Planning Sustainable Infrastructure

Unit 3:

Transport Systems – 3
Sustainable Transport

Contents

Introduction

In this first unit on the topic of transport, you were introduced to systems thinking and systems analysis with a specific example of the process and methods engineers use to analyse and design transport facilities within a region. The progression through these units has moved from the transport technologies in the first week to that of the transport and wider urban or regional system in the second unit.

Staying with this concept of system, the idea of a system can be extended further to connect our urban and regional systems to those of the earth's ecological systems in which they function. Climate change is an example of where the connection between these systems have given us all a wake up call to live within the limits we have been given. Since the 1970's community and government have been aspiring to the notion of sustainability and this has steadily become a driving goal for our built environment.

The systems approach is equally valid to the study of urban transport and its connection to sustainability. In this unit, you will be introduced to the processes and methods engineers use in the "land use/transport/environmental" system at the regional and sub-regional scales when addressing urban transport's contribution to sustainability.

In fact, much of contemporary practice involves "managing the demand for transport" to make better use of existing infrastructure and avoid the unnecessary waste of major capital expansion, especially of major roads. As with other topics in this course, "sustainability", is a major contextual driver of policy and practice in transport, and is discussed in this unit .

First, we will compare the traditional approach that engineers have taken with the approaches now taken with sustainable urban transport. This historical evolution is important to understand because the information on models and analysis presented in the previous unit (Unit 11) remains appropriate in the study of sustainable urban transport. One of the major changes has been expanding the objectives and goals of a transport system to include sustainability goals, and this is discussed in some detail with a number of exercises designed to reinforce this important step in the systems approach. Sustainability constraints on the system are introduced. Performance indicators are discussed that influence the design, operation and monitoring for continuous improvement in sustainability performance.

A number of techniques for strengthening the connection between community, agency and the infrastructure delivery are discussed. These are practical methods for enabling sustainability within our cities to

move from visions to operating infrastructure that delivers the sustainability outcomes needed.

The readings included in this unit provide background on the topics discussed. Finally, case studies illustrate various aspects of the systems approach to sustainable urban transport.

Learning outcomes

After the study of this unit you will be able to:

- Understand some of the issues in urban transport.
- Understand the processes that lead to goal and objective formulation, and to be able to critically examine transport reports on sustainability in the wider context of world's best practice.
- Recognise the importance of performance indicators.
- Discuss how the development of engineering solutions to transport problems involves a number of iterations; often coming back to ask "what really is the problem we are addressing"
- Understand the relevance of the systems approach to achieving transport supply that contributes to sustainability.
- Follow the typical procedures used by transport engineers to move from problem definition to solution, and understand the many influences on the process, especially the political context for this work.
- Discuss the key arguments of the "transport sustainability" debate when applied in practice.

Transport Systems Planning – Changing Societal Context

Unit 11 explained the steps in the systems approach as applied to the land use, transport and environmental system. Whilst this is a technical process it is also a process where societal goals and objectives must be included. In simple terms, this inclusion occurs at the problem definition stage where issues are identified and goals and objectives for the plan (policy or program) are set. This stage also interacts very strongly with the evaluation of alternatives because the evaluation criteria must be consistent with the objectives that have been set.

This can be illustrated with reference to Sydney as a case study. Look at the objectives that are set in the Metropolitan Strategy <http://www.metrostrategy.nsw.gov.au>. What are the objectives set in this plan? Do they include "minimise the amount of vehicle emissions" or locate employment in such a way as to equalise zonal accessibility to employment"?

How would you assess against goals such as those mentioned? To start you will need to have quantifiable measures to input objective information. Where do get this from and how can you make comparisons? You will see a little later in this unit that performance indices can be generated from survey or census data and land-use transport modelling. However, there meaning is largely lost without an evaluation framework. As in the real world, there are seemingly conflicting objectives of a social, economic and environmental nature that makes plan evaluation tricky. Often there is the technical "appraisal" by professionals followed by an "evaluation" by politicians and their advisors.

Previously, defining goals and objectives was seen primarily as a task for experts where stakeholders and the community were excluded. Today, the situation is very different because the societal context for transport planning has changed dramatically and there is now much more participation and consultation, as this and other case studies will reveal. Furthermore there is more stakeholder and community involvement in developing the options to be evaluated and to defining the evaluation criteria.

Canberra provides a case study that demonstrates how planning objectives have changed with shifting community aspirations. In 1967, all of the work was undertaken by a US engineering consulting company, Alan M. Voorhees and Associates, and a few professionals from the Nation Capital Development Commission. Their recommendations on the preferred long-term strategy for Canberra (up to a population of 1 million people) were accepted by government and still form the basis of development policy.

The details of the story are contained in Black (1981, Chapter 6), but the salient are as follows

- Goals and objectives were set by the experts, for example, minimise road traffic congestion.

- The options were generated by the experts (interestingly, the optimal plan – the Y- plan - developed arose from serendipity when the question was asked: if we move the airport from this "potential town site" what can we achieve?

- The evaluation criteria were very narrow, with the minimisation of travel time becoming the key evaluation criterion.

- Transport impacts on the environment were not considered (as was practice in the 1960s).

From 1970 onwards there have been numerous investigations into public transport technologies suitable for Canberra. Some of these studies are described by Black (1981, Chapter 7). In more recent studies you can draw a number of contrasts with the process that recommended and implemented the Y – Plan. The salient points are as follows.

- Sustainable development is a driving force for the investigations.

- The issues (for public transport and urban development) were obtained from widespread interviews with key stakeholders (other government agencies, transport operators) and the community (leading figures in the community, neighbourhood community associations, lobby groups such as the Nature Conservation Council).

- The consultants explain there work in progress to workshops involving stakeholders and the community where key inputs are obtained in the formulation of options to be investigated more thoroughly by the consultants and evaluation criteria to be applied when testing each option.

- Evaluation is based on the "triple bottom line" of contributions to social, economic and environmental variables.

If you are employed in the public or private sector and have duties connected with development and the environment, or are a member of a community association, it is possible you may be invited to such a workshop. Here are some typical characteristics of such workshops using

the example of the urban release area in south-western Sydney as an example.

- The NSW Department of Planning and Transport produced structure planning workshop manuals based on best international practice called "design by inquiry."

- The workshop is held over five-days where the agencies involved are committed to achieving workshop outcomes.

- Draft workshop objectives are circulate prior to the meeting and are confirmed at the workshop.

- The different agencies (who have engaged their own consultants on the subject matter of the study area) brief participants on the key issues and constraints. Reports may cover up to 20 areas such as transport studies, infrastructure planning, water cycle management, flora and fauna assessment, natural heritage assessment, and so on.

- Draft planning scenarios (for example, high conservation of natural resources, or maximum urban development of the site) are presented and confirmed at the workshop.

- Draft multi-criteria analysis for plan evaluation are presented, discussed and confirmed at the workshop.

- Breakout groups are then allocated a scenario, and on base maps interactively design that option using the technical information base provided by the consultants, including constraints on development (such as woodlands to be conserved.)

- The options from each scenario are presented at a plenary session then scored according to the multi-criteria analysis.

- The workshop outcome is one or two options of merit for more detailed planning and investigations.

- Further investigations of these following the workshop are made available to agencies before any commitment to place plans on public display as part of the formal process of New South Wales Government community consultation.

Sustainable Transport – The systems approach

Inter-governmental agreements in Australia (Commonwealth, State and Territory, and Local Government) on sustainability place importance on ecologically sustainable development, and this has shaped the way engineers approach land use, transport and environmental planning. The systems approach not only remains a valid methodological framework but has increased its relevance in delivering sustainability. The approach is building on its strength as a holistic evaluation framework. However it is also adapting in the following ways to meet the challenge of delivering transport systems that build sustainability into our cities and regions:

- Responsive to the major shift in societal value system
- Goals and objects align with sustainability issues on economic, social and environmental development
- Study goals are not set by professional experts but involve input from agents (stakeholders)
- Visualisation is important to communicate the impacts of alternative plans (GIS, computer graphics, 3-dimensional models)
- Evaluation techniques reflect the broadening of goals and objectives, and transport (and land use) alternatives are appraised from economic, social and environmental perspectives.
- Performance measures or indicators of progress towards sustainability are being developed.

Reading 3.1

Black, J., 2006,"Sustainable urban transport technologies and policies: a research perspective", *Dialogues in Planning*, University of Sydney, pp 1-5, 17-21

Reading 3.2

Doust, K., 2008,"Paper 1 Week 3 Visualisation- matching planning to community aspirations & Expectations", *extracts PhD thesis*, UNSW

Sustainable Transport – Goals and objectives

Visioning is a formal process where a group brainstorms images of the future. These, and other techniques, are used in meetings of key stakeholders to determine the goals and objectives of a transport study. Invitation workshops were held in 2004 by the NSW Government in the process of formulating the metropolitan strategy for Greater Sydney. The first comprehensive study of goals for a sustainable transport sector in Australia was in the Report of the Ecologically Sustainable Development (ESD) Transport Working Group. For urban transport, the report recommended, among other things:

- Better public transport
- Encouragement of walking and cycling
- More convenient location of homes and workplaces
- Avoiding suburban sprawl with higher density housing
- Traffic calming
- Stricter air quality standards

A decade later, there are complementary visions for sustainable urban form and transport as listed below. The process of integrated planning is to find out the effective integrated policy mix to meet the visions.

1) Complementary visions for sustainable urban form
- urban suburb
- compact city
- growth management / smart growth
- inner-city regeneration
- land use with higher QOL
- linear network conurbation
- assured landscape

2) Complementary visions for sustainable transport
- seamless transport systems/trips
- motorisation without auto-mobilisation
- slower transport in urban areas
- priority to transport systems with less burdens on the environment and finance
- reliable transport.

To meet the visions the following three integrations are necessary:

- integrated strategy of de-suburbanization and de-auto-mobilisation

- integrated strategy of de-suburbanization and re-concentration in inner areas

- integration of
  - transport and land use systems
  - stakeholders
  - transport infrastructure and operation
  - land use control and land taxes
  - inner-city and suburbs

Reading 3.3

Blue Mountains City Council, 2003*, A 25 year vision for the city - Towards a more sustainable Blue Mountains*, Blue Mountains City Council
(Also
<http://www.sustainablebluemountains.net.au/imagesDB/resources/BlueMtsOurFutureHowWeDitIt.pdf , Jan 2010)

Today these visions continue to be developed, although the connection to infrastructure programs to deliver the visions is slow to develop. Since the early years of this century the idea of visioning has been combined with backcasting techniques to not only choose the future city form and characteristics but also the policy packages that are needed to get there. These techniques have been applied in the London since 2006 and have become a central focus of any transport studies that the Asia Development Fund supports.

Reading 3.4

Hickman, R. and Banister, D., 2007," Looking over the horizon: transport and reduced CO2 emissions in the UK by 2030", *Transport Policy*, 14: 377-387.

Exercise 3.1

The Greater Sydney Metropolitan Strategy was released in late 2005 (<http://www.metrostrategy.nsw.gov.au, Jan 2010). It also contains an Appendix on Transport. From these documents extract the sustainable

transport goals and objectives. Taking each in turn, summarise how each goal or objective will contribute to a more sustainable transport system.

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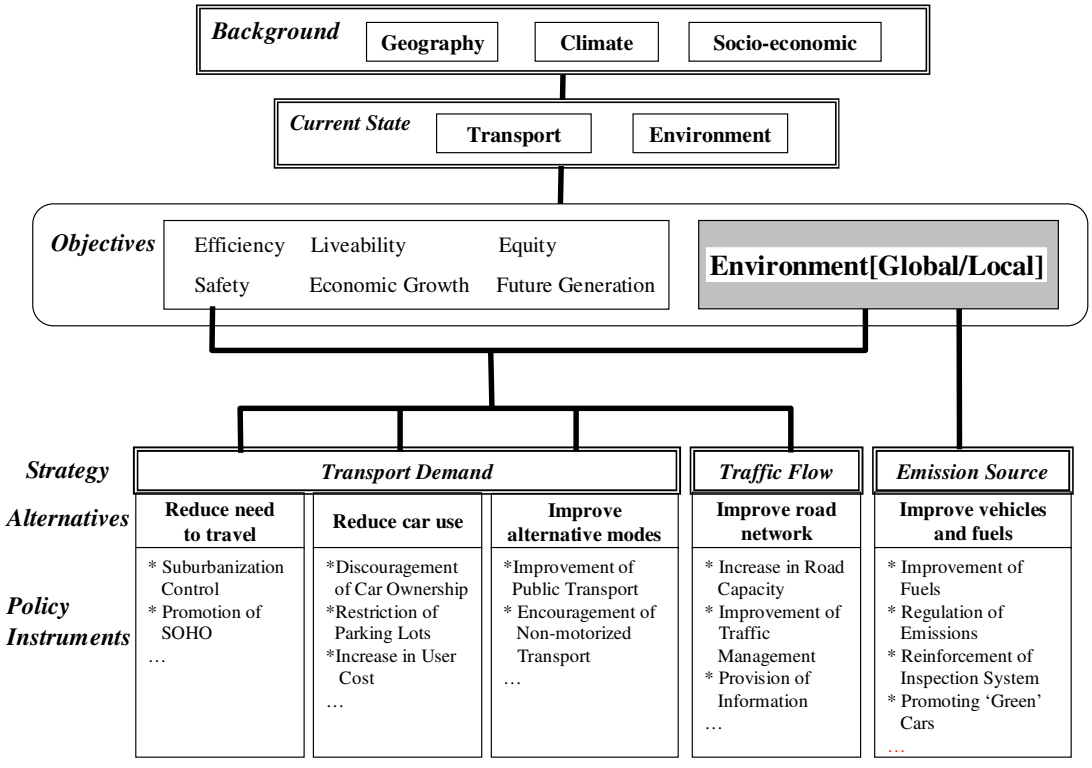
Of course, the issue of the transport sector contributing to sustainability is a global one. The Institute of Transport Policy Studies in Tokyo in association with the World Conference on Transport Research Society formulated a generic, common conceptual framework towards sustainable transport strategies (plans) in response to broad goals of quality of life. The figure is structured to show the objectives of the land use, transport and environmental system, and the broad category of strategic response and policy instruments to achieve that strategy.



(Source: WCTRS and ITPS, 2004, Figure 1.4, p.8)

This book is highly recommended reading for further study on transport. The bibliographic citation is:

"World Conference on Transport Research Society and Institute for Transport Policy Studies (2004) *Urban Transport and the Environment: An International Perspective* (Amsterdam: Elsevier)"

The above framework emphases strategies to achieve sustainability and policy instruments. The following tables sets these out in more detail, covering technological, regulatory, information and economic policy instruments. There is no one solution to a "sustainable transport system". Integrated policy packages are required.

		Strategies				
		Reduce need to travel	Reduce car use	Improve alternative modes	Improve road network	Improve vehicles and fuels
Instruments	**Technology: Infrastructure Vehicles/Fuel**	Transit oriented development …	Community roads …	Rail & bus infrastructure New public transport vehicles …	New roads New parking facilities ...	Low Emission Vehicles Zero Emission Vehicles Alternative fuels …
	Regulation: Management Control	Land use regulations Sub-urbanization control ...	Access permits Parking restrictions Traffic calming ...	Bus priorities Service improvements ...	Traffic management Urban traffic control ...	Emission regulations Restriction of low-quality fuel Vehicle inspection system …
	Information: Advice Awareness Communication	Teleworking ...	Awareness campaigns ...	Real time public transport information …	Driver route guidance Safety guidance Traffic information provision …	Eco-consciousness ...
	Economy: Charges Taxation	Land taxes ...	Road pricing Fuel taxes Vehicle taxes ...	Fares policy …	Road pricing Parking charges ...	Fuel taxes Green taxes ...

Exercise 3.2

Reproduce the table above with its row and column headers and fill in the appropriate information that you can extract from the Greater Sydney Metropolitan Strategy

Sustainability constraints on the development of systems

Whilst it is relatively easy to formulate broad goals and objectives and to suggest strategies together with a package of policy instruments it is much harder to model and analyse the impacts within a sustainability framework. Monitoring of progress towards sustainability is essential.

Environmental Management Systems developed for regions and facilities require performance indices to be defined and measured, in order to determine whether the processes in the systems are sustainable into the future. Transport is no exception to the other units in this course, so what follows should seem familiar. The facility and the region will be

sustainable from a transport perspective if the following material utilization objectives are met:

- renewable energy resources used in transport are harvested at a sustainable rate;
- non-renewable resources (oil) are extracted at a rate, and in a manner, which recognises that other fuels will need to replace the oil once it is exhausted from available sources of supply;
- emissions from mobile and non-mobile sources are disposed into the atmosphere at a rate which does not interfere with the preferred environmental quality.

Of particular interest to transport and environmental engineers is the objective whereby emissions into the environment are limited to levels that will not degrade preferred environmental quality, i.e. at levels below the "carrying capacity" of the environment. A range of approaches can be used to determine these acceptable levels, and then to adjust the metabolism of the land use / transport system to be consistent with them; included are:

- The use of Best Available Technology (BAT) to minimise emissions to the extent that is technically (and sometimes economically) achievable. In this approach, we do not know whether the BAT emissions are greatly below the limits of the environmental carrying capacity, or whether the technology still needs to be improved.
- The use of environmental risk assessment, to limit the risk of causing harm to ecosystems and human health to acceptable levels (these levels are socially determined). In this case, an upper bound to the level at which materials can be absorbed into the environment is attempted to be determined, and adjustments to regional economies and facilities within the economy, may need to be made through political decisions, if acceptable risk levels are to be maintained. Environmental risk assessment is a difficult approach, because of the complexity of ecosystems and human health, and the issue of multiple materials of anthropogenic origin (in combination through unknown synergistic effects) influencing ecosystems and human health .

Performance Indicators

Measurable performance indicators or metrics of an urban land use and transport system are required to check progress against goals and objectives. Understanding of interaction between urban form, transport and community has been shown to be essential for meaningful interpretation of performance of the three pillars of sustainability.

It can be observed in the literature that indicators or metrics need to be considered together to give a holistic picture of the sustainability performance of a city.

The American Society of Civil Engineers commissioned technical articles on "new advances in the state-of-the-art", and Reading 3.2 addresses recent developments in sustainable urban transport performance indicators.

Reading 3.5

Doust, K., 2008,"Paper 3 Week 1- Forms Of Sustainability Measurement*",extracts PhD thesis*, UNSW, pp.1 - 9

Reading 3.6

Black, J., 2006,"Sustainable urban transport technologies and policies: a research perspective", *Dialogues in Planning*, University of Sydney, pp 5-10

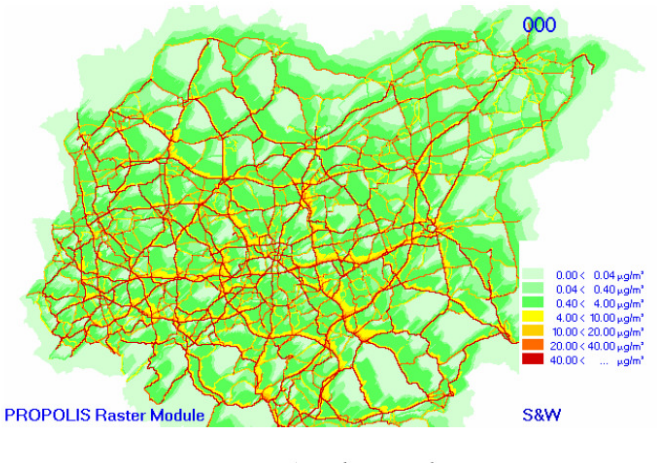
Reading 3.7

Black, J.A., Paez, A., and Suthanaya, P., 2002, "Sustainable urban transportation: Performance indicators and some analytical approaches", *American Society of Civil Engineers: Journal of Urban Planning and Development*, vol. 128, no. 4, pp. 184 – 209, extracts pp.184 - 192

Exercise 3.3

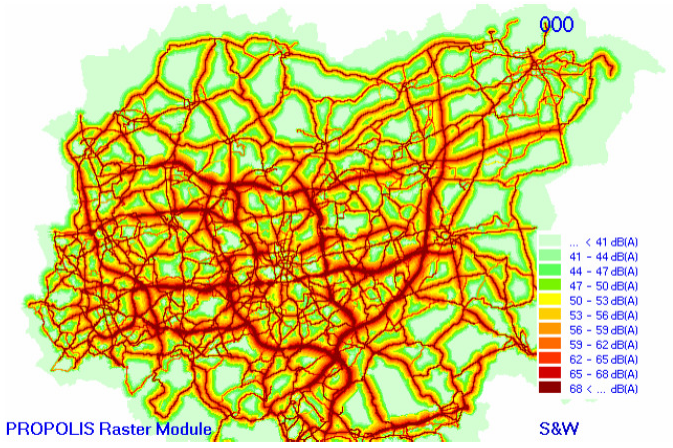
Consider the performance indices obtained from the Eurostat website (<http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/introduction >, Jan 2009) Identify the sustainability indicators and pick some from the economic, social and environmental areas. For each performance indicator in turn write a brief description against it in terms of a sustainable transport argument. (For example, "Road Fatalities" – To become truly sustainable, road transport should aim for a zero- fatal accident road toll).

Ongoing research continues to provide methodologies and tools that are able to be simply and meaningfully understood and used by community and government. A key part of this is the visualisation of indicators and metrics that allow simple presentation of performance but are still traceable to objectively based methodology. GIS is proving a useful method of doing this.



Air quality in Dortmund region

(source: Spiekermann and Wegener, 2003, p. 14; http://www.ltcon.fi/propolis , Jan 2005)



Traffic noise in Dortmund region

(source: Spiekermann and Wegener, 2003, p. 14; http://www.ltcon.fi/propolis , Jan 2005)

Moving From Vision to Reality

One of the challenges in enabling sustainability performance through transport is the meaningful engagement of the community in the selection of urban form and transport system options. Visioning has given much greater opportunity to gain a shared vision between community and government and in more recent years backcasting has opened the opportunity for community participation in policy development.

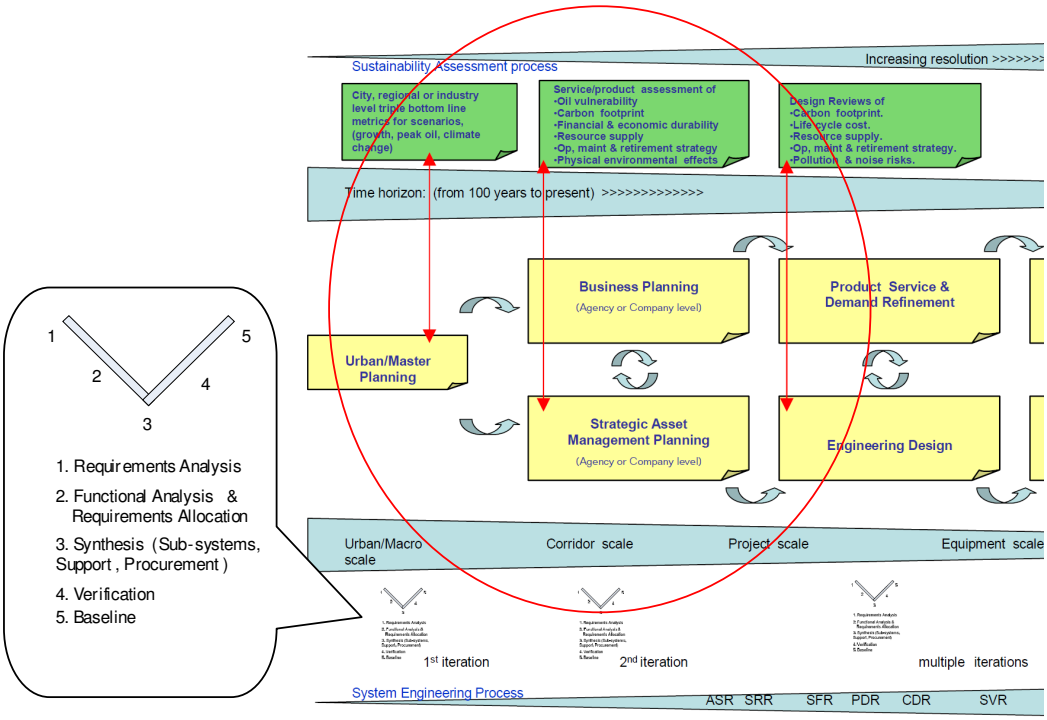
However community participation in the selection of options for enabling that vision has been limited. A sustainability framework and visual sustainability performance metrics are beginning to form the basis for a meaningful interactive optioneering process between community and government. The ability to make adjustments to planning instruments and observe sustainability performance at a macro or sub regional level in a short time frame gives the prospect to include community in system choices, not limiting their participation to the visioning of cities alone.

Reading 3.8

Doust, K., Parolin, B., 2009, "Enabling City Sustainability Through Transport Systems: Moving From Vision to Reality" *4th State of Australian Cities Conference*, Perth, pp 5-12.

A second challenge to getting sustainability to happen is how to ensure the sustainability performance choice made at the planning stage actually becomes a physical reality in the operating system. The sustainability performance choice against goals, objectives, indicators made with the community is in reality setting the sustainability requirements that needs to be delivered by the physical system when operational.

The systems engineering principles were discussed in relation to asset management in Unit 11. This process which is already effective in reducing the non performance risk of complex assets at the project level is a practical methodology for enabling the sustainability performance expectations to traverse the complexities of planning and project delivery. It minimises the risk of losing sight of the original intent of the plan/ strategy.



An important characteristic of systems engineering process is the transparency in decision making and its logic and good continuity from one development phase to the next. Community inclusiveness in combination with these methods throughout the urban planning and delivery phases is likely to also improve the community ownership and public knowledge. A particularly good outcome could be that it is more difficult for successive governments to overturn transport delivery strategies without proper justification to the public.

The systems thinking approach in the sustainability framework, the visualisation metrics and the management of the delivery process bodes well for enabling sustainability to happen in reality with out the need for complete changes in the way assets are delivered.

Reading 3.9

Doust, K., Parolin, B., 2009, "Enabling City Sustainability Through Transport Systems: Moving From Vision to Reality" *4th State of Australian Cities Conference*, Perth, pp 12-23.

Practical Examples - Australia

A Sydney Example

One of the greatest changes to the context of strategic land use and transport planning has been the introduction of principles for sustainable development in that transport development must be assessed in terms of its contribution to government's sustainable development objectives. The contemporary approach is to first engage the key stakeholders in a collaborative exercise to shape the vision for the future, and formulate study objectives and performance indicators. For example, based on the Sydney South West Sector Design by Inquiry Workshop, the New South Wales Department of Infrastructure, Planning and Natural Resources (2003) have articulated the following vision for areas of new development in these urban release areas that :

- respects and benefits from the natural environment,
- meets the lifestyle and employment expectations of its residents and
- complements the development of other cities and places in the region.

The delivery of such a vision for the South West sector requires the achievement of the following key outcomes that were articulated in the workshop by stakeholders:

- linked corridors that conserve the endangered flora, fauna, and ecological communities of Western Sydney.
- Housing choices that are affordable and meet the lifestyle aspirations and needs of people from a wide range of age groups and income levels.
- New jobs that match local skills and help the region to grow and transition into the new "economy".
- A public transport system that provides a competitive alternative to car travel, including for local trips.
- A fine-grained, connected road network that allows ease of movement for vehicles whilst maintaining pedestrian-friendly environments.
- Town centres and neighbourhoods with distinctive identities which relate to the landscape and have a high quality of urban design.
- An urban environment enriched by the conservation of items and landscapes of cultural heritage.
- Water cycle management that maintains riparian ecosystems and incorporates innovative reuse of stormwater and waste water.

- High quality and accessible human services and open spaces, linked to the rate of growth.

The next step in the planning investigation is to define more specific objectives and define measurable performance indicators that are linked to these objectives. The South West Sector Study for Sydney was informed on this matter by European practical experience. From the European Commission 5th Framework – EESD Project Prospects (*Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems*) six sub-objectives for sustainability are proposed that expand slightly on these environmental, economic and social components of sustainability:

- economic efficiency;
- liveable streets and neighbourhoods;
- protection of the environment;
- equity and social inclusion;
- safety; and
- contribution to economic growth.

Government planning in Sydney is inclusive of all key stakeholders so as to build commitment to common goals and outcomes. Table 1 classifies the criteria identified at Inquiry by Design Workshops (2003) in metropolitan Sydney into the six sub-objectives of sustainability that build upon European experience. *Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems* defines economic efficiency as:

> "…the sum of user benefits (in transport and housing), producer surpluses (including investment in rolling stock, rents), government surpluses (including investment in infrastructure) and external costs. External costs include noise, accidents and air pollution."
>
> (Minken, *et al*., 2002, p. 40)

Table 1. Sub-Objectives for Sustainability and Assessment Criteria Proposed for Urban Release Areas in Metropolitan Sydney

Six Sub-Objectives for Sustainability	Inquiry by Design Criteria
Economic efficiency	Sum of user benefits that are calculated from: decreased journey to work travel in VKT; reduced car dependence; increased use of public transport; and reduced energy usage; access to a range of activities. Government investment in infrastructure - timely and co-ordinated provision of transport
Liveable streets and neighbourhoods	Increased walkability and cycling; support active street and land-use interfaces, designs that have an interconnectedness of streets
Protection of the environment	Reduction in pollution levels
Equity and social inclusion	Equitable access to services
Safety	Safety and security
Contribution to economic growth	Not mentioned*

* - This is based on the UK SACTRA (1999) study that has laid a new foundation for research on the growth impacts and regional impacts of transport investment.

Some of the information in the above table is not expressed in measurable form to allow performance indicators to be defined but, fortunately, Minken (*et al*., 2002)[1] provide a comprehensive list of indicators tied to the sub-objective it is meant to reflect. They also provide a shorter list of those indicators most likely to be used in planning studies (http://www.ivv.tuwien.ac.at/fileadmin/mediapool-verkehrsplanung/Diverse /Forschung/International/PROSPECTS/DMG_English_Version_2005.pdf , pp. 12 – 15, Jan 2010). The indicators are quantitative, and are estimated on an annual basis (with dollar values discounted back to a base year). Table 2 suggests a practical list of indicators and their definition that would gain general

[1] Minken, H. et al. (2002) Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems- Deliverable No.2 Evaluation Tools, Version 2.0 (http://www.ivv.tuwien.ac.at/forschung/projekte/international-projects/prospects-2000.html, Jan 2010).

support from stakeholders involved in planning "green-field" developments on the metropolitan fringe of Sydney.

Table 2 Draft Indicators for Transport Sustainability in Sydney

Indicator	Definition
Economic efficiency	The annual value of this indicator is the sum of user benefits (in transport and housing), producer surpluses (including investment in rolling stock, rents), government surpluses (including investment in infrastructure) and external costs. External costs include noise, accidents and air pollution.
Liveable streets and neighbourhoods	The vulnerable user accident indicator is the annual number of accidents in the city involving pedestrians/cyclists and the car, multiplied by the average cost; the local activity index is defined for each destination zone as a measure of the attractivity of the zone with respect to shopping and other leisure activities
Protection of the environment	Carbon dioxide cost is the annual volume of emitted CO_2 from transport and energy use in the households, multiplied by a value thought to represent the marginal cost to society of reaching national targets for CO_2 reductions; the air pollution indicator is a weighted sum of local and regional air pollutant volumes emitted from transport and energy use in households; the noise cost indicator consists of the unit cost/km by the different

	types of road vehicle multiplied by VKT by type
Equity and social inclusion	Maps of zonal accessibility; accessibility for those without a car relative to those with a car; public transport performance measure is the number of vehicle kilometres per hour by public transport; the quality of public transport with respect to the mobility impaired is a verbal description of their travel opportunities
Safety	Accident cost indicator is a weighted sum of accident costs for different modes and across-modes accidents; The accident indicator is the annual number of victims for each mode, sub-divided by severity

(Source: Minken, *et al.,* 2002)[1]

Exercise 3.4

You are responsible for organising a "Design by Inquiry" Workshop for the NSW Government that will formulate the detailed structure plans for the Greenfield "Town Sites" to be developed as part of the South West Growth Centre. Climate Change has become a major constraint to Sydney and a concern to Sydney's Community, Local, State and Federal Governments. List the studies that you would commission to inform participants of the workshop.

A Melbourne Example

The state governments in Australia are confronted with growth issues and policies are shaped to address such issues. For example, in metropolitan Melbourne an additional one million people are expected by 2030. A general problem is the development of Australian cities at low densities of development by world standards and the dependency of the private motor vehicle in the sprawling outer suburbs. Probably the best starting point for anyone less familiar with urbanisation issues in Australia is to look at how Melbourne is managing growth with *Melbourne 2030: Planning for Sustainable Growth*,(< www.melbourne2030.vic.gov.au>, Jan 2010). The website introduces the Victorian planning system, legislation and regulations, and current initiatives by the Government on implementing *Melbourne 2030: Planning for Sustainable Growth.*

The vision for transport in Metropolitan Melbourne is contained in the Government's policy statement *Growing Victoria Together.* During consultation for Melbourne 2030 transport emerged as a dominant theme. The key directions that are required to deliver the vision are (State of Victoria, 2002, pp. 2 – 5):

1. A more compact city
2. Better management of metropolitan growth
3. Regional transport corridors
4. A more prosperous city
5. A great place to be
6. A fairer city
7. A greener city
8. Better transport links
9. Better planning decisions.

The target for public transport is to increase its share of motorised trips from the current 9% to 20%. There is an intent to promote the growth of regional centres and key towns along regional transport corridors with fast public transport to the southwest (Geelong), the west (Ballarat), the northwest (Bendigo), the north (Seymour), and the east (Traralgan). The focus has shifted from expansion at the periphery of Melbourne to a more compact city with corridors radiating out through regional centres. The specific policies to support these key directions are found in State of Victoria (2002; www.melbourne2030.vic.gov.au).

A Canberra Example

The ACT Government has made a commitment to sustainability to ensure that future generations have a quality of life that equals or surpasses the current generation. Meeting the climate change challenge is part of that commitment. The ACT Climate Change Strategy provides an overview of climate change science, the predicted impacts on the ACT, and the Government's vision and direction for responding to climate change. It has evolved from a discussion paper released in March 2006, to which many submissions from the public, business and community groups were received.

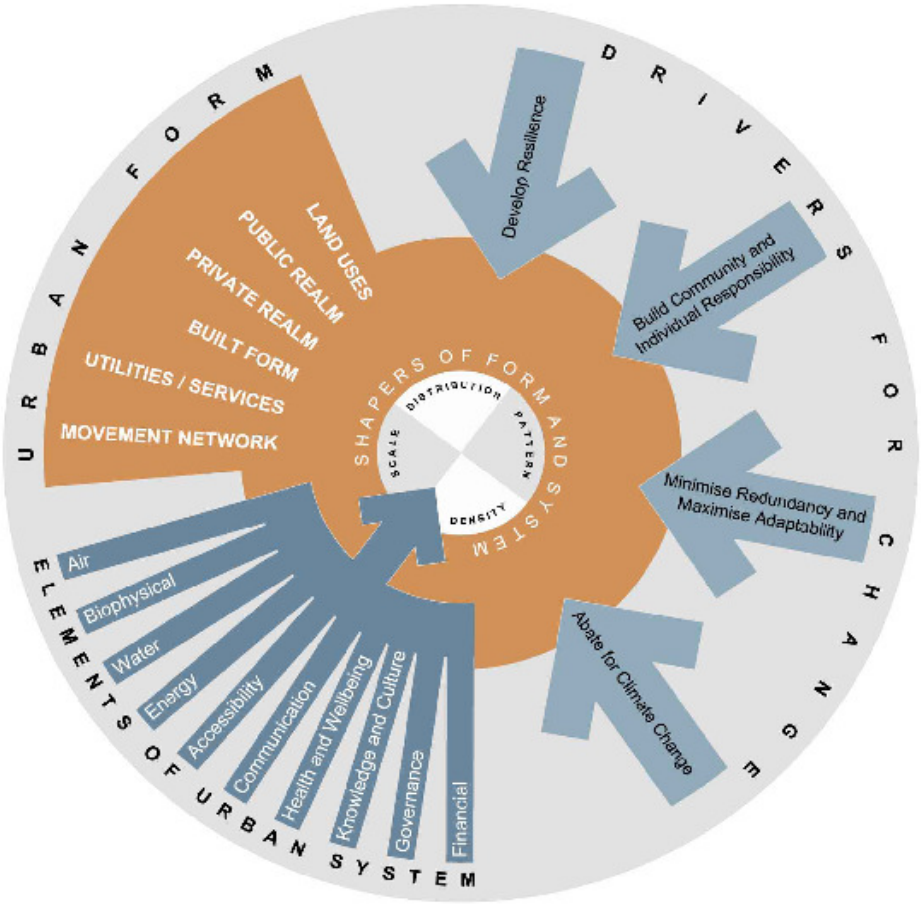
The aim of the Government's sustainable communities program is "*to put into effect a planning policy framework for more sustainable living that draws on the inherent qualities of Canberra and builds a greater sense of place, spirituality and responsibility*". A series of objectives are derived from five major drivers of change, as shown in the figure on the following page. Under each of the drivers of change are a set of objectives grouped under Built Form, Urban Ecology and Community. The figure identifies these interrelationships between the various elements of Canberra's form and urban systems.

Against this background, the first stakeholder workshop in Canberra addressed transport and mobility. Among other recommendations:

> "Transport proposals for private transport solutions are evaluated with a full understanding of their direct social, environmental, and health costs and other externalities to the transport sector."

In the context of Canberra, the ACT State of the Environment Report 2007 - 2008 provided the following facts. Compared with other Australians traveling to and from work, Canberrans used their cars more (81%), cycled a little more (2.5%) and walked some more (4.9%), but used public transport less. Currently, Canberra only achieves a 7.9% public transport patronage on the city's bus system. Given Canberra's design, comparatively small population and low density, commuting offers the greatest opportunity for achieving significant improvements in this sustainable travel ratio. The greatest opportunity for significant change is in travel to and from work as it involves large numbers of people traveling at the same time.

(http://www.actpla.act.gov.au/topics/significant_projects/change/sustainable_future, Jan 2010)



Elements of Canberra's form and urban systems (source: ACT Government)

Assignment - A High Speed Guided Transport System Case Study

Sydney land use and transport has been characteristic of a car dependent city. Its original trunk corridors centre on the CBD of Sydney, located at the harbour entrance to the city. Landuse was originally focussed around the CBD and radial trunk corridors. The advent of car in the late 1950's onwards has seen a spread of residential areas away from these corridors as accessibility by car became a possibility. This was followed by a slower shift of employment into the middle suburbs.

Even with the increasing effort on sustainable land use changes in the past 10 years, the city continues significant urban fringe residential development until this day. This mixed land use policy has been a significant driver to a large increase in person trips by car in the middle to outer ring suburbs.

The western half of Sydney's geographical space contains over 50% of Sydney's 4.1 million population. The bulk of the rapid increase in person trips by car, have taken place in the suburbs of this area.

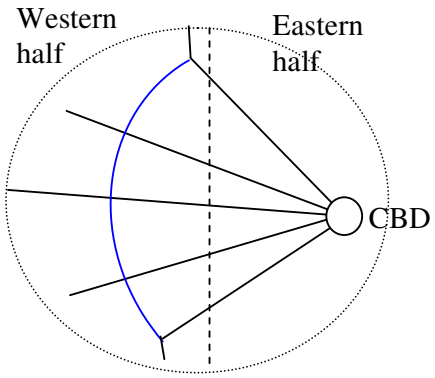
At a number of forums in 2002 and 2003 local government and community groups alike have strongly canvassed the need for a realignment of Sydney's transport. Priorities to establish for more containment of trips and an increase in public transport share of the journey were top billing at a Western Sydney transport forum in June 2003.

Central to this, is a restructuring of the trunk corridors within the western sector. Current trunk corridors are largely radial. The major new trunk rail corridors planned or under construction are radial extensions from eastern Sydney.

The Western Sydney motorway orbital is one trunk corridor developing a reorientation for accessibility within the western half of Sydney. To increase accessibility and mobility by public transport, the corridor was modified in principle to multi mode. However, the construction commitment has only been provided for multiroad across the full length of the link at this time. Never the less, the spatial relationship to other trunk

road corridors develops the type of web structure that provides a big step in accessibility for the population of Sydney's western half.

Sustainability Step 2 for Sydney, hinges on getting an effective multimodal trunk web structure in the western half of Sydney. The orbital motorway principle invites us to develop a multimodal trunk web structure by overlaying an orbital public transport corridor over the top of the network of radial motorways and rail lines. Conceptually, the structure is illustrated in the following figure.



By being intentional about this, it is possible to include within the Western Sydney orbital motorway, a trunk NW/W/SW arc of an orbital public transport system. To complete the city wide web structure, extensions of the orbital arc, together with additional radial capacity, will need to be added to the public transport within the system. Extensions of the orbital arc would be to the northern and southern areas of Sydney.

In 2002, the NSW Government was presented with a private sector proposal to build an additional layer of public transport into Sydney that would integrate the existing trunk transport corridors and a high speed overlay transport system. The following reading provides some of the material developed for that proposal.

Reading 3.10

Doust, K., 2002, "A case study: a high speed limited stop guided transport system" *Extracts from the 2002 High Speed train Proposal for Sydney,* Transrapid

Your assignment assumes that this orbital proposal from 2002 is the basis for establishing a sustainable transport blue print for Sydney. You should

also use the Metropolitan Strategy documents to set the urban planning context. Any transport directions in the Metropolitan Strategy should be adapted to integrate with the orbital transport system. You should also draw on your knowledge of the systems approach you have learnt about in these Units and knowledge of the transport technologies that are to be applied.

You are a team in the lead agency that is to brief the agencies that will deliver the maglev system. Your task in this assignment is to prepare the following key information to be the basis of the brief:

- Put your sustainability vision for Sydney and identify the goals and broad requirements. Define some specific requirements for this option to meet (i.e what are the expectations required of this system to contribute satisfactorily to the sustainability vision and goals you adopted?). (10 marks)

- Describe the system engineering management principles that you recommend to guide how agencies will design and enable this system so that it delivers to the system requirements. Identify the system functions and the subsystems. Allocate one or two system requirements to the subsystems. Use illustrations to show this if it is easier.(10 marks)

(5 marks will also be allocated for how well the brief is structured and formatted)

Context documents for the Metropolitan Strategy can be viewed on the metropolitan strategy website:

"The New South Wales Government formulated a metropolitan strategy to set out how the State Government intends to "sustainably manage growth and change in Sydney and the Greater Metropolitan region (stretching from Port Stephens in the north to Kiama in the south and westwards to the edge of the Great Dividing Range) over the next 30 years." The Metropolitan Strategy: Ministerial Directions Paper may be found under "Documents" for 14 May at http://www.metrostrategy.nsw.gov.au In this paper, Chapters 10 and 11 deal with transport, airports and ports, although reference to transport may be found elsewhere in the document. Also look at the Metropolitan Strategy Update Report (under Documents / 2007/ 15th June on the web site). (Look at the http://www.metrostrategy.nsw.gov.au web address and look up tabs for subregional planning / north west subregion and southwest subregion) "

Also consider in your context the implications of Sydney becoming a city of 7 million by 2050 (part of the 35 million forecast for Australia) See 7.30 report http://www.abc.net.au/7.30/content/2010/s2805432.htm, 22nd to 29th January 2010)

Length Guide: 10 to 15 pages (approximately 3000 – 5000 words).

Group Number: Work in groups of 2 or 3.

Reading

Reading 3.1 Black, J., 2006,"Sustainable urban transport technologies and policies: a research perspective", *Dialogues in Planning*, University of Sydney, pp 1-5, 17-21

Reading 3.2 Doust, K., 2008,"Paper 1 Week 3 Visualisation-matching planning to community aspirations & Expectations", *extracts PhD thesis*, UNSW

Reading 3.3 Blue Mountains City Council, 2003*, A 25 year vision for the city - Towards a more sustainable Blue Mountains*, Blue Mountains City Council

Reading 3.4 Hickman, R. and Banister, D., 2007," Looking over the horizon: transport and reduced CO2 emissions in the UK by 2030",
Transport Policy, 14: 377-387.

Reading 3.5 Doust, K., 2008,"Paper 3 Week 1- Forms Of Sustainability Measurement*",extracts PhD thesis*, UNSW, pp.1 - 9

Reading 3.6 Black, J., 2006,"Sustainable urban transport technologies and policies: a research perspective", *Dialogues in Planning*, University of Sydney, pp 5-10

Reading 3.7 Black, J.A., Paez, A., and Suthanaya, P., 2002, "Sustainable urban transportation: Performance indicators and some analytical approaches", *American Society of Civil Engineers: Journal of Urban Planning and Development*, vol. 128, no. 4, pp. 184 – 209, extracts pp.184 - 192

Reading 3.8 Doust, K., Parolin, B., 2009, "Enabling City Sustainability Through Transport Systems: Moving From Vision to Reality" *4th State of Australian Cities Conference*, Perth, pp 5-12.

Reading 3.9 Doust, K., Parolin, B., 2009, "Enabling City Sustainability Through Transport Systems: Moving From Vision to Reality" *4th State of Australian Cities Conference*, Perth, pp 12-23.

Reading 3.10 Doust, K., 2002, "A case study: a high speed limited stop guided transport system" *Extracts from the 2002 High Speed train Proposal for Sydney*, Transrapid.

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