SUSTAINABLE URBAN TRANSPORT TECHNOLOGIES AND POLICIES: A RESEARCH PERSPECTIVE

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Introduction

Transport is intertwined with people's daily lives and with socio-economic and cultural activities. Considering the interactions amongst all forms of transport, the location of facilities and land use (spatial development), and the fact that a variety of transport systems and technologies co-exist within a limited area where environmental loads are the heaviest, urban transport has become one of the major issues for the lives of citizens and well as for local business. Sustainability and transport is a major issue in Australian cities (with water and energy, see, Australia, House of Representatives, 2005) and in the global cities of the 21st Century. Governments play a major role in shaping visions for the future sustainability of urban societies, and for formulating land use, transport and environmental policies, and the private sector is involved in the delivery of technology, both as producers, and, increasingly owners and operators of infrastructure.

Technologies (and associated techniques) can be studied in terms of form, function and their political, economic and social context. Urban transport – the infrastructure that supports the movement of people and goods – is an example of a technological system and the first section of this paper explores this link between technology and culture. The context for this exploration into contemporary research issues on sustainable urban transport is provided in the following section with a brief history of transport planning and policy.

The great societal challenge now is how to create sustainable urban environments to improve the collective human experience. In Australia, ecologically sustainable development (ESD) with the inter-governmental agreement is one of the current external drivers to urban transport planning and policy. This paper then explores research issues that are relevant to metropolitan regions in Australia, such as an appropriate definition for "sustainability", performance indicators, and their spatial scales. It also provides a specific case study of sustainable urban transport policies and technologies in urban Japan. This is based on interviews with government officials conducted by the author and his colleagues at Nagoya University. Drawing again on the Japanese experience, and on comparative data from other international cities, the relative roles of public transport technology and road technology are explored, and implications for policy are outlined. Finally, and given the importance placed on practical experience and policies from other global cities, a research challenge is finding mechanisms to facilitate international collaboration in sustainable transport and cities. One such research collaboration involving Nagoya University and

Tongji University, The People's Republic of China, is outlined. One of its internationally competitively awarded research projects – into the dynamics of poly-centric employment formation, and associated land-use and transport policies – is briefly described. Finally, the conclusions summarise the main points of a research agenda for sustainable transport and cities with particular reference to Sydney.

Technology and Culture

The characteristics of society play a major part in determining which technologies are adopted, and how they are implemented and controlled: "…the direction of change is a product of the particular alignment between the technological possibilities and the society and culture that exists" (Murphie and Potts, 2003, p. 21). Technologies (and associated techniques) can be studied in terms of form, function and their political, economic and social context. Urban transport – the infrastructure that supports the movement of people and goods – is an obvious example of a technological system. It is an ordered technological system that involves people and organisations, living things and machines. An associated concept to that of technology is "technique" – the use of skill to accomplish something (Murphie and Potts, 2003, p.5) – where the "skill" of relevance in this dialogue is the urban and regional planning process, as applied by practitioners, and the persuasion of policy makers to adopt recommendations on products (technologies), strategies and policy instruments.

Technologies, like rivers and streams to use an analogy, also flow. Technologies and techniques, like rivers and streams, are produced by particular contexts and change as these contexts change. Like rivers and streams, technologies are produced by particular contexts and change as these contexts change. The technology (and technique) of the land-use and transport planning process in the USA arose at a time of rapid motorisation and road traffic congestion (contextual problem), the advent of the main-frame computer to store and manipulate vast amounts of individual and household travel data (parallel technological development) and a Federal mandate to undertake urban transport studies following standard procedures that took about three years in all US cities with populations greater than 50, 000 (for the political/ administrative context, see Sweet, 1969). Later, I will return to the form and function of the land-use and transport planning process (technique), but, next, the flow analogy is pursued. Constant mutations and new developments in these "flows" of technology and technique, and the political, economic and social context, are described.

Transport Planning and Policy – A Potted History

Learning from the past is the first lesson in transport planning and policy. For example, in Los Angeles, as throughout the United States, public transport ceased to be an innovative industry (technological products) after World War One (Foster, 1981; Bottles, 1987). Public and private organisations – highway engineers, vehicle manufacturers, oil companies, motorist organisations – banded together to build streets, arterial roads and freeways that today remain part of the built form inheritance of American cities. This network of road facilities enabled car manufacturers to promote private transport into a mass luxury commodity (Warner, 1992, p.9), then into a consumer necessity from the mid-20th Century onwards.

To facilitate rising car-ownership levels, conventional urban planning practice in the mid-20th Century in America was dominated by highway engineers. Regional employment was heavily centralised in the CBD and inner areas. Residential suburbanisation – planned subdivisions – was taking place at an unparalleled rate. Highway engineers conducted origin-destination surveys (technique) to establish the current "demand" for peak-hour road traffic. These "desire lines" were then factored up by a growth factor to accommodate the projected populations of the future and their spatial distributions. The end result was a thicker set of desire lines focusing on the central city. The universal policy recommendation, albeit based on a seriously flawed technique, was to build a ring-radial freeway system (technology) to cater for this increase in road traffic (with the noticeable exception of Los Angeles where a grid system was built). An alignment of economic interests and politics ensured that budgets were allocated for expressway implementation. Closer to home, this flawed technique obviously appealed to the engineers in the New South Wales Main Roads Department, because, in the preparatory work for the County of Cumberland Planning Scheme, a traffic survey was conducted in 1944 that formed the argument for a radial system of "expressway" (freeways) for Sydney with a major interchange planned for Ultimo (Winston, 1957).

Suddenly, a piece of research fundamentally changed the way of academic thinking about highway planning and produced a revolutionary new technique that still forms the backbone of urban transport analysis today. Mitchell and Rapkin (1954) demonstrated the key interaction that "traffic is a function of land use." Whilst intuitively obvious, this concept opened the way for a rigorous and quantitative analysis of land use, traffic and transport as a system[1]. The application of the "systems" process (for example, McLoughlin, 1969; Chadwick, 1971) in the Detroit and Chicago transport studies, and its wider adoption in other US cities, there was an early export of technology in the 1960s to British cities, Australian cities and Japanese cities (Black and Salter, 1975; Black, 1974; Black and Rimmer, 1981), then to most major cities throughout the world (Witheford, 1976). The form of this technique was a systematic process of defining goals and objectives, collecting data, formulating key relationships with mathematical models, using these traffic forecasting models with exogenous inputs of a "land use plan" and alternative transport technologies, formulating an evaluation model (cost-benefit analysis) and then making recommendations to decision makers. This remarkably uniform technique prompted Ben Bouanah and Stein (1978) to suggest there is "a generalised international urban transportation planning process."

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1. The first formalisation of these concepts of land-use and transport interaction anywhere in the world was produced by the Professor of Traffic Engineering at the University of New South Wales, the late Ross Blunden (a graduate of Sydney University), and published as *Introduction to Traffic Science* (Blunden, 1967, 1971). He also introduced the systems concept of "feedback" that becomes an important ally when analysing alternative plans and policies, but a concept that has been grossly misunderstood in practice where open-ended extrapolations still have credence.

Half a century later, the systems approach continues to be employed in metropolitan-wide transport studies, it has mutated to form the basis of studies at different geographical scales: national and regional studies; sub-metropolitan; studies and local studies. It has also formed the rational basis of studies with different planning horizons from short-term, transport system management (Dial, 1976), to long-term strategic, sketch planning (Wilson, *et al*., 1969; Hutchinson, 1974; Black, 1981). In 2005, the 9th Conference on Urban Planning and Urban Management (CUPUM) celebrated the 40th anniversary of the special edition of the *Institute of American Planners* journal on urban models. The mathematical structures of these models remain much the same, with the greatest advances being in computational power, graphical output and visualisation (see, for example, Cheung and Black, 2005). To follow the river analogy on the systems approach, its topographical cross profile has entered the stage of "maturity" – or even "old age" (Monkhouse, 1964, Fig. 51, p. 121).

As previously noted, the characteristics of society play a major part in determining which technologies are adopted, and how they are implemented and controlled. This would be a study in itself for the deployment of specific urban transport technologies in Sydney. Why, for example, have private sector-public sector partnerships dominated the delivery of urban tollways and tunnels? Why was the Darling Harbour monorail constructed? Why did the airport rail link fail to attract passengers? However, suffice to argue: there is a relative immutability of the techniques for urban transport planning, but a highly volatile contextual situation (see, for example, Black, 2006). The responsibility for transport and land-use planning in metropolitan Sydney was, and still is, an uneasy alliance between the state government, its agencies and local government. As concluded by Neutze (1978, p. 138):

> "Despite the widespread recognition that they are interdependent it has not been possible to integrate land use and transport policy."

Inner city freeways were stopped in the mid- 1970s because of the environmental backlash and threats of the Federal Labor Government withholding road funding to the non-conforming state government policies. The road lobby vehemently opposed local area traffic management schemes, such as in Paddington, but, later, in the early 1980s, the NRMA became a strong supporter after realising their safety and environmental benefits. Initially, road traffic "calming" in Australia was ridiculed as being a "European only solution", but, more recently, the publication, *Sharing the Main Street* (New South Wales Roads and Traffic Authority, 2000; Black, 1993) has won international acclaim for its integrated approach to development control, urban design, landscaping and traffic engineering. A final example: in March, 1998, the New South Wales Government launched *Action for Air* – its long-term, 25-year Air Quality Management Plan. In order to meet air quality targets in an ever-growing city there needs to be a change in the distances people travel and the transport modes they use. It galvanised action behind the imperative of breathing clean air, and the urgency of restraining the vehicle kilometres of travel by car with policies that promoted (although arguably failed to deliver) more compact cities and better public transport and walking and cycling facilities.

In the first decade of the 21st Century, the great societal challenge is how to create sustainable urban environments to improve the collective human experience. In

Australia, ecologically sustainable development with the inter-governmental agreement is the current external driver to urban transport planning and policy. The Ecologically Sustainable Development (ESD) Transport Working Group of the Commonwealth Government issued a report in 1991 full of recommendations for change in the transport sector. When these recommendations are classified into the steps of the systems approach – goals/objectives, data and analysis, plan making and forecasting, evaluation criteria - most of them are either aimed at altering the value system by specifying new goals and objectives for a more sustainable transport sector, or they were aimed at solutions to the perceived problem, such as encouraging higher density cities (for a full summary, see, Black, 1996).

Noticeably absent from the set of recommendations by the Working Group were suggestions on analytical tools and evaluation methods (see, Minken, *et al.,* 2002), including appropriate "sustainability" indicators, and on targets to achieve them. Thus, in Australia, this political, economic and social context has realigned appropriate urban transport technologies in favour of public transport (and associated techniques) that then lead on to a series of research questions. Globally, sustainable cities are one of the major challenges (see, World Conference on Transport Research Society and Institute of Transport Policy Studies, 2004). The river is, perhaps, in a process of rejuvenation.

Having sketched, very briefly, a few of the key relationships between urban transport technologies (and techniques) and policies, and the changing societal context, it is appropriate to consider the role of policy-relevant research on sustainability. Approaches to urban policy research can be classified in various ways, but much of transport research is directed to estimating the costs and benefits, and distributional consequences of alternative technological projects, programs and policy instruments. Whilst the ultimate aim of this paper is to raise some research topics for debate and discussion, it is now timely to indicate some of the current streams of research engagement on sustainable transport and cities – that is, matters of form and technique.

Urban Transport Sustainability – Various Definitions

Reaching a consensus on an acceptable definition of "Sustainable Urban Transport" is a bit akin to 19th Century explorers tracing the exact source of the River Nile. A research study (PROSPECTS) supported by the European Commission under its Framework 5 Environment and Sustainable Development Programme (May, *et al*., 2001), has provided a working definition of sustainability of the urban land-use and transport system, and furthermore, has sought decision makers' acceptance of such a definition:

> "A sustainable urban transport and land use system:
> - provides access to goods and services in an efficient way for all inhabitants of the urban area
> - protects the environment, cultural heritage and ecosystems for the present generation, and
> - does not endanger the opportunities of future generations to reach at least the same welfare level as

suitable for planning practice, the specification of performance indicators and how to measure or model them, and appropriate geographical scales for such analysis.

When applying these generalities for a research agenda for Sydney the role of centres in metropolitan planning policy requires careful examination. The outcome expected from this research is a better understanding of multi-centric urban growth and associated commuting patterns that will illuminate policy making on environmentally and economically sustainable urban development. The results from this research, could suggest suitable land-use policies that encourage employment creation in the right places, and the role of public transport technologies serving those centres, or the role of travel demand management, parking policies and "green transport plans". The Sydney specific research can provide the springboard for testing a series of assumptions about "centres" in the metropolitan region, and the relative influence of market forces and planned interventions Central to this is the role of public transport to support these centres. Integrated public transport (including different technologies), housing and commercial developments should be examined for their feasibility, and for costs (life cycle) and social, economic and environmental benefits.

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