Reinventing the Bicycle Wheel

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Abstract: *Education in transport engineering traditionally has been forced to fit within the field of civil engineering. However, it has been an uncomfortable fit, as transportation affects a wide spectrum of fields of knowledge, not only different sub-fields of engineering but also the sciences, planning and design and the environment. More recently, links with health and social sciences have been recognised, as documented by the World Health Organisation and in the proceedings of the NSW Childhood Obesity Summit.*

As a result, there has been a paradigm shift in the planning and design of bicycle facilities, with significant increases in State and Local Government funding and a strong focus on the provision of high quality off-road transportation facilities. In NSW alone, the State Government has published a bicycle master plan (Bike Plan 2010) that involves the expenditure of $250 Million over 10 years across NSW. In addition, the NSW State Government is committed to build off-road cycleways when new roads are built, such as a 40km off-road cycleway adjacent to the Western Sydney Orbital.

The paradigm shift has created a void in transport engineering knowledge. There is a strong need to reinvent the bicycle wheel and plug the hole.

This paper provides an overview of the recent changes from a consulting engineer's perspective, using the bicycle wheel as an image to drive the curriculum beyond the traditional civil engineering focus. The planning and design of bicycle facilities necessitates an understanding of associated health, social and environmental issues. There are strong links with urban planning, design and (landscape) architecture. There is a need to provide all-inclusive design responses to address multiple problems in a complex social and natural environment.

Keywords: *sustainable, bicycle, transport*

Background

Typically, a professional field is described as a slice of cake and each profession provides its own distinct contribution. Traffic engineering has traditionally fitted within the slice of civil engineering with strong connections to road building. As the profession matured, more emphasis was placed on the infrastructure planning aspects, the relationships between roads and the surrounding buildings and the transport impacts on the environment (Figure 1).

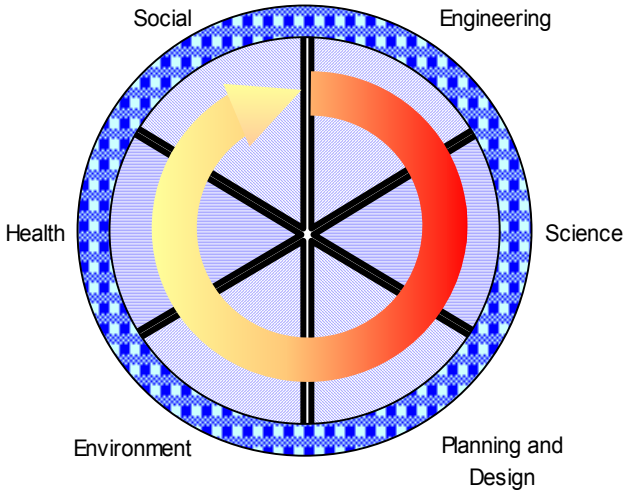

Figure 1: The bicycle wheel - individual segments have formed a whole

Despite the maturing of the profession generally, designing for the bicycle has changed little. The focus of the engineering profession remained on large infrastructure development, with only small contributions to bicycle infrastructure (Dorrestyn, 2003). For example, in many Council areas the implementation of bike plans consists of signposting a few selected bicycle routes with low traffic volumes and modest gradients, while there is limited construction of new pathways.

In future, however, there is a need for engineering design to incorporate the health and environmental benefits of cycling (and walking). Australian health authorities now recognise our sedentary lifestyle and our reliance on motorised travel as major ongoing public health issues (Sallis, Bauman, Pratt, 1998).

Similarly, social and environmental planners recognise that active transport (such as cycling and walking) is a key contributor to developing sustainable and socially harmonious communities. The engineering profession needs to be equally responsive to these social changes.

Of particular relevance in this context are the 2002 NSW Obesity Summit and the 1999 WHO Charter on Transport, Environment and Health and the findings are discussed in the following two sections of this paper.

Obesity Summit

In August 2002, the NSW Premier called for a summit on childhood obesity to address increasing concerns from the medical profession. This section is an extract of the proceedings which is largely based on the background paper to the conference (NSW Childhood Obesity Secretariat, 2002) and Booth (2002).

The level of overweight and obesity in Australia has risen at an alarming rate in the last 20 years. In 1980 when the National Heart Foundation conducted the first large national survey of Cardiovascular Disease (CVD) risk factors they found that 48% of men and 27% of women aged 25-64 years and living in capital cities were overweight.

In the 2000 AusDiab study, the rates of overweight for the same population segment were 65% amongst men and 45% among women. Obesity rates rose from 7.2% in men in 1980 to 17.1% in 2000. For women the rise has been even greater, moving from 7.0% in 1980 to 18.9% in 2000.

More alarming is that the greatest proportionate rise in rates of obesity has occurred in the youngest age groups. Figure 3 shows that the level of obesity in the 25-34 year old age group more than doubled in men in the last 20 years whilst in women it quadrupled in the same age group.

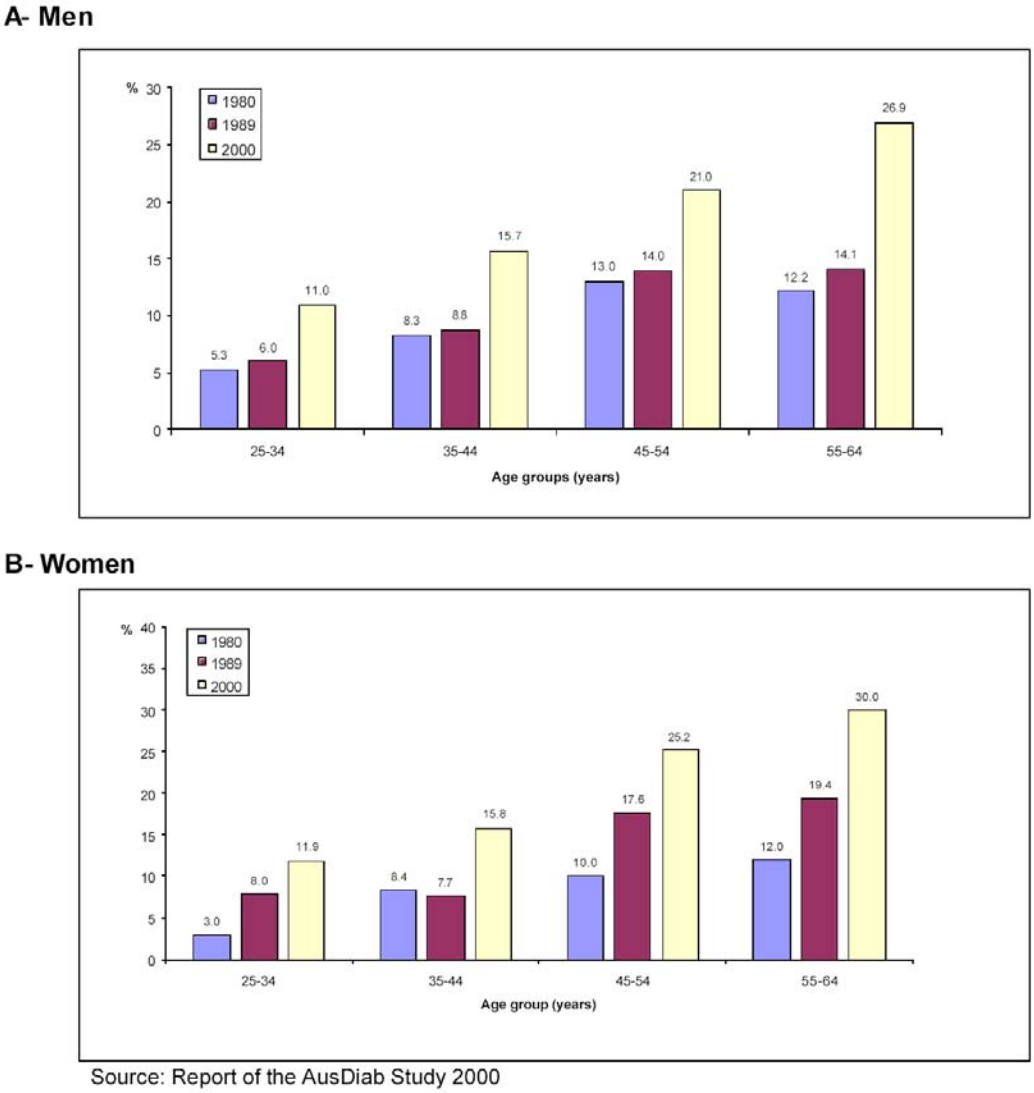

Figure 3: Changes in prevalence of obesity in Australia 1980-2000 by age groups and gender

Almost every aspect of the way we live has the potential to contribute to reduced activity among our children, for example:

- Increased opportunities for sedentary recreation - eg television and video
- Increased demands for better academic performance - eg coaching and homework
- Increased car travel and less person-powered transport
- Increased concerns over child safety - eg stranger danger, traffic
- Fewer walkable destinations - eg shops and letter boxes

- Changes to the urban environment - more car and less pedestrian friendly
- Higher density living which do not consider the needs of young people
- Changes in architecture - eg homes with bigger "footprints"
- Personal injury litigation and reduced opportunities for physical activity
- More families with two working parents - "Go inside and lock the door until we get home"
- Parents working longer hours and are too tired and too busy to play
- Poor fundamental movement skills - as children participate less, they fail to develop these fundamental skills so want to participate less

While no single factor is the main cause so we need to consider and address all of the potential culprits, it is clear that infrastructure planning and design is a major influential factor on the way people go about their lives.

World Health Organisation

In 1999 London WHO Health Summit, the European Ministers for health, transport and the environment agreed that there were strong links between their three port folios. They resolved in a joint Statement, inter alia, that cycling and walking were key modes of transport that needed to be encouraged to the simultaneous benefit of these three areas (WHO et al, 1999).

Since 1999, the work has continued with the development of the Pan-European Program (THE PEP) which was adopted by the High-Level Meeting on Transport, Environment and Health at its second session in Geneva in July 2002 (UN, 2002). The PEP program consists of:

- Priority areas and actions for the tripartite work on transport, environment and health at the pan-European level
- A proposed institutional setting to carry out the work
- THE PEP Work Plan, outlining a number of specific and concrete activities, which could serve as examples of how tangible progress could be made in the priority areas.

The development of measures for promoting and improving safe conditions for cycling and walking is specifically referenced as a key element of urban transport management, such as the WHO "Guidelines for walking and cycling" discussed by Dora & Racioppi (2002).

These guidelines confirm that walking and cycling are increasingly being promoted as a means to reduce traffic congestion, air and noise pollution and the consumption of fossil fuels Figure 2). The following extract provides useful insights for engineering education and infrastructure development:

> *"Importantly, walking and cycling have also very relevant health implications, by reducing the risk of cardiovascular diseases, diabetes and hypertension, which are among the leading causes of death and disease in western countries, and their risk factors, such as obesity, particularly among children.*
>
> *"The United States Centre for Disease Control and Prevention for example, estimates potential savings from increasing physical activity of the most sedentary segment of the American population to be around $50bn in 1998.*

"Increasing walking and cycling as a means of getting from A to B, that is for transport, is not only good for our health. It has been proposed as a serious means to reduce traffic congestion, air and noise pollution [refer Figure 2] *in the urban environment and the consumption of fossil fuels. More cycling and walking for transport is believed to be one of the few feasible options to increase the levels of physical activity among the general population.*

"There is a concern that promoting cycling and walking for transport could increase traffic injuries. Even though this concern is frequently raised, only one assessment has been done to date on the balance of risks and benefits from increasing cycling and walking for transport. It found that the benefits were estimated to outweigh the loss of life through cycling accidents by 20 times.

"What is rather shocking is that partly because there is no agreement on the methods of how to take account of the health impacts of cycling and walking, these modes of transport have been excluded from present assessment of costs and benefits of transportation policies.

"There is an urgent need to develop the methods and gather the data sources which will make possible the assessment of the overall health impacts of increasing walking and cycling as part of transport and land use planning policies. This should allow the health effects of physical activity to become systematically a component of health impact assessments of those policies."

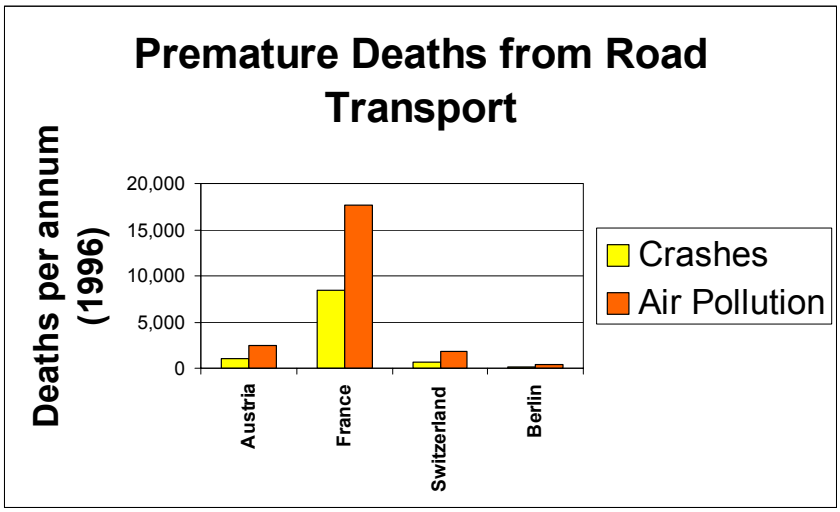

Figure 2: Premature Deaths from Road Transport

Budget Allocation

Funding allocation in NSW has increased from a mere $2M per annum for ad hoc facilities some 10 years ago, to an average of $25 million per annum including funding to support Local Government network development and implementation. The NSW Government has released its 10 year plan *Action for Bikes - Bike Plan 2010* for the provision of cycling facilities and the promotion of cycling. It is a $251 million program that will create an average 200 kilometres of cycleways across NSW each year. The NSW Government has made a commitment to establish high standard cycleways in conjunction with all new

transport and road infrastructure developments, such as TransitWays, Parramatta to Chatswood Railway, Western Sydney Orbital Motorway and M5 East Motorway (Table 1).

Project	Description	Length	Cost
Liverpool to Parramatta Rail Trail	Largely off-road cycleway parallel to the Parramatta - Liverpool Railway	17 km	$12 M
Concord to Eastwood Rail Trail	Largely off-road cycleway along the Concord to Eastwood rail corridor (Figure 5)	8 km	$3 M
M4 Viaducts	Off-road cycleway underneath the motorway viaducts	6 km	$13 M
Bay Run Cycleway	Largely off-road cycleway with parallel jogging track along Iron Cove Bay	7 km	$7 M
Western Sydney Orbital	Fully off-road facility with 84 exclusive bridges and underpasses (BOOT project under construction)	40 km	$50 M
Fairfield to Homebush Bay	Off-road cycleway from Fairfield City Farm to Sydney Olympic Park	28 km	$8 M

Table 1: Some examples of current and recent bicycle infrastructure projects

This year the NSW Government has spent over $40 million on its bicycle program. The engineering profession needs to develop the capacity to translate this political will into high quality facilities that serve the active transport needs of their local communities.

The long term objective, surely, must be to achieve cycling levels similar to those in The Netherlands and Denmark, where some local governments record up to 30% of all trips made by bicycle. While per capita expenditure on infrastructure development and maintenance by these government agencies exceeds current local funding allocations, Australian governments have come a long way. However, sustained and increased infrastructure investment is required to meet national and international targets for health, the environment and transport that focus on increasing the modal share of bicycling (and walking).

Bicycle Infrastructure Provision

The provision of bicycle infrastructure has started to mature and there has been a sea change in the level of facilities, as contrasted by Figures 4 and 5. While it is sad to see that even today many bicycle routes continue to consist of merely “blue signs”, Australia has started to emerge as a potential leader in the development of “bicycle freeways”. These facilities consist of high quality “mini” roadways with grade separated intersections, that even the Dutch have only just started to consider. Although currently none exist in Australia, construction has commenced on the Western Sydney Orbital Cycleway, while planning has started for the North Shore Cycleway.

Figure 4: Early infrastructure for bicycles - a sign to lead the way

Figure 5: Recent infrastructure for bicycles - John Whitton Bridge, Meadowbank, Sydney, which is part of the Concord to Eastwood Rail Trail

Bicycle Network Planning

The planning of bicycle networks requires an integrated approach involving a range of professions. A good current example of such an approach is the public domain planning and design for a major urban renewal project. The multi-disciplinary team is led by a group of urban designers to establish design parameters for a broad range of urban development issues, including (Figure 6):

- Drainage system development
- Building set backs
- Cross section design
- Landscaping
- Tree planting policy
- Heritage protection
- Social planning
- Pedestrian network design
- Public transport routes
- Bus stop locations
- Site planning
- Through site links
- Art strategy
- Road network design
- Stormwater detention
- Open space planning

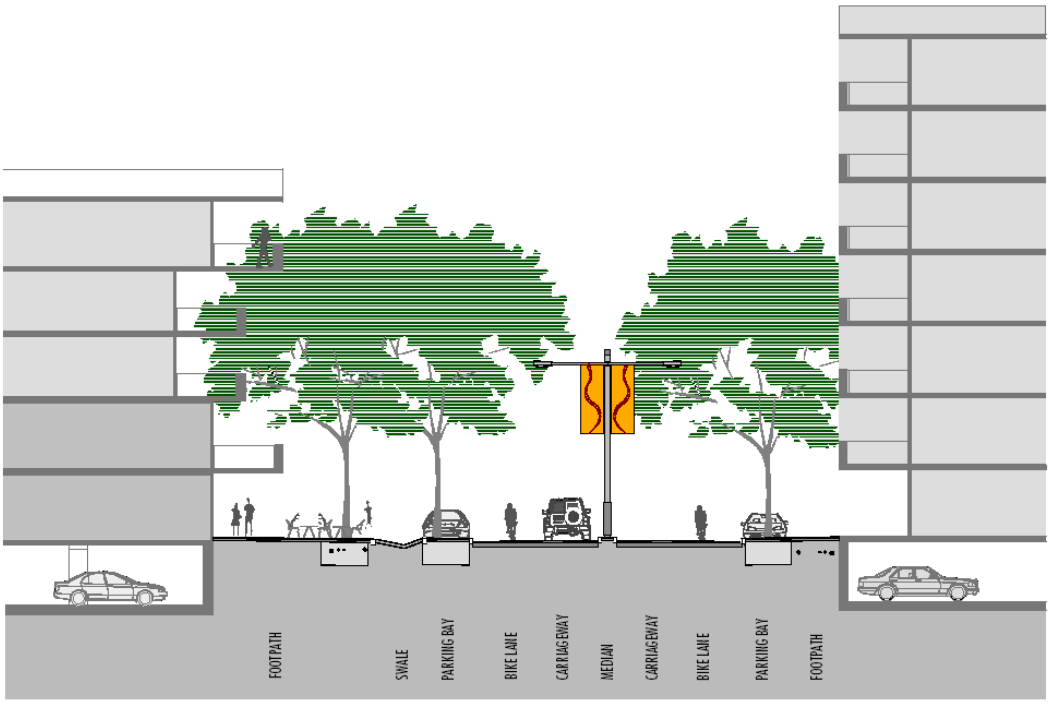

Figure 6: Boulevard design for urban renewal project

Curriculum Requirements

This paper has shown that there has been a dramatic change in both the underlying planning philosophy and in the provision of infrastructure for bicycles. There is a similarly strong need for engineering education to embrace the awareness of such negative outcomes and ramifications of engineering design. This awareness must be holistic and inclusive of public health and safety, personal well-being, social equity and much, much more. Similarly, there is a need for engineering education to incorporate the latest engineering design and evaluation techniques.

The Australian Bicycle Council is currently developing "Resource Kit" for use by engineering education institutions, which may include:

- WHO Guidelines for Walking and Cycling
- Austroads Australia Cycling - the National Strategy, 1999 - 2004
- Austroads Guide to Traffic Engineering Practice - Part 14, Bicycles
- Some Cycling References
- Some Relevant Cycling Website Addresses
- State Cycling Contacts
- NSW Cycling Guidelines
- NSW How to Prepare a Bike Plan - an easy three stage guide
- NSW Bicycle and Pedestrian Training Course Manual
- TransportNSW Sydney Cycling Data
- NSW Action for Bikes - Bike Plan 2010
- Cycling assignment descriptions and data
- List of cycling research opportunities for Masters and PhD theses.

The development of this resource kit has been endorsed by the National Committee of Transport of the Institution of Engineers, Australia and is planned for release later this year.

The following university and TAFE programs could consider including all or some of the information from the "Resource Kit" into their curricula:

- Civil engineering
- Highway engineering
- Environmental engineering
- Local government engineering
- Project management
- Asset management
- Town planning
- Urban design
- Landscape architecture
- Civil engineering drafting
- Specialist short courses transport planning, traffic engineering, etc.

Conclusion

Over the last decade there has been a significant increase in the level of investment in bicycle infrastructure. This infrastructure has been funded, planned and constructed by the 3 levels of Government (Commonwealth, State, Local Government). In addition, there has been a marked change in the design requirements for bicycle infrastructure, driven by an increased awareness of the health and environmental benefits of cycling (and walking). Improved access to the cycling and walking networks was a key issue at the 2002 NSW Obesity Summit as well as the 1999 WHO Charter on Transport, Environment and Health. To be able to meet these new challenges, professional engineers, planners and designers now require the skills to better integrate cyclists in road design, transport planning and urban development. The Australian Bicycle Council is currently seeking to redress this issue by working with tertiary institutions to include bicycle related design topics to undergraduate and postgraduate courses.

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