THE BARTLETT SCHOOL OF PLANNING

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Incorporating Principles of Sustainable Development within the Design and Delivery of Major Projects: An international study with particular reference to Mega Urban Transport Projects for the Institution of Civil Engineers and the Actuarial Profession

Working Paper 8

Perspectives of sustainability visions as applied to MUTPs

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Sustainability visions – principles and appraisal frameworks: An overview of their influence on defining MUTP sustainability and capacity to appraise it

"indicators arise from values (we measure what we care about), and they create values (we care about what we measure)" Meadows 1998

1. Introduction

This paper presents an overview of an exploration into the large field of sustainability, identifying key emerging visions, goals and principles used to define and operationalise the concept, as well as a review of the subsequently developed frameworks established to measure progress towards sustainability.

The paper examines the influence which key sustainability visions have had on Mega Urban Transport Projects, as defined by the OMEGA Centre at UCL; *so land-based transport infrastructure investments within and connecting urban areas, perceived as critical to the success of major urban development initiatives, and which entail construction costs of over 500 million US dollars*.

The literature shows an abundance of possible definitions of sustainability and sustainable development, terms often[1] used interchangeably. In general, sustainability refers to long-term availability of proper means that are necessary for a long-term achievement of prespecified goals (Nijkamp, 1993). As a result, there has been numerous attempts, to define these different goals, by different, academics, institutions, nations, sectors; resulting a plethora of sustainability visions and frameworks of varying influence.

Bossel (1999) points out that the sustainability concept/framework (with its embedded goals) we adopt has consequences, as our interpretation of the concept directs our focus to certain indicators, used to aid our decision making towards achieving these goals, at the neglect of others. Conversely, if we rely on a given set of indicators, we can only see the information transmitted by these indicators, and this defines and limits both the system and the problems we can perceive, and the kind of sustainable development we can achieve.

[1] (wrongly as is expanded later in this paper)

So the investigation of the different goals, visions, principles being used to define and provide meaning to this vague term and indicator frameworks used to measure progress towards it, carried out in this paper, enables us to attempt to answer two fundamental questions. Firstly, whether and how these key sustainability frameworks/visions have influenced the nature of transportation, and subsequent definition of sustainable transportation, and implications regarding the definition of a sustainable MUTP. Secondly, whether sustainability indicator frameworks, address the transportation system adequately, and whether they actually affect the nature of MUTPs.

For sustainable development to be more than just a popular description for any desirable goal, it must be defined with some precision. In addition, according to George (1999) if the concept is to become a reality, it should be possible to test whether a development (in this case a MUTP) is sustainable. This need, has resulted in considerable effort being directed in the field of sustainability evaluation framework and indicator development over the last 30 years. Nevertheless, there is no consensus as to what consists of the ideal sustainability framework. Therefore in this paper sustainability evaluation literature is reviewed including predominant evaluation frameworks (Chapter 3), identifying the gaps and overlaps and extracting best practice to inform the development of the MUTP sustainability evaluation framework (Chapter 4).

In research carried out by SUE-MOT (2004), more than 600 urban sustainability indicator tools were identified. Indicators have long been identified as desirable 'measuring rods' to assess and monitor progress towards sustainable development (Briassoulis, 2001) and different definitions for indicators reflect their intended purpose (Box 1.1). An array of sustainability indicators ‘tools’, ‘toolkits’, and ‘checklists’ have been developed to measure sustainability at different levels (Bell and Morse, 1999; Hardi and Zdan, 1997; Bossel, 1999; Woodall and Crowhurst, 2003; WS Atkins, 2001).

Box 1.1. Examples of indicator definitions

“*Indicators are proxies that suggest impacts on underlying features of concern. The proxies are more observable than those of concern, but should also act as indirect indices of change in those features*” (Nugent, 1996 in Guy and Kilbert, 1998, p 40)

“*An indicator is a parameter, or value derived from parameters, which points to, provides information about, describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value*” (OECD terminology, quoted in CRISP, 2001, p 5)

“*Sustainability indicators are ‘bellweather tests of sustainability and reflect something basic and fundamental to the long-term economic, social and environmental health of a community over generations*” (Sustainable Seattle, 1993, p 4)

“*Indicators are clearly a tool for education and require a process that will insure their success*” (Guy and Kilbert, 1998, p 40)

Despite this diversity, there is no indicator framework, which has been developed and used to evaluate the sustainability of MUTPs specifically. Furthermore, the use and nature of existing sustainability indicators has not been without criticism (Gudmundsson, 2001;2002;2004; Bell and Morse, 1999; Mitchell, 1996). For example, there are problems of oversimplification of complex issues through the use of indicators (Hemphill et al, 2002). There are concerns of introducing bias through the selection of indicators (Bossel, 1999) and doubt over indicators' actual capacity to measure long-term sustainability (Bell and Morse, 1999 and 2003). Thus a review of key sustainable transport indicators is carried out in order to evaluate they capacity to truly evaluate MUTP sustainability (Section 2).

Bell and Morse (1999) propose the acceptance of subjectivity and the adoption of a participatory approach to the development of indicators to ensure the inclusion of key stakeholders views. This is in line with more general evaluation and sustainability literature aforementioned (Patton, 2002; Ukaga 2001). However, the adoption of such an approach for MUTP sustainability evaluation requires a deepened understanding of MUTP stakeholders and decision making processes, involved throughout the life cycle of such a project.

Furthermore, despite the plethora of emerging sustainability indicator tools and frameworks, (indicatively the IISD Indicator Compendium identified 625 sustainability indicator frameworks in 2005, and the SUE-MOT (2004) review of indicator tools identified 632 urban sustainability indicator tools), there is little documented evidence of their implementation, and even less on their evaluation (Pediaditi et al, 2006; Innes and Booher, 2000; Mitchell, 1996; Deaking and Huovilla et al, 2002; Bell and Morse, 2003). Innes and Booher (2000, p. 174), referring to sustainability evaluation tool development, state:

> *'this movement is developing so quickly that little has as yet been published documenting, much less critically evaluating, these experiments or assessing their impact. The internet is a much better source than the library for finding out about much of this work, although its descriptions are sketchy and reflect the image each group wants to offer.'*

Mitchell (1996) comments on the ad hoc development of tools and sustainability indicators, whereas Deaking, Huovila et al (2002) note the existing overlap between tools. Moreover, with regard to the quality of existing tools and the extent of their use, there is also little information (SUE-MoT, 2004) This underlines the need to review existing sustainability tools and the extent of their implementation, as well as relevance to MUTPs (Section 4).

Susskind et al (2001) comment on the general lack of evaluation of policy or project success, and attribute this to the idea that nobody likes to look at past failures. However, this phenomenon has significant consequences in that there is a lack of transfer of knowledge, or learning from past mistakes. Cozens et al (1999) talk of mistakes of the 1960s in terms of urban development projects

being repeated. Tinworth (2004) expresses concern over (a) the lack of knowledge and understanding of sustainability of the people leading the development efforts and (b) the lack of attempts to evaluate and learn from past projects. According to the OMEGA Centre this holds true also for the case of MUTP, and according to Gudmundsson, (2002) for transport policy evaluation in general.

Considering the increasing growth in the number of MUTPs and the evidence of continued failure to evaluate sustainability, and for decision makers to learn from past experience (Carley and Christie, 1992; Rootheroo, et al 1997), this paper reviews existing sustainability indicator frameworks, and appraisal methods establishing their strengths and weaknesses with the aim of proposing recommendations for MUTP sustainability evaluation, in the form of proposed SD MUTP evaluation framework specifications.

1.1. Structure of paper

This paper starts by providing an overview of key international visions-frameworks of sustainability exploring their relevance to MUTPs and the transportation systems nature. A brief outline of the emerging indicators of these key frameworks is presented followed by reflections of the implications the indicator selection, may in fact be having on the definition of what sustainable transport entails (Section 2).

A review of generic sustainability evaluation theory is carried out in Section 3. The main influential sustainability monitoring and evaluation frameworks utilized are presented along with their strengths and weaknesses. In Section 4 a framework for sustainability assessment development based on the Bellagio Principles is presented, followed by an investigation of the characteristics of ideal indicators for MUTP evaluation (Section 4.1). A review of existing sustainability evaluation tools (potentially relevant to MUTP scale of appraisal) is conducted based on the Bellagio principles as well as of existing appraisal processes which MUTPs may be subjected to taking the example of the UK . The paper concludes (Section 5) with recomdenations for further research and measures required to enable MUTP sustainability evaluation as well as a list of proposed specification for debate regarding the characteristics which MUTP evaluation should follow.

2. Defining sustainability an overview of key visions, principles, goals and frameworks.

Early on in nearly every discussion about sustainability the question arises, "What is the definition of sustainability?" Through the years, hundreds of definitions have been created. One of the most frequently quoted definitions is from the Brundtland Report which states:

> "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*." (WCED, 1987, pg 43).

The Brundtland definition (WCED, 1987), although criticized for its vagueness, does embed within it fundamental principles (in conjunction with Agenda 21 and the Rio Declaration), which their true embracement would result in fundamental changes, in the way decisions are taken from then on. This definition implies a very important shift from an idea of sustainability as a primarily ecological concept to a framework that also emphasizes the economic and social context of development, underlining the need to balance all three dimensions (often referred to as the triple bottom line). The principle of interdependence of society, economy and environment, which the notion of maintaining capital and limits to growth not surpassing carrying capacity are also embedded. The principle of equity is also embedded in this definition and has to do with fairness - whether all people have similar rights and opportunities, basic needs to maintain an acceptable quality of life. Equity, in this context, refers to the idea that all people throughout a community, whether a village, town, city, country or the entire world, have these same basic needs that must be taken into consideration.

With the term future generations this definition embeds another dimension, the temporal one, and requires all aforementioned principles to take a long term view of impacts and responsibilities.

This involves the consideration and acceptance of uncertainty, which has been expressed as the precautionary principle which was incorporated into the 1992 Rio Declaration on Environment and Development (Table 2.1), stating that, "*Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*" Finally, a key principle is that of the polluter pays Principle, and which has manifested itself in the form of impact assessment procedures instated globally. This principle recognizes that the polluter should pay for any environmental damage created, and that the burden of proof in demonstrating that a particular technology, practice or product is safe should lie with the developer, not the general public. Unfortunately, when and how much the polluter should pay is often unclear.

Arguably the most fundamental and influential policy document which described a programme for the achievement of sustainable development adopted at the Rio World Summit in 1992, was Agenda 21. Agenda 21 called on all countries to develop sustainable development strategies with goals, and sustainability indicators to monitor the achievement of those (Chapter 40 of Agenda 21).

As a result, different, Institutions, Organizations, Countries, Sectors, Governments have sought to provide their definitions of sustainability or sustainable development, which are characterized by similar visions, goals,

objectives presented in frameworks/strategies which subsequently form the basis of indicator frameworks. The question rises to what extent do these visions differ and to what extent to they influence-facilitate sustainable decision making for the transport sector?

Transportation is recognized as having a direct link and key role in the delivery of sustainable development (CST 2005, ECMT, 2004). Transporation is advocated for its assistance to economic growth by providing accessibility to resources and markets. It is also perceived to improve quality of life linking persons to employment, health, education, recreation and other amenities, thus playing a key role in economic and social development (Rassafi & Vaziri, 2005). However, its negative environmental implications are also increasingly recorgnised, such as congestion, safety. Pollution and non renewable resource depletion (EEA, 2007).

In Table 2.1, are summarized different principles/ goals of influential sustainable development strategies. The Rio Declaration principles are presented as they consist of the basis on which other strategies and principles where subsequently developed. Although the Rio Declaration does not refer explicitly to transport, it does figure in its subsequent Action Programme meaning Agenda 21. Interestingly transportation is referred to explicitly, mainly in Chapter 9, which refers to emissions "*The basic objective of this programme area is to develop and promote cost-effective policies or programmes, as appropriate, to limit, reduce or control, as appropriate, harmful emissions into the atmosphere and other adverse environmental effects of the transport sector, taking into account development priorities as well as the specific local and national circumstances and safety aspects" (Agenda 21 par 9.14).* This gives rise to the question, regarding how holistically is transporations role in contributing to Sustainability considered from the onset, when mentioned primarily with regard to its contribution to emissions.

Activities proposed to achieve the above objective as stated in Agenda 21 are to *"Develop and promote, as appropriate, cost-effective, more efficient, less polluting and safer transport systems, particularly integrated rural and urban mass transit, as well as environmentally sound road networks, taking into account the needs for sustainable social, economic and development priorities, particularly in developing countries"(Agenda 21, par 9.15).* This Agenda 21 proposal underlines the relevance and potential contribution of MUTPs towards sustainable development, however, the need to take into account nationally relevant and context specific priorities and needs it also underlined. The narrowness of the context and range of proposed transport actions, is evident, as recommendations are based mainly on modal choice, infrastructure provision and technological improvements, something which has been now established as insufficient (Gudmundsson & Hojer, 1996; CST, 2005, Zegras, 2006).

The Millennium Development Goals (MDGs) are eight goals to be achieved by 2015 that respond to the world's main development challenges. The MDGs (www.un.org/millenniumgoals) are drawn from the actions and targets contained in the Millennium Declaration that was adopted by 189 nations-and signed by 147 heads of state and governments during the UN Millennium Summit in September 2000 The MDGs, even though they do not explicitly refer to sustainable development, they are nevertheless influential goals of policy relevance, due to their phrasing. They are supposed to be taken into account by, signed up nations, donor agencies and organizations, when deciding whether to fund investment, aid, development projects and programmes (UN millennium project, 2005).

MUTPs are large investment projects, of often national importance, in some cases, funded as development aid. Thus, theoretically, they should be evaluated with regard to their contribution to achieving the MDGs, signifying that MDGs could potentially effect the nature of MUTPs. However, neither the MDGs nor their indicators selected and targets set, make any reference to transportation. UNEASAC (2006), comment on the role of transport in achieving the MDGs and mention as a limitation, the absence of targets relevant to transport[2].

The EU sustainable development strategy (Council of the European Union, 2006 & See Table 2.1) is based on the Rio Declaration and Agenda 21, but incorporates a problems based focus to its strategy by identifying the key challenges to be addressed. This strategy has been developed in order to be compatible with Agenda 21 the MDGs, and the Johannesburg implementation plan It has a more binding yet still guiding role for EU member states policy development as well as a basis for EU member state National Sustainability Strategy development. The EU Sustainable development strategy even though vague, **does** make explicit reference to sustainable transport and thus could be perceived as an influential vision for MUTP nature characterization.

Therefore, based on Agenda 21 all nations should develop sustainable development national strategies, and the UKs one is presented as an example of such a strategy, barring in mind that it should be compatible with all the aforementioned strategies. Again explicit mention of transport in the UK strategy is absent.

Table 2.1- Principles- visions- goals etc of key sustainable development strategies

[2] The author disagrees with UNEASAC 2006 comments regarding the introduction of transport targets and indicators, as transport is one of many potential means towards achieving the MDG goals. So the inclusion of such indicators would be essentially measuring input and process rather than outcome indicators, which are required in this case.

Rio Declaration- principles of Sustainable development (UNEP, web)

Principle 1: Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 2: States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Principle 3: The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.

Principle 4: In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

Principle 5: All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world.

Principle 6: The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, shall be given special priority. International actions in the field of environment and development should also address the interests and needs of all countries.

Principle 7: States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Principle 8: To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

Principle 9: States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the

development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.

Principle 10: Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

Principle 11: States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.

Principle 12: States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means
of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus.

Principle 13: States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage. States shall also cooperate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.

Principle 14: States should effectively cooperate to discourage or prevent the relocation and transfer to other States of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.

Principle 15: In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Principle 16: National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

Principle 17: Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

Principle 18: States shall immediately notify other States of any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment of those States. Every effort shall be made by the international community to help States so afflicted.

Principle 19: States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary environmental effect and shall consult with those States at an early stage and in good faith.

Principle 20: Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development.

Principle 21: The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all.

Principle 22: Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

Principle 23: The environment and natural resources of people under oppression, domination and occupation shall be protected.

Principle 24:Warfare is inherently destructive of sustainable development. States shall therefore respect international law providing protection for the environment in times of armed conflict and cooperate in its further development, as necessary.

Principle 25: Peace, development and environmental protection are interdependent and indivisible.

Principle 26:States shall resolve all their environmental disputes peacefully and by appropriate means in accordance with the Charter of the United Nations.

Principle 27: States and people shall cooperate in good faith and in a spirit of partnership in the fulfilment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development.

Millennium Development Goals

- Goal 1: Eradicate extreme poverty and hunger
- Goal 2: Achieve universal primary education
- Goal 3: Promote gender equality and empower women
- Goal 4: Reduce child mortality
- Goal 5: Improve maternal health
- Goal 6: Combat HIV/AIDS, malaria and other diseases
- Goal 7: Ensure environmental sustainability
- Goal 8: Develop a Global Partnership for Development

EU sustainable development strategy

Key objectives

Environmental protection
Social equity and cohesion
Economic prosperity
Meeting our international responsibilities

Policy guiding principles

Promotion and protection of fundamental rights
Solidarity within and between generations
Open and democratic society
Involvement of citizens
Involvement of businesses and social partners
Policy coherence and governance
Policy integration
Use best available knowledge
Precautionary principle
Make polluters pay

Key Challenges

Climate Change and clean energy: To limit climate change and its costs and negative effects to society and the environment

Sustainable Transport: To ensure that our transport systems meet society's economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment

Sustainable consumption and production: To promote sustainable consumption and production patterns

Conservation and management of natural resources: To improve management and avoid overexploitation of natural resources, recognising the value of ecosystem services

Public Health: To promote good public health on equal conditions and improve protection against health threats

Social inclusion, demography and migration: To create a socially inclusive society by taking into account solidarity between and within generations and to secure and increase the quality of life of citizens as a precondition for lasting individual well-being

Global poverty and sustainable development challenges: To actively promote sustainable development worldwide and ensure that the European Union's internal and external policies are consistent with global sustainable development and its international commitments

UK Principles of Sustainable Development (HM Government, 2005, pg 3)

UK as an example of National Sustainable Development Strategy – emerging principles and priority areas.

Living within environmental limits:
Respecting the limits of the planets environment, resources and biodiversity- to improve our environment and ensure that the natural resources needed for life are unimpaired and remain so for generations.

Ensuring a strong, healthy and just society:
Meeting the diverse needs of all people in existing and future communities, promoting personal well being, social cohesion and inclusion, and creating equal opportunity for all.

Achieving a Sustainable Economy
Building a strong and sustainable economy which provides prosperity and opportunities for all and in which environmental and social costs fall on those who impose them (polluter pays) and efficient resource use is incentivized

Using sound science responsibly
Ensuring policy is developed and implemented on the basis of strong scientific evidence, whilst taking into account scientific uncertainty (through the precautionary principle) as well as public attitudes and values

Promoting good governance:
Actively promoting effective participative systems of governance in a levels of society- engaging peoples creativity, energy and diversity.

Priority areas for action of UK SD strategy

Sustainable Consumption and Production
Sustainable consumption and production is about achieving more with less. This means not only looking at how goods and services are produced, but also the impacts of products and materials across their whole lifecycle and building on people's awareness of social and environmental concerns.
This includes reducing the inefficient use of resources which are a drag on the economy, so helping boost business competitiveness and to break the link between economic growth and environmental degradation.

Climate Change and Energy –
The effects of a changing climate can already be seen. We will seek to secure a profound change in the way we generate and use energy, and in other activities that release these gases. At the same time we must prepare for the climate change that cannot now be avoided. We must set a good example and will encourage others to follow it.

Natural Resource Protection and Environmental Enhancement
Natural resources are vital to our existence and that of communities throughout the world. We need a better understanding of environmental limits, environmental enhancement and recovery where the environment is most degraded to ensure a decent environment for everyone, and a more integrated policy framework.

Sustainable Communities
Our aim is to create sustainable communities that embody the principles of sustainable development at the local level. This will involve working to give communities more power and say in the decisions that affect them; and working in partnership at the right level to get things done. The UK uses the same principles of engagement, partnership, and programmes of aid in order to tackle poverty and environmental degradation and to ensure good governance in overseas communities.

These priorities for action within the UK will also help to shape the way the UK works internationally, in ensuring that our objectives and activities are aligned with international goals.

Guiding Principles for Sustainable transportation
OECD International Conference, Vancouver Canada, 24-27 March 1996

- **Principle 1: Access** People are entitled to reasonable access to other people, places, goods and services.
- **Principle 2: Equity** Nation states and the transportation community must strive to ensure social, interregional and inter-generational equity, meeting the basic transportation-related needs of all people including women, the poor, the rural, and the disabled.
- **Principle 3: Health and Safety** Transportation systems should be designed and operated in a way that protects the health (physical, mental and social well-being) and safety of all people, and enhances the quality of life in communities.
- **Principle 4: Individual Responsibility** All individuals have a responsibility to act as stewards of the natural environment, undertaking to make sustainable choices with regard to personal movement and consumption.
- **Principle 5: Integrated Planning** Transportation decision makers have a responsibility to pursue more integrated approaches to planning
- **Principle 6: Pollution Prevention** Transportation needs must be met without generating emissions that threaten public health, global climate, biological diversity or the integrity of essential ecological processes.
- **Principle 7: Land and Resource Use** Transportation systems must make efficient use of land and other natural resources while ensuring the preservation of vital habitats and other requirements for maintaining biodiversity
- **Principle 8: Fuller Cost Accounting** Transportation decision makers must move as expeditiously as possible toward fuller cost accounting, reflecting the true social, economic and environmental costs, in order to ensure users pay an equitable share of costs.

By reviewing Table 2.1, a number of important conclusions can be drawn. Firstly the principles between different strategies are not conflicting, primary reason being their vagueness. However, the devil is in the detail and the operationalisation of these principles is where the difficulty arises.

Interesting is the limited reference in these strategies to transportation. This could be justified from the fact that transport is a means to an end (including that of sustainability) rather than an end in itself. Explicit reference to transportation is made in the EU strategy under the category of challenges, whereby a definition of sustainable transportation is provided. However, an examination of the sustainability indicators selected to monitor progress towards achieving their

visions/ goals, transportation indicators feature in all apart from the MDGs (See Table, 2.2). This indicates that transportation sustainability is essentially being defined through indicator choice!

Table 2.2 : Transport relevant indicators measured to assess progress towards achieving sustainability strategies.

UNCSD, 2007, Indicators of sustainable development which make reference to transport	Category: consumption and production patterns- transportation Modal split of passenger transportation Modal split of freight transport Energy intensity of transport
EU sustainable development strategy indicators – relevant to transport	Category: Sustainable transport Energy consumption by transport mode Modal split of passenger transport Volume of freight transport relative to GDP Volume of passenger transport infrastructure by mode Greenhouse gas emissions by transport mode People killed in road accidents Emissions of ozone precursors from transport Emissions of particulate matter from transport Average CO2 emissions per km from new passenger cars
UK Sustainable Development strategy- framework indicators	Category Mobility: Number of trips per person by mode Distance travelled per person per year by broad trip purpose.
MDG indicators	(No directly transport related indicators- see ENSCA, 2006 report for a critique)

A range of definitions of sustainable transportation have been developed which, can be argued to add to the aforementioned confusion (Box 2.1). Nijkamp (1993), point out that there is no such thing as a generally accepted definition of sustainable transport and argue whether one , would, could or should exist. What is widely accepted however are transportations significant economic, social and environmental impacts, and subsequent effect on achieving sustainability (Litman, 2009). Zegras (2006), provides a detailed review of the historical development of the concept of sustainable transportation and sustainable mobility, commenting on the lack of operational definitions, and the vagueness of existing ones. However, Zegras (2006 pg 9) identifies within the plethora of sustainable transport definitions three basic concepts: access (accessibility), recognition of resource constraints (financial, economic, natural, cultural) and equity (intra and intergenerational).

In Table 2.1, the Vancouver principles (which were never formally endorsed www.sustreport.org/background/principle_eg.html) for sustainable transportation, indicate the need for a significant paradigm shift to occur in transport planning, moving away from its evaluation in terms of mobility

(physical movement), but rather in terms of accessibility (peoples ability to obtain desired goods and services) Litman (2009). Principle one states " Access to people, places goods and services is important to the social and economic well being of communities. Transportation is a key means, **but not the only** means through which access can be achieved." What also emerges from the non endorsed Vancouver principles and more recent Transport academic literature (eg Minken et al, 2003; Stead & Meijers, 2004; Martinez, 1995), is the need to integrate land use planning with transport planning, as accessibility provision may not involve transportation systems at all.

Box 2. 1: Indicative definitions of sustainable transportation

Sustainable Transport: To ensure that our transport systems meet society's economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment (EU Sustainable Development Strategy)

A sustainable transportation system as one that: "Allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations. Is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy. Limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, limits consumption of renewable resources to the sustainable yield level, reuses and recycles its components, and minimizes the use of land and the production of noise" (Canadian Centre for Sustainable Transportation, ECTM, 2004)

"Sustainable transportation concerns systems, policies, and technologies. It aims for the efficient transit of goods and services, and sustainable freight and delivery systems. The design of vehicle-free city planning, along with pedestrian and bicycle friendly design of neighborhoods is a critical aspect for grassroots activities, as are telework and teleconferencing. It is more about accessibility and mobility, than about 'transportation'. (Sustran network)

sustainable mobility is "the ability to meet the needs of society to move freely, gain access, communicate, trade, and establish relationships without sacrificing other essential human or ecological values today or in the future. (World Business council for Sustainable Development)

However, from a review of sustainability indicators used to measure sustainable transport, or transport's contribution to sustainable development (Table 2.2), it is evident that accessibility does not feature directly. Where accessibility is mentioned as an indicator, yet often the metrics used to calculate it make reference again to mobility measures. The methodological difficulties of developing measurable accessibility indicators, is recognized in the literature (Pirie, 1979; Niemeier, 1997; Handy and Niemeier, D, 1997, Bertolini et al 2005).

This raises the question "to what extent have the Vancouver principles, and plethora of academic literature on accessibility and sustainable transportation

effected Key sustainability visions, policy and indicator frameworks?" A review of EU transport monitoring framework TERM 2006 and TERM 2008 and indicators, whose purpose are to monitor strategies and integrate environment concerns in transport policies since 2001, indicate serious limitations. The evaluation of social and equity issues is deficient, accessibility indicators are still not agreed or very limited in scope, with again a predominant focus being on technology and modal split. With regard to MUTP, concerning is the use of TERM indicator 19 "infrastructure investments". A detailed review of this indicator, although not accompanied by a target, demonstrates firstly the flawed approach of evaluating processes and inputs, rather than sustainability outcomes, (http://themes.eea.europa.eu/Sectors_and_activities/transport/indicators/TERM19,2002) , and secondly the potential danger of branding infrastructure investments as inherently sustainable, as was the case in the UK through the use of "% of development on brownfield land" Headline sustainability indicator, which resulted in brownfield redevelopment being branded as inherently sustainable- regardless of impacts (Pediaditi et al, 2005).

So if Bossels (1999) and Meadows (1998) theory on how indicator selection and frameworks, limit system boundaries and subsequently options to progress towards sustainable development, is accepted; it becomes apparent from the above review of strategies and adopted indicators, all things being equal, that transport policy and planning actions will continue to focus on the provision of means of mobility, new technologies and modal split adjustments. However, if Zegras (2006), as so many other academics more recent proposals (Litman, 2009, Gudmundsson, 2002; Bertolini et al, 2005; Ahman, 2008) for the explicit re-orientation towards and grounding of sustainable transport in the idea of accessibility is adopted; the need to develop the appropriate indicator frameworks and indicators to evaluate this becomes a pressing priority.

A second important, yet generic issue arising from the review of Table 2.1 and Box 2.1, is the inconsistent use of terminology. It is evident that there is confusion regarding the difference between the meaning of "a principle, goal, objective, challenge, issue", which has planning, management and evaluation implications (Litman, 2009). The management of the process towards sustainable development is based on the development and implementation of Sustainable development strategies (Hametner & Steurer, 2007) According to the Resource Book on SD strategies, "*Being strategic is about developing an underlying vision through a consensual, effective and iterative process; and going on to set objectives, identify the means of achieving them, and then monitor that achievement as a guide to the next round of this learning process*." (IIED, 2002:29).

As this quote emphasises, developing a long-term vision and setting concrete objectives are two initial key steps of a strategic process. Ideally, these steps are based on an assessment of the status quo and current trends, and they are accompanied by high-level political commitment. So in the case of MUTPs if the theoretical (yet not necessarily true) procedure would be to, when developing an

MUTP strategy, take a step back and define its vision and goals, which as stated above should be to improve accessibility, and thus develop an accessibility strategy (Brecher & Nobbe, 2007; Bertollini & Salet, 200X). This strategy should then incorporate an initial comparative options appraisal, where one of the options could be an MUTP. However, if the current status quo, due to existing utilized indicators is expressed in modal split and infrastructure investment indicators rather than true accessibility measures, the potential to conduct a holistic options appraisal is limited, taking into account Bossel's (1999) theory. Moreover, if the strategies visions are wrongly expressed, as procedural objectives such as "investment priority for environmentally-friendly transport infrastructures" (EEA, 2009), subsequent evaluation through monitoring can only be process and output based rather than outcome focused. The above point has considerable implications regarding MUTP sustainability evaluation. As Kaparos and Skayannis (200X) note sustainability is the outcome of a combination of plans policies and interventions across all sectors and within a global context, the transportation system- and subsequently an MUTP cannot be sustainable in its own right. Methodologically regarding evaluation, this implies that outcome evaluation is necessary to evaluate sustainability condition of a given area (eg the planet) and not that of the transportation system or MUTP itself. As can be concluded from the above, this evident (Table 2.1) semantics confusion regarding what a goal, vision, objective means, has direct influence in the capacity to measure and subsequently manage progress towards sustainability.

Moreover, Bell and Morse, (1999) and Zegras (2006), refer to the important difference between the term sustainability and sustainable development. Sustainability signifies a state/ condition (albeit ever changing). As a term it is used to describe a goal and is evaluated using outcome indicators. Sustainable development refers to the ongoing process being carried out in order to achieve sustainability, and thus is evaluated using process operational objectives and indicators. As is evident from Table 2.1, this distinction is not clear, and when referring to goals or principles often, procedural objectives on how to achieve sustainability are referred to without clearly defining the wished for outcome and vice versa. Evaluation theory clearly indicates the methodological differences and implications of conducting outcome- output and process evaluations. (Stufflebeam & Shinkfield, 2007) Disappointingly, it is evident that this is not clear to those developing the strategies and indicator frameworks.

From all the above the main conclusions which can be drawn are that:

- There is no consensus on the goals of sustainability
- There is no consensus on the principles and definition of sustainable transportation.
- There is terminology confusion and inconsistency in the use of Sustainable development (visions, goals, objectives etc) and sustainability,
- Indicators play an important yet implicit role in operationalising the concept of sustainability.

- The aforementioned Terminology confusion regarding sustainability which is resulting in the use of methodologically and theoretically inappropriate indicators such as modal split to measure progress towards sustainability.
- A sustainability goal is improved accessibility and not access to means of mobility
- Subsequently transport is one of many potential means or threats to the end of goal of sustainability and thus:
    - Cannot be sustainable in its own right (and subsequently neither an MUTP)
    - Should not feature as a principle goal or measure of sustainability in SD strategies
- Emphasis should be placed on defining accessibility objectives and targets rather than explicitly transport policy driven goals.
    - MUTP appraisal should consist of comparative options appraisal with regard to its potential to improve accessibility in relation to other means like land use planning- telecommunications etc.

3. Sustainability Evaluation

Conceptual frameworks for indicators help to focus and clarify what to measure, what to expect from measurement and what kinds of indicators to use. Diversity of core values, indicator processes and sustainable development theories have resulted in the development and application of different frameworks. The main differences among them are the ways in which they conceptualize the key dimensions of sustainable development, the inter-linkages among these dimensions, the way they group the issues to be measured, and the concepts by which they justify the selection and aggregation of indicators (UN, 2007).

A review of the fundamentals of evaluation theory, however, indicates the need to examine the purpose which an evaluation is intended to serve, in order to develop an appropriate evaluation methodology and subsequently selection of relevant indicator framework and indicators (Stufflebeam & Shinkfield, 2007). This question is not easily answered for the case of MUTP sustainability evaluation, and may consist of the fundamental reason why, there is to date no single sustainability evaluation procedure of MUTP projects. A subset of questions need to be answered which consist (yet not limited to) the following:

- Who is the evaluation outcome user?
- Do they have the means- will- and institutional tools to act upon the findings?
- What decision making processes are meant to be informed by the evaluation (needs assessment regarding project purpose? Assessment of project impacts eg EIA or project risks eg RAMP?, or ex ante evaluation of impacts eg policy evaluation and NSD indicator type monitoring?)
- Which stage of the MUTP life cycle is being evaluated?
- What is the scale of the evaluation? (the project it self or its wider impacts?) local, regional, national, international, global?
- Who is the evaluation funder!!!

Who will utilize the results of the evaluation process, is it the developer/ investor of the MUTP? The planning/ regulatory authorities of the area in which the MUTP is being built? What about stakeholders who will receive the impacts (negative or beneficial) of such a MEGA project, yet whose regulatory authorities are not involved in the decision making process? Or maybe national- EU level policy makers, due to the MEGA nature of such projects?

Answering this question, will determine firstly the scope and subsequently the duration of the evaluation. An investor or developer will most likely be interested in the risks and impacts to the project it self and thus in a short term project appraisal approach prior to development initiation. Such and an appraisal may or may not include evaluation of project delivery effectiveness evaluation (criteria of which most likely will be based on cost, timing etc).

Regulators and planning authorities will also require a project appraisal, prior to the authorization of the project (whose scope may well be larger, taking into account parameters other than financial viability). The scope of such an appraisal will be of the impacts effects, not to the project or company funding the project, but rather the wider environment/ society/ economy, whose boundaries, could be determined by decision making or administrational authority, and specialization of the person conducting the appraisal (Brugman, 1997). However, due to fragmentation of public sector decision making remits and responsibilities (Carley and Christie 1992), evaluation of the long term implications and sustainability of MUTP outcomes, will not lie with the same authorities. Policy makers which may be interested in the long term implications of such a project, will no doubt require ex-ante long term evaluation methods, based on outcome, policy relevant indicators[3].

However, this indicates procedural problems in the design of the evaluation methodology and subsequent selection of indicator framework. An MUTP, by definition is a project. So according to evaluation theory, requires project evaluation methods (Stufflebeam & Shinkfield, 2007). However, the impact of MUTPs is of policy evaluation scale, due to their MEGA size, complexity and impacts. Therefore, from the onset we identify a procedural barrier, which needs to be overcome before designing an appropriate sustainability evaluation framework. There is no point in undertaking an evaluation (whether it be an appraisal or long term monitoring programme) if there is no ownership of the process and decision making, and institutional capacity to act upon the results.

Based on the above, it can be concluded that in order to develop a sustainability framework from MUTP evaluation, there is a need to define the MUTP context and purpose of the evaluation. However, as mentioned in the introduction there has been an explosion of emerging sustainability frameworks, which also have their limitations which need to be reviewed before decising on a MUTP specific sustainability evaluation framework. The UN (2007) and Pinter et al (2005) broadly classify emerging frameworks into four categories:

A. Driving force-state-response (DSR) -Pressure State Response (PSR)- Driving force- Pressure- State Impact Response (DPSIR) frameworks
B. Issue- or theme-based frameworks
C. Capital frameworks
D. Accounting frameworks
E. Aggregated indicators
F. Other indicator approaches (eg Headline indicators- goal based indicators, performance measurement)

A brief outline of what these approaches consist of, including generic limitations, is presented in order to allow readers to explore potential applicability and value for MUTP sustainability evaluation. It needs to be underlined from the onset that while these and many other frameworks were developed in the 1990s, only a few

[3] Complications of isolating the impacts of the MUTP alone are an issue in itself See Glasson et al, 1999.

of them gained international acceptance. The majority has remained in an experimental stage or has never become practically relevant. It also needs to be emphasized that such frameworks have been primarily adopted for high level (international- national scale) monitoring, rendering their appropriateness to inform project level decision making problematic. However, as frameworks they form the backbone of sustainability evaluation approaches- which has subsequently been adjusted for utilization for project sustainability evaluation.

Two of the above mentioned frameworks - the PSR and capital accounting-based frameworks — were developed prior to the concept of SD, although subsequently attempts were made to adapt them to be used in assessing sustainability. The PSR framework, in particular was developed for environmental statistics in Canada, then further developed and adopted internationally for use in methodological handbooks and country studies (Rapport and Friend 1979; UN 1984, 1988, 1991). The framework was later adopted by OECD for use in environmental indicator reports (OECD 1991). The UNCSD called the modified framework driving force-state-response (DSR) and used it in the categorization of its first set of 134 SDIs (UN 1996). UNEP also adopted a version of the framework as driving force-pressure-state-impact-response (DPSIR) for use in the Global Environment Outlook (GEO 1997, 1999 and 2002).

However, all variations of the PSR frameworks can only be linked to sustainability evaluation through the use of assumptions. A limitation of such PSR models is that they do not work if evidence for causal linkages is missing, and that they oversimplify inter-linkages among issues (Pinter et al, 2005). Often, it is ambiguous as to whether the issue measured by an indicator represents a driving force or a state (Hak et al, 2007). There are also multiple pressures for most states, and multiple states arising from most pressures, creating difficulties in identifying indicators. This is the main reason why the DPSIR was abandoned in the UN (2001) indicator report, even though its use is still promoted in the EU for utilization in the Water Framework Directive (2004). At a higher level, decision-makers demand sustainability indicators that can be integrated into the relevant level of policy-making (local, regional, national, international). This brings up the challenge that indicators, including social and environmental indicators, usually without a known and accepted monetary value, are brought to bear on economic policy-making (Pinter et al, 2005). These demands lead to the following preferences:

- a small set of indicators;
- indicators that are linked to policy targets; and
- environmental and social indicators that are compatible with macro-economic indicators and the budgeting process.

These preferences help explain why decision-makers tend to select indicators that are linked to the policy process; or why they derive indicators from policy targets. However, for the case of MUTP evaluation, the policy evaluation process, is only implicitly linked to MUTP decision making, and thus policy target

based sustainability evaluation cannot be expected to isolate the specific impacts or contribution of a given MUTP to the specific policy. In addition for MUTPs where there is such uncertainty regarding their impacts, as well as of causal linkages (Pretorius and Mee Kam, 2008), such PSR type framework utilisation can be considered unsuitable, at least until more information and knowledge on MUTPs is gained, to inform indicator selection.

Issue- or theme-based frameworks are the most widely used type of frameworks, especially in official national indicator sets (Hametner & Steurer, 2007). In these frameworks, indicators are grouped into various different issues relating to sustainable development. The issues or themes are typically determined on the basis of policy relevance. Most countries in all regions of the world that have developed national sustainable development indicators have based them on a thematic framework. This is also true of regional strategies and indicator programmes (UN, 2007).

A main reason for the prominence of thematic frameworks is their ability to link indicators to policy processes and targets. This provides a clear and direct message to decision-makers and facilitates both communicating with and raising the awareness of the public. A thematic framework for indicators is also well suited to monitor progress in attaining the objectives and goals stipulated in national sustainable development strategies. It is flexible enough to adjust to new priorities and policy targets over time. However, as indicated from at review of such indicator sets developed by EU member states by (Hametner & Streurer, 2007; Steinbuka & Wolf (web)), indicator selection is often based on data availability rather than relevance, the use of output and input indicators is prominent, and the extent to which conclusions can be drawn regarding outcome indicator trends are limited. Existing indicator sets using this framework, upon review, indicate that they can provide some potentially useful information, regarding the needs assessment for MUTP decision making phase- however, they are limited in their capacity to evaluate, MUTP specific impacts due to scale issues. The framework methodologically, if downscaled could potentially be utilized for MUTP evaluation. However, the necessity of identifying an appropriate institutional mechanism which will take ownership of the process and utilse and act upon the results is imperative (Patton, 2002).

The capital approach to measuring sustainable development has received the most attention, and at the same time criticism (Bell & Morse, 1999; Hak et al, 2007). Capital based sustainability evaluation frameworks, simply put attempt to calculate, mainly using monetarised values, for example at a national level, national wealth as a function of the sum of and interaction among different kinds of capital, such as financial capital, produced capital goods, but also human, social and institutional capital. The frameworks for sustainable development indicators based on this approach vary, but, in general, they all try to identify first what development is, and, second, how development can be made sustainable. This draws attention “to what resources we have at our disposal today, and

towards the issue whether we manage these in ways that make it possible to maintain and further develop the resource base over time." Knut, & Thorvald (2005, pg7), Explicit in the capital approach is the notion of substitutability between different types of capital, which is indeed a complex issue. There are clear examples of substitutability - machines for human labor, renewable for non-renewable sources of energy, synthetics for some natural resources. And future technological innovation and human ingenuity may greatly expand the scope. However, there may also be assets that are fundamental and for which no substitution is possible. This could include, for example, a reasonably stable climate or biodiversity. These methods are problematic and although supported at national and international levels, there remain unsolved challenges which make them unsuitable for MUTP sustainability evaluation. These challenges include disagreement about how to express all forms of capital in monetary terms; problems of data availability; questions about substitution; and the integration of intra-generational equity concerns within and across countries (UN, 2007).

There have been several efforts to develop aggregated indicators to capture elements of sustainable development (Sing et al, 2009). Most aggregate indicators are primarily used for raising public awareness and receive notable attention in the media. Rather than offering a comprehensive view of sustainable development, many of these indicators are specifically focused on the environmental dimension of sustainable development and resource management. There appears to be a continuing trend in the development of aggregate indices that characterize progress towards SD or at least some of the dimensions of SD (See Sign et al, 2009, for a detailed review of developed sustainability indices).

This explains the popularity of the ecological footprint (WWF 2005; EEA 2005b; Global Footprint Network 2005); the Human Development Index – HDI (UNDP 2004); and the recent interest in the Environmental Sustainability Index – ESI (WEF 2005), or its offshoot, the Environmental Performance Index (EPI). Other more prominent indices and underlying frameworks that had been developed and applied on various scales include the Barometer of Sustainability (IUCN-IDRC 1997); the Genuine Progress Indicator – GPI (Redefining Progress 2004); the Genuine Savings Indicator (Hamilton et al. 1997; Pearce 2000); the Total Material Requirement (EEA 2001); the Compass of Sustainability (AtKisson 2000); and eco-efficiency indices (WBCSD 2003). Most of these indices have not generally been accepted for actual decision-making because of measurement, weighting and indicator selection problems (Bartelmus 2001). This is even more so, for development or project appraisal sustainability evaluation, due to issues of context specific applicability and issues of up and down-scalling. These issues are discussed in more detail in Section 4, when trying to characterize the "ideal" indicator for MUTP.

Pinter et al, (2005), following a review of over 625 different sustainable development indicator framework initiatives (iisd, 2005 web) and (SUE MOT, 2004 of 623 urban sustainability tools) conclude that although such initiatives have gained popularity, their effectiveness in influencing policy and practices has remained limited (referring to all types of sustainability indicator frameworks). This view of sustainability indicator limited influence is also supported by Gudmudsson (2002) with regard to sustainable transport policy development. All indicator authors (Pinter, et al, 2005, Bell and Morse 2003, Ukaga, 2004, Gudmudsson 2002, SUE MOT, Sign et al, 2009, Steinbuka & Wolff (web), etc) refer to an unmet potential (of indicator frameworks) which is inhibited by the following institutional, methodological and technical challenges/ barriers.

Bossel (1999) and Pinter et al (2005,p3) state "*From the institutional perspective, the key challenge is to ensure sustainability indicators are integrated into mainstream policy mechanisms, instead of being an environmental "add-on" to already existing and used statistical, measurement and reporting systems*". Regarding sustainability indicators for transport, a study conducted by Gudmundsson (2002), indicated that monitoring reports and results actually, played a limited role in policy development, and had a more symbolic role. Sustainability indicator reporting is still often assigned to environmental agencies without the sufficient mandate, capacity and influence to ensure indicators are brought to bear on key policy decisions, such as the development of government budgets, sectoral policy frameworks, or long-term plans and sustainable development strategies. This political weakness of SD indicators mirrors the relatively low weight of SD in mainstream politics, with a lot of lip service for sustainability but often insignificant real consequences (Pinter et al, 2005). Meaningful is the statement by Sager and Ravlum (2005) "political decision makers gather information and do not use it; ask for more information and ignore it; make decisions first and look for relevant information afterwards".

From the methodological point of view, there are continuing uncertainties and debates about what and how to measure and how to link specific indicators to time-bound targets and thresholds (See Section 4 for a discussion). Comparability of indicator systems continues to be limited by the use of different indicator frameworks that often adhere minimally to standards of how the same variables should be measured A report of EUROSTAT technicians (Steinbuka & Wolff (web)) commented on the difficulty they were facing regarding comparability of indicator systems within member states, amongst other things being variable measurement . Aggregated indices are attractive for communication but require high quality data for consistent, comparable and complete indicator sets, plus a political consensus on indicator weights that is difficult to achieve and to date does not exist, even for small sets of indicators used for example for MDG monitoring (UN Millennium Task Force, 2005).

Sustainability indicators also continue to be affected by serious technical challenges, particularly related to problems with data. The challenges include

data availability and quality, a pertinent problem for the transport sector according to Rassafi and Vaziri (2005) and EEA(2009). However, these problems go deeper and have to do with lack of common definitions and of long-term, consistent monitoring mechanisms that would supply data with adequate temporal and spatial resolution. The issue, however, is not simply the lack or inadequacy of the right kind and quality of data, but also that in some cases the data that are collected at considerable cost have little apparent use in decision-making (Gudmundsson, 2004 in Hester and Harrison). Making significant progress on any of these issues (institutional, technical and methodological) will require a more serious investment of time and effort, and coordinated action of many agencies at all levels. (Pinter et al, 2005).

Having reviewed generic frameworks for sustainability and its evaluation, it is now time to, look at MUTP and propose theoretical specifications for a framework to evaluate their impact on the sustainable development process.

4. Setting the specifications for the development of an MUTP SD evaluation framework.

One of the key documents on sustainability and its evaluation are the Bellagio Principles (Box 4.1) (Hardi and Zdan, 1997). The Bellagio Principles set out the ideal requirements for assessing progress towards sustainable development (ibid) and in doing so also indirectly define sustainability (Bell and Morse, 2003). Therefore, for the purpose of denoting the specifications of an evaluation of MUTP contribution to the process of sustainable development, the Bellagio Principles can be considered as Key. These Principles serve as guidelines for the whole of the assessment process, including the choice and design of indicators, their interpretation and communication of the results (International Institute for Sustainable Development IISD; 2006). The first Principle calls for a vision, which provides orientation and is expressed in practical terms by clear goals. Principles 2-5 address the content of the assessment procedure, and arguably define sustainability. Principles 6-8 concern the actual analysis and Principles 9 and 10 underscore the importance of sufficient and continuous reporting capacity (Hardi and Zdan; 1997). Gessner *et al* (2001, p. 69), state that the Bellagio principles are '*user friendly, robust and widely known and accepted as a concrete expression of Agenda 21'*. However, Bossel (1999) points out that it is practically impossible to fulfil all the Bellagio principles meaning any evaluation will require trade-offs. A range of sustainability frameworks have subsequently been developed which have used the Bellagio principles as a basis but have been modified to suit the specific application or context. For examples, see Water Supply and Sanitation Collaborative Council (2005), Hardi and Zdan (1997), Gessner *et al* (2001), Hass *et al* (2003) and Becker (2004). In the same way there is a need to critically consider these broad themes emerging from these principles and translate them into specifications for the appropriate evaluation of MUTP sustainability.

Box 4.1. Bellagio Principles[4]

1. GUIDING VISION and GOALS Assessment of progress toward sustainable development should: • Be guided by a clear vision of SD and goals that define that vision.
2. HOLISTIC PERSPECTIVE Assessment of progress toward sustainable development should: • Include a review of the whole system as well as its parts; • Consider the well-being of social, ecological and economic subsystems their state; as well as the direction and rate of change of the state of the component parts; and the interaction between parts; • Consider both the positive and negative consequences of human

[4] Source: Hardi and Zdan (1997)

activity in a way that reflects the costs and benefits for human and ecological systems, both in monetary and non-monetary terms.

3. ESSENTIAL ELEMENTS

Assessment of progress toward sustainable development should:

- Consider equity and disparity within the current population and between present and future generations, dealing with such concerns as resource use, over consumption and poverty, human rights and access to services as appropriate;
- Consider the ecological conditions on which life depends;
- Consider economic development and other non-market activities that contribute to human and social well-being.

4. ADEQUATE SCOPE

Assessment of progress toward sustainable development should:

- Adopt a time horizon long enough to capture both human ecosystem time scales, thus responding to current short term decision making needs as well as those of future generations.
- Define a space of study large enough to include not only local but also long distance impacts on people and ecosystems;
- Build on historic and current conditions to anticipate future conditions; where we want to go, where we could go.

5. PRACTICAL FOCUS

Assessment of progress toward sustainable development should be based on:

- An explicit set of categories or an organising framework that links vision and goals to indicators and assessment criteria;
- A limited number of key issues for analysis;
- A limited number of indicators or indicator combinations to provide a clearer signal of progress
- Standardising measurement whenever possible to permit comparison
- Comparing indicator values to targets reference values ranges thresholds or direction of trends as appropriate.

6. OPENNESS

Assessment of progress toward sustainable development should:

- Make the methods and data that are used accessible to all;
- Make explicit all judgments assumptions and uncertainties in data and interpretations.

7. EFFECTIVE COMMUNICATION

Assessment of progress towards sustainable development should:

- Be designed to address the needs of the audience and set of users;
- Draw from indicators and other tools that are stimulating and serve to

engage decision makers; • Aim from the outset for simplicity in structure and use of clear and plain language.
8. BROAD PARTICIPATION Assessment of progress towards sustainable development should: • Obtain broad representation of key grass roots, professional technical and social groups including youth women and indigenous people to ensure recognition of diverse and changing values. • Ensure participation of decision makers to secure a firm link to adopted policies and resulting action
9. ONGOING ASSESSMENT Assessment of progress towards sustainable development should: • Develop a capacity for repeated measurement to determine trends; • Be iterative, adaptive and responsive to change and uncertainty because systems are complex and change frequently; • Adjust goals, frameworks and indicators as new insights are gained; • Promote development of collective learning and feedback to decision making.
10. INSTITUTIONAL CAPACITY Continuity of assessing progress towards sustainable development should be assured by; • Clearly assigning responsibility and providing ongoing support in the decision making process; • Providing institutional capacity for data collection maintenance and documentation; • Supporting development of local assessment capacity.

The first Principle calls for the creation of a clear vision and goals for the achievement of sustainable development. However, as discussed previously, there is no consensus regarding the definition of this concept. Ukaga and Maser (2004) and Bell and Morse (1999) attribute this phenomenon primarily to individual values influencing this definition. The importance of values and the different perceptions of sustainable development is widely addressed in the literature especially with regard to sustainability evaluation frameworks and indicator development (Maclaren, 1996; Bell and Morse, 1999; 2003; Owens and Cowell, 2001; Innes and Booher, 2000; Brugman, 1997; Ukaga, 2001; Breheny, 1994; Brandon *et al,* 1997).

Meppem and Gill (1998) in Bell and Morse (2003) assert that to operationalise sustainability requires moving from literary or scientific definitions towards a process that recognises diversity of perspective. Brugmann (1997, p. 63) states that:

> '*sustainability indicators need to be developed with input from a broad range of stakeholders since sustainability is such a value-laden and context sensitive concept*'.

Ukaga (2001) asserts that sustainability indicators should be designed to provide the information which people want to know in order to promote sustainability in their area of interest, which is also in line with the Bellagio principles. This points out the need for a participatory approach to sustainability indicator development which will allow evaluation users to define sustainability themselves**.**

This has important implications regarding the development of a framework for the evaluation of MUTPs. Adopting an approach which makes use of participatory methods would differ from the usual technocentric top-down methods adopted to develop many of the existing sustainability evaluation and indicator tools (Bell and Morse, 2003).

However, some direction can be drawn from the aforementioned review of principles and definitions of sustainable development and sustainable transportation, regarding the need for a shift in goal from mobility to accessibility, thus setting the basis of any MUTP appraisal against participatory developed accessibility criteria.

Additionally, adopting a participatory approach to sustainability indicator development is also essential when considering the function of indicators as educational tools (Box 1.1). Guy and Kilbert (1998) emphasise the value of sustainability indicators as educational tools. Innes and Booher (2000, p. 177) state that '*indicators' main influence is not primarily after they are developed and published, but rather during the course of their development*.' Both Bell and Morse (1999, 2003) and Innes and Booher (2000) convey that the learning value of sustainability indicators is during the development, implementation and analysis of the indicators rather than the acquisition of results.

This is an important consideration when taking into account Tinworth's (2004) and Ball's (1999) comments on the lack of knowledge and understanding of sustainability of planners/ decision makers and developers themselves (Pediaditi et al, 2007) as well as Ahmans (2008) conclusions that transport planners do not have the knowledge background to conduct, environmental or economic evaluations. In evaluating the sustainability of MUTPs, emphasis could therefore be placed on the process of development of the indicators and assessment, rather than on the actual indicators themselves or the results obtained. In fact, the role of such an evaluation could be seen as a procedure through which new knowledge and ideas on sustainability could enter the MUTP decision making process. This could be achieved through a strategically designed deliberative process which would allow different expertise to collaborate and enable integrated assessments, avoiding the common phenomenon of silo thinking (Carley & Christie, 1992).

However, Patton (1997, 2002) emphasises the need for evaluation users to define the function of the evaluation. Furthermore, Clark and Dawson (1999) point out that benefits from participative evaluation processes, such as learning and communication, do not just occur but rather have to be carefully designed in the evaluation. Therefore, further investigation is required to identify MUTP stakeholders, and to obtain their opinion/ input with regard to the specific purpose they perceive MUTP sustainability evaluation should fulfil.

Giampietro *et al* (2006, p. 62) state that '*sustainability cannot be defined in a substantive formal way once and for all*' and Breheny (1994) points out that any definition of sustainability needs to be **context specific** in order to be operationalised; yet the difficulty of doing so is expanded upon in George (1999). However, Patton (1982, 1997) discusses the general lack of utilisation of evaluation findings at length and attributes it to several things, including the lack of situational responsiveness in evaluation methodology. Mitchell (1996) attributes the lack of implementation of a common set of sustainability indicators to the differences between both evaluation users and evaluation developers and the differences between localities.

For example, Todd and Geisler (1999), in reviewing the Green Building Tool, developed to monitor the sustainability of buildings internationally, identified the difficulty in obtaining sustainability benchmarks and in defining and weighting criteria appropriately as they differed between localities. Bentivenga *et al* (2002, p. 93) states:

> '*strategies that should be employed* [with regard to sustainability evaluation] *should not be based on a fixed target or blueprint, but on an integrated and flexible approach that adjusts to local conditions and the local community requirements*'.

This issue was also raised in literature relevant to transport sustainability indicators (Litman, 2009; Rassafi & Vaziri 2005; Gudmunsson, 2001). Thus,

there is a need for the evaluation of MUTPs to be context specific and flexible, aiming to develop sustainability indicators with the input of decision makers which are appropriate for informing MUTP decision making at the MUTP defined boundary level (as that is defined by each MUTP yet preferably taking into account also impact boundaries). Due to the Mega Scale of MUTPs, with impacts and influences from local to global scales, this may prove to be more than challenging.

The need for a holistic approach meaning an evaluation which considers equally the social, environmental, economic dimensions of sustainability is a Bellagio principle. However, a review of existing development project sustainability evaluation tools by Pediaditi et al (2006) as well as by Levett and Therivel (2004) and Deaking et al (2002) a general fragmentation and a lack of tools addressing all three issues was identified. Levett and Therivel (2004 p. 3) identified that environmental and economic tools prevail, with a lesser emphasis attributed to the social dimension and attribute this phenomenon to the fact that 'there is less consensus about what social issues are and more contention surrounding what significant social impacts are, than about environmental and economic ones.' With regard to transport related indicators the problem of defining accessibility and subsequently indicators to measure it has been problematic (Rassafi and Vazziri, 2005, Minken et al 2003, Marsden et al 2005). Rotheroo et al (1997) point out that generally when developing sustainability indicators the focus usually reflects the expertise of the developer of the indicators. Also Cooper in Brandon et al (1997) identifies a particular gap with regard to building assessment methods addressing social issues as dues Lucas et al, 2007 with regard to transport assessment tools. In fact, when reviewing the tools listed in Table 4.1 Pediaditi et al (2006) observed that in some cases tools which claimed to address social or economic issues did so very sparingly, if at all. For example, one tool which claimed to address all sustainability issues had only one indicator relating to social issues and it consisted of the number of work accidents during construction. So although there are a number of tools, they mainly focus on environmental issues and tend to be fragmented, thus not proving to be entirely appropriate for the purpose of MUTP evaluation. However, there is a plethora of literature regarding the different issues which should be considered in order to evaluate holistically transportation sustainability impacts and are summarised in Table 4.2 based on Litman and Burwell, (2006), as a starting point in any evaluation.

Table 4.1 – Tools reviewed by Pediaditi et al (2006)

CEEQUAL – Civil engineering Environmental Quality Award www.ceequal.com

BRE- Methodology for environmental Profiles of Construction Materials, Components and Buildings www.bre.co.uk

The Boustead Model www.boustead-consulting.co.uk

Building Design Advisor http://gaia.lbl.gov/bda/

DOE-2.2 http://simulationresearch.lbl.gov

Community Sustainability Assessment http://gen.ecovillage.org/activities/csa/English/toc.php

SPeAR The sustainable Project Appraisal Routine

http://www.arup.com/environment/feature.cfm?pageid=1685

Athena www.athenaSMI.ca

BRE Sustainability Checklist for developments www.bre.co.uk

City Green www.americanforests.org

ECOTECT www.squ1.com

EcoCal www.bestfootforward.com/ecocal.htm

ENVEST 2 www.bre.co.uk

The Hong Kong Building Environmental Assessment Method HK-BEAM

http://www.bse.polyu.edu.hk/Research_Centre/BEp/hkbeam/HK

Green Building Challenge www.greenbuilding.ca

GaBi 4 www.pe-europe.com

LEED Leadership in Energy and Environmental Design www.usgbc.org

Landscape urban planning tools

Minnesota Sustainable Design Guide MSDG

http://www.develop.csbr.umn.edu/msdg2/MSDG/guide2.html

Planning for Community Energy, Economic and Environmental Sustainability PLACES

http://www.energy.ca.gov/places/EXECSUMM.PDF

Social Costs of Alternative Land Development Scenarios

www.fhwa.dot.gov/scalds/scalds.html

SEEDA sustainability Checklist www.sustainability-checklist.co.uk

SPARTACUS System for Planning and Research in Towns and Cities for Urban Sustainability http://www.raumplanung.uni-dortmund.de/irpud/pro/sparta/sparta.htm

TEAN, Tool for Environmental Analysis and \Management www.ecobilan.com

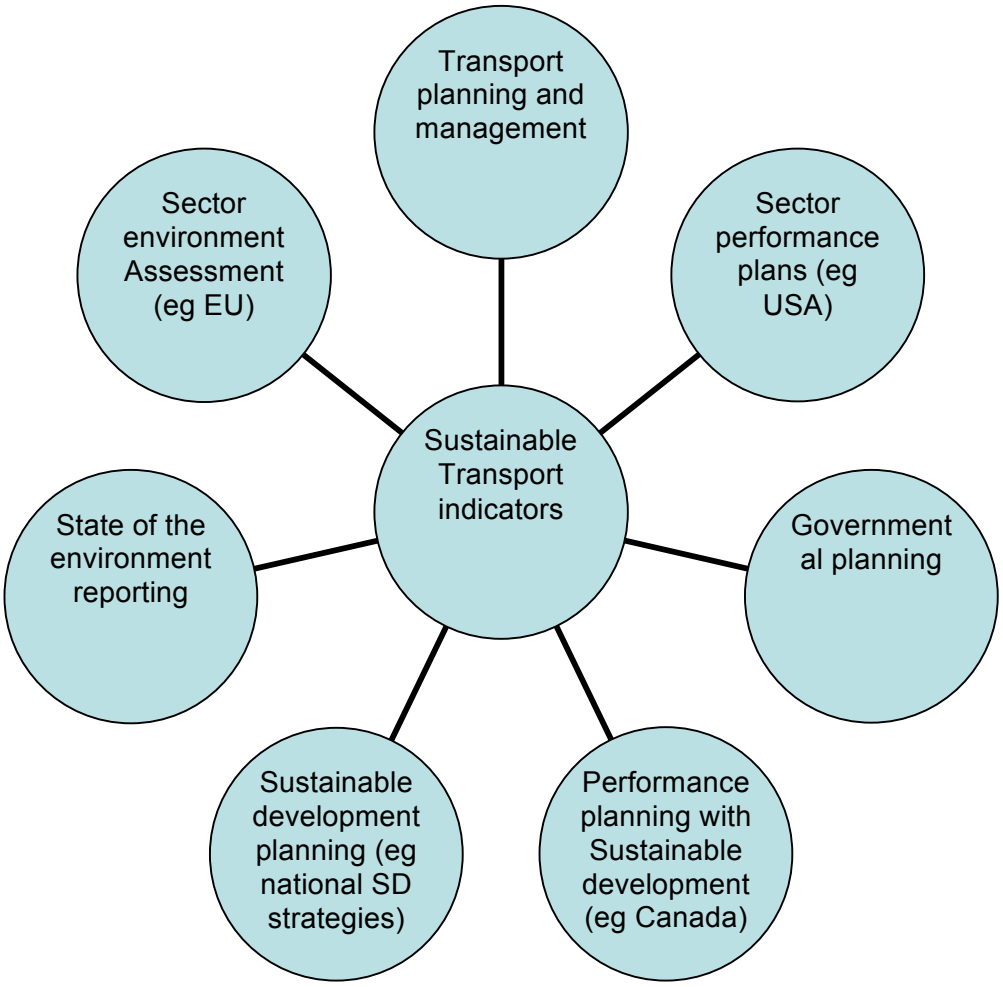
Table 4.2 Sustainable Transport Issues (Source Litman & Burwell, 2006)

Economic	Social	Environmental
Accessibility quality Traffic congestion Infrastructure costs Consumer costs Mobility barriers Accident damages Depletion of non renewable resources	Equity fairness Impacts on mobility disadvantaged Affordability Human health impacts Community cohesion Community liveability Aesthetics	Air pollution Climate change Noise pollution Water pollution Hydrological impacts Habitat and ecological degradation Depletion of non renewable resources

The lack of use of existing sustainability indicator tools is also discussed in Rootheroo *et al* (1997), Mitchell (1996), Pediaditi et al (2006) and Gudmundsson, (2002). SUE-MoT (2004) comments on the limited published information about the extent of use as well as the quality of existing tools. This is attributed in part to their lack of integration with existing institutional decision making processes which have the power to influence a project's sustainability (Rydin *et al*, 2003). Tonn *et al* (2000) comment on the lack of a structured investigation into methods of incorporating sustainability into the process of decision making and Parr *et al* (2003) underline the need to examine how systems like research and planning work together, with the aim of identifying ways in which research results can increase their capacity to influence change. Weston (1997 & 2002) expands on the limited role well legislated and established assessments like EIA, actually influence decision making, signalling that much work is needed this field.

Institutional capacity regarding the development of sustainability indicators is also a Bellagio Principle. There is therefore a need to identify existing MUTP decision making processes which influence the sustainability of projects and to integrate them when developing a sustainability evaluation framework. Gudmundsson (2002), presents the different policy contexts for which sustainable transport indicators can be found-used (See Figure 4.1). However, he also questions the actual extent which the information transmitted from these indicators is actually taken into account in decision making.

Figure 4.1 Examples of policy contexts for Sustainability Transport indicators (source Gudmundsson, 2002).



A MUTP regarding the issue of institutional capacity is highly complex. Brecher and Nobbe (2007), point out the need for sustainability appraisal of MUTPs during the plan preparation phase not during project appraisal, on the proviso that this would allow for an early enough consideration of need and different options appraisal in relation to other alternatives. This issue is also raised by Marsden et al, (2005) following an investigation of the different transport related appraisal frameworks for the UK, concluding that institutional mechanisms fragmentation is a barrier to sustainability learning through appraisal and monitoring. They identify that transport appraisal in England of transport policies and projects exist at two main levels. Transport policies and programmes such as Local transport plans which are supposed to be evaluated based on criteria and monitored using (Dft, 2004) criteria as well as be subjected to Strategic Environmental Assessment, (Therivel, 2004). Regional Transport Strategies are also subject to sustainability appraisals (ODPM, 2004) which essentially widen

the scope of the assessment of SEAs by including social and economic considerations. Whereas for projects classified as major schemes of a budget of over 5 million (so much smaller than the MUTP 500million) in England a NATA appraisal needs to be carried out (Dft, 2005) in addition to Environmental Impact Assessment, which is necessary for projects listed within Annex I and II of the Directive 85/337/EEC.

A review of the aforementioned criteria, frameworks and indicators utilised in both cases indicates that, indicator selection is very limited and unable to provide a holistic picture needed to facilitate sustainable decision making at the policy and plan level. Appraisal procedures like NATA due to the absence of a good baseline and knowledge of implications / impacts of transport intervention alternatives limits are at the moment of limited value. The authors view is that the appraisal framework such as NATA is very limited as alternatives consideration (like in EIA) is obligatory only for the do nothing scenario, rather than other land use planning interventions which could potentially improve accessibility- if that was the intended purpose. With regard to academic and commercially developed sustainability assessment tools, out of all the tools in Table 4.1 only the BRE buildings checklist and the SEEDA development checklist made reference to policy and planning relevant criteria. However, again the context specific criterion of the evaluation renders the use of these tools at best only suitable for use in the UK, and mainly for housing developments. Meaning that, tool developers have paid little attention to this issue, which may explain the limited take up of any of the tools listed in Table 4.1.

The issue of institutional integration of appraisal processes within existing decision making processes is even more complex in the case of MUTPs. Although MUTPs are classified under the category of Project, which would imply the relevance of standard project appraisal methods (eg NATA, Environmental Impact Assessment, Risk Assessment eg using RAMP) the sheer scale of expected desired and undelivered impacts, are of policy dimensions and thus would require different methods of appraisal. Yet neither appraisal mechanism (policy or project), in the case of MUTP falls within the direct responsibility of a single decision making or institutional mechanism. MUTPs do not fall within the standard remit of decision making of neither policy makers neither stakeholders (e.g. development control planners) involved in project level appraisal/decision making. Essentially a new decision making procedure and determination of who is accountable for what, who should be involved, consulted etc needs to be developed/ created with the emergence of each such project, and new procedures for evaluation devised each time! This phenomenon, at once renders top-down standard lists or Blue prints of indicators inappropriate for utilisation. It rather signals the need for recognition and acceptance of this irregularity and the adoption of a flexible sustainability evaluation framework, which takes into account the particularities of each MUTPs institutional and decision making structure. This irregularity also signifies the need to develop a better knowledge base regarding the sustainability implications of Transport interventions in

general and the need for long term monitoring regardless of MUTP(eg through standard policy monitoring procedures e.g. Figure 4.1), which would subsequently feed into the decision making process and help inform assumptions– albeit indirectly as well as through systematic MUTP post auditing and monitoring (Noble and Storey 2005; Glasson, 1994; 1999).

All sustainability principles (Section 2) and Bellagio Principles indicate the need for long term monitoring and evaluation. Glasson et al (1999) describes how all development projects have a life cycle, which will include planning, construction, operation and decommissioning, which may cover a very long period, and which should be evaluated throughout. MUTPs are characterised apart from their large spatial scale, also for their long duration and thus extended temporal scale. This indicates further difficulties for any sustainability evaluation of such project as it should be designed to incorporate such long term monitoring (Ahman, 2008). Long term monitoring of sustainability indicators is currently available, only at the policy level (eg Figure 4.1) and more recently SEA level. However, project long term monitoring through procedures like EIA is not mandatory and thus not practiced, with a well established build and forget culture prevailing (Glasson, 1999, Arts et al 2001), limiting the potential to learn from past project experience. Despite the current absence of an institutional mechanism to follow up the long term sustainability impacts of an MUTP the need to do so is underlined as is its difficulty, due to issues of complexity and uncertainty. Due to the complexity and uncertainty and the long temporal dimension of the MUTP the evaluation framework would have to be designed to be flexible, and incorporate indicator revisions, in accordance to MUTP strategy revisions “always in an ideal world”. With regard to the existing academic and commercial tools reviewed (Table 4.1) Pediaditi et al (2006) and in accordance with conclusion drawn by other sustainability tool reviewers Curwell and Cooper (1998) and Deakin, Huovila et al (2002) there are very different tools and assessment approaches in planning (strategic and local) and between the different sectors of development projects (i.e. design, construction and operation). Deaking et al (2002) for example, through the BEQUEST examination of the different tools available, identified a tendency for the initial planning and design phases, to overshadow the sustainability assessment needs of the construction and operational phases of a development. Pediaditi et al (2006) when examining the different evaluation tool websites (of Table 4.1) and SUE-MoT (2004) reviews, some tools were found which claimed to be applicable to all phases, but there was no evidence of long-term monitoring which would be of particular relevance to the operation phase of a development project and even more so of an MUTP. Only the BRE, SEEDA and Arup SPeAR tools were found to make assessments of operation sustainability, albeit at the planning and design period of a development and based on project specifications5.

[5] Tool SPeAR can undertake assessments post-development completion to certify that specifications have been met, but it is unknown if continuous performance monitoring is carried out and requires further investigation. It needs to be pointed out that this tools criteria and benchmarks are non transparent and adjustable to suit each development.

In addition to these generic, methodological issues, there are several issues regarding the nature of indicators, addressed in a number of the Bellagio Principles which require further consideration before attempting to propose such a sustainability evaluation framework for MUTPs.

4.1. Defining the ideal sustainability indicator

There is extensive dispute in the literature over the ideal methodological characteristics of indicators (Hardi and DeSouza-Huletey, 2000; Shane and Graedel, 2000; Custance and Hillier, 1998) which are also relevant to the Bellagio Principles which the MUTP evaluation framework should aspire to meet. The main methodological disputes concern:

- the appropriate number of indicators;
- the most suitable way of presenting them; and
- their nature (i.e. qualitative vs quantitative).

They are considered here as they aid in the development of an indicator selection process to be used for the MUTP evaluation framework.

It is evident from a review of the literature (Litman, 2009; Sustainable Seattle, 1993; Nurick and Johnson 1998; LGBM, 1995; Cartwright, 2000; Guy and Kilbert, 1998) that there is a lack of consensus regarding the appropriate number of indicators needed to evaluate sustainability. Bell and Morse (2003) identify a tendency for the selection of 20 indicators. Guy and Kilbert (1998) propose the use of an initial list of 100 indicators which can be distilled to manageable sets of 15-20. However, drawing on general evaluation theory (Patton, 1997), the question lies in: what is manageable to whom and for what? Bossell (1999, p. 57) states that '*the number of indicators should be as small as possible, but not smaller than necessary*'.

For the purposes of a framework for MUTP evaluation, it is not possible or theoretically appropriate to predetermine and specify the number of indicators which should be used. Instead the number of indicators should be agreed upon by the evaluation users (Ukaga and Maser, 2004) having taken into account the scale and nature of MUTPs they are evaluating as well as the relevant feasibility issues, such as cost and availability of data.

Apart from the Bellagio Principles there is a great deal of literature reflecting on the ideal nature (characteristics) of sustainability indicators (Table 4.2). There are disputes as to whether indicators should be quantitative or qualitative (Pinfield, 1996). Guy and Kilbert (1998) and Mitchell (1996) do not explicitly exclude the use of qualitative indicators but make the assumption that they should be quantitative (Table 4.2). This is evident when looking at proposed indicator selection criteria (Table 4.2) and Bellagio Principles (Box 4.1) where several authors make recommendations on the characteristics of indicators upon which their selection or development should be based. Gallopin in Moldan *et al* (1997), even suggest conditions under which qualitative indicators are preferable. For

example it is proposed that qualitative indicators are often more appropriate to evaluate social issues (ibid). Bell and Morse (2003) point out the compatibility between qualitative research and analysis of sustainable development due to the fact that qualitative methods allow for a multiplicity of perspectives and values, which essentially reflects sustainability. Considering the participatory approach recommended for the evaluation of MUTP sustainability it becomes apparent that a strictly quantitative set of indicators is not considered necessary or appropriate. Instead Todd and Geissler's (1999) and Ukaga and Maser's (2004) view is embraced which proposes that evaluation users determine the characteristics of the indicators themselves following a structured consideration of the various sustainability aspects which they wish to monitor and evaluate.

Table 4.2 Indicative list of criteria for the assessment and selection of ideal indicators

Litman, 2009 (pg 5-6)	• comprehensive and balanced • data feasible to collect • understandable and useful • dissagregation • reference units (use of per capita accounts proposed) • level of analysis should reflect ultimate rather than intermediary effects • utilise where possible performance targets
Bell and Morse (2003) pg 31	• Specific (must clearly relate to outcomes) • Measurable (implies that it must be a quantitative indicator) • Usable (practicable) • Sensitive (must readily change as circumstances change) • Available (it must be relatively straight forward to collect the necessary data for the indicator) • Cost effective (it should not be a very expensive task to access the necessary data)
LGBM (1995) pg 35	• Be significant • Have a reasoned relationship to sustainability at both global and local level • Be relevant to local government but also to the ordinary citizen • Reflect local circumstances • Be based on relatively easy to collect information • Show trends over reasonable timescales • Have a relationship to other sets of indicators • Be both individually and collectively meaningful • Be clear easy to understand and educate as well as inform • Provoke change in policies services lifestyles etc • Lead to the setting of targets or thresholds
Church and McHarry 1994 pg 208	• Linked to sustainability, ideally both locally and globally • Relevant to ordinary citizens as we as to local government and easy to understand • Likely to change form year to year and more importantly, open to being changed as a result of local action

	• Linked to setting targets for action • Measurable either by the local authority or by a body that can make the data available.
Maclaren (1996) pg 186	• Integrating • Forward looking • Distributional • Developed with the input from multiple stakeholders in the community
Mitchell (1996) pg 9	• Relevant to the issues of concern and scientifically defensible • Sensitive to change across space and social groups • Sensitive to change over time • Supported by consisted date • Understandable and if appropriate resonant • Measurable • Expressed in a way that makes sense (percentage rate, per capita, absolute value) • The identification of targets and trends that allow progress towards or away from sustainability to be determined.
Holland (1997) pg 43-44	• Resonance: would the audience empathise with the indicator? • Significance: is the indication unambiguous and clear? • Comparability: is the indication capable of comparison with other values reported elsewhere? • Action orientation: is it clear who will carry out the required action? • Relation to other indicators: as well as being meaningful on its own does the indicator have a collective meaning?
Guy and Kilbert (1998) pg41	• Community involvement: were they developed and acceptable by the stakeholders of the system of concern? • Linkage: do they link environment economic and social issues? • Valid: do they measure something that is related to the state of the system? • Available and timely: can the data be collected on an annual basis? • Stable and reliable: compiled using a systematic and fair method? • Understandable: simple enough to be interpreted by lay persons? • Responsive: they respond quickly and measurably to changes? • Policy relevance: relevance to public or corporate policy? • Representative: as a group they cover the important dimensions of the focus area • Flexible: they are important to use regardless of whether data is not readily available considering the data might be available in the future? • Proactive: do they act as a warning rather than measure an

	exiting state? • Long range: do they focus on the long-term? • Act locally think globally: do they promote sustainability at the expense of others?

There is also disagreement on the desirable extent of aggregation or integration of indicators (Morse *et al,* 2001; AtKinsson and Hatcher, 2001; Neumayer, 1999; Meadows, 1998; Mitchell, 1996). Aggregation refers to:

> "*combining a wide range of similar measures into a number with a common denominator like Gross Domestic Product (GDP), or combining measures of different kinds into an index (like the Human Development Index)*" (AtKinsson and Hatcher, 2001, p. 512).

The appeal of this approach is evident with the wide adoption and use of GDP, and similar indices which are recommended for their ability to easily compare scenarios and situations (Sign et al, 2009; Therivel and Levett, 2004). However there is much criticism of this approach (Clifford *et al*, 1994; Morse *et al*, 2001). Increased aggregation requires the translation of qualitative subjective parameters into values, for example placing a monetary value on biodiversity which can be misleading, providing a sense of certainty and objectivity which does not necessarily exist (Eiswerth and Haney, 2001). Monetarisation also implies that everything can be given an economic value which according to Dahl (1997) is not possible. Increased aggregation also does not allow evaluation users to identify where the problem exists in order to take action, and thus is unsuitable for project level evaluation which should provide the evidence base for mitigation and improvement (George, 1999).

There are different approaches to numeric integration and valuation. Mitchell (1996) outlines some of the monetary approaches which as Bell and Morse (2003) identify are most appealing to policy, government and those responsible for setting the relative charges, for example, taxes for meeting sustainable development. Examples of non-monetary yet numeric aggregation indicators, created through weighting of values and relative importance techniques, can be found in Hemphill *et al* (2002) and Manyong and Degand (1997). Fuzzy set theory is another technique of aggregation (Cornelissen *et al,* 2001). But these face similar limitations to monetary integration techniques (i.e. lack of transparency in the identification of the cause of sustainability issues) and are deemed inappropriate for the purpose of this project. However, the processes of weighting for prioritising sustainability objectives as described in Cole (1999) are seen as relevant techniques as they can be used by evaluation users to identify the main indicators required to assess a particular MUTPs sustainability.

The presentation of indicator results is another issue needing clarification. Cartwright (2000) amongst others points out the need for simplicity in presentation when considering the importance of indicators as educational tools. Thus, Bell and Morse's (2003 pg 43) comment;

> "*on the need to integrate information in a way which can lead to action, thus not disguising through visual integration the areas which need addressing"*,

is relevant, and the approach recommended for the selection of MUTP sustainability indicators.

However, when developing sustainability indicators and presenting their outputs, there is also the need to develop reference conditions to gauge progress (Bossel, 1999). This is inherently difficult and even more so for the case of MUTPs. An indicative and relevant example to MUTP, is the European TERM 19 indicator on "infrastructure investment", which although monitored lacks, a target, benchmarks or even directional preference, rendering it in the authors view at best worthless.

Common techniques use historic references whereby the sustainability of the system's condition is compared to those in the past which are assumed to be more sustainable. In the case of MUTPs this is not really possible, as in cases such projects are proposed to improve unsustainable conditions, such as improve accessibility, or stimulate regeneration in an area as part of a wider land use change scheme, which may or may not have been characterised by previous industrial or unsustainable uses. Furthermore, MUTPs resulting change in land use increases the difficulty of comparison. There is inherent subjectivity in setting reference conditions for sustainability indicators and the issues of scale of relevant data and benchmarks complicate matters further (Bell and Morse, 2003; Therivel, 2004). Ukaga and Maser's (2004) and Bell and Morse's (2003) approach is therefore adopted, who propose the use of a context specific and participatory approach for the establishment of reference conditions and benchmarks. However, Sheate (2003) points out the potential risk of ignoring global – long term risks such as climate change when using participatory approaches, a phenomenon identified in Burningham and Thrush's (2001) study of local communities perception of sustainability issues "rainforests are a long way from here". Both Sheate (2003) and Burningham and Thrush (2001) propose the use of a transparent framework of global and potential local issues which does not allow for tradeoffs between the two.

The above shows there is no consensus regarding the nature of an ideal indicator and that indicator selection is a subjective process. Different indicators will be appropriate in different evaluation processes and circumstances. Although a general approach has been proposed for the case of MUTP sustainability evaluation it is also considered appropriate that indicator characteristics and evaluation criteria used for selection (Table 4.2) should be agreed through a deliberative approach by stakeholders in the MUTP (Todd and Geissler, 1999; Ukaga and Maser, 2004 and Bell and Morse, 2003). Monetarised and highly aggregated numeric and visualisation approaches are considered inappropriate, and an action and decision making focus as well as a locally relevant benchmark approach based on participatory methods is proposed.

5. Conclusions

From this review paper, a series of conclusions can be drawn as well as issues identified which require addressing if MUTPs contribution to sustainable development is to be evaluated. From the review of existing sustainability frameworks and visions/ principles/ goals, it can be concluded, that there seems to be a certain degree of concensus, however, the author attributes this due to their vagueness and limited standalone operationalisation capacity (Section 2).

Transport, apart from in the EU sustainability strategy does not figure explicitly, and it is the authors view, that this is not necessarily wrong, as transport is one of many means to achieve accessibility, (which is a sub-goal of sustainability), yet not the only means. Sustainable transport has been defined more recently, but mainly from academic and less influential institutions, and there appears to be a shift in its intended purpose, from improved mobility to improved accessibility. In section 2 a brief review of sustainability indicators utilised to evaluate progress to achieve these key visions was carried out. It was surprising to discover, that although transport in most cases did not feature within these visions, transport related indicators did feature. This implies that transport sustainability is being defined through indicator selection.

The review of the transport indicators utilised, indicated, that there is an inconsistency between the paradigm shift proposed by academics for a focus on accessibility, to policy evaluators, as predominantly mobility indicators continue to be used. Methodological and technical difficulties in defining such accessibility indicators, do appear to be an issue, an this could well be an area for further research.

The review of existing sustainability evaluation frameworks as well as an examination of their limitations and relevance to the transport sector and more specifically MUTP project evaluation indicated the following. Despite the plethora of existing frameworks, to date there is no single framework designed to evaluate the sustainability of MUTP. The reason for this was explored based on evaluation theory, which indicated that the reasons maybe procedural and of institutional

The MUTP evaluation procedure would have to be:

Holistic: evaluate environmental, social and economic aspects of the MUTP

Context Specific:

- The appropriate spatial and decision making scale of the evaluation would have to be defined, enabling MUTP impacts to be measured
- Evaluate at the appropriate scale and include evaluation of associated impacts resulting eg from planning conditions and secondary impacts.
- Base evaluation on (appropriate scale) relevant benchmarks and issues (these benchmarks prerequisite policy scale long term monitoring baselines to pre- exist)

Long-term

- Evaluate the sustainability of all MUTP life cycle periods, design, construction, operation)
- Design flexibility within the evaluation process which will ensure the capacity to revise indicators, as well as sustainability goals of the project.
- Integrate risk assessment approaches within the evaluation

Participatory

- Identify evaluation users- their decision making capacity and evaluation purpose needs.
- Enable evaluation users to make their values and risk perceptions explicit as well as develop their own sustainability indicators based on those.
- ensure transparency of evaluation process (indicator- data- benchmark- targets) used

Integrated within existing decision making processes (planning & project management)

- Relevant to planning policies and community strategies
- Linked to SEA, SA, EIA and other institutional assessment processes
- Link to project management decision making processes

Feasible:

- Appropriate duration and timing
- Resource efficient
- Appropriate to existing skills and Know-how

capacity nature. It is thus proposed that further research is required, to determine the institutional and decision making processes involved in MUTP design, construction and operation/ maintenance, which can subsequently be used as a basis of development of an evaluation framework which may have the capacity to be actually utilised. The author proposes an exploratory needs assessment with MUTP stakeholders, questioning them with regard to their evaluation needs, and the ideal specifications such a framework should comply with. The review indicated, that top down blue print lists of indicators could not work as an approach for MUTPs. It also indicated the need for further investigation into existing planning and policy evaluation procedures, and identification of methods

to optimise sustainability evaluation at the policy and plan development phase. Sustainability project appraisal of MUTP, in the absence of information accumulated from long term policy monitoring and knowledge establishment of cause and effect relationships, could at best be considered as a structured guessing game, arguably of little value. Based on the review of evaluation literature, findings of Pediaditi et al (2007) and consideration of Bellagio Principles the following specifications for MUTP sustainability evaluation are proposed for debate.

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