go Extreme. Go MK.

## Joachim Allgaier

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### Abstract

Before moving to Milton Keynes in 2003, the author looked at the Milton Keynes council website and was impressed by the information about the ease of cycling in the borough. When he arrived in Milton Keynes, he got a shock. He sent the following text and images to Milton Keynes Council and, other than an e-mail auto-response, heard nothing for a few weeks. Then he was contacted by the Editor of a Milton Keynes promotional website requesting permission to put some of the text and the images on the web. Some of it appeared on <http://www.mkweb.co.uk/transportmk/> but it was rewritten... particularly the Editor of MKWeb praised National Express, something he wouldn't have done were he a regular passenger. Following complaints from the author, the Editor of MKWeb removed it from the website. However, the rewrite can be found here:

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[www.mkweb.co.uk/transportmk/home.asp%3Fr%3D6260+%22go+extreme%22+www.mkweb.co.uk&hl=en&lr=lang\\_en&ie=UTF-8](http://www.mkweb.co.uk/transportmk/home.asp%3Fr%3D6260+%22go+extreme%22+www.mkweb.co.uk&hl=en&lr=lang_en&ie=UTF-8)

### Arrival

I did something extreme. I moved to Milton Keynes. Without a car. Yes, it's true, I went to the city of the car – without a car. Quite a brave thing to do, as it turned out. I was young, naïve and optimistic and thought things would work out. And I believed that website which said that the possibilities for cyclists in MK were excellent:

“The Milton Keynes's superlative routes for walking and cycling are now part of the ongoing project to develop the National Cycle Network throughout the UK.” <http://www.mkweb.co.uk/cycling/DisplayArticle.asp?ID=10772>



**Figure 1. Welcome to Milton Keynes Coachway at Junction 14 of the M1.**

Most National Express coaches call at bus stations in town centres. In Milton Keynes, they call at the Coachway which is about 8 km from the Central Bus Station. While there are National Express coaches calling at the Coachway at times throughout the night, the last local bus departs for Central Milton Keynes at approximately 2030, after which passengers must use taxis. By taxi from Mr Allgaier's house to the Coachway costs more than a coach trip through half of England.





Figure 2. The white-on-blue sign at the entrance to the shops says 'welcome', the sign on the covered walkway reads 'Pedestrians do not have Priority'. Are pedestrians *genuinely* welcome in Milton Keynes?



Figure 2b. Another view of the walkway which links different parts of the shopping mall.





**Figure 3. A burned-out motorbike beside a path in Milton Keynes; a not uncommon occurrence.**

At least the vandals had the courtesy to burn the motorbike *beside* the path, rather than *across* it where it would have damaged the surface and given cyclists a nasty nighttime surprise.

Then I got here... and made my acquaintance with the Redways. My initial thought was that these would be some kind of cycletrack, as in many other countries. But what I didn't know was that these Redways are the official ways for almost everything bar cars.

Apart from sheer boredom, the situation for car drivers is not that bad in MK. Many of the roads have two lanes and there are not many traffic lights. True, the road grid may be a bit irritating, because every road looks exactly like every other road and getting lost is the norm for visitors. But there are no cyclists or pedestrians getting in the way. And even in the city centre big signs remind one that 'Pedestrians do not have Priority'. By the way, if you arrive in MK (not by car but) by coach it is likely that the coach will drop you off at MK Coachway – a place so poor and miserable that it is a perfect location for a good director to shoot an awesomely disturbing horror movie.

So the Coachway is a perfect welcome and introduction to MK. If you're not wealthy enough to

afford a taxi you will have to rely on one of the local bus services. But how is that possible? As one of the youngest and 'most modern' cities in Britain, more-or-less planned from scratch, it should easily have been possible to design a fully functioning public transport system. The conditions were almost perfect, structures could have been modified in almost any way. But what we see in reality is an unacceptable mixture of poor management, privatisation, different price systems and very restricted timetables. Does it really have to be that bad, or is the local authority an assembly of taxi drivers and owners of local taxi companies?

### Redways

But back to my special friends, the Redways. While the highways have been arranged almost logically in a grid system, the Redways seem to be some kind of antithesis to the systematic approach of the 'real' streets. Often these lead you around your destination and sometimes end in culs-de-sac facing green fields. On some journeys if you follow the Redways you would travel twice as far as if you stuck to the highways. You simply have to; the Redway guide doesn't provide



**Figure 4. Central Milton Keynes. A social, cultural and environmental desert.**

any alternative ([http://www.mkweb.co.uk/cycling/documents/MK\\_Redway\\_Map.pdf](http://www.mkweb.co.uk/cycling/documents/MK_Redway_Map.pdf)). And don't bother hanging up street signs, people might actually find their way. In addition, using the Redways is quite risky, especially as you have to share them with dogs, inline-skaters, pedestrians and pram pushers who don't expect or know how to react to cyclists. Cycling is especially exciting on unlit stretches of the Redways: burned furniture, motorbike-parts or pieces of broken glass lurk in dark underpasses while dogs', horses' or whatever else kind of excrement turn the Redway surface into a slippery and smelly adventure. But I'll try to be fair and blame no one for the local climate and the often heavy winds that make cycling additionally unattractive around the area.

Be that as it may, somebody has to be blamed for the appearance of the city. When you start working in Milton Keynes your colleagues will probably tell you sooner or later, that living in the town really isn't that bad, even that it is quite a good place to live – once you got used to it. This sentence actually tells you the truth about what it means to settle down here. You will hate it. It is boring and not much happens. It is a cultural desert. You will get lost all the time, everything looks exactly the same. Feelings of monotony, depression and loneliness will creep up since most of the residential

areas are deserted and you never meet anybody on the streets. The whole city is an assemblage of concrete, parking lots, boring prefab houses, asphalt, some trees and green spots and that unpleasant big shopping machine in the centre. You start to wonder if you will meet any residents of this town that are not taking antidepressants. And the best thing that could actually happen to you is that you will get used to it. None of your colleagues would tell you or even mention that living in the city isn't actually that bad, if you would move to an average 'normal' city. But if they do you had better watch out. Some of the people that came to Milton Keynes at the same time as I did, and that's not very long ago, are still employed here, but have chosen to live in Bedford, Cambridge, London or elsewhere – simply because they couldn't stand it. I was lucky and found a place at the edge of the town where it is quite pleasant – but still I have to make my way through this manifestation of misanthropy every day to get to work. Everything would be fine if I would do it like everybody else: by car. But I like to ride to work on my bike. Since we are not in continental Europe where this kind of transportation practice is quite common and widespread I will try to explain my reasons for this oddity to British dwellers.



### Cars stink

Cars stink. They are noisy and dangerous. And it is no secret that more than 3000 people die each year on the streets in car accidents. I did my civilian service in an emergency operation room and I can assure you that most victims of car accidents did not look very good when they came in. Recently I read that within the next fifty years about one million species will be extinct as a result of climate change (<http://news.bbc.co.uk/2/hi/science/nature/3375447.stm>). The scientists that conducted the study themselves felt shocked because not even they expected such catastrophic results. And driving cars and the exhaust fumes it causes are an important cause of climate change. Britain has the world's highest rate of children with asthma. Maybe it would be a good idea to do something for a better air quality? 'Two million litres of fuel are delivered by 200 tankers to MK's 36 filling stations each week. Tesco in Bletchley, one of the busiest petrol outlets, shifts an incredible 20 million litres of fuel each year' as it reads proudly in the October 2003 edition of *LiveMK*, a publication of the Milton Keynes Council (p. 12) [http://www.heathmill.com/livemk/pdf/backissues/october\\_2003.pdf](http://www.heathmill.com/livemk/pdf/backissues/october_2003.pdf). But may I remind you that fuel is produced from fossil oils; limited natural resources. And it is often necessary to overcome complicated natural, physical and political obstacles to extract it or even more questionable to forge doubtful alliances that demand high prices. From that point of



**Figure 5. Redways! the home of home entertainment!**

view moving around in cars is a backward rather than sustainable mode of transport. Burning fuel pollutes the air and can cause a wild bunch of respiratory diseases and smog that harms buildings, animals, plants and humans. But if you cycle you are able to experience more of your environment – able to hear, see and smell what is going on around you. If you cycle along the same route every day you can literally see how the seasons change (and you can enjoy the sun in summer and curse the rain, wind and darkness in winter). If you cycle in Milton Keynes you learn where the homeless live, where policemen take their breaks and the tattooed



**Figure 6. The indoor Ski Slope in Milton Keynes. Note that it is indoors. This is an analogy for our attitude to transport: we don't like to get wet or cold.**



**Figure 7. Squaring the Sweatshop circle at the Milton Keynes Xscape**

youngsters smoke their spliffs. And isn't it more fun to fuel yourself with a good meal and a pint or two, thus supporting the local pub, instead of filling stinking and carcinogenic petrol into your car and pay greedy oil companies for it? And besides a lot of people pay a fortune to fitness centres to stay or get fit. Why not just hop on a bike, at least occasionally?

### **The City of the Car**

As mentioned above, one of the problems of cycling in MK is the streets: you cannot go where you want, you have to stick to the Redways. This is exacerbated by the notorious recklessness and high speed of MK drivers. The town itself is dominated by the Hs and the Vs, the Horizontals and the Verticals, the 'real' streets for the cars. Using these on a bike resembles a suicide mission. If you are a cyclist or a pedestrian you have to look for bridges or tunnels to avoid the streets. They are like endless dangerous streams, impossible to cross on your own, without the help of the few devices the urban planners have designed for that cause. The streets separate residential areas from one another and often lead to vast and grey asphalted places where automobilists can get rid of their mobility prostheses. And the bad thing is that, while it might have worked in the 1970s, nowadays these streets and parking lots are overcrowded... and, worse, the big expansion of

Milton Keynes is yet to come. Since the streets are everywhere (remember MK is known as 'the city of the car') cars are everywhere, which means that throughout the city, even outside its boundaries, you cannot escape the roaring sound of its inhabitants and their vehicles. A city of the car cannot be a quiet and relaxing place. In other words the noise pollution accentuates the air pollution.

### **The City of Gloom**

Now comes the ugly bit: Milton Keynes is not at all aesthetically pleasing as a city, with indifferent buildings and architectural monotony everywhere. Nearly all buildings are the same height, thus making it difficult to navigate in the town. If you walk around in MK with a map as blueprint of the place, you will probably find out that MK was a purposeful experiment to annihilate every sense or experience of aesthetics, joy, pleasure and fun in general. It seems to have been a major goal to get around fast in cars, but it did not seem to matter how long it would take pedestrians to arrive.

What strikes me is how people react to this problem. It appears to be 'given that we live in such an uninteresting and dull place let's just hide inside buildings so that we don't have to see our own environment anymore'. Said and done. MK has one of the longest shopping centres in the world. You can



**Figure 8. A highway designed for speed. Note that the bridge where the photographer is standing is protected from crashes by barriers. Note, too, how poorly the Redway is protected by a grass verge. Compare this with Tanzanian roads in Figure 6, 7 & 8 below [pp. 27, 28 & 29].**

spend the whole day in this Temple of Mammon without ever catching a drop on a rainy day. More bizarre is the Xscape bazaar. There you find even more shops (with sometimes embarrassing and politically incorrect names such as the sports outfitters SWEATSHOP<sup>2</sup>), some pubs that mostly belong to the same chain and some quite artificial pieces of nature, such as a plastic climbing rock and the even more outlandish indoor ski-slope that costs about £20 per hour. What are all those youngsters who do not have the nerve and the money to shop all day doing? Since all the parks and tree assemblages are as highly artificial as the ski slope and climbing wall, is there any piece of accessible *real* nature in Milton Keynes? What do you do in a city that leaves you no choice but consume? In my view it is even more disturbing that even though so many basic infrastructure institutions are missing, the city council has commissioned a PR company to change the city's image. The GO MK campaign has tried to portray the city as a vibrant and exciting place with fantastic sports and leisure facilities. This can only lead to disappointment. It is likely that many visitors to MK have been to a real

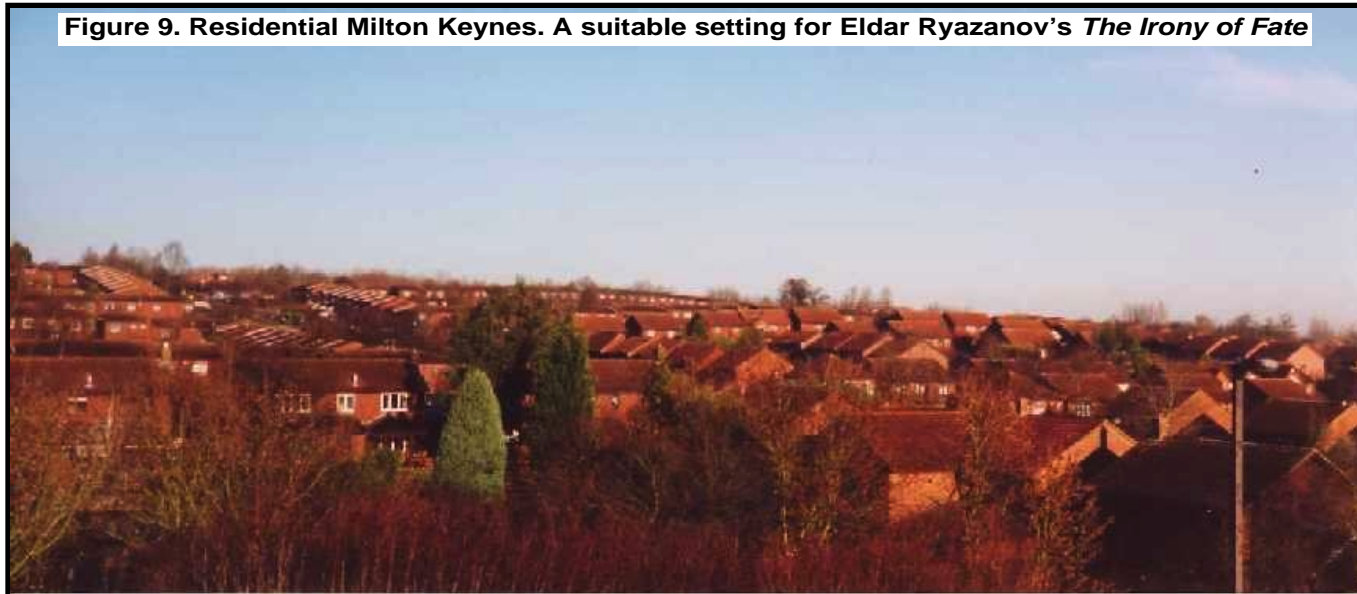
rock or a mountain before. How do you compare the great view on a mountain, the feel of real rock for free with places where you have to queue to ski down a tiny slope in a huge fridge or to climb up a piece of plastic, where you can't even see the sun and have to pay boasting prices for it?

#### **Maybe things can get better...**

Do not despair. There is still hope to improve life in Milton Keynes, the youngest of the new towns. Here are my recommendations:

- A Increase and improve public transport immediately. The streets are quite crowded already and the situation will get worse when the city expands further. Make it cheaper and faster, and organise and co-ordinate it better. Let more buses run. Subsidise, promote and advertise it. The more people using public transport, the fewer cars there will be on the roads. The consequence is that there will be fewer traffic jams and accidents, air quality will improve and noise pollution will be reduced. Make *real* nature accessible by public transport. There are people who prefer a walk in the green to



**Figure 9. Residential Milton Keynes. A suitable setting for Eldar Ryazanov's *The Irony of Fate***

an afternoon in a grey hangar-shaped fridge. Why not try one car-free day in summer, just to see how calm it would be and to audit how much public space is used for streets and parking lots. And if nothing helps encourage car owners to share their cars, and transport more than just the driver or organise a lift exchange, then what about employers? They could motivate their employees to use public transport and bicycles by paying mileage for the use of these virtuous modes, as they already do for the car.

- B Civilise MK's notorious drivers! Please decrease speed in the streets and in residential areas and stop the deadly races and joyrides on the Redways! Yes, the Redways are used by joyriders on motorbikes and in cars. While MK is 'the city of the car' maybe *some* of the car junkies could learn that pedestrians and cyclists are human beings with rights too. Furthermore, parked cars on and over the Redways and especially on crossings where Redways turn into streets is a pain for parents with prams, people in wheelchairs, cyclists and pedestrians who all have to climb over walls or push themselves through the bushes and scratch themselves, just to pass these obstacles whose purpose, ironically, is to increase mobility, not to hinder it!
- C Don't take that image campaign too seriously. Milton Keynes is already the butt of many jokes. If Milton Keynes continues to pretend to be a fascinating and vibrant place, then visitors will

laugh even more. However, we all can see that the visitor centre is closed. No comment necessary? Let's face it, there are far more attractive towns within reach, with which Milton Keynes cannot compete. So why not show a little humour and have a little fun with the city's image. Celebrate its ugliness. Instead of calling it 'the city of the car' it could be called 'the city of roundabouts', round and about. Or it could attract events that match the synthetic character of the city. So why not bring more arts to Milton Keynes – to MK gallery would be a good start, for example electronic arts could be advertised as 'Artificial Music in an Artificial Town' or 'Modern Arts in a Modern City' and so. MK still has got the potential to establish itself in this field. And don't forget that there are actually quite a lot of young people living in this town, even though you don't see them around.

- D Cycle! Make cycling more attractive, easier and promote it. This would help a lot to make Milton Keynes a really modern, quieter and less polluted showpiece city with a very high standard of living.

#### Postscript

I recently found another comment on public transport in Milton Keynes; it seems that I am not the only dissatisfied customer. 'Poor bus service in Milton Keynes' <http://www.weeklygripe.co.uk/a66.asp>

# An analysis of the regulation & transportation of hazardous waste in the United States of America

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## Abstract

This research analyses current practices and trends related to the transportation of hazardous waste materials with special emphasis on the Department of Transportation's guidelines for transporting contaminants. Several major problems associated with hazardous waste are addressed including the following: tracking and documenting of the movement, notification requirements of imports and exports, labelling and placement of safety markers, initial and recurrent records of employee training for handling contaminants, compliance and violations. Additionally, this study will analyse the impact of the regulations and guidelines for the transport of hazardous materials using the *2001 Penalty Action Report* from the Department of Transportation (OHMS, 2002).

## Keywords

transportation safety violations, hazardous waste management, transporting environmental waste, USA, business regulation

## Introduction

The environment can be viewed as a composite asset that provides a variety of services. It is a very special asset since it provides the life support system that sustains our very existence. As with other assets, we wish to prevent undue depreciation of the value of this asset, so that it may continue to provide aesthetic and life sustaining services.

The environment provides the economy with raw materials, which are transformed into consumer products by the production process, and energy to fuel this transformation. Ultimately these raw materials and energy return to the environment as waste products and contaminants. Environmental contamination can occur as the result of hazardous materials incidents, but data are not routinely collected on the extent of the damage. The environmental impacts of these incidents will depend on the concentration and type of material spilled, the location and volume of the spill, and exposure rates.

As freight is transported, damage can occur to the

human and natural environment. The extent of damage throughout these life cycles of transportation fuel, equipment, and infrastructure can vary by mode. In all cases, actual impacts on the human and natural environment are dependent on ambient levels or concentrations of pollutants and rates of exposure.

Ever since the passage of the Clean Air Act in 1955, many amendments to this Act and other laws have been passed to minimise our environmental problems. More recently, the government has provided regulations entitled *Hazardous Materials Regulations* (OHMS, 1996). These regulations govern the transportation of hazardous materials in interstate, intrastate and foreign commerce by rail car, motor vehicle, aircraft and vessel.

## Definition of hazardous waste for transportation purposes

Hazardous wastes are usually defined as those waste which, due to their quality or quantity, are potentially hazardous to human health or the environment and which require special disposal techniques to eliminate or reduce the hazard. Unlike non-hazardous waste, they have characteristics such as toxicity, flammability, corrosivity, and thus have a wide range of potential impacts due to these hazards, and at times, due to their tendency to persist in the natural environment. The factsheet on 'Transporting Hazardous Waste' (Environment Canada, 1991) further points out that some of the more common hazardous wastes are spent acids and caustics, still bottoms, the left over from oil refining and the manufacture of chemicals. Also, hazardous wastes often contain phenols, arsenic, mercury, lead and a large number of other toxic chemicals. It is therefore evident that laws have become necessary to protect the lives of human beings directly – and indirectly – through the environment from the effects of hazardous waste. Hazardous waste is a 'solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or



**Table 1. Hazardous materials incidents by mode and year**

Mode	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Air	297	299	414	622	931	817	919	1029	1386	1584	1420	1081
Highway	7296	7644	7843	11,095	14,011	12,868	11,962	11,864	13,110	15,004	15,126	15,885
Rail	1279	1155	1128	1113	1157	1155	1112	1103	989	1074	1059	898
Water	7	12	8	8	6	12	6	5	14	8	17	5
Total	8879	9110	9393	12,838	16,105	14,852	13,999	14,001	15,499	17,670	17,622	17,869

Source: OHMS (2002) 'Ten Year Hazardous Materials Incident Data'

pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed'.

### Hazardous waste transportation in the United States

Contaminants, such as flammable liquids and corrosives, are pervasive in commerce and are transported to meet numerous consumer demands and industrial needs. The specific classes of hazardous materials shipments include explosives, gases, flammable liquids, flammable solids, oxidisers and organic peroxides, toxics, radioactive materials, corrosive materials and miscellaneous dangerous goods. The Department Of Transportation (DOT) estimates that more than 3 billion tons of regulated contaminants are transported each year and that over 800,000 shipments of these materials occur daily.

During the last 10 years, the transportation industry reported to the DOT that, on average, about 22 deaths and 493 injuries occurred each year because of some 13,113 releases of hazardous materials in transportation. Most of these releases and associated deaths and injuries typically occur in the highway mode. A large percentage of shipments of contaminants are transported without any reported release.

### Safety record

Safety in hazardous materials transportation depends extensively on industry practices that are guided, in part, by government-issued requirements monitored by federal and state inspectors. Many hazardous materials container manufacturers, shippers, and carriers implement measures to promote transportation safety that exceed federal requirements. Despite these efforts, roughly 400 serious hazardous material transportation incidents per year are reported to the DOT. Many consider the industry to have a comparatively good safety record, but others point out that additional steps should be taken to improve safety (Rothberg & Hassan, 2000). This becomes very important since the number of hazardous materials incidents reported to the DOT has increased from 8,879 in 1990 to 17,869 in 2001.

From 1990 to 2001 the amount of damages resulting

from the transport of hazardous waste increased by 360%. The actual amount of damage as measured in real dollars increased from \$22.8 million to \$82.4 million. The Consumer Price Index was used to calculate changes in price during the years of this research. \$22.8 million in 1993 is worth approximately \$27.9 million today. Thus, the actual increase is 295% in real terms.

The DOT reported that the total number of incidents has increased from 8,879 in 1990 to 17,869 in 2001. A further analysis of this composite information reveal that incidents resulting from the transport of hazardous waste are separated into the following modes of transportation: air, highway, rail and water. The number of major incidents has fluctuated in the given years with a maximum of 54 in 1994 and a minimum of 18 in 2001. The number of minor incidents has shown a downward trend from a maximum of 593 in 1993 to 116 in 2001, resulting in a 511% decrease.

According to the Bureau of Transportation Statistics (2004), transportation firms reported more than 15,300 hazardous materials incidents in 2002. These incidents resulted in 7 deaths and 129 injuries, compared with annual averages of 22 deaths and 419 injuries between 1992 and 2002. During that decade, the number of reported hazardous materials incidents increased. United States highway vehicles transported 56% of the tons of hazardous materials that were shipped in 1997. Between 1992 and 2002, 61% of the injuries and 52% of the fatalities attributed to hazardous materials were the result of highway incidents. Since 2002 the percentage of fatalities attributed to hazardous materials as a result of highway incidents has declined. Fatal hazardous materials transportation incidents in other modes tend to be less infrequent.

### Regulations governing the transportation of hazardous waste

The major regulations governing the transportation of hazardous waste are detailed in Chapter 1, Subchapter C of the *Hazardous Materials Regulations* (OHMS, 1996). Some important aspects of these regulations are as follows:

1. No person may offer or accept hazardous waste material for transportation in commerce unless that

**Table 2. HAZMAT 2001 Penalty Action Report (OHMS, 2002)**

Code	Failures	Rate
107	Registration	0.0606
171	Telephone notification, filing, identification, description, quality	0.0138
172-172.3	Shipping papers, listings, shipping name, hazard classification, description, technical name, exemption number, shipper's certificate, emergency response information, technical information, identification number, orientation markers	0.021
172.4-172.45	Labelling requirements	0
172.5-172.6	Placarding requirements	0
172.7-172.704	Training requirements	0.625
173	Over packing, reconditioner, incorrect registration, alternate leakage test, marking portable and tank requirements, cylinder retesters, rebuilder requirements, packing	0.14
178	Third party packing certificates, insuring packages, certifying packing, Retesting packing, maintaining testing records, improper marking, date of making inspections, reports of inspections	0.0386
177	Carrier requirements	0.138
Other	Other miscellaneous minor penalties	0.101

person is appropriately registered and the material is properly classed, described, packaged, marked, labelled and in condition for shipment as required by the applicable subchapter of the law.

- No person may transport a hazardous material in commerce unless that person is properly registered to do so.
- No person may represent, mark, certify, sell or offer a packaging or container as meeting the requirements for the transportation of hazardous material unless the packaging or container is manufactured, fabricated, marked, maintained, reconditioned, repaired and retested as appropriate in accordance with the law.

### Penalties

The law also prescribes certain punishment for violations. It points out that any person, who knowingly violates a requirement of the Federal hazardous material transportation law, is liable for a civil penalty of not more than \$27,500 for a violation that occurs after January 21, 1997 and not less than \$250 for each violation. Based on the laws described above and the penalties for breaking any of them this paper analyses the violations and penalties from 1990 to 2001.

### Major violations in the transport of contaminants

The Office of Hazardous Materials Safety (OHMS) is responsible for setting initial proposed penalties for hazardous material (HAZMAT) violations. They indicate baseline amounts or ranges for probable violations frequently cited in enforcement reports and set forth as general OHMS policy for considering statutory criteria. The initial baseline determination partially considers the nature, extent, circumstance, and the gravity of the alleged violation. That determination is then adjusted to consider all other

evidence concerning the nature, extent, circumstances, and the gravity of the alleged violation; degree of culpability, history of prior violations; ability to pay; effect of the penalty on ability to do business; and such other matters as justice may require. In making a penalty recommendation, the baseline or range may be increased or decreased on the basis of evidence pertaining to these factors. Title 49 CFR Part 107 Subpart D lists all of the frequently cited violations for Hazardous Material Transport. A subset of these violations, those most often cited in the *2001 Penalty Action Report* (OHMS, 2002), are examined in Table 2.

During 2001 most of these codes were violated but there was one category that far outweighed the others. These codes were between 172.7 and 172.704, a category relating to the inadequate training of employees as outlined by federal guidelines. Some experts in the field think that abiding by the minimal federal training guidelines could leave a company and its employees inadequately prepared for the rigours of transporting hazardous materials. Although government regulations say workers should be certified once every three years, that is not often enough (Bierlein, 2000). They believe that certain key personnel should be briefed as often as once a year. They also state that shipping hazardous waste materials is a complicated matter supervised by a number of government authorities, including the DOT, Federal Aviation Administration, Occupational Safety and Health Administration and the Environmental Protection Agency (EPA); this affects the ability of the businesses to comply with legislation.

## Conclusions & Recommendations

The ultimate safe disposal of hazardous wastes is the final phase in the life-cycle approach to the management of toxic chemicals. The life-cycle concept is a convenient way of expressing the stages of transformation a chemical may go through during its life: from research and development, introduction to the market place, manufacture, transportation, distribution, use and disposal. All hazardous waste transporters in the USA must follow regulations from both the EPA and the DOT. While the EPA transporter regulations focus on hazardous waste management and the manifest system, the DOT governs the packaging, marking and labelling of hazardous materials before transport, and emergency response procedures for discharges during transport. The EPA has adopted the DOT's hazardous materials rules for hazardous waste transportation, giving the EPA the authority to enforce all applicable regulations, regardless of the DOT's action.

As accidental spills of hazardous substances during transportation are making the news, we are also becoming increasingly concerned about our ability to keep track of hazardous wastes. Moving hazardous wastes, from their point of origin to ultimate safe disposal, requires more planning and information as well as an effective tracking system which is applicable to multi modal transportation, including air, marine, road and rail. We recommend an extensive tracking system to be used for tracking the movement of hazardous wastes throughout the entire process, including types and volume of waste being shipped, a record of the various firms or individuals involved in the transaction, and information on the treatment, storage and disposal of the wastes when they reach their final destination.

The findings of this study indicate that there were a disproportionate number of penalties for violations of transporting contaminants due to inadequate training for employees in 2001. Approximately 62.5% of the 2001 Civil Penalty actions were because of failure to train employees adequately. Also, in 2001, some 44.5% of the Civil Penalty actions were served on small companies (those with 10 or less employees) because of failure to train employees adequately.

In the United States, pollution damage estimates are used to design future environmental protection policies. Under the *Comprehensive Environmental Response, Compensation, and Liability Act*, local, state, and federal governments can seek monetary compensation from those responsible for injuring or destroying natural resources through spills or releases of hazardous waste and contaminants. The data in this research indicate that the magnitude of these awards and the associated reoccurrence should be reviewed and

reassessed for the transportation industry. The main reason for the reassessment is because this is only a partial cost, which is charged to these shipping agents. This partial cost is less than the benefits received by shipping agents who continue to violate the laws pertaining to the transport of contaminants. Obviously these agents are content to accept the penalties partly because of the minute magnitude of the penalty. A true and total assessment of the magnitude of these penalties will include:

- 1) identifying the affected categories;
- 2) estimating the physical relationship between the pollutant emission and the damage occurred to the affected category;
- 3) estimating responses by the affected parties toward averting or mitigating some portion of the damage; and
- 4) placing a monetary value on the physical damage (Tietenberg, 2001).

Each of these steps is often difficult to accomplish but totally necessary if we are to maintain and hopefully preserve our current environment as well as the safety and security of the nation.

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# Urban road infrastructure policies in Africa: the importance of mainstreaming pedestrian infrastructure and traffic calming facilities

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## Abstract

The scale and orientation of urban road infrastructure works that are implemented in Africa usually depend strongly on the financial position of the local and national government. The reality in most cities is that the available budget is small compared to the total volume of works that ought to be carried out and, since that has been the case for the last three decades, a huge backlog of essential infrastructure demands has built up. Given the scarcity of funds it is very understandable that the works that have been carried out have focused largely on increasing the capacity of the main arterial road networks for motor vehicle traffic.

However, looking at the composition of urban travel demand in African cities, at mobility levels, at affordability of travel costs, and at the actual road infrastructure and traffic quality that has in general been achieved, the question must be asked: understandable, yes... but wise? The short answer to this question is: no.

This paper discusses the importance of mainstreaming pedestrian infrastructure and traffic calming facilities as an immediate priority – precisely because of the enormous backlog in infrastructure supply and the low traffic performance quality that most currently adopted road infrastructure designs have led to.

## Keywords

Africa, Dar es Salaam, pedestrians, traffic calming, non-motorised transport, Sustainable Cities Programme

## Background

This paper was a contribution to the AFRICITIES workshop on urban mobility issues in Yaounde, December 2003. The experience reflected in the paper has to a large extent been built up in extensive urban mobility and non-motorised transport studies and pilot projects which were carried out in east Africa between 1992 and 2000 under the World Bank's Sub-Saharan Africa Transport Policy Program (SSATP), and which

were complemented by other studies and research by students on the UNESCO-IHE Urban Infrastructure Engineering MSc programme. In addition, based on this experience, the decision was taken by the UN-HABITAT/UNEP Sustainable Cities Programme, in 2002, to incorporate a demonstration component into the Programme to support cities in creating and implementing sustainable low cost urban mobility policies. The demonstration component would focus on:

- pedestrian and two-wheeler traffic,
- traffic calming,
- safety, and
- the pedestrian/public transport interface.

The activities concerned were kick started at the Sustainable Cities Programme conference in Alexandria, Egypt, October 2003, and the first demonstration activities are now underway in Kisumu, Kenya (2005).

As part of the urban mobility component of the Sustainable Cities Programme, an expert network on low cost urban mobility was initiated, with the aim to stimulate further research and development of improved, low cost, urban mobility policies and road design standards. Since 2004, research on the issues dealt with in this paper have been communicated through the network's website. Experts in the field of urban mobility in Africa with an interest in the subject and the willingness to make a contribution from their side, are invited to take part in these activities as a member of the network, thus getting access to and further enriching the networks' knowledge base. This is possible irrespective of being directly involved in Sustainable Cities Programme project activities.

## The structure of the paper

The paper is divided into four main sections:

### 1 The urban travel market

Experience shows that it is often difficult to obtain a clear overview of the actual build-up of the travel market in African cities. How many trips are made? Over what distances? By what modes? At what

**Table 1. The mobility market in the Temeke sub-municipality of Dar es Salaam, 1994**

distance (km)			<2	2–5	5–8	>8	
mode	cost (US\$ cent/km)	speed (kmh)					Total
Walk	0.2	3.5	23%	20%	4%	0%	47%
Cycle	0.8	10.0	0%	2%	1%	0%	3%
Public Transport (Bus)	2.4	10.0	2%	6%	8%	27%	43%
Car	20.0	15.0	0%	10%	10%	40%	60%
Total			26%	29%	14%	31%	100%

Total trips per adult (≥15 years old) on weekdays (Monday–Friday): approximately 1.9/day

Source: de Langen & Tembele, 2001; data collected by means of household travel survey

direct and indirect costs?

A discussion of urban infrastructure priorities will produce much better results if it is based on a good overview of the entire travel demand market. The paper therefore starts with a very brief overview of the composition of the urban travel market.

## 2 Travel cost and benefit structure

A second step to prepare for a valuable discussion of urban infrastructure priorities is to look briefly into the composition of travel costs and benefits. Some of these are direct, priced costs and benefits, but very important cost and benefit categories are indirect, both priced and non-priced. And there are also non-priced, direct costs and benefits. Decisions on priorities must be based on knowing all these components, not just on direct financial (priced) costs.

## 3 Affordable urban travel

The next step is to pull the composition of the travel market, the full economic cost structure and the existing economic reality of a city (its city product, affordability) together. This makes clear why good provisions for low cost modes of travel, of which pedestrian travel is a cornerstone, ought to be the first urban infrastructure priority in cities in Africa at this moment in time.

## 4 Recommended low cost mobility interventions

This examines in detail the question of what can best be done in practice with respect to urban travel infrastructure provision for pedestrians and two-wheelers, and improving the pedestrian/public transport interface. This section is the substantial contribution to the formation of practical ideas on low cost urban infrastructure and mobility needs.

## The urban travel market

Logically, the decisions on where to invest in the urban transport system should, to a large extent, depend on the relative importance of the different market segments in the urban travel market, in combination with the severity and urgency of the problems that each market segment faces. The most illuminating way to describe the urban travel market is to separate the

total number of daily trips, firstly, by mode of travel and, then, by trip distance. Table 1 shows an example of this mobility matrix for the Temeke sub-municipality of Dar es Salaam.

Looking at the data, we see that:

- The largest part of trips made by adults is on foot (47%);
- The almost equally large and second most important mode is public transport. In Dar es Salaam this is almost entirely by mini- or midibuses run by private operators (with bus licences, but in terms of business operation part of the informal sector). Note that all trips classified as bus trips include a pedestrian access and egress trip of an average length of 1–2 km and 0.5–1 km respectively;
- Private car traffic accounts for a low percentage of daily trips. (Note, the two other sub-municipalities of Dar es Salaam have more higher-income inhabitants. The modal share of cars is a bit higher there, around 10%, still unimportant relative to public transport and walking. In a 1994 household travel survey in Nairobi, overall modal share of private cars was also around 10%;
- The average number of trips made per adult per day is low. Going and coming back from one activity produces two trips. Thus, a trip rate of 1.9 means that the mobility of the average adult is low, with some not engaged in a single activity away from where they live during the day. Comparing this trip rate to the (in general) much higher rates in cities where the affordability of travel is not a problem, the conclusion can be drawn that in the case of Temeke there is a significant suppressed travel demand – people cannot afford to make trips because the money or time (to walk a long distance) is not available; and
- The large majority of all pedestrian trips are relatively short distance. This, *inter alia*, demonstrates the high percentage of economic and social activities carried out rather close to where one lives. A large part of these pedestrian trips are over informal and unpaved walking routes in



unplanned or semi-planned parts of the city, and often face significant accessibility problems, in particular during the rainy season. Strongly increasing the efficiency and speed of these pedestrian trips which take place within districts unrelated to the CBD would considerably enhance the economy of these districts. Locating residential, employment and market/shopping activities in a balanced way at relatively short distances from each other is an important economic policy

instrument.

Summing up, the data show the large size of the pedestrian traffic market segment and the public transport market segment, as well as the (compared to these) relative unimportance of the private car as a mode of daily urban travel. The different impression that someone might have of the relative size of the urban car market segment in a city such as Dar es Salaam, Nairobi, Harare, etc., namely that it is much



**Table 2. The mobility market in Amsterdam, 1993**

distance (km)			<2.5	2.5–5	5–7.5	>7.5	
mode	cost (US\$ cent/km)	speed (kmh)					Total
Walk	1.0	4.5	22%	2%	1%	0%	25%
Cycle	3.0	12.0	11%	7%	4%	1%	23%
Public Transport (Tram & Bus)	25.0	12.0	2%	3%	3%	8%	16%
Car	25.0	25.0	5%	6%	6%	18%	35%
Total			40%	18%	18%	27%	100%

Total trips per adult (≥15 years old): approximately 3.5/day  
Source: Ministry of Transport, Netherlands

higher than shown in the data above, results from not understanding three key facts:

- 1 the big difference in vehicle occupancy between a private car and a public transport vehicle (i.e. the distinction between number of vehicles and number of travellers);
- 2 the time of the day that the impression is based on (probably between 8.00 a.m. and noon), while a large part of long distance pedestrian trips take place between 6.00 a.m. and 8.00 a.m.; and
- 3 many pedestrian trips do not use the main arterial and collector road network, partly because other routes are more direct and partly because walking along these roads is in practice very difficult, dangerous and uncomfortable due to the lack of footways).

The only logical conclusion that can be drawn from seeing what the size of the different market segments is, is that pedestrian traffic is crucial to efficient mobility and must be provided for. This is most urgent because it has been neglected during recent decades.

#### *A comparison with the travel market segmentation in a European city*

To show that a high share of low cost modes of travel, and of pedestrian travel in particular, should not too quickly be interpreted as a sign of poverty or backwardness (as some might unconsciously do), the mobility matrix for Amsterdam is shown in Table 2. The share of pedestrian plus bicycle traffic in Amsterdam is just as high as it is in Dar es Salaam! However, in Amsterdam half of that is cycling, which in Dar es Salaam is almost absent (to a large extent because of the great risk of traffic accidents for cyclists in Dar es Salaam). On the other hand, public transport in Amsterdam is the least important mode, being much less important than the car. Also, take note of the column giving costs per passenger km of each mode: in Dar es Salaam, public transport is a low cost mode (8x cheaper

than the car), in Amsterdam it is high cost (same cost as the car)!

#### **Travel cost and benefit structure**

Table 3 categorises the different cost elements that play a role in the analysis of costs and benefits of infrastructure investment. A Cost-Benefit Analysis is usually carried out for large urban infrastructure projects. In general for smaller projects such analysis is not done, yet an understanding of the different cost components is vital to making the right decisions.

#### *Direct priced effects*

Direct priced effects are straightforward: for example a reduction in vehicle operating cost as a result of improved traffic, or a reduction in accident damage to vehicles. Benefits related to reduced congestion as a result of road infrastructure investment (such as intersection reconstruction) are partly a direct benefit (as a cost reduction; reduced vehicle operating costs, public transport vehicle utilisation increase) and partly a direct non-priced effect (reduction in travel time costs).

#### *Direct non-priced effects*

Non-priced effects are those for which there is no financial market. One cannot buy back the life of someone killed in an accident, or purchase a certain

**Table 3. Categories & examples of Cost Benefit Analysis**

		Examples
Categories	Priced	Non-Priced
Direct	bus fare	travel time
	vehicle operating cost	accident cost
	road construction costs	air pollution, noise
Indirect	increased land value	congestion

Note: Table 3 does not provide a complete list of all direct, indirect, priced & non-priced effects (costs & benefits) of urban infrastructure investment & maintenance. This is quite deliberate: it is a rewarding learning & awareness raising experience to make such a list oneself, & discuss its correctness with colleagues. The reader is invited to do so, taking one particular example, e.g. the construction of bus bays/passenger platforms along a bus route.



quantity of noise or air pollution. There is also no market for buying or selling travel time. Part of the non-priced costs are costs that are incurred immediately, such as noise, others will only be paid for later, such as the effects of loss of tree cover along city roads. In many cases the direct non-priced effects are significantly larger than the direct priced effects, so it is important to consider all of them carefully and estimate their value.

#### *Indirect non-priced effects*

Apart from direct non-priced effects, there are also indirect non-priced effects. Health problems induced by exposure to pollution over a period of time are good examples. Congestion is another example: increases or decreases in congestion can occur as an indirect effect, such as improved public transport performance which leads to a modal shift from car to bus traffic, thus reducing the number of vehicles on the road and hence the congestion. Another example would be bicycle facilities leading to a decrease in motor vehicle trips – a lot of investment in bicycle facilities in Amsterdam was made because of its modal split effect, thus saving on road infrastructure provision for cars, reducing car vehicle operating costs and other non-priced negative effects of car traffic (such as air pollution).

Another example of congestion as an indirect effect is the impact of new urban highways on land use; usually they stimulate more separation between activity locations and thus increase trip distances, which in turn, over time, creates an increase in congestion – both priced (e.g. increased fuel consumption per vehicle km) and non-priced (time losses) effects.

#### *Indirect priced effects*

A very important indirect effect of road infrastructure is its effect on land value. This is a priced indirect effect: there is a market for urban land. Good accessibility increases land value. This is in fact the bottom line of what urban transport infrastructure is for: creating access. It is interesting to note that in most cities with a good and complete urban transport infrastructure, its construction was historically linked to, and directly or indirectly financed from, the increase in land value created during the urban land development process, i.e. the increase in value directly accrued to the municipality where it acted as the land developer, or indirectly as a tax on real estate development profits and property tax. The absence of such financing mechanisms is an important reason why cities in Africa have failed to construct the urban infrastructure that they require.

#### *Economic costs*

One aspect of cost-benefit assessment has not yet been mentioned; this is the distinction between

financial costs and economic costs. An explanation of the difference between the two, and of the importance to base public governance decisions on economic costs, can be found in transport economic textbooks (e.g. Adler, 1987).

The factors to take into account in the calculation of economic costs are (broadly):

- 1 the shadow rate of foreign currency (in a country where foreign currency is scarce, it has a shadow price that is higher than that reflected in the official exchange rate);
- 2 the shadow rate of unskilled labour and abundant local materials; and
- 3 the elimination of all transfer payments in the national economy (taxes and subsidies).

The effect of making decisions based on economic costs and benefits is that investment, which is in the local currency and/or is labour intensive, becomes cheaper (so has a higher chance of being preferred), and the weight of benefits in a foreign currency becomes higher. In practice this concerns transport investment benefits that consist of saving on transport cost in foreign currency, such as a modal shift from private cars to public transport, or from public transport to cycling).

#### **Affordable urban travel**

##### *Developing cities need low cost mobility because:*

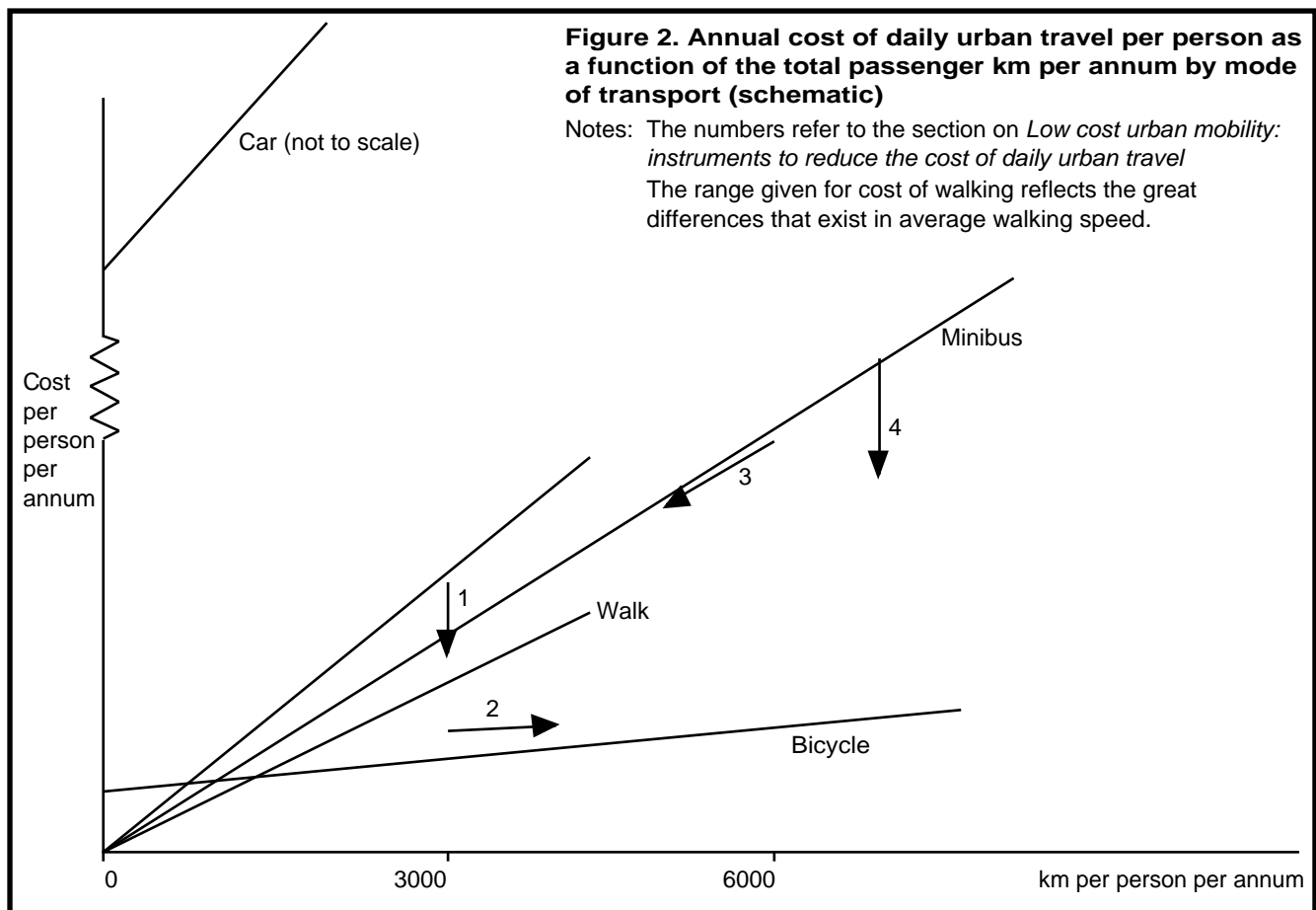
- Mobility and accessibility are required for economic and social well-being, i.e. for healthy growth of the city;
- City income is low and household income of inhabitants is low; and therefore
- low cost mobility is needed – with low direct, indirect, priced and non-priced costs.

##### *Understanding and accepting the economic reality...*

##### *What to do in practice?*

With severe mobility problems, high non-priced costs of transport and incessant, induced costs from lack of mobility, most inhabitants have little money to spend on travel and the municipal government has little money to invest in infrastructure. Practical solutions, accordingly, are vital:

- Identify areas with a high improvement potential (waste no time on problems one cannot tackle successfully);
- Look for actions that directly benefit most inhabitants;
- Look for 'no-regrets' interventions (tested, fitting in a low cost environment, strong, simple, robust, uniform);
- Look for actions that have a clearly visible impact, that most people recognise as positive, that have a



positive psychological effect; and

- Implement a package of interventions that is large enough to be very visible and to have a tangible impact ('no drops in the ocean').

*Low cost urban mobility policy options are:*

- Best possible use of low cost and environmentally friendly modes of travel;
- Control of the growth of trip distances; and
- Reduction of the negative impact per vehicle-km of private transport (accidents, pollution, noise).

*Rationale for an action programme for the first policy above, and in particular to enhance pedestrian and (where relevant) bicycle traffic:*

- Large improvement potential, usually overlooked;
- Proven effective intervention menus exist;
- Integrates well with agenda on good governance: safety, health, slum upgrading, job creation, tree cover;
- Directly benefits the worst-off market segments;
- Not technically difficult (but requires specialist expertise); and
- Not financially too demanding (step-wise implementation in manageable steps).

*Low cost urban mobility: instruments to reduce the cost of daily urban travel (see Figure 2):*

1. Increase the efficiency of walking (higher walking speed due to better pavements and less obstructions, shorter direct walking routes);
2. Increase the urban road domain on which cycling is safe. This triggers more cyclists, and allows cyclists to make more and longer trips;
3. Reduce the average trip distance (by stimulating economic activity beyond the CBD, *inter alia*, through good internal accessibility in these districts); and
4. Increase the operational efficiency/reduce fares of low cost public transport (*inter alia* by providing an efficient pedestrian/public transport interface, reducing profit margins necessitated by price competition from the alternative low cost modes of travel (walking and cycling), and fostering price competition in the informal public transport sector).



**Figure 3. A raised zebra crossing in Temeke. Note the triangular bollards designed to prevent vehicle infringement into pedestrian space.**

### **Recommended low cost mobility interventions**

A tested intervention menu for

- Traffic calming,
- Improved pedestrian/public transport interface, and
- Pedestrian infrastructure.

### **Introduction**

At the moment of deciding on the actual priorities in carrying out infrastructure works, it is important to be sufficiently sure of the impacts that a particular type of infrastructure will have in relation to the existing travel market, traffic behaviour and vehicle fleet composition in the place where it is built. Knowledge of these impacts can only be obtained properly by careful analysis of the current performance of the infrastructure in the place concerned (or in other cities with a highly comparable economic and travel situation) and, in particular, by analysing the immediate effects and the long-term effects of earlier infrastructure interventions.

In the areas of pedestrian infrastructure, cycling, traffic calming, and the interface between pedestrians and public transport, a significant body of knowledge has been built up with the support of the SSATP over the last decade (see, for example, de Langen & Tembele, 2001). In addition to earlier monitoring and

evaluation, a long-term impact evaluation has been carried out of a large number of the interventions tested in the SSATP (de Langen, 2003). The findings of this evaluation can be used to formulate a clear list of 'no regrets' interventions which can be implemented with confidence. The planning and design details of these interventions are not dealt with here, but can be found in de Langen & Tembele (2001).

Most interventions discussed below are 4–7 years old now, so their lasting impact on traffic and their maintenance requirements (total life cycle costs) can now be judged properly. Therefore, conclusions can be drawn with more certainty than was possible on the basis of earlier evaluations that were carried out immediately after implementation of the tests (see Kisisa, Rwebangira & de Langen, 1998; Kisisa, Sambali, Zuidgeest & de Langen, 1998). Some interventions reported on here have not been presented previously. This concerns roads rehabilitated in Morogoro (200 km west of Dar es Salaam) in 2000/01 under the Tanzanian Urban Sector Rehabilitation Project. Design recommendations for these roads were given in 1999 by the team that implemented the other SSATP test interventions.

The evaluation findings underline the importance of researching the impacts of different types of road and

traffic facility design on urban traffic in Africa. The choice of designs is crucial as these have great impact on the performance of the traffic system. Proper design choices are a powerful instrument to improve urban traffic performance and mobility in Africa to the benefit of the large majority of its inhabitants who are captive pedestrians, public transport or private two-wheeler users.

### *Summary of findings*

#### Raised Zebra Crossings

So-called Raised Zebra Crossings give very good value for money as a traffic calming measure. They create a strong safety improvement for pedestrians (safer crossing in particular), two-wheelers (safer driving on the carriageway), and motor vehicles (fewer collisions), and positively influence traffic by reducing large speed differences between vehicles. In that manner they increase road capacity. In addition, Raised Zebra Crossings influence the stopping-for-passengers behaviour of informal public transport vehicles in a way that can be utilised to significantly reduce the delays caused by this behaviour (see below under bus bays).

The strong reduction in traffic accidents arising from Raised Zebra Crossings, observed immediately after their construction, is a permanent feature (Kisisa, 1998; de Langen & Tembele, 2001; de Langen, 2003). Accident reduction does not gradually fade away as people get fully used to the new conditions. This is a very important outcome.

At many locations, having a pedestrian crossing on top is not important as the Raised Zebra Crossing function is purely vehicle speed control. Speed reduction always occurs at Raised Zebra Crossings (they function as 'Sleeping Policemen'). It is not possible for drivers to ignore one unlike, e.g. the carriageway deflection past a traffic island (for which some drivers 'compensate' by driving dangerously), or traffic lights, speed limits, or painted-only pedestrian crossings.

Where pedestrian crossing is a vital aspect, the Raised Zebra Crossing should preferably be 5–6 m wide, well connected to walkways, bus bays and footpaths leading to the crossing point, and clearly visible as a crossing point.

Although effectively creating safe crossing points, the general impact of the systematic application of Raised Zebra Crossings along the entire road length is that the traffic becomes significantly safer, and that many pedestrians cross safely elsewhere, often in the vicinity of a Raised Zebra Crossing. This pedestrian crossing pattern observed in 2003 is identical to what was observed immediately after project implementation in 1997. Apparently the pattern is

stable; no gradual concentration of pedestrian flows to Raised Zebra Crossing locations takes place. It should be noted that such a more dispersed pedestrian crossing behaviour reduces delays that motor vehicles experience from crossing pedestrians.

It is very important that where a Raised Zebra Crossing is constructed storm water drainage is good. No water should be able to accumulate on the pavement in front of, and behind, the Raised Zebra Crossing or on the road shoulder next to it. Where this happens the road base will weaken and pavement damage will occur. The Raised Zebra Crossing has the potential to impede storm water run-off and with vertical pressures on the pavement in front of the Raised Zebra Crossing being higher than elsewhere (due to vehicles humping up or down), so road base strength (compaction) at the Raised Zebra Crossing spot is of critical importance. At some test intervention spots storm water drainage was insufficient and this triggered pavement damage.

Assuming proper storm water drainage, road base compaction/strength and concrete quality, the technical life of a Raised Zebra Crossing with precast concrete sloping blocks and brick pavement on the raised part is estimated at 25 to 30 years. On average, periodic maintenance (relaying brickwork) will be required every 8 years. The lifetime of Raised Zebra Crossings is significantly higher than the 10 years assumed when the interventions were first designed. This means that the benefit-to-cost ratio of Raised Zebra Crossing investments is higher than the 1.75 calculated earlier (de Langen, 2001).

In Dar es Salaam, the effectiveness of the Raised Zebra Crossing and its value-for-money has been generally recognised by the market. Many applications can be seen on new and rehabilitated roads. This is an extra reason for the municipal government to lay down precise detailed design guidelines for Raised Zebra Crossings.

The vehicle speed reduction achieved by a Raised Zebra Crossing depends on its slope and height (although height is a less critical factor; 10–12 cm being enough if a straight slope is used). Therefore, the desired speed reduction can be obtained permanently by carefully selecting the slope of the concrete sloping block. The shape of the transition between the flat top and the slope is of considerable influence on the speed reduction impact. A design with concrete sloping blocks, a straight slope without asphalt overlay, a brick pavement on the raised section and a non-rounded transition between the slope and the brick section reduces speed considerably more than a Raised Zebra Crossing design with sine curve slopes, as often used in Europe.





Figure 4. A bus bay in Temeke

Slope/height specifications for different road types and speed reduction targets are to be worked out in detail. Some additional research is required for this. The current best estimate for African traffic and vehicle fleet conditions is that, with a straight slope design, a slope of 1:8 reduces the speed to around 10–15 kmh, a slope of 1:10 to 20–25 kmh, and a slope of 1:12 to 30–40 kmh (de Langen & Tembele 2001).

The widespread application of Raised Zebra Crossings should be enhanced, and they should be included as a standard elements in urban road design standards prescribed by the municipal government.

#### Asphalt concrete speed humps compared to Raised Zebra Crossings<sup>1</sup>

The main purpose of testing the conventional speed humps side by side with Raised Zebra Crossings in the SSATP pilot project was to compare their performance. In 2003, the humps constructed in Temeke continued to slow down the traffic as intended. However, their pavement had deteriorated significantly (deformation of the hump itself) in the 5 year period since they were constructed, and the surrounding carriageway pavement shows more potholes than in the case of Raised Zebra Crossings. Over time, the Raised Zebra Crossings perform significantly better than the humps.

The conclusion is that Raised Zebra Crossings are

superior to asphalt concrete speed humps as a traffic calming facility:

- Lower Raised Zebra Crossing life-cycle cost. Although its initial construction is cheaper (60% – 70% of Raised Zebra Crossing costs), the asphalt hump has much higher maintenance/rehabilitation costs, and creates a much higher risk of pavement damage near the hump in the event of insufficient drainage or road base compaction (due to the higher vertical forces it generates);
- Raised Zebra Crossings are considerably more comfortable for vehicles (compared to asphalt humps that create the same speed reduction effect); and
- Raised Zebra Crossings are dimensionally stable, their impact is constant over time. Asphalt concrete humps deform gradually and thus become less effective.

Recent evaluation of the impact of speed humps in Nairobi is worth mentioning here (Mburu, 2002); three humps were constructed on Nile Road in 1996 as a traffic calming measure, as part of the SSATP tests. Their positive effect on traffic safety was such that residents along nearby roads urged Nairobi City Council to construct more humps, which it did in 1998–99. Analysis of traffic accident data for the roads concerned shows that, as in the case of Raised Zebra Crossings, provision of humps on a road section significantly reduces the number of accidents. It also shows that where the distance between two humps is large (in this case around 600 m) the accident risk remains high in the middle of that section. This

<sup>1</sup> Asphalt concrete is commonly used in Kenya and Tanzania (and in Europe) as a pavement mix. In addition to bitumen and gravel of varying size it contains some cement. The stiffness of the mix can be adjusted by varying the percentages of the ingredients used; for humps a stiff mixture is used to minimise deformation.



**Figure 5. Triangular concrete bollards encourage vehicles to remain on the highway**

underlines the need to choose carefully the locations for humps/Raised Zebra Crossings in relation to important pedestrian routes, bus stops, road corners, intersections and nearby humps.

Bus bays, passenger platforms & Raised Zebra Crossings constructed in combination

The 2003 evaluation reconfirms the effects that were found immediately after construction (Rwebangira 1998) of well designed bus bay/Raised Zebra Crossing combinations. The bays have established themselves as the only relevant points to collect or drop passengers along the road section concerned. Some bays turn out to be slightly too small in the peak hour, which resulted in some pavement/road shoulder damage at their exit.

The strength of the bus bay design that was adopted, with a brick pavement in the bay, and heavy kerbs and slab pavement on the passenger platform, is found to be very satisfactory. No maintenance (apart from regular cleaning) has been carried out yet (after 4-6 years) and, for the bay pavement, will probably not be needed for the next 3 years (i.e. first relaying of the bricks after about 8 years). A significant advantage of the brick pavement in the bus bays is that it is not affected by oil leakage from the buses, unlike asphalt concrete, which quickly gets soft and then damaged as

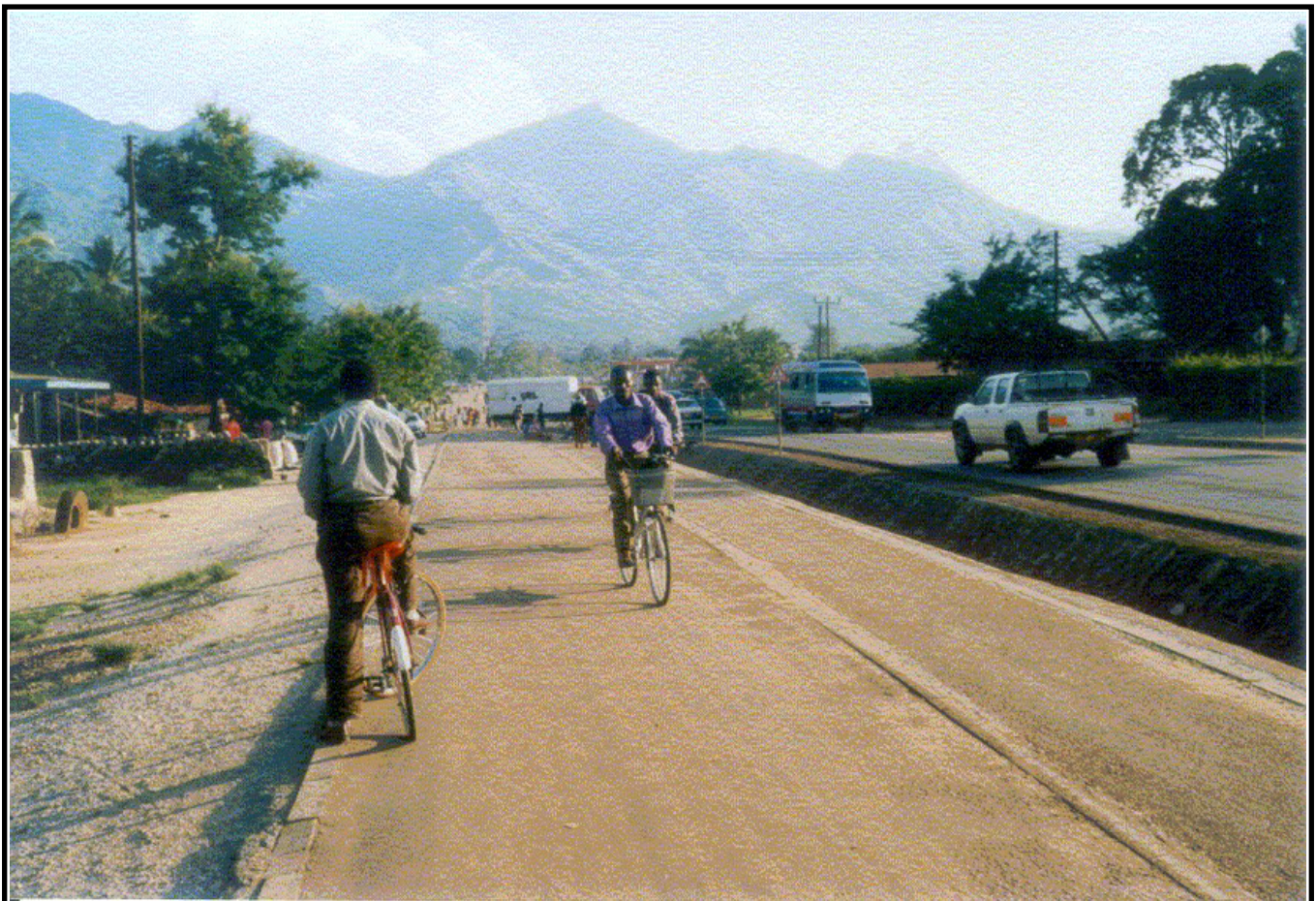
a result of leaking oil.

The conclusion is that bays for minibuses give high value for money, once the following requirements are met:

- proper size (large) and frequency along the bus route;
- in combination with paved passenger platform;
- location at points that logically connect with walking routes;
- in combination with Raised Zebra Crossings for low motor vehicle speed near the stop, thus providing a safe pedestrian crossing; and
- in combination with a road design that prohibits stopping on road shoulders outside bus bays.

Bays combined with these other measures reduce traffic delays (both for mini buses and general traffic) and reduce traffic accident risks, previously caused by random stops of buses on or half-on the carriageway. Well constructed bays also increase the economic attractiveness of their location (visible from increased kiosk and street trading density). In co-operation with the (mini-)bus operators, one should try to exploit the potential of this road design approach to encourage the sector to improve its operational efficiency.





**Figure 6. An open drain segregates road users & encourages good road sense on Morogoro main road**

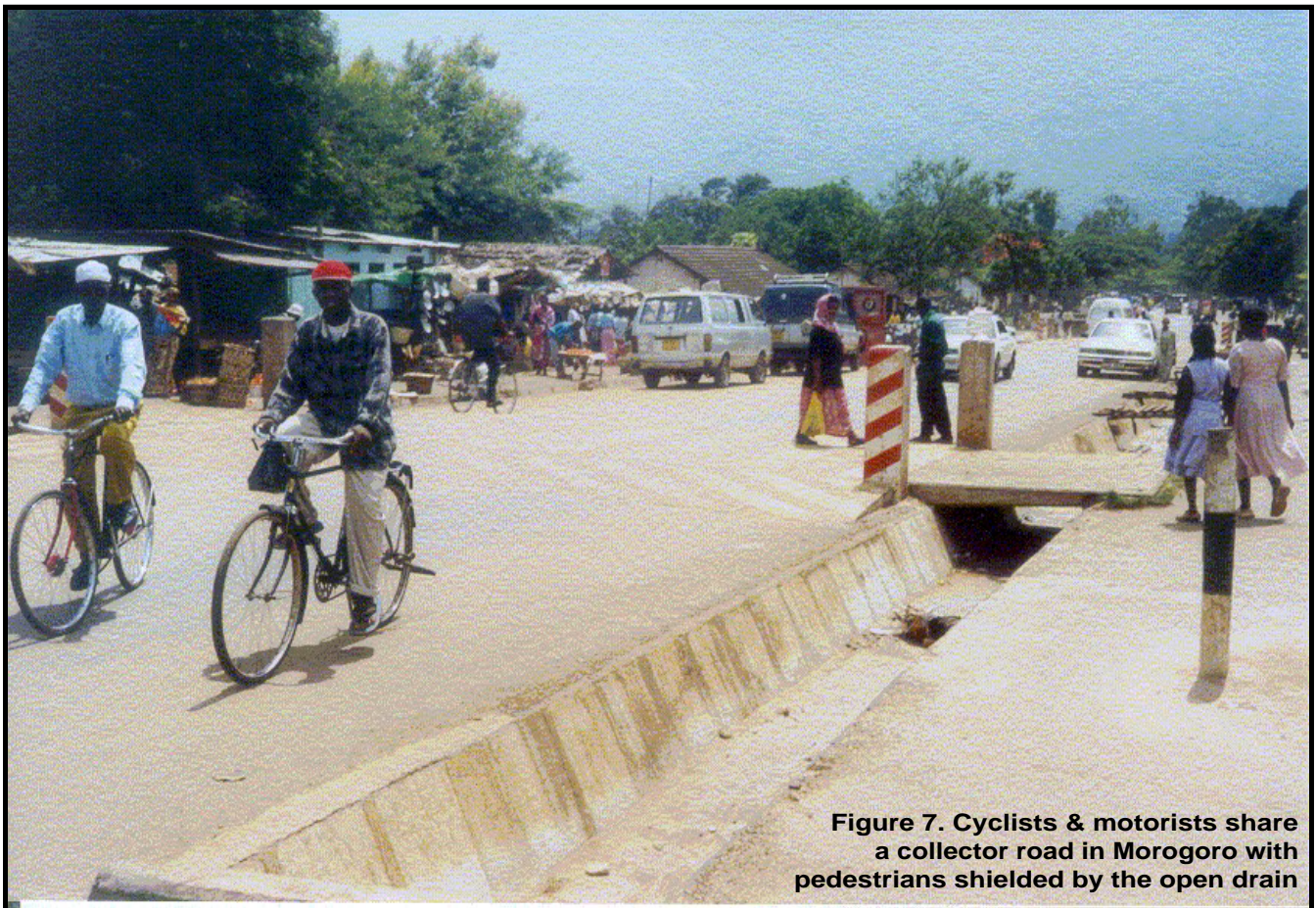
Carriageway/road-shoulder separation to assure space for, and safety of, pedestrians

Systematic use of road design features and road furniture to separate the carriageway from the pedestrian road-reserve area (whether constructed as a walkway or not) is effective; where road shoulders are allocated to pedestrian traffic and protected against use by vehicles this significantly enhances the safety and efficiency of walking. The main segregation options are road furniture such as low triangular concrete blocks and bollards, or open drains.

**T-blocks, bollards** Looking at carriageway/shoulder separations by means of concrete blocks or bollards 4–6 years after their construction, it is instantly apparent that this type of traffic calming measure requires careful and regular maintenance. The amount of damaged, uprooted and knocked-off parts of the concrete, is considerable. Depending on the location, over half of all elements are damaged. Even though in most cases it does not make them ineffective as a barrier, the damage has a negative effect by creating a run-down image and stimulating careless behaviour. The main cause of damage is a vehicle that hits a blocks or bollard. Hitting with a tyre usually only results in a block being pushed out

of position (particularly by heavy vehicles). Notching off concrete suggests contact between the block or bollard and the body of the vehicle. The number of drivers that do not manage to keep their vehicle on the carriageway appears to be alarmingly high. It is interesting to investigate the actual frequency. Seeing that so many 'hits' take place, how should we react? While it is natural to feel sorry for drivers who damage their cars, one cannot avoid thinking about what would have happened if the block or bollard had not been there. Would the driver have ended up against one of the trees, or a pedestrian, or a street vendor, or a parked vehicle? Such a collision would have been much more harmful. If only 10% of the damage to the road furniture signals such prevented mishaps, then the road furniture is even better value for money than initially thought. If indeed the damage to the blocks mainly relates to incompetent driving or non-roadworthy vehicles (drink driving, driving at night without proper lights, brake failure, etc.), the conclusion has to be that the blocks and bollards serve a very useful sleeping policeman purpose, and contribute positively to the enforcement of proper driving behaviour.





**Figure 7. Cyclists & motorists share a collector road in Morogoro with pedestrians shielded by the open drain**

On many places along urban roads, containing the motor vehicles on the carriageway by means of road furniture contributes significantly to traffic efficiency, both vehicular and pedestrian.

However, the highly recommendable systematic use of this traffic calming instrument must be accompanied by equally systematic maintenance. Such maintenance mainly involves labour. It does not cost much, but requires good organisation.

**Open drains** Open road-drains were found to function very well as separators. Moreover, they seem to convince drivers that it is better to reduce speed, probably in view of the unpleasant and expensive consequences of driving into a drain. Observation of traffic behaviour on a completely reconstructed road in Morogoro, designed with a 4.5 m wide carriageway each way and the outer 1.5 m a (painted separation only) bicycle lane, plus walkways on both sides behind open drains, indicates that this design increases the efficiency of traffic. There are fewer pedestrians on the carriageway, hardly any traffic conflicts between cyclists (of which there are many in Morogoro) and motor vehicles, and less disturbance by wrongly parked vehicles). It should be noted that the traffic safety on this road was assured by the construction

of Raised Zebra Crossings at regular intervals (300 m – 400 m). Without these, some of the vehicles would drive at a much too high speed and create a considerable accident risk.

#### Pedestrian crossing islands

Given the prevailing driver behaviour, a small pedestrian refuge island is ineffective as a means to simultaneously facilitate pedestrian crossing and achieve a significant 'no-discomfort' traffic calming (in particular vehicle speed reduction) effect. The test was carried out in Dar es Salaam, but there is no reason to assume a different outcome in other African cities. Considering all effects, the conclusion has to be that short mid-block pedestrian crossing islands must be advised against in African cities.

These small traffic islands turn out to have a number of undesirable effects:

- The reduction in vehicle speed that is achieved reduces over time because some drivers learn and like to drive fast past the island;
- The shortness of the islands (12 m), good visibility of the on-coming traffic and a lack of respect for traffic rules tempt some drivers to use the opposing lane to overtake, dangerously; and
- The problem of incompetent drivers is unnecessarily





**Figure 8. An tree-lined open drain segregates motorists and pedestrians along the route to Temeke market.**

aggravated by this type of island.

The conclusion about small mid-block pedestrian crossing islands should not be generalised to all forms of traffic island. The following other applications remain worth considering.

- Traffic island in the single-leg of a T-junction;
- Traffic islands at an intersection;
- A large mid-block crossing island where a high-volume non-motorised transport route crosses a high volume road; and
- A long median in a single carriageway urban road which has the traffic calming effect of eliminating overtaking (tested in Eldoret, Kenya).

#### Junction reshaping

Conversion of Y-shaped junctions to rectangular, and reduction of road corner radius are an effective 'no discomfort' instrument to reduce the speed of motor vehicles that turn into the street concerned. Such a change in road shape works immediately (as shown during the monitoring in 1998/99), and its effect remains the same over time, as is clear now. Drivers do not gradually increase speed or develop other dangerous type of behaviour once they get fully used to the new shape (unlike in the case of short traffic islands).

#### Carriageway width

The use of 3.0 m wide carriageway lanes was tested in Morogoro, on the main (single carriageway) arterial road connecting the city centre to the Tanzam (Tanzania-to-Zambia) highway, which was redesigned and rehabilitated in 2000/01. Access to the main carriageway is limited to motor vehicles only. The design has open drains, with a 0.5 m shoulder between the carriageway and the edge of the drain. Bicycles and pedestrians are provided with separate tracks of their own on one side of the road, behind the drain. The road is in use for two years now, and functions very well. The design is significantly narrower than is now common in Tanzania for such roads (usually 3.5 m lanes and a 1.0 m shoulder). It was looked at from several sides with suspicion. In practice, the narrow carriageway encourages safer and slower driving, convincingly shows the driver that they are in an urban area now and must adapt their speed. The nearness of the open drain significantly contributes to the effect.

The narrow width equally appears to discourage cyclists from using the carriageway meant exclusively for motorised traffic (cars, buses, trucks, motorcycles) and encourages them to use the cycle track provided, even though it is only on one side of the road. A more

detailed monitoring of traffic behaviour on this road is desirable before generalising the findings to other situations. However, the indication given by the current brief evaluation of this road design is quite relevant, not least because of its impact on construction costs. The cost saving achieved by using a narrower carriageway was large enough to pay for the separate bicycle and walkway facilities.

#### Pedestrian domain/infrastructure: Parks in low income areas

The long term impact of reclaiming the Mwembe Ladu open space in Temeke to a pedestrianised park and recreational area, combined with direct pedestrian routes across it, has been successful beyond expectation.

Temeke is a planned district of Dar es Salaam, first constructed in the 1960s. Mwembe Ladu was left open as a recreation/sports ground in the centre of the district. By the mid-1990s, the area had lost almost all its trees and was used as a dumping ground and overnight lorry park. Blocking vehicle access and bringing back the trees lining the pedestrian routes (and protecting them) was the key to the success. This intervention has strongly upgraded the whole surrounding Temeke area. To a smaller extent the same applies to the tree-lined pedestrian routes that were established towards a newly constructed central market in the district (Stereo market).

The reason for documenting this finding here is to underline how very helpful it is to enlarge the domain in which we search for ways to improve pedestrian mobility in a city beyond the strict boundaries of the urban road network as registered by the ministries of works or the municipal engineering and planning departments (or – even worse – the carriageway of the main arterial and collector road network). A large part of pedestrian travel in a city is walked along tracks outside the official road reserve domain. With ongoing and increasing urban density, these ‘as the crow flies’ routes, if ignored, will disappear, thus inhibiting pedestrian journeys further. Accordingly, ignoring these routes will force pedestrians to take more circuitous detours with longer distances between the same origin and destination.

Additionally, in order to create an atmosphere in which large numbers of people are instilled with optimism that positive development indeed takes place (a feeling that positive development is possible at the place where they are, and that it is a suitable location in which they can invest their money and energy, makes people actually do that), one needs highly visible icons. Even when dealing with mobility issues, these icons do not necessarily have to be smooth new road pavements. Experience in Temeke shows that the psychological impact of the intervention described

here (developing the Mwembe Ladu park as a pedestrian domain, and of pedestrian routes lined with trees, which gives them a high-quality appearance) was far greater than that of any of the other interventions tested, and at the same time greatly contributed to the credibility of the municipal government in its task of (with integrity) caring for the mobility problems and interests of the average low-income Temeke inhabitant.

#### Improvement of arterial non-motorised transport-only routes (core network of pedestrian routes)

A big improvement of existing informal non-motorised transport routes was achieved by constructing missing network links in impassable places (*inter alia* non-motorised transport bridges over small rivers). There was an immediate increase in utilisation of the routes (tested in Temeke and Eldoret (Kenya)). Furthermore, travel time was reduced and user comfort increased. This was already clear from the monitoring in 1998/99. It is a lasting effect, as current utilisation of the route in Temeke shows.

The concept of community maintenance of such routes after initial construction by the municipality (in Temeke) turned out to be a failure, despite considerable efforts made at the time to encourage user participation in the process. In retrospect, the idea is not realistic; the diversity of users is too great, as are their social networks. Hence, a logical community organisation or non-government (‘private’) leadership that has the willingness, the authority (including that of raising money and work from its members) and the capability to take care of the maintenance of this type of multi-user free-of-charge public infrastructure does not exist. Looking back, the idea that the ‘ownership concept’ could work for this type of facility was wishful thinking. Typically, this type of provision illustrates why a local government is necessary, that is in a fair way responsive to the needs of all its inhabitants irrespective of their lobbying power. This responsibility cannot be waived by blaming the users for non-commitment.

The conclusions that can be drawn from testing new improved and independent pedestrian routes, unrelated to the motor vehicle network, are:

- these routes have a very important function in providing efficient direct pedestrian routes and thereby efficient pedestrian travel in the city;
- the choice of permanent track alignments and the initial upgrading of such routes must be carried out in close co-operation with the local community;
- the land reserves for these routes must be officially established – and if necessary enforced – by the municipality; and

- to assure permanent proper functioning of the routes, the municipality must take care of all necessary maintenance/cleaning. This does not require a large budget, being in the first place a matter of organisation, and partly the responsibility of the solid waste collection department.

#### *Implications for urban road design choices & priorities in Africa*

Evaluation of the long-term impacts of a range of studies of traffic calming facilities and road designs yields interesting findings. The most important one is that a few straight-forward traffic calming instruments exist that perform excellently in African traffic conditions, continue to work well in the long run, and have a high benefit-to-cost ratio.

From a comparison of different options it becomes clear the most elementary and robust ones are the most successful, and that large scale improvement is a matter of large scale application of elementary traffic calming devices, not of creating complex solutions.

*Firstly*, the key to improved urban traffic and mobility in an African city is to calm down its traffic, i.e. to make it impossible to drive in the city at a speed of above around 50 kmh. This can best be achieved by constructing short raised road sections which penalise drivers decisively for trying to exceed this speed. Raised pedestrian crossing sections have been tested and work well, raised intersection platforms with similar slope designs will probably also work well. This measure reduces traffic accident hazards dramatically, as it reduces the severity of the remaining accidents. As a side effect, two-wheeler traffic becomes safe enough again to be utilised by those for whom it is the economically most attractive option.

This may look like a draconian prescription to someone used to thinking in terms of North American and European urban freeway networks as the solution to urban mobility problems in Africa. However, the following points should be taken into consideration:

- i) the recommendation formulated above concerns the priority at this point in time and, accepting economic reality, for the next decade; and
- ii) one should bear in mind the great success of traffic calming policies throughout northwest Europe (Britain, Germany, Scandinavia, Holland, parts of France) in completely reshaping traffic conditions, efficiency and safety in urban centres and in residential areas.

The budgets available in Europe and the traffic composition (*inter alia* level of private car ownership), of course, cannot be compared with the prevailing conditions in African cities at this

moment, but basic principles of safety and efficiency can be compared.

*Secondly*, accept that pedestrian traffic has an overwhelming presence and great economic and social importance in all cities in Africa – and provide for it. Separation of pedestrians from vehicles on the carriageway is very cost-effective. Safety and efficiency of both vehicle traffic and pedestrian traffic increase considerably. Ignoring or wishing away the pedestrians has never produced good results.

*Thirdly*, create an efficient interface between public transport and pedestrian access and egress journeys, accepting the market position and proven effectiveness of informal public transport while, at the same time, reducing the loss of traffic efficiency caused by some of its operating practices.

The most important unanswered question with respect to the traffic calming policies outlined above is: how to shape them for the main arterial roads? A discussion of that question, unfortunately, is outside the scope of this paper, and demands examination beyond the scope of this paper.

#### **The mainstream road infrastructure works agenda**

Based on the travel market analysis and the intervention evaluation findings presented above, the following conclusions are proposed for discussion.

The most relevant and cost-effective priorities for mainstream investment in urban road infrastructure in the average African city, at this point in time, are:

- Road pavement maintenance;
- Systematic traffic calming by means of raised road portions (Raised Zebra Crossings, raised intersection platforms);
- Systematic provision of good public transport bays/stations with good pedestrian access and waiting provisions;
- Provision of a good core network of pedestrian walkways and access tracks;
- Building new access roads and tracks in non-served urban expansion areas (in most cities land and budget availability will dictate a large portion of this access infrastructure to be non-motorised transport tracks built in combination with area drainage and water supply); and
- Creating sufficient capacity on the main arterial roads (in most cities land and budget availability will dictate a form of demand management here, in particular through providing priority lanes for public transport vehicles that minimise congestion delays experienced by public transport).

Implementing the agenda outlined above is a task demanding all resources that are available for public



investment in urban transport system infrastructure; adding more is counter-productive.

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