

**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**

Literature Review Report

Omega centre

Centre for Mega Projects in Transport and Development

A global Centre of Excellence in Future Urban Transport sponsored
by Volvo Research and Educational Foundations (VREF)

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1.0 Purpose of report

1.1 The RAMP handbook and its users

This report provides a synthesis of the literature reviews commissioned by the OMEGA Centre at University College London (UCL). It forms the first main deliverable in the Study, for the Institution of Civil Engineers (ICE) and the Actuarial Profession (AP) aimed at providing guidance on better incorporating environmental and social factors into the appraisal of major projects for the next edition of the jointly published RAMP Handbook.

The Institution of Civil Engineers now has the current overall vision of ‘Civil engineers at the heart of society, delivering sustainable development through knowledge, skills and professional expertise.’ This indicates a mission to become more sensitive in practice to the requirements of sustainable development in the planning, appraisal and implementation of all activities involving civil engineering expertise, including the planning, appraisal and implementation of major projects. This forms a key focus in the engagement by the Institution and its partner the Actuarial Profession of the Omega Centre for this task.

The literature reviews provided herewith are of eight working papers in all (see Bibliography). Seven are written from the respective perspectives of different professional communities; these address the treatment of social and environmental concerns in project appraisal, with particular reference to Mega Urban Transport Projects (MUTPs). The eighth paper considers alternative frameworks for assessing sustainable development visions as applied to MUTPs.

The RAMP Handbook was first published in 1998 and the second edition was published in 2005. The Handbook is directed towards those engaged in the management of project risk, anywhere in the world. The RAMP process takes a "whole lifetime" strategic approach to risk, and especially targets the possible financial implications. So the results are especially useful at the project appraisal stage, where decisions are being made about whether to authorise a project. RAMP is therefore particularly oriented towards decision-makers, including sponsors and investors, in both the public and private sectors. (It is, for example, recommended in HM Treasury's Green Book for use in appraising UK public sector projects – HM Treasury, 2003). It also forms a valuable reference for managers of projects, their advisers and others involved in a project in any professional capacity.

The RAMP handbook defines a project as “any organised business activity where an investment is made” It identifies the most common use of the term as applying to the planning, appraisal and construction of infrastructure, especially major schemes. The working papers and this synthesis have particularly reflected this coverage in addressing the challenges confronted by MUTPs. However, the definition of projects also covers other initiatives where there is a lapse of time while the change is being prepared before it becomes operational: for example, a major change in the operating methods in a business or public administration system.

1.2 The importance of context for risk assessment

Sustainable development as a concept and vision has been of growing significance to the world at large for around two decades, with the Brundtland Report of 1987 and the Kyoto Conference of 1992 providing particular markers. It has, however, taken some time to translate this concept into operational use regarding how we use the natural environment and our resources and how we apply it to the development of the built environment. Sustainable development has been widely adopted as a watchword and as a key policy reference by international development agencies and national and local governments alike, as well increasingly by progressive local and global corporations. Its translation into practice has proved much more difficult with numerous tensions emerging between global and local concerns and short and long terms goals. Generally this has been associated with the need to focus on environmental and social impacts of projects and efforts to link these with concerns regarding economic sustainability; this is discussed in Section 3. The OMEGA Centre has added a fourth dimension, namely, that of institutional sustainability where the premise is introduced that visions of sustainability (whether economic, environmental or social) cannot be sustainable without sustainable institutions and governance.

There are many stakeholders concerned with the effects of major projects, ranging from the general population of a region through to specific organisations. Most are not themselves decision makers or professionals engaged with the projects. The RAMP Handbook Glossary defines such stakeholders as “parties whose interests are affected by decisions about the operation of an asset which they do not necessarily own or enjoy property rights in” (ICE & AP, 2005). Major projects can have significant impacts on the environmental and social aspects of they traverse and serve. Thus stakeholders interested in optimising, economic, environmental and social conditions – informally or formally - may seek to influence a project, both during its planning, appraisal and subsequently during its construction and operation. They may support it, and contribute to effective decision-making regarding its development; or they may oppose it; and different stakeholders may take different and sometimes opposing views on a particular project. The assessment which a number of stakeholders make of the impact of a project may well give priority to factors which lie outside the interests of the main project decision makers and which might not easily be converted to quantitative measures. This discourse should be seen as part of the context in which projects are planned, appraised and managed (or mis-managed as the case might be).

RAMP offers a methodology that seeks to ensure the maximum understanding of risks seen from the viewpoint of project promoters: essentially the key stakeholders. It is a management process seeking to provide the best quantitative assessment of risk in order to avoid it or at least mitigate it. To date RAMP has not said much about social and environmental risks. It has understandably focused on the principal areas in which risks may arise as perceived by the civil engineering and actuary professions, most of which are likely to affect the funding, construction and operation of the project itself. The concern here is that this may have been an appropriate principle for smaller projects, as most such risk factors are more likely to be

identifiable. Major projects, however, can have a very significant impact on the communities and regions where they are built and operated in terms of their environmental and social implications and these may often be far reaching and complex, and bring into question the broader viability of the project if set against sustainable development goals.

In order to offer more effective guidance in such circumstances, the RAMP process must seek to internalise certain factors which are quite often external. It does so by apportioning risk to them to optimise decision making. This is essential for good project appraisal and management. But there are two fundamental issues in this part of the RAMP process that have to be approached with great care:

- If the project is to provide the financial return expected, then all the factors which may have a potentially significant impact, whether directly or indirectly, must be soundly appraised and have sufficient mitigation provided for. This requires very considerable application and thought.
- This does not necessarily remove the problem if it (the impact) is outside the project.¹ If project promoters are seeking to genuinely pursue sustainable development goals, they need to also consider how far they are willing (and able) to secure real environmental and social security ends which the project could yield over and above the economic results. This requires project promoters to use broader risk assessment processes to establish the possible environmental and social outcomes more fully and being prepared to address these, whether they manifest themselves within the project or outside it.

This literature review seeks to generate a better understanding of the above factors, issues and approaches in current project planning and appraisal for major projects as a basis for informing and further developing the appropriate processes for RAMP.

¹ For example, constructing a new road or rail line might increase the risk of flooding in a locality. For the scheme promoter the risk may be quantified in terms of payment for insurance cover, to recompense local businesses and residents. But local stakeholders – residents, business owners, public administrators – will want to reduce or even eliminate altogether the risk of flooding.

2.0 Professional contexts

2.1 Professions' roles in planning and appraisal for major projects

The main decisions made in project development for major projects are those appointed or elected to positions in the relevant key stakeholder decision making groups – whether they be in the public or private sector (or public/private partnerships). These are mostly commercial company boards and elected authorities; most major projects involve both types of organisation, sometimes in unison. The majority of work in bringing a project from initial idea to final completion, however, lies one way or other with those experienced and qualified within the various professional communities and the financial community. They plan the project, appraise it, and provide recommendations for its development over numerous phases. They also take many of the decisions within specific fields (e.g. engineering design, environmental assessment).

Different professions represent different elements of a project. For example, infrastructure planning is seen to be the responsibility of urban, regional and transportation planners; infrastructure design and assessment is primarily attributed to civil engineers; equipment for constructing it to mechanical engineers; and funding methods to economists and finance specialists. Environmental and social factors are likely to be considered part of the work of urban and regional planners and transport planners, and specifically assessed by specialist professionals. Major projects are likely to engage staff from most of the key professions to work together to cover appropriate fields advising government and corporate and commercial investors (see Hirst, 2009).

Different professions bring different tools to project appraisal. Sometimes these overlap quite strongly: for example, a transport economist and a funding manager both need to measure the likely cash flows and their consequences; sometimes they do not. By and large specific professions are associated with particular methodologies. For example, transport economists work primarily with the Cost Benefit Analysis (CBA), which forms the conventional standard mode for appraising transport projects; it is notable that a CBA is heavily based on forecasts derived from modelling of transport patterns (in the service of economic growth) and simulating efforts to achieve transport operations efficiency (sometimes above all else), which is conventionally deemed the main activity of transport planners. Urban planners, on the other hand, are more associated with broader and more holistic forms of assessment entailing methodologies such as Multi-criteria Analysis (MCA), which are used to appraise urban and land use plans and development scenarios and also such work as a Environmental Impact Assessment (EIA). There are substantial differences between these core methodologies (as discussed in section 4). These differences may be seen as reflecting different roles (past and present) of the different professions some of which, as in the case of civil engineering, have much changed over time and are still evolving. This is reflected inter alia by the commissioning of this Study by the Institution of Civil Engineers and Actuary Professions.

The roles of the different professions may be seen as principally framed by two main factors, which overlap significantly. One is statutory provision: the requirement that a particular process with public statutory implications should be carried out on a defined basis. The other is convention: it is accepted that certain areas of concern and processes require a defined set of expertise. So, for example, the role of planners, including urban and regional planners and those in specialist fields such as environmental planning, is largely defined by the statutory planning system, which has two main functions: the preparation of development plans, policies and strategies; and setting the basis for the regulation of development proposals. Expertise in these areas is then established and validated by the relevant community of interest, usually focused on one or more professional institutes and the complementary educational and research communities. So the UK planning system is determined by national government priorities as set out in legislation. But national policy also has to have regard to policy at the European Union (EU) level, such as that set out in EU Directives, on matters such as EIAs and SEAs. (Knight and Rydin, 2009).

Project stakeholder decision makers often fall into these separate roles as well. In some cases, such as the directors of major companies, they may be professionally experienced in the relevant field (e.g. civil engineers on the boards of major project promoters and contractors). Many decisions are also taken, however, by public authorities, including governments, and by funding agencies and development organisations, whose members are elected for their experience in business and / or public administration. They are required to follow the statutory or accepted processes in reaching their decisions and are thus by implication involved in the relevant professional community as public servants.

The roles of the professions have changed over time and mostly expanded. When the Institution of Civil Engineering was created in the early nineteenth century, its members were responsible for all the planning and assessment work on projects, as well as designing them and supervising their construction. As issues have become more complex over the last century, with the growing need for expertise in various specific fields, other professions have developed to take over segments of this work. Particular examples include the development of systematic transport planning and the requirement for environmental appraisals, leading to the emergence of transport planners and environmental planners respectively. (Hirst, 2009)

2.2 The contributors' perspectives

In order to draw out these various professional standpoints and what they mean in terms of environmental and social aspects of risk project appraisal, seven Working Papers were commissioned from specialist practitioners and researchers. Each of these considered the treatment of environmental and social factors in major transport project appraisal from their own professional standpoint. The seven papers were:

1. The perspective of the Economist – Roger Vickerman, Professor of European Economics, University of Kent

2. The perspective of the Actuary – Anthony Gopaul, Senior Project Manager, Capita Symonds
3. The perspective of the Civil Engineer – Mark Hirst, Director of Development Planning, Capita Symonds
4. The perspective of the Transport Planner – Peter Hine, Associate Director – Development Planning and Environment, Capita Symonds
5. The perspective of the Environmental Planner – Marianne Knight, Deputy Director of the UCL Environment Institute, and Yvonne Rydin, Professor of Planning Environment and Policy, University College London
6. The perspective of the Social Planner – Claire Colomb, Lecturer in Urban Sociology and European Spatial Planning, University College London
7. The perspective of the City Planner – Liane Hartley, Principal Socio-Economic Consultant, Capita Symonds

In addition one other paper was prepared:

8. Perspectives of sustainability visions as applied to MUTPs – Kallia Padiaditi, Lecturer at the Mediterranean Agronomic Institute of Chania, Crete

3.0 Principles and issues

3.1 Sustainability development – overall concept and varied responses

The key starting question about regarding sustainable development must be "What is its definition?" Very large numbers of definitions have been coffered. A very widely accepted definition is from the Brundtland Report (Brundtland Commission, 1987) 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."

This embeds within it fundamental principles which, if fully embraced and enacted, 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: economic, social and environmental. (Pediaditi, 2009)

Because there is nothing definite about the future, this involves the consideration and acceptance of uncertainty and thereby the necessity of taking calculated risks. This has been expressed as the 'precautionary principle', which was incorporated into the 1992 Rio Declaration on Environment and Development (as its Table 2.1). This states 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."

A key principle adopted in this is that of the "polluter pays": 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. This principle has manifested itself in the form of impact assessment procedures instituted across the world. However, it is often unclear when and how much the polluter should pay. (Pediaditi, 2009)

Arguably the most fundamental and influential policy document adopted at the Rio World Summit in 1992 was Agenda 21. This described a programme for the achievement of sustainable development and called on all countries to develop sustainable development strategies with goals, and sustainability indicators to monitor the achievement of those. As a result many different institutions, sectors and governments have sought to provide their definitions of sustainability or sustainable development. These are characterized by similar visions, goals and objectives, presented in strategies which subsequently form the basis of indicator frameworks. But to what extent do these visions differ and to what extent to they influence or facilitate sustainable decision making for the transport sector? (Pediaditi, 2009)

Transport is recognized as having a direct link and key role in the delivery of sustainable development. It is advocated for its assistance to economic growth by providing accessibility to resources and markets. It is also perceived to improve quality of life by linking persons to employment, health, education, recreation and other amenities, thus playing a key role in economic and social development. However, its negative environmental implications are also increasingly reorganized; these include as congestion, safety, pollution and non renewable resource depletion. The Rio Declaration includes specific reference to reducing transport's negative impact (in Chapter 9) but the proposed transport actions in Agenda 21 are relatively narrow, based mainly on modal choice, infrastructure provision and technological improvements. (Pediaditi, 2009)

The Millennium Development Goals (MDGs) are eight goals to be achieved by 2015 that respond to the world's main development challenges, drawn from the actions and targets contained in the Millennium Declaration that was adopted and signed during the UN Millennium Summit in September 2000. The MDGs do not explicitly refer to sustainable development, but they are influential goals of policy relevance, which are supposed to be taken into account by committed organizations (signed up nations, donor agencies, etc.) when deciding whether to fund investment, aid, development projects and programmes. In principle, they should therefore affect the appraisal of MUTPs. However, the MDGs do not include specific transport goals. (Pediaditi, 2009)

The EU Sustainable Development Strategy 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 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 offering a basis for their national sustainability strategy development. Though vague, the EU Sustainable Development Strategy does make explicit reference to sustainable transport and thus could be perceived as an influential vision for MUTP nature characterization. As part of this the UK has set out its Principles of Sustainable Development; these, however, lack explicit mention of transport in the strategy advanced. (Pediaditi, 2009)

The Vancouver principles for sustainable transport (advanced by the OECD in 1996 but which were never formally endorsed) indicate the need for a significant paradigm shift to occur in transport planning, moving away from appraisal in terms of mobility (as physical movement) towards appraisal in terms of accessibility (as people's ability to obtain desired goods and services). 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 particularly emerges from this, and from more recent transport academic literature, is the need to integrate land use planning with transport planning, as accessibility provision may not involve transport systems at all. However,

accessibility almost never features directly in measures of sustainable transport, the only metrics relating to what are essentially measures of mobility. (Pediaditi, 2009)

The conventional framing of the concept, as reflected in the *Shared UK principles of Sustainable Development*, emphasises that it has three main dimensions: economic, environmental and social. (The OMEGA Centre's paradigm of sustainable development includes a fourth: that of institutional governance (see OMEGA Centre, 2005)). At the heart of the official discourse on sustainable development endorsed by most national governments and international organisations lies the idea that these three dimensions (or objectives) of sustainability can be reached or fulfilled jointly, i.e. that we can have economic growth which *does not* irreversibly damage the environment and human health, and is equitably distributed. This approach, sometimes termed the 'triple bottom line', is reflected in the conventional policy discourse on 'sustainable transport'. However, critics of the concept of sustainable development (or at least of its practical applicability), stress that inevitable trade-offs *have to* be made between the three components of sustainable development: in order to fully reach one of the three objectives, concessions have to be made with regard to the other two. So the critical (often unaddressed) question arises of whether the objectives of sustainable development involve complementarity or conflict? (Colomb, 2009)

Figure 1: The triangle of conflicting goals for planning and the three associated conflicts

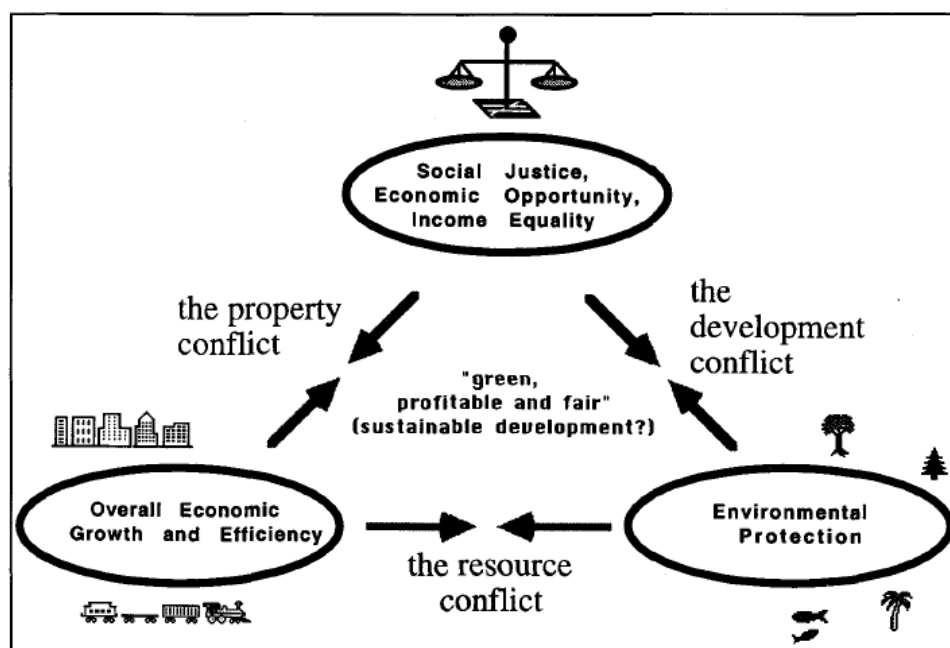


FIGURE 1. The triangle of conflicting goals for planning, and the three associated conflicts. Planners define themselves, implicitly, by where they stand on the triangle. The elusive ideal of sustainable development leads one to the center.

[Source: Colomb, 2009, from Campbell, 1996]

If there is a conflict, then it is sharpened by the nature of the world's economic structure. This is built primarily on continuing economic growth, which therefore becomes the core determinant of all policy action. The growing pressure for genuinely sustainable development has led to discussion of sustainable economic growth but without (some would claim) a clear definition of what this involves. It has also led to very substantial use of the term sustainability throughout a myriad of policy documents and statements, frequently unaccompanied by any definition of what is intended in the particular context; this has been termed 'green wash' by critics. A crucial factor in economic growth is the continuing evolution of technology and techniques, which provide for more effective ways of doing things but also raise expectations and create demand, leading to increased consumption, including the consumption of more travel.

An example of the focus on sustainability in principle in transport terms is the relatively new transport policy line developed by the UK Government, set out in the 2007 White Paper *Towards a Sustainable Transport System* (Department for Transport, 2007) and followed by the programmes termed *Developing a Sustainable Transport System* (Department for Transport, 2008). These in principle have sustainability at its heart. The key question here perhaps is, does it (the document) lead to programmes and projects that are focused on achieving the true 'triple

bottom line' of sustainable development? And if so, how can these be recognized as valid and effective?

3.2 Putting sustainable development visions into practice

If sustainable development visions are to provide for effective ways forward rather than just vague hopes, then they need to be translated into practice. Doing this requires the development of appropriate plans, entailing suitably focused programmes and projects. The appraisal of these plans and programmes should establish whether and how far they achieve sustainability – or fail to do so. This approach has been developing over recent decades at the international level at least. The World Bank, for example uses economic analysis 'to help design and select projects that contribute to the welfare of a country'. This is much broader than traditional cost/benefit analysis. The ten questions that an economic analysis in the World Bank examines are:

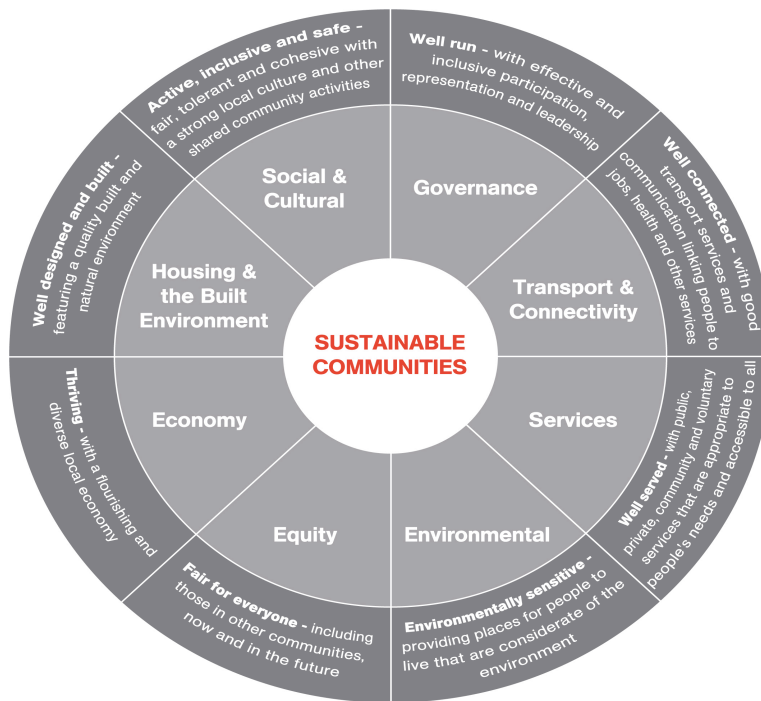
- What is the objective of the project;
- What will happen if the project is implemented;
- Is the project the best alternative;
- Are there any separable components and how good are they separately;
- Who are the winners and losers;
- Is the project financially sustainable;
- What is the project's fiscal impact;
- What is the project's environmental impacts;
- Is the project worthwhile;
- Is it a risky project?

Much emphasis is placed on the institutional and regulatory environment into which the bank is lending. Project lending which contributes to improvement of that environment is thus of particular interest. Judging the extent to which that is being achieved depends on some of the high level priorities which the Board of the World Bank have adopted. These include the avoidance of environmentally damaging investments, the widespread distribution of the benefits of projects throughout the national recipient community and the avoidance of uncompensated losses by virtue of spatial or occupational displacement resulting from a project. Strict standards are applied both to the environmental design of projects, which have to have formal environmental clearance before they are submitted for Board approval, *and* to the resettlement and involuntary employment severance. The requirement to attend to distributional aspects is increasing as the Bank concentrates further on its poverty reduction objective but remains less prominent. (Hartley, 2009)

The EU has similarly sought to establish a strong focus on achieving environmental goals in practice through policy instruments establishing the requirements for Environmental Impact Analysis (EIA) and Strategic Environmental Analysis (SEA). It is notable that these are focused on environmental aims across mostly developed countries, some of them among the world's richest nations, while the World Bank processes are aimed more at achieving primarily social goals among poorer nations.

Focusing on goals in one area is not necessarily sufficient: sustainability requires a holistic approach. Sir John Egan recommended a structured view to the UK Government in 2004, in the form of the Egan Wheel – Figure 2. This links eight principal areas of attention to build sustainable communities. (Gopaul, WP2)

Figure 2: The Egan Wheel



Economic growth also changes the standards that people expect to have: this is another aspect of the different focus of the EU sustainability instruments and those of the World Bank. Individuals and communities in poor economic circumstances are more concerned with having basic needs met (a principle raised in the Millennium Development Goals). Once these basic needs are assured, then aspirations rise. As economic prosperity grows and spreads so people want more, as do communities. These 'wants' generate higher aspirations and standards which move from individual expectations to formalized requirements of governments and the market, driven by both commercial and political reflection. For example, the demand for affordable cars to reach more distant places and gain access to a wider choice of goods is in some countries transmuting into a demand for more environmentally secure cars and then into demand to provide alternatives to cars. The search for sustainability can thus be seen as an evolutionary process. (Hartley, 2009)

However, while the evolution of appraisal processes aimed at achieving goals of sustainable development may itself be beneficial, it raises some crucial questions in practice, both about the frameworks for appraisal and the information collected and analyzed within them. Two methodological problems have become apparent (after Padiaditi, 2009):

- Firstly, debates continue about what and how to measure and how to link specific sustainable development indicators to time-bound targets and thresholds. Comparability of such 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. Aggregated indices are attractive for communication but require high quality data if they are to provide 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).
- Secondly, sustainable development indicators continue to be affected by serious technical challenges, particularly related to problems with data. Such challenges include limitations associated with data availability and quality. 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. And the problems are not simply the lack or inadequacy of the right kind and quality of data. In some cases the data that are collected at considerable cost ultimately can have little apparent use in decision-making.

Another feature is that appraisal methodologies created for assessing projects largely rest within a demand related culture that have sometimes tended to be developed to act as appraisal tools *against* sustainability goals principally because either the tools themselves or the culture of the practitioners have not moved on significantly from their original use and orientation toward servicing economic growth goals (often above all else). A specific example of this is the current 'New Approach to Transport Appraisal' (NATA) system for transport appraisal in the UK (discussed in the next section) which is based on methods first established to appraise car related roads projects. (Hine, 2009)

There has also been an increasing tendency for many developed countries to move away from former aims of universal social welfare provision to a more neo-liberal model, in which the provision of public services is procured from commercially run bodies against defined and mostly quantified (especially commercially-driven) targets (Colomb, WP6). There is then an increasing risk that many governments no longer see themselves as directly able to influence any one project to ensure that it is coordinated within the overall national policy framework. This is perhaps especially the case in the Anglo Saxon world and less so in Continental Europe. For mega transport projects it may result in regional and local authorities having less influence over matters which seriously concern the communities they represent and traverse but which are seen as relatively minor matters within the overall framework of the project.

Sustainability (as defined e.g. by the Brundtland definition) focuses on the opportunities for future generations. Therefore the appraisal of projects requires impacts and values to be considered over time with inter generational preferences

being established. Forecasting is always a difficult exercise if the results are to be considered a valid basis for decisions taken now. Many forecasts are built on extrapolation of existing patterns, within a particular field of interest. For example, car growth forecasts are usually based on relationships with a few key economic and social indicators, and the future level of car ownership and use is derived from forecasts of these.

The possibility of step-change is rarely accepted in such exercises. Often the forecasts are not even linked up with complementary fields: e.g. changes in land use development, world oil fuel prices and preferred behaviour which could together impact on car ownership growth. More significantly, these forecasts are taken as given influences rather than as indicators of policy areas where change is needed. For example, set against the imperatives of the overriding needs of achieving sustainable lifestyles, forecast continuing growth in car ownership may be seen as a feature to be constrained rather than supported: especially if this implies growing dependency on one transport system. This would imply changing the types of projects developed and the values attributed to them.

In the case of major projects, the scale requires a longer time period to be considered. Furthermore, major projects have an impact that can cause significant changes in the balance of communities and ecologies and thus bring about changes that differ from generally expected patterns. For this reason especially there are questions over whether mega projects can be *truly* sustainable? This is an argument posed by Adams (2008).

Another feature of time passing is that small changes can build up cumulative effects. Thus many small changes can amount to a very large change in due course. In principle, this means that planning for a sustainable future requires consideration of small factors as well as major ones. To date there has been little consideration of the implications of this.

In some circles it might be suggested that the costs for action identified through appraisal of programmes and projects may not be justifiable. This is answered by the work undertaken by Sir Nicholas Stern for the UK Government (Stern, 2007). Stern assessed the costs, in monetary terms, of not taking action to offset climate change and pointed out that they are also considerable. On this basis, he was able to recommend substantial expenditure in measures to achieve a sustainable economic future. Whether these calculations of costs were accurate or even appropriate is something that runs counter to opinions in some quarters, notably for those who believe firmly in the 'precautionary principle'. One definition of this is 'a moral and political principle which states that if an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action.' Since this principle requires that the promoters of a project should take responsibility for not causing environmental or social damage, it also implies that they should also appraise the project comprehensively in terms of all potentially significant environmental and social factors.

4.0 Appraisal methodologies in major projects

4.1 Defining project appraisal and its relationship to planning

A project as defined by RAMP (and indeed other formal systems) involves a complete cycle of activity. This cycle includes planning, appraisal (as pre-project construction appraisal), implementation, evaluation (as post-project construction appraisal) and monitoring; it also includes termination (when the project is closed down and the asset or activity disposed of). Project appraisal forms a key element of this and should in principle address the whole cycle. It forms a crucial part of the decision making process on whether to proceed with the project or not and on the form of the project. In this sense it cannot be seen as an independent exercise.

The planning for a project will itself be rooted within the context of the area, time and circumstances where it is being proposed. Part of the context will include the relevant policies and strategies adopted by the public authorities, principally national and regional governments. These policies may also be subject to appraisal as part of the process for a decision on their adoption. Thus appraisal methodologies also exist for policy cycles. These differ from project appraisal, though there may be some overlaps in approach; and also in choice of criteria and information.

4.2 Review of main types of appraisal: where and how used

There exists a good range of methodologies for transport project appraisal. These can be differentiated by their purpose, coverage and intended output. A large number of variations on the different approaches have been informatively identified by Lichfield, (1996), who assessed them in the context of decision making on spatial planning.

Overall, the various methodologies can all be basically considered as falling within two main types:

- Cost Benefit Analysis (CBA), in which all the factors considered are measured in money terms – the common medium of exchange - over a defined period of years. This enables the results to be summarised into overall flows of costs and benefits, from which a single rate of return can be defined. This in principle offers simplicity to the decision makers. It is a quantitative methodology, essentially on the same principles as the RAMP process.
- Multi Criteria Analysis (MCA), in which the results for each factor are presented in a summary table setting out all the criteria identified for assessment. This requires decision makers to exercise their judgement as to the relative weighting among the various criteria. It is also a more qualitative methodology, although quantitative measures are used wherever possible. (The term Multi Criteria Decision Analysis (MCDA) is also used.)

These definitions form a starting point for considering what the various appraisal methods and their application offer in terms of understanding how environmental and

social factors are incorporated into project appraisal that seeks to contribute to visions of sustainable development and what the different approaches imply.

CBA generally forms the principal basis for most traditional project evaluation. All projects require funding and the use of those funds in one project means that other uses of them are foregone (i.e. that there is an opportunity cost). Large projects obviously demand very large sums, which are necessarily drawn from major funding organisations, including governments and international agencies. Identifying how effectively these funds may be used in projects forms an essential part of their use of resources. Commercial funding bodies will be mostly interested in obtaining the best return in funds as they are typically driven by comparable targets related to commercial rates of return that can be earned elsewhere; this may well involve converting identified values into actual flows of money (e.g. by making charges which users of the planned new infrastructure will pay to save time). Non-commercial organisations, including governments, wish to identify that the expenditure of funding brings a return that offers 'value for money'. In principle all projects looking beyond a purely commercial return involve some element of public money and thus there will be competition between projects for national funds; an issue which becomes particularly significant for major projects, especially at times of seriously restricted public funding. National governments can at least gain results from such investments within their own country. International agencies, such as the World Bank, however, have a less direct interest and are more concerned with achieving the best set of results from the projects they support both in commercial terms and in contributing to wider and often more long term development objectives.

A hallmark of CBA is that all benefits and all costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "present value." Usually this is net present value (NPV) but an alternative measure may be derived: these include PVB (present value of benefits); PVC (present value of costs); NPV (PVB less PVC); NPV/k (where k is the level of funds available); and BCR (benefit cost ratio, PVB divided by PVC).

The central feature of preparing a CBA appraisal is setting prices and costs on all factors: monetization. There are various techniques for doing this, depending on circumstances and criteria. These include:

- The creation of surrogate markets, where market prices are used as an indirect reflection of, for example, environmental impacts (as in the case of the cost of insurance against the possible impact of an event).
- Basing spending decisions on revealed behaviour, derived from an analysis of people's actual spending patterns (as in the case of higher payments for quicker travel indicating their value of time).
- Basing spending decisions on stated preferences derived from an analysis of people's responses to questions about spending in hypothetical situations.

A very considerable amount of research and development in establishing these price and cost factors has taken place over decades and continues today. The determination of costs and prices starts from the basic economic principle that there

exists a 'perfect market' where all actors are aware of all factors; in many respects much of the continuing research addresses the practical situation of 'market failure'. From the economist's perspective it is still possible to establish sound figures despite such market failures. Some other professions, however, challenge the validity of data derived from this approach, suggesting for example that the measure of 'willingness to pay' may not be valid among communities and groups who do not have the funds to pay the assessed prices (particularly pertinent in developing and transitional economies). Further discussion on these concerns is provided by Vickerman (2009) and Colomb (2009).

MCA is more commonly used for processes that do not require a single monetary return or where it is impossible to arrive at such a measure. It is a methodology aimed at supporting decision makers who are faced with making numerous and conflicting evaluations that involve monetary and non-monetary assessments. MCA aims at highlighting conflicts of multiple goal pursuit and seeks to assist in the arrival of compromise among choices in a transparent process. It is more likely to be used for appraising plans, strategies and scenarios; the Strategic Environmental Analysis (SEA) that has become a statutory requirement for assessing plans within the European Union forms a major example. MCA is also important for environmental and social assessments of projects, such as Environmental Impact Analysis (EIA), Social Impact Analysis (SIA) and Sustainability Appraisal (SA).

Since MCA openly acknowledges a certain element of subjectiveness in decision making, the morals, values and ethics of the researcher implementing MCA play a significant part in identifying the accuracy and fairness of the conclusions; they also affect the choice of data and sometimes the compilation of data where no definitive source exists. The ethical dimension is particularly important when one is making a decision that seriously impacts on other people and communities, as opposed to a personal decision. (see Knight and Rydin, 2009 and Hartley, 2009 for further discussion on this) This/these challenges are, however, not exclusive to MCA: the choice of data for a CBA approach offers the same potential problems. Though the form of presentation in the MCA approach does allow the data, data derivation and data use to become more transparent by decision makers.

Appraisal methodologies have developed over time, in line with economic and social development and have been influenced by passing phases of schools of economic thought. Following the global credit crisis there has more recently been a move to return to Keynesian welfare economic values following a period of experimentation with increasingly unregulated neo-liberal approaches that placed a higher value on the leadership offered by the market. Notwithstanding these neo-liberal influences, the last two decades have seen in certain quarters a growing international emphasis on appraisal methodologies that seek to address aspects that are far wider than measurable aspects or the direct effects of projects. This reflects the growing importance of a number of other global challenges such as climate change; energy use; the impact of emissions on the health of communities and the environment; rising levels of poverty, deprivation and inequity in certain areas of the world; and problems of food production and distribution. All of these can bring to the appraisal process a very different perspective than that solely based on monetized returns.

These different perspectives, especially in the case of major projects, can increase local opposition to projects which bring major changes but only with 'trickle-down effects' or benefits accruing to the transport user more than non-user. These circumstances require appraisal approaches that are more understanding of the context of the project. Areas of concern that were in the past deemed to be external to the project are now becoming aspects that need to be internalised in the project's appraisal (as in the case of changes in air quality or employment access through construction of a new road or railway line). This transition is happening as part of the continuing political process, itself fuelled by popular concerns and interests as the failure of market driven solutions become increasingly apparent and accepted.

In the UK the main methodology for transport appraisal is now the New Approach to Appraisal (NATA). This first appeared as part of the current UK government's 1998 new transport policy initiatives. Its origins lie in the CBA approach first used exclusively in highway scheme appraisal but NATA now seeks to establish the wider environmental and economic impacts of projects. Because of the difficulties in ascribing monetary values to these impacts, they are not fully incorporated into a formal cost-benefit analysis but are often instead left as physical or indicative values in an Appraisal Summary Table (AST). The AST is similar to the MCA approach which is used by a number of other countries, but refrains from placing formal weights on each indicator and leaves final decisions to the judgement of the decision maker. This, it should be noted, is separate from the statutory duty to provide an Environmental Impact Appraisal (EIA) for most large schemes. This leaves open the central question of how the CBA and MCA elements of NATA can be used in comparisons by decision makers. (see Vickerman, 2009; Hine, 2009)

Other appraisal processes include Strengths, Weaknesses, Opportunities and Threats (SWOT) analyses, DELPHI techniques and review of case studies to establish best practice features; all are effectively variations in MCA methodologies. (Hartley, 2009)

The different methodologies used in the appraisal of major transport projects tend to be associated with different professional groups. The more specifically numerate professional disciplines, such as economists, civil engineers and transport planners, primarily employ CBA methodologies. MCA methodologies, on the other hand, are generally led by professional groups associated with the environment, society and urban and regional planning. There is a misconception in some circles that the quantification of results spawns greater accuracy in predictions, especially within a CBA approach, and that such results therefore provide a more valid result than those set out in non-quantified terms, as in a MCA approach.

4.3 Setting objectives for projects

However disciplined its practice, project appraisal is essentially a political process because of the way it is situated in the decision making context. Because appraisal methodologies establish results which are intended to inform and guide decision makers, they should address objectives that go beyond the purely internal dimensions of the project. Major projects are often seen as agents of change, and so

the performance of these in relation to the changes aspired to also need to feature in the appraisal process. These can ideally be adopted as formal objectives, especially in terms of projects where the main promoter is within the public sector. Projects may, however, also address objectives set informally through national convention or guidance. Even where the project is primarily promoted by the private sector, the defined objectives are still very likely to observe wider goals where they form the basis of market demand or areas where the promoter wishes to influence public support.

The right to set the appraisal framework typically lies ultimately with the body providing the funding for the project. With mega projects there is likely to be a significant degree of involvement of bodies wholly or partly in the public sector. These include international bodies such as the World Bank and the European Union (as discussed earlier) and also national and regional governments. From a strategic planning perspective, in principle the objectives for a major project should be derived from a national strategy, itself developed by the government and facilitated by legislation, guidance and funding. This national strategy should echo at other levels, for example at the regional and city level. This is recognised in the EU directives on environmental assessment: where an SEA required before an EIA is carried out. However, national governments differ in their planning traditions and perspectives about the role and value of national planning and strategies. Some Continental countries such as France, Germany and the Netherlands and many Developing Countries (encouraged by the EU) place great emphasis on these national planning frameworks in operationalising their development visions for the future. Other countries, such as the UK and USA, place more emphasis on market led strategies that better accommodate the shifts in competitive forces of globalization. Notwithstanding these different approaches, if policy statements and strategies fail to identify particular aspects of environmental or social effect, then any project deriving its objectives against them may well also fail to cover that aspect. What is left unsaid in policies is not likely to come on to the agenda.

Some European countries (e.g. France, the Netherlands) have firmly established transport strategies which act as a reference point for project development and appraisal, including setting the objectives. The UK does *not* have such strategies, in place even though sustainability is now claimed to be at the heart of Government policy. The new regime created under the Planning Act 2008 to replace the present planning system, will incorporate a series of national policy statements, against which a new Infrastructure Planning Commission will take decisions on major projects. Sustainable development is said to sit at the heart of the new regime, and new national policy statements will be prepared with the objective of contributing to the achievement of sustainable development. (Hine, 2009) It is questionable, however, how far such policy statements, which are bound to be of a more general nature, will provide a useable framework for developing project objectives.

As part of the NATA study process, the WebTAG guidance² anticipates that specific local objectives will be set, and that these will 'nest' within the Government's five

² WebTAG (www.dft.gov.uk/webtag) is the Department for Transport's website setting out guidance on the conduct of transport studies for appraisal of transport plans, and of major highway and public

objectives for transport. By their very nature, such objectives will be specific to each study so that there is no requirement for them to be the same in all studies. It is therefore not practical for WebTAG to be prescriptive about their formulation or measurement, although it is recommended that a key set of indicators are developed against which to measure the performance of solutions. (Hine, 2009)

In any project the principal promoters' aims are likely to be crucial. These will certainly incorporate national policy statements, however, the weight applied to them in practice through the appraisal process may vary according to the relevance applied to them by the key promoters. These may remain as external influences which are internalised only so far as is necessary. Ultimately, the objectives for all projects are driven by the set of key stakeholders who control the project appraisal overall rather than the many other stakeholders who may be affected. What is important to appreciate here is that these parties can frequently change over time, especially in the case of major projects given the lengthy periods that typically exist between their project conception and execution.

Seen from the viewpoint of achieving a more sustainable world, projects should make a positive contribution to environmental and social aspects. However, the criteria established in many cases only aim at avoiding a negative impact or even provide for mitigation measures to offset negative impacts.

4.4 Aims and structures of methodologies

All project appraisal methodologies have a firmly developed structure, usually setting out a series of steps within in a defined overall planning process. This is likely to include break points, where the appraisal results reached by that stage are submitted to consultation with stakeholders or to a decision on the next stage, or sometimes both.

Thus, for example, the EIA process can be represented as a series of iterative stages which should be a cyclical activity, with feedback from later stages to earlier ones. It is in fact useful to consider the EIA process as two stages based around the principal consent decision for a development proposal. The pre-decision stage incorporates the early stages of an EIA process prior to proposal implementation (i.e. screening, scoping, impact prediction, and decision). The post decision stage, assuming consent has been granted, is the follow-up stage and is concerned with the various stages of the project life cycle (i.e. final design, construction, operation, and decommissioning, project and environmental management). In the UK, however, post-auditing activities are not widespread and this limits the cyclical nature of the process. (Knight and Rydin, 2009)

A most important aspect in the evolution of EIAs was the fact that through this exercise developers would be required to consider alternative options. The US

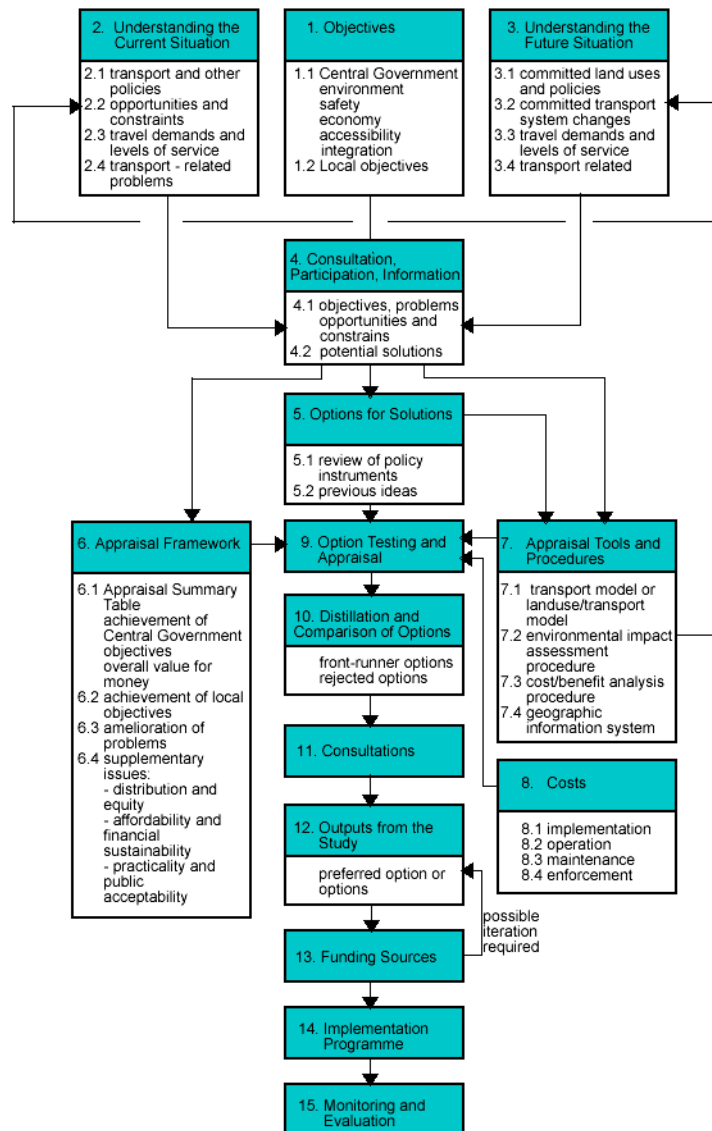
transport schemes. It includes detail sections on setting objectives and identifying problems, developing potential solutions, creating a transport model for the appraisal of the alternative solutions, and conduct an appraisal which meets the Department's requirements.

Council on Environmental Quality (CEQ) noted 31 years ago that the discussion of alternatives is “the heart of the environmental impact statement”. There are good reasons for this: an in depth discussion of alternatives ensures that the developer has considered other approaches and of other ways of mitigating environmental damage. In the UK the consideration of alternatives is given less consideration by the local planning authorities (LPAs) than might have been anticipated. (Knight and Rydin, 2009)

Option generation is in fact a vital part of project planning. It needs to be guided by the policies and strategies established by the relevant public authority (government, regional authority, city). To do this the appraisal process needs to have sufficient time and resources. Alternatives need to be developed, in outline at least, and discussed, so that they provide the basis for a project design that is already starting to address potential impacts.

The UK NATA process is made up of a 15 step process, described in the specific Web site WebTAG and shown in Figure 3. This starts with setting the objectives and leads up to completion of the Appraisal Summary Table (AST), which is used to assess the achievement of the government’s transport objectives, broken down into a number of sub-objectives. The main impacts in relation to each of the sub-objectives are summarised in text form together with any relevant quantified information. A summary assessment is provided in order to indicate whether the impact in each category is generally beneficial or adverse and how large it is. Where monetary values can be derived, as in the case of accidents or transport economic efficiency, the summary assessment uses those values. Where impacts can be quantified but not monetized, the summary assessment is quantitative. Impacts that cannot be quantified are assessed on a (usually) seven point scale (these scales are not necessarily cardinal in nature); but, because each seven point scale measures a very different objective, they cannot be compared with each other. The way in which the impacts under each sub-objective should be assessed is explained in further WebTAG sections. At an early stage in the study process, WebTAG recommends that current and future transport related problems should have been identified, analysed and displayed using text, tables and plots as appropriate. An assessment of the extent to which the problems identified would be solved by the option or options proposed then needs to be made, considering both absolute and relative performance against key indicators. (Hine, 2009)

Figure 3: The UK NATA process



4.5 Range of criteria, indicators and information

The range of criteria and indicators used in a project appraisal reflects a number of factors:

- the decision making bodies, including promoters and funders, and what they need to identify;
- the objectives for the project, which may include the objectives for the planning context within which the project is being developed;
- the professional basis and purpose;
- statutory requirements; and
- conventionally accepted items.

The choice of indicators and the level of information used may well be partly determined by the availability of data, the cost of obtaining it and the extent to which it is judged valid. Certainly there are statutory requirements within some fields but these do not necessarily lead to high quality information being generated where this is difficult to achieve.

An example of the range of criteria and indicators can be seen in the key objectives and the defined indicators for the NATA process. Projects appraised by this approach (as set out in the WebTAG site) requires all projects to be set against the five key objectives defined in the 1998 White Paper *A New Deal for Transport*. For each of these several indicators are required. The UK government objectives have now been updated, to reflect the new focus of the 2008 document *Developing a Sustainable Transport System* (Department for Transport, 2008). Appendix 1 sets out the NATA objectives and criteria and compares them to the current DaSTS objectives.

NATA demonstrates the typical practice of aggregating indicators to provide an apparently easier guidance for decisions. However, the more that data is aggregated, the higher quality it needs to be in principle in order to still be meaningful. Under any circumstances, aggregation means compounding, thus any lack of validity may be increased significantly.

Equally crucial is the issue of quantitative (data) as against qualitative (descriptive) information in indicators. Quantitative measures provide in principle a sound basis for comparison whereas qualitative measures do not offer such hard references. On the other hand, a single set of numerical data – or even just one summary figure – leaves open concerns over how it was calculated – the ‘black box’ issue. And both types of information have to be soundly based and relevant to be valid. All information sets raise questions of subjectivity, value assessments and stakeholder bias. In consequence there is little benefit in implementing a comprehensive system of environmental or social assessment if no check is made on the validity and impartiality of the data presented to the decision makers.

4.6 Other factors in appraisal

Some other aspects of project appraisal are also important which are not always handled thoroughly. These especially include the scoping stage, the follow-up stage, consultation and the use of scenarios.

The scoping stage is arguably the most important stage of the appraisal process of a project. This is so because it establishes the context, the objectives and the availability of information of the project. It also offers a key opportunity for developing options for consideration before appraisal starts on one particular option. Yet it remains a poorly understood and under-researched component. There is typically a lack of sufficient consideration of alternative options, of cumulative impacts, and of project monitoring and auditing tasks. The range of data identified and gathered in EIAs, for example, is heavily bio-physical in focus where in reality development decisions involve trade-offs between bio-physical and socioeconomic impacts.

Research has also shown that public consultation in project appraisal is sporadic and limited, despite the fact that it is supposed to occur at every stage of the process. In most UK cases, it actually only happens when the findings outlined in the ES are presented. All these have a significant impact to the quality of an EIA. The scoping stage involves the interpretation and evaluation of the concept of 'significant effects' involved in any given project, as well as initiates early contact between the developer and competent authority. There is a tight time frame for this process and the emphasis is usually on the 'significant' effects rather than on all effects, as other issues may be of little concern for that particular development. (Knight and Rydin, 2009)

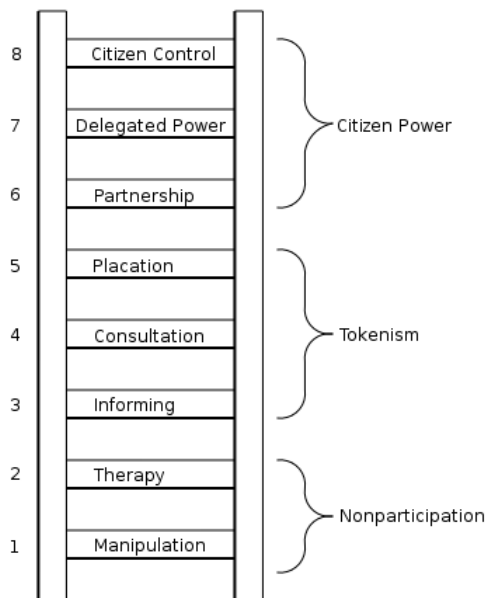
Research has also shown that project follow up – i.e. auditing and monitoring - remains a major weakness in EIA. It is in practice only performed in a minority of cases. A lack of follow up is, therefore, a major constraint on the advancement of overall EIA practice. This almost certainly holds good for assessing the actual impact in terms of social factors (including socio-economic ones) too. Gaining planning permission for mega projects should provide a means to obtain good environmental management and community development insights over the life of the project. Mechanisms for the dissemination of results would be vital in ensuring successful measures are implemented in future projects and less successful ones improved upon or abandoned.

Consultation with stakeholders is a required part of appraisal and planning processes of major projects at local, national and international levels. The processes for carrying it out however are not always clearly defined and vary widely. It is suggested (see Colomb, 2009) that there are two broad approaches to public involvement: consultative and participatory:

- The *consultative* approach – This meets the basic requirements of consultation with the public but falls short of providing participation of the public or all stakeholders in the project decision-making process. The public and stakeholders may be consulted at various points throughout a public process but are not involved directly in developing the material or assessing the effects, or in project decision making.
- The *participatory* approach - This more innovative but more challenging approach allows stakeholders to participate in the project decision-making much more directly. The move to truly participatory forms of appraisal is not easy because it requires a shift in values, which allows for a more open, honest and transparent relationship to develop among all parties, and shift in the way power is shared, as well as time, resources, and commitment by all parties including the public and stakeholders. Additionally there is frequently a tension between the requirements of public involvement in the appraisal process and the increasing sophistication and complexity involved in CBA, MCA and modelling approaches used by professionals. From a practical point of view, it should be noted that early involvement in consultation (as now practiced in Sweden) can act as a way of clearing contentious issues which would re-

appear in the formal consultation stages. The range of types of involvement is shown in Figure 4 below. (Colomb, 2009).

Figure 4: The ladder of public participation



[Colomb, 2009, from Arnstein (1969)]

As indicated earlier, one of the weaknesses of appraisal in major projects is the failure to develop 'real' alternatives. Too often in the appraisal the simple option is given to decision makers of approving the project or of accepting a 'do-nothing' (or sometimes 'do-minimum') option; there is no scope for considering a wider range of actions. It is important here to consider the potential role that can be played by formulating alternative scenarios for assessment. These may cover broad outline options, at an early stage of project development: in effect defining whether there might be a project and what it is. At a later stage in the process they can be developed and tested to cover different aspects: specific type and scale of project, route alignment, charging regime. (Hartley, 2009)

4.7 Possible implications of using different methodologies

The principal issue that arises between methodologies and between groups of professionals is over the extent to which all indicative measures can be compiled *together* through a single measure. Quantification is generally seen as more significant than non-quantified information and quantified data tends to have priority over descriptive information. In practice the principal form of quantification is through assigning as money values, which offer a single point of reference. This is at the heart of CBA appraisal and of groups who consider this as fundamental. The central argument is that prices are the most common indicator and that bringing all measures to a single indicator figure (the NPV or other single measure) gives the

clearest value. Since a major part of the decision process will be for the funding bodies, then they need to have a clear indication of the results in financial terms.

The main question hangs over determination of what prices to use. For some major projects there is no direct user charge. For others there is a charge but the impact of a major project may be to change behaviour patterns very significantly and thus assessing the charge is not straightforward. The usual way to measure prices is through the operation of a market. A well functioning market adjusts the prices faced by buyers and sellers to reach equilibrium. However, to be well-functioning there needs to be perfect information available to all agents in the market. Any asymmetries in this information and the prices can be distorted by the agents with the better information. But most of the factors affecting the environmental impact of transport do *not* have well-functioning markets. Economists claim that this does not mean that they cannot define the implicit price, just that they cannot use an existing market to do this job. Thus, they argue, the first task is to establish an appropriate price without a market. (Vickerman, 2009)

The usual immediate objection to this approach is that CBA practitioners are attempting to measure the value of things which, because they are not traded, have no market price. But the argument is usually taken further than this to suggest that it is wrong to place a money value on things which are in a sense beyond value. However, not placing an explicit money value, or more strictly a money price, does not avoid this issue because everything will have a relative price. If the decision is taken *not* to do something because the price is deemed too high for environmental reasons, then by implication that action has been given a price associated with the lost activity – the opportunity cost. (Vickerman, 2009)

The NPV figure is also determined by the discount rate used, related to interest rates for money. This means that future costs and prices have a lower value than current ones: and more distant costs and prices carry a particularly low weight. This directly contradicts the principle that sustainability is about preparing the world for future generations. In any case, a major project generally involves a longer time scale and thus longer term impacts are more significant as a total part.

In contradiction to this, CBA is seen by many in social science and urban planning as not offering a sound reflection of the true 'price' anyway. From this viewpoint CBA is generally considered to have a systematic bias of a regressive kind, so that some benefits (and costs) are emphasized compared with others. For example, in terms of social equity, benefits accruing to higher income groups are emphasized compared to those for lower spending groups. (This is especially regressive for projects in the Developing World). It has been argued that the perspective of social equity cannot be addressed properly by CBA, because CBA relies on aggregates, i.e. counts the sum of benefits against the sum of costs, no matter who or how few people get the benefits and who or how many people suffer the costs. So the practice of CBA, by definition, ignores the fact that the very existence or objectives of a project may be totally opposed or strongly contested by some groups, because different groups have different perceptions of a positive and of a negative impact. (Colomb, 2009)

Similarly, a single CBA final net value cannot readily reflect different environmental (ecological) values because they are complex, local and of very different character.

The accuracy of the outcome of a CBA appraisal is dependent on how accurately costs and levels of use have been estimated. Some post implementation studies have found serious differences between estimated and actual figures, variations in both being around 50% higher for rail projects and 20% higher for road projects. Comparative studies indicate that similar inaccuracies apply to fields other than transportation. These studies indicate that the outcomes should be treated with caution, because they may be highly inaccurate. Inaccuracies of this size may be argued to be a substantial risk in planning, because they are likely to lead to inefficient decisions. Such inaccurate estimates arise because they (after Hartley, 2009):

- rely heavily on past like projects (frequently differing markedly in function or size, and certainly in the skill levels of the team members),
- rely heavily on the project's members to identify (remember from their collective past experiences) the significant cost drivers,
- rely on very crude heuristics ('rules of thumb') to estimate the money cost of the intangible elements, and
- are unable to completely dispel the usually (unconscious) biases of the team members (who often have a vested interest in a decision to 'go ahead') and the natural psychological tendency to "think positive" (whatever that involves).

In principle, MCA appraisal methodologies avoid the problem of presenting an apparently sound single valuation whose calculation is lost somewhere in a 'black box'. Instead MCA methodologies present the results in terms of a set of measurements. These can include both quantitative and qualitative information. This leaves the decision makers to bring their own judgement to bear on the balance of results. However, MCA methodologies are also open to a possible risk of easy and arbitrary assessment if the results compiled for the various criteria, whether quantitative or non-quantitative, are put together on the basis of poorly founded assumptions with no testing. This can be avoided if problems are carefully established, and models of possible impacts are developed from different perspectives and used in a participatory way in stakeholder consultations. (Hartley, 2009) The central requirement is that there should be transparency in the compilation and use of facts and figures.

A combination of the two approaches is found in the Appraisal Summary Table (AST) used in the UK NATA process. The AST includes both qualitative and quantitative information, the latter of which is expressed in monetary terms or other units. Monetized items currently include direct effects (travel time benefits, providers' revenues and costs), accidents, carbon emissions and noise impacts, and are input for a partial CBA to estimate a benefit/cost ratio, which, in turn, is input for an MCA. However, no weighting information is provided, and decision-makers must apply their own judgement when weighing the impacts to reach an assessment of the overall monetary value of a proposal. Providing the information in this way enables a consistent view to be taken about the value of projects. The AST does not

automatically provide a mechanistic way of estimating value for money, but summarises the effects in each area so that decision-takers have a clearer and more transparent basis on which to make a judgement. The inclusion of any sub-objective in the AST, with the associated qualitative and quantitative analyses, cannot be used to imply weightings between objectives in forming decisions. (Hine, 2009; Hartley, 2009)

Furthermore, supporting analyses recommended by WebTAG cover three additional groups of issues that do not easily fit within the Appraisal Summary Table. These issues are (after Hine, 2009):

- distribution and equity which aims to show the distribution (spatially, across modes, etc.) of the impacts of the solution, thus enabling an assessment to be made about the fairness of impacts on those affected;
- affordability and financial sustainability which aims to outline the financial performance of the solution, identifying public and private sector input; and
- practicality and public acceptability which follows a checklist that includes such measures as feasibility, area of interest, complexity, time scale, phasing, and political nature of solution.

In principle it is possible to extend tightly drawn methodologies to more effectively incorporate environmental and social factors. The AST in which results of NATA appraisals are presented forms an example; though the limitations of that have been indicated. Colomb (2009) provides an example of extending CBA through specifically identifying and assessing the equity aspects of the appraisal. It might be possible to group the population to determine the fairness of the distribution of gains and losses to specific subpopulations. This might form a useful way of incorporating social factors within a formal appraisal. However, different groupings of the population would result in different assessments of a project's fairness. Furthermore, it would require application of judgement within the process over how to choose groupings.

5.0 Treatment of environmental issues

5.1 Defining environmental concerns

Environmental concerns have been of growing significance for perhaps the last half century. They have developed from initial concern over the impact on eco-systems, often at local level and usually by specific groups of people. But they have also taken in wider aspects, such as the effect of projects or activities on particular species of bird or animal or on types of habitat. At this level, the approach has been, in general terms, to adapt projects or activities to mitigate their impact on the parts of the eco-system, leading to adoption of appraisal elements which would measure the possible impact and how to mitigate it.

However, the levels of concern have widened beyond this, reflecting both the widening awareness generated by research and the growing discussion of such matters. This has led to a growing interest in 'green issues'. This has gradually brought increasing requirements for environmentally focused policies and for projects to be appraised in relation to their environmental impact. As part of this evolution, the interest has moved on beyond simple mitigation at the time of building a piece of infrastructure; there is a widening interest in having the environmental effects of activities to be addressed. The possibility of serious climate change and its potential impact on life on earth have become a central feature of debate since the 1991 Rio Summit. This has focused the need to understand and mitigate everyone's generation of carbon.

But while these matters have become enshrined in public debate and policy instruments, they have not become universally accepted; at all levels there remain debate and indeed controversy. In particular environmental aims are often seen to be in conflict with goals of economic prosperity; especially where they concern growth in transport systems. It is however part of the controversy surrounding environmental issues that sound environmental practices are also seen in many quarters as underpinning good economic practice. This is all part of a continuing evolution of concerns over the environment.

5.2 Environmental issues – concerns and aspects in principle

It follows that sustainable development is more often seen in terms of environmental concerns. This is reflected in the high level at which environmental appraisal has become formalised. Strategic Environmental Assessment (SEA) of certain plans and programmes, including Local Transport Plans and Regional Transport Strategies, is required under European Directive 2001/42/EC to assess their effects on the environment. SEA is broadly consistent with NATA and is now required as part of the NATA process for such plans and programmes. Effectively the principal focus is on ecological factors.

Environmental assessment applied to one project may not be properly valid if it does not fully set it in the wider environmental context. Thus, for example, the

environmental strategy for the railway system in Great Britain focuses on three core themes:

- developing a better understanding of the environmental footprint of the railway;
- improving the environmental performance of the existing railway; and
- ensuring that future investments in railway infrastructure and rolling stock take full account of all environmental impacts.

However, it is possible that a railway project with an insufficiently high environment score might be rejected, even if the result of its implementation would be changed travel patterns in its region which lowered environmental impact of transport significantly. This demonstrates the importance of objectives and approaches being properly set in the strategic context.

The rationale for applying SEAs to planning and policy making is also subjected to much criticism for its shortcomings. There is a weakness perceived in planning and policy making in that it is focused too much on utilitarian and economic principles which the SEA seeks to address. However, environmental issues – particularly those that are of a strategic nature – are still frequently treated as simple ‘add-ons’ that are taken into account not during, but after policy and planning processes have been conducted. In dealing with environmental issues reactively the focus is shifted to mitigating negative impacts, rather than proactively seeking alternatives that enhance positive impacts, which is a limited approach to addressing environmental concerns. This is short-sighted and the lack of baseline data in current plan making practice means that it is often politically expedient decisions that prevail for short term interest. (Knight and Rydin, 2009)

Another argued advantage in the application of SEAs is in the consideration of cumulative and synergistic impacts of multiple projects. SEA can support a process by applying structured frameworks and creating the context for a more focused approach. This aim is, however, hindered by the previously discussed criticism of its reactive application, for a proactive approach would enable the SEA to detect not only direct but indirect cumulative and synergistic impacts.

SEAs form a major factor in determining the planning context within which projects need to be appraised.

5.3 Appraisal of environmental factors in practice

Appraising the environmental aspects of a major project requires an Environmental Impact Analysis (EIA) which leads to an Environmental Statement (ES). Through the EIA a more balanced decision-making process should emerge in this appraisal, giving environmental factors greater consideration and weight alongside other facts such as cost. EIA is not a substitute for project decision-making but it should help clarify some of the trade-offs associated with the proposed project and lead to a more rational and structured decision-making process regarding its outcomes. The second purpose of the EIA is to aid the developer. If the process is fully integrated

into the project design cycle, it can enable developers to identify environmental issues at an early stage, allowing them to minimise or eliminate the adverse impacts on the environment. This may lead to improved relations between the developer, the local authority and the local communities and therefore lead to a smoother planning permission process. (Knight and Rydin, 2009)

There are two levels of data that need to be considered as part of the scoping exercise; the baseline data, which provides information on the existing conditions, or standards against which the effects of the proposed development may be judged, and the range of data that needs to be compiled and included in the ES. Typically the assessment of both of these levels of data tends to be focused on bio-physical aspects. It often fails to take into consideration the socio-economic characteristics of a development project. Of the data gathered, the general preference is also for quantitative over qualitative analysis of data. However, qualitative analysis is used quite widely, in part because identifying quantities can be very difficult. The main qualitative measure may well simply focus on whether the project would bring a better or worse situation for the factor. This requires clear establishment of its present situation as part of the scoping work.

The EIA involves production of the ES. It is normally carried out and presented as an MCA process, with the results for the various criteria set out in a summary table. Formally the ES is usually presented as part of the supporting papers for the decision processes.

5.4 Implications of how environmental factors are treated

There is a wide range of items that may be considered within an EIA. Appendix 1 shows those that are required under the NATA process. Defining the exact criteria and baseline measures for what is a complex and varied set of criteria. It requires careful work; some of the aspects covered may prove difficult to quantify. Establishing the potential impact of the project in many fields can prove complex. Often it is likely to involve judgement.

Judgement is also applied when formulating the criteria and targets within the scoping study. This covers, for example, what constitutes a local eco-system and how might its components be altered by the project. The retention or otherwise of a lake, riverbank or meadow may be straightforward to indicate and assess. But landscape may be less easy to define in terms which neatly fit within an EIA structured process. In practice there remains a wide variety of detailed approaches, especially where the important scoping report is concerned (Knight & Rydin, 2009).

In addition, the judgements used in the establishment of the baseline situation, the criteria and the impact for the designated environmental factors will be those of the appraisal team. While the environmental planners in that team should have suitable experience, their judgement, especially on the more sensitive matters, may not match the preferences of stakeholders from community and other local or regional interests. Thus the EIA could produce a result for the decision makers which actually conflicts with the interests of many affected parties.

If the ES is presented as a complementary document, but not necessarily a core part of the project appraisal, then it may be given lower priority by the decision makers. This may happen especially if they are taking the position of 'economy v. environment'.

For these reasons Knight & Rydin (2009) set out two important ways forward. First, they see environmental appraisals, especially SEAs, as forming part of a social learning process. They draw out the role of deliberative approaches here, perhaps with formalised 'citizen juries' or similar approaches. They also consider the EIA as forming a valuable management tool for the life of the project.

This indicates how even purely ecological factors have implications for people. However, environmental factors within an EIA generally include aspects of the built environment, such as heritage and townscape. These almost invariably concern settlements and therefore directly affect people in some way. The growing focus on sustainable development has extended the requirement for environmental assessment to one for a Sustainability Appraisal (SA) which also covers the direct impact on people, i.e. the social factors.

6.0 Treatment of social issues

6.1 Defining social concerns

The growing requirement for Sustainability Appraisal (SA) has brought the need to define and measure impacts in social terms as well as environmental. The word 'social' itself has more than one meaning: it can refer to communities of people, at levels ranging from local groups to the populations of countries or continents (the basic meaning here); or to a characterisation of friendliness (by implication not a serious factor). In some cases the term societal has been used instead.

Social concerns have always been a feature of society, in the sense that differences in condition and aspiration between different groups have always formed part of public and political debate and action. Social dispute thus forms the backbone of history. Essentially social concerns are part of the political process. This means that defining social concerns as part of a formal evaluation process is a complex and difficult matter. Different forms of project can have different implications for the various groups in society, not least in terms of richer and poorer.

6.2 Addressing social concerns and issues in principle

Social issues have lagged behind environmental ones in terms of their incorporation in project appraisal. They are often not easily measurable and are very often politically sensitive, for reasons indicated above. Indeed the language of social issues itself is not always definite, and terminology differs according to context. In the European context, the terms of 'social cohesion', and its corollary 'social exclusion' gained currency in policy discourses (in France and the UK) in the 1990s. The term 'social exclusion', initially developed in France, was first used by the European Commission in 1989. The New Labour government in the UK, with the setting up of the Social Exclusion Unit in 1998, took the concept on board in official debates on social and urban policies, as have other European governments. The term 'social exclusion' has gained currency, instead of poverty or deprivation, to refer to the fact that new processes which go beyond income deprivation and lack of work are at play in contemporary forms and processes of urban deprivation. It corresponds to the recognition that poverty is multidimensional, is a process, is not only material but is characterised by a wider exclusion from the worlds of work, education, consumption, political life and sociability, and mobility. (Colomb, 2009)

For a long time the discussion of social exclusion by researchers in sociology and social policy ignored the 'spatial' or 'mobility' related aspects of social exclusion. Conversely, transport researchers in various disciplines (economics, geography, planning, public policy, civil engineering) long neglected the potentially positive and negative impacts of transport and mobility on patterns of social exclusion. This has changed substantially over the last decade, leading inter alia to the UK Government's report on social exclusion and transport *Making the Connections*, which was followed by the requirement for local transport authorities to carry out accessibility planning. However, this has not yet penetrated the field of appraisal for major projects, which, if not carefully planned and thought through, can have various

negative impacts on social equity or social cohesion broadly defined, which can outweigh the positive impacts generated by increased access to jobs and services. This can happen in two ways: either directly through the 'severance' of physical space and social communities (leading to a reduction in pedestrian mobility or increased crime), or indirectly via the urban restructuring processes which are generated as a result of a new major urban transport project, for example: e.g. eviction through compulsory purchase, displacement to make way for commercial development, increase in real-estate prices resulting in long-term displacement etc. (Colomb, 2006)

Table 1: Major Urban Transport Projects (MUTPs), social equity and social exclusion

| Direct impacts of MUTPs on social equity and exclusion | |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Affordability | <ul style="list-style-type: none"> - Fare levels and fare structure can have regressive or progressive distributional effects (in relation to the primary distribution of income through the labour market and/or the state) in a given society/territory. - Share of transport costs in household budget can increase or decrease as a result of an MUTP. - Compensatory measures: concessionary fares |
| Accessibility | <ul style="list-style-type: none"> - Scheduling can favour certain social groups (or not). - Physical accessibility (for disabled individuals) - Safety (for women, older people, children etc...) - Signage and availability of information (cognitive aspects) |
| Availability | <ul style="list-style-type: none"> - Siting and spatial coverage (defining minimum standards?) - Relation to land use planning and the location of housing and economic activity - Direct physical displacement of communities: through CPO and expropriation - direct effects of the MUTP on patterns of in-migration or out-migration in a given area: can be positive or negative. - Health impacts |
| Indirect impacts of MUTPs on social equity and exclusion | |
| The economic impact (job creation and/or improvement of access to jobs) of an MUTP | <ul style="list-style-type: none"> - A limited trickle-down effect? An MUTP could generate growth and jobs - however, the public sector always has to ensure that 'social' regeneration follows – i.e. getting disadvantaged people into jobs. Many barriers to employment exist... mobility is just one of them. |
| Indirect transformations of urban and regional space triggered by, or accompanying, an MUTP | <ul style="list-style-type: none"> - Transformations of urban spaces and urban economies as a result of MUTP can have unfair, unequal impacts 'distributing benefits and costs in a disproportional way among privileged and unprivileged social groups' (Kaparos and Skayannis 2008) - Long-term physical displacement of communities: altered land values and gentrification |
| 'Opportunity cost' involved in the use of public resources for MUTPs | <ul style="list-style-type: none"> - 'Opportunity cost' if public resources which could have been used for key services such as education and housing are diverted towards flagship MUTPs with little benefits for disadvantaged social groups. |

The major difficulty in including social impacts in transport project (and policy) appraisal is that they can take on many forms, some of which are particularly difficult to estimate with any precision. Perceptions of the relative importance of different types of social impacts may also vary widely: perhaps, in part, because relatively little work has been done to develop methods, tools and techniques to rigorously

estimate probable social impacts of transport changes. However, ignoring social impacts in ex-ante assessments of transport infrastructure projects would suggest that *only* economic and environmental impacts are important. Often, furthermore, no clear distinction can be made between social, ecological and economic impacts. In general, ecological impacts merely focus on receptors, such as flora and fauna, whereas social and economic impacts concentrate on human beings. For instance, air pollution, noise and climate change affect flora and fauna, as well as human beings. Therefore, they have both social and ecological impacts (and sometimes economic impacts, as well). The distinction made in many appraisal studies between economic and social impacts is often pragmatic. Economic impacts included in transport appraisal focus typically on (the valuation of) changes in travel times and related consumers' surplus, changes in employment and business activity and earnings, whereas social impacts focus on changes in social patterns, social problems and lifestyles. Indeed, some social impacts can be very intangible. (see Colomb, 2009; Hartley, 2009)

Some countries have adopted the practice of developing a social impact assessment (SIA) to complement the EIA, as in the case of Canada and Australia. In Europe, however, the profile of social appraisal is lower and such impacts tend to be less well considered in the UK. Generally across Europe a very broad definition of social impacts is used and, therefore, the different views on what should be included as a social impact and what not is often sidestepped. For example, option values can be seen as economic impacts, but are essentially also social ones. The same applies to safety and some environmental impacts, such as health impacts due to emissions. Both the current Dutch and, in particular, the UK transport appraisal guidance, pay attention to a wide array of potential social impacts, but do *not* cover the full spectrum. A small number of impacts is addressed through quantitative measurements and assigned a monetary value, for instance, for traffic casualties, noise nuisance and air pollution. These impacts are typically included in CBAs and EIAs, forming the basis for guidance of both. Some of these differences in guidance are also induced by differences in transport policy, for example, social exclusion is a major policy issue in the UK but not in the Netherlands. (Hartley, 2009)

6.3 Appraisal of social factors in practice

Incorporating social factors in the appraisal of major projects involves consideration of a wide range of issues. Whether or not factors are included in the appraisal, and how they are included, reflects the interests of those who select the criteria for assessment and the judgement of the project promoting bodies and possibly the (public) regulatory bodies.

Much of the social impacts concern the distributional effects of projects: i.e. they way in which they affect the distribution of opportunities and resources across the different socio-economic groups in society over space. As shown above, this can happen in direct ways (i.e. the project provides more benefits to some groups than others) or in indirect ways (i.e. where the project alters the built and socio-economic shape of communities in ways which affect some groups more than others). The main concern of social planners and social scientists is over regressive distributional

effects, i.e. poorer groups benefiting less or even suffering more as a result of a project. Their aim is likely to be the promotion of social justice, which involves among other things an active effort to avoid regressive redistribution or even achieve progressive redistribution where appropriate. The pursuit of social justice requires an appropriate process to ensure that it actually happens, possibly involving active steps to make it happen, supported by focussed assessment. In this respect an equal redistributive impact is not the same as an equitable one. (Colomb, 2009)

Social impacts often reflect spatial impacts which are particularly likely to be caused by mega transport projects. Such projects can cause substantial spatial differentiation, affecting different areas in different ways and thus have different effects for the communities in them. In principle, major transport projects aim at improving accessibility, often through making travel cheaper or better: however, this does not always equate to better accessibility. (Colomb, 2009)

The general principle advanced by economists (and most transport planners as well) is that successful transport projects bring with them 'trickle-down' or ripple effects. For example, the gains to commercial activities in central locations and to those engaged in them which major projects bring about is expected to lead to better incomes and facilities access to opportunities for the poorer groups in the area as well. However, the truth of the matter is that this assumption is not always fulfilled. This is so because the CBA approach preferred by economists relies on aggregating results to one single figure but, because of this, cannot handle equity issues. In consequence, it does *not* lead to relative improvement for the poorer groups, who may, despite increased resources, fall behind. This is not seen as social justice and can exacerbate social tensions. Sociologists would argue that relative benefits might be gained only by direct intervention. (Colomb, 2009)

The impacts of transport on health have been an under-represented issue in transport appraisal. The negative aspects through, for example, local air pollution or noise have been researched and incorporated, but the positive benefits through improving access to various services as well as recreation have *not* been incorporated in such detail, except as part of general improvements in accessibility. What is not incorporated elsewhere is any direct impact on physical activity such as walking or cycling which a scheme may have. There is a potential problem here that transport improvements which have a strong measurable economic impact, e.g. through contributing time savings, may have a significantly negative impact on health if they discourage walking and cycling. Conversely, projects which encourage walking and cycling may extend journey times and appear to have negative economic impacts. (Vickerman, 2009)

The NATA AST does include an objective of accessibility: to improve access to facilities for those without a car and to reduce severance:

- to improve access to the transport system;
- to increase option values; and
- to reduce severance.

The NATA 'refresh' has seen some changes incorporated in the AST so that it reflects the new transport goals and changes. These especially highlight carbon impacts and ensure alignment between local and national goals, for decisions often made within wider local and regional planning processes, touching areas such as social and distributional impacts, health impacts of transport, housing and economic development.

6.4 Implications of how social factors are treated

While transport project appraisal methodologies are now seeking to increasingly incorporate social factors, there remain serious limitations to these efforts, especially in the view of social scientists and urban planning. CBA is generally considered particularly weak in this respect. It is considered to have a systematic bias of a regressive kind, so that benefits (and costs) enjoyed by high-spending groups are emphasized, compared with those to lower spending groups, conflicting with social equity (fair distribution of costs and benefits). In fact, it has been argued that the perspective of social equity cannot be addressed properly by CBA, because CBA relies on aggregates, i.e. it counts the sum of benefits against the sum of costs, no matter who or how few people get the benefits and who or how many people suffer the costs. So the practice of CBA, by definition, ignores the fact that the very existence or objectives of a project may be totally opposed or strongly contested by some groups, because different groups have different perceptions of a positive and of a negative impact. Some social impacts can be of a very intangible nature (e.g. community cohesion and identity) and cannot be adequately grasped by traditional CBA appraisal. (Colomb, 2009)

In an MCA framework, the result of the CBA (in the form of net present value or rate of return) can make up one of the scoring criteria (usually treated as the most significant). As with CBA, however, a number of technical and methodological issues arise when attempting at including a wide range of social impacts in MCA, in particular:

- identifying and defining the impacts to be included;
- specifying the measurement method and how each impact will subsequently be assigned a score;
- deciding upon the use of weights and how these might be obtained in practice; and
- dealing with variations in how the scores and weights are combined to give an overall project score.

In the UK, despite the claimed strong emphasis given by the New Labour government on the role of transport in fighting social exclusion, there is *no* specific appraisal method directly associated with social exclusion. The current method used to assess Local Transport Plans, based on the NATA methodology, has three very simple measures of accessibility but is still lacking a comprehensive and robust method of social exclusion appraisal and monitoring. Following the SEU 2003 report, from 2006 onwards, Local Transport Authorities have had to submit accessibility

planning strategies within their Local Transport Plans; but these appear to have little impact.

Summarizing the main arguments, there are three main reasons why the assessment of social impacts, beyond direct transport benefits and environmental impacts, remains underdeveloped in conventional MUDP appraisal approaches:

- technical and methodological difficulties (i.e. the challenge of creating indicators that can be measured and modelled, of valuing certain types of social impacts, of defining the spatial and time scale at which impacts may play out);
- the very philosophy of CBA, which is unable to grasp equity issues; and
- the political importance given (or not) to social equity issues, which often do not feature prominently in the agenda of decision-makers, lying behind economic growth and environmental concerns. The prioritization of equity issues in transport obviously depends on national (regional and local) context and the political ideology of the decision-makers.

Furthermore, approaches based primarily on assessment by professionals and allowing little involvement by other stakeholders are less likely to take on board all aspects of social factors or give them sufficient weight. This is much more likely to happen through appraisal which incorporates strong participation by stakeholder groups. This means that the project's design and assessment reflect the myriad and sometimes complex matters which concern stakeholder groups much more effectively. It may also mean a gain of local information which improves the effectiveness of the project. However, it does involve the project's promoters adopting a suitable style of appraisal and allocating appropriate resources. Carrying out SIAs effectively does require this. Such methods mean reflecting the interests of minority groups, and the issue arises of defining who minority groups are in this context. (Colomb, 2009)

In all appraisal methodologies, there is the risk that the main focus is on those who use the new system created by the project, i.e. travellers on the transport infrastructure; non-travellers receive less or even no attention.

7.0 Treatment of risk, uncertainty, complexity and context

7.1 Treatment of risk and uncertainty

All the Working Papers reviewed for this study were addressing, in one way or other, the question of how uncertainties should/could be addressed in project appraisal and what are the risks and opportunities posed by particular treatments of these uncertainties. Such risks include those primarily of project stakeholders potentially impacted by a project, where and how environmental conditions may be worsened by the project or where opportunities for betterment may be lost. Risk also presents itself to the project promoters, in that they may fail to achieve their goals by promoting the project despite its high cost. The uncertainties lie particularly in the extent to which the project appraisal processes fails to address the risks intended or fails to understand them in the first place. The various working papers reviewed reflect these issues of risk and uncertainty throughout despite the fact that (except for the Actuary perspective provided) they rarely specifically refer to risks and uncertainties.

The issues involved in addressing risk and uncertainty in decision-making for projects are particularly brought out by the work of Adams (1995). He draws out several crucial factors regarding risk in transport development and use. In particular, he sees major dangers with what he terms hypermobility: i.e. the very high levels of travel now becoming the accepted norm across the developed world at least, and with which many major transport projects such as airports and fast train stations are closely associated.

Essentially Adams sees the treatment of risk in decision making as a balancing act, assessing likelihood and taking steps to manage it (the risk). It is in fact a balancing act carried out by every individual throughout their lives, developed as a continual learning process. Risk is, for the individual, a perceived threat, a feared potential outcome of a future event. People have different attitudes to risk according to their culture: Adams identifies four categories, each of whom is likely to act differently in a given situation. One particular factor he draws out is the steep socio-economic gradient risk experienced across society, whereby, the poor suffer much higher casualty rates than the richer members of society. There are also differences between different communities of people, including national communities (illustrated by comparing standardised ratios of mortality from accident and violence in different countries).

The individuals' management of risk often reflects the involvement of institutions in risk management. To manage risk directly, institutions must first gather information about the likelihood of risk and use this as a basis of measures introduced. These include regulation and guidance measures to be enforced by public bodies, such as statute based standards prescribed by government. Other institutions, such as commercial bodies, seek to manage risks, through the application of measures which may be imposed (such as standards set by government regulation) or may be chosen for their expected beneficial effect on business performance (e.g. measures to prevent accidents at the workplace should reduce lost staff time and

compensation claims and may increase productivity). Common standards across particular industries are widely found. Industry standards may also reflect statutory regulation or government guidance; and some public regulation may be developed in association with commercial bodies or other relevant stakeholders.

The institutional management of risk in decision making for project appraisal depends on the measurement of that risk by the relevant bodies. It falls to each institute to choose what they measure, how they measure it and why they are measuring it. Adams stresses that all research to establish risk is affected by the biases of the culture and the interests of the institutions undertaking the research for risk management purposes. As an example, he examines road safety, suggesting that most studies have examined the safety of people in cars rather than pedestrians and cyclists; that most road safety legislation focuses on mitigating the effect of car movement, and that good safety statistics often reflect a fear of crossing the road that causes serious constraint on local residents' activities. He extends the question of management into whether or not risks can be effectively reflected in monetary values, as used in CBA of possible safety measures: he questions how far values can be attributed, whose values are to be used, and who benefits from using them. Adams' principal conclusion from this is that environmental degradation reflects, for many stakeholders, excessive consumption; for them, the environment needs less management rather than more.

The principles that Adams sets out are reflected clearly in various arguments developed by the working papers. Appraisal methods require to deal with a range of future values, all of which in practice are often unknowns. For CBA appraisal, these values need to be monetized, which implies a degree of precision. In all appraisal methodologies though, quantitative or partly quantitative analysis takes place. Projecting values into the future involves uncertainty. The level of uncertainty increases with time; sometimes at an exponential rate. This implies that the results in an NPV for a major project extending over a long time period can include a considerable level of uncertainty.

This is differently addressed by other approaches. For those professions more involved with numeric methodologies, especially CBA, the problems can be overcome to a large extent by continuing technical development and by using appropriate techniques to assess the possible impact, through alternative scenarios. The latter, provide a better approach in that they accept there is a measure of uncertainty: however, they still imply that definite figures can be fixed at least to the range of likely values.

7.2 Treatment of context in decision making

The context in which project appraisal is carried out is of very significant interest in terms of the consideration of environmental and social factors. A principal concept of the OMEGA Centre at UCL is that context matters for almost everything. It is thus essential for a risk analysis methodology, such as that outlined by RAMP, to identify and explain the critical contexts which cut across decision making in appraisal - both for the social and environmental aspects of sustainability. Context can determine the

character, nature and severity of risk and uncertainty. Appraisal undertaken *without* consideration of critical contexts can lead to the sub-optimal or inappropriate application of quantitative and qualitative tools and techniques, and expose the project to the aspects of path dependency which ultimately (but not always) serve to increase project risk.

The impacts of major transport projects are potentially so great and increasingly so political - being closely associated with such issues as climate change, wealth distribution and environmental quality, for example - that their study requires an understanding of a broad range of contexts before one can ultimately derive any lessons from past experiences. The unique forces of spatial, temporal, institutional, ideological, governmental, economic and managerial contexts must be analysed and their relationship to decision making under risk, uncertainty and complexity (RUC) understood.

Stakeholder responses to the challenges of RUC within major projects require the appreciation of the complex interrelationships of the above factors (contexts) in three different areas:

- within the project itself,
- within the context of its delivery, and
- among the various stakeholder institutions in their decision-making process.

The diversity of such perceptions and interpretations may have important implications for the development of more context-sensitive decision making under conditions of risk, uncertainty and complexity.

The acknowledgement that there are differences in context between countries has been highlighted for conventional transport planning by a study for the NATA Refresh. (Hine, 2009) This brought out a number of key differences at international level. However, the main concern in their use was primarily for technical reasons. This reflects the extent to which the technical processes are seen as dominant from the perspective of professions geared more towards quantified appraisal methods: notably CBA. But comparisons between different countries open up questions about methodologies themselves. For example, the UK has built very few urban rail schemes or kilometres of high speed rail compared to the other nations of western Europe, despite strong broad similarities in terms of economic geography: does this reflect the appraisal systems used in decision making or some other influence?

Professional bodies who focus more on the wider spectrum of impacts, primarily from the MCA approach, are more concerned with how and why context affects the appraisal of major projects, and hence the treatment of environmental, social and territorial impacts. For example, since most major projects involve more than one important institution, the interaction between institutions plays a potentially important, role in the appraisal methodology and in the decisions subsequently made. The institutions' policy framework is also of considerable importance in setting the appraisal methodology. This includes the approach to public consultation and/or participation which, as discussed earlier, is crucial to the effective incorporation of social factors, and perhaps environmental factors in major project appraisal.

8.0 Conclusions

This report has considered the research literature on the treatment of sustainable development concerns in major transport projects. To do this, it has looked at the treatment of environmental and social (societal) factors, as seen from seven different professional standpoints, based on seven commissioned working papers. These have been complemented by an eighth working paper on sustainability visions and the implications of these for appraisal of major transport projects. The following main conclusions may be drawn:

- Sustainable development as a concept and a vision is increasingly being applied in infrastructure development, involving well phrased aims and increasingly regulatory frameworks. International agreements and national policy goals are strongly focused on seeing how this vision can be operationalized and measured and relate to more traditional assessments of project performance. Sustainable development is a term that is becoming the watchword of many sectoral policies, including those for transport. However, the visions for sustainability set out in international definitions and agreements, such as the Millennium Development Goals, are often couched in general terms with their main objectives rarely specifying transport directly; transport development is generally seen as an agent of development rather than an aim in itself. But transport forms an important agent of change and an essential means of providing high quality access to goods, services, opportunities and basic needs. So it is critical to translate the sustainability concept into transport operations and appraisal, particularly, since evidence is emerging that the cost of failing to do this may be identified as very high.
- Achieving the holistic vision of sustainable development involves addressing economic, environmental, social and institutional factors in a sustainable way, understanding (and acting on) the tensions between them. Creating a sustainable world society for the future implies that agents of change should become familiar with handling risk, uncertainty and complexity recognizing that different contexts impact on the nature and pace of change and the effectiveness of project management. Professions well versed in decision-making in climates of high uncertainty inform us that skills in strategic planning and strategically executed actions need to be taken (often) simultaneously in a variety of related fields at different levels. In principle, this requires the establishment of strategic policy frameworks that direct and inform project appraisal methodologies and information sets rather than strategy being led by projects; although a two way communication between policy and project development is often essential. To date the policy - project interface generates too many tensions and contradictions, while efforts to address these tensions are taking place at too slow and piecemeal a pace. Policy frameworks in the transport field against which major project promoters and sponsors may consider the validity of their project and draw their objectives are of variable quality; sometimes such policy frameworks do not exist.

- A range of project appraisal methodologies exist but for the purposes of review they can all be considered within two main types:
 - **Cost Benefit Analysis (CBA)**, where all factors considered are measured in money terms over a defined period of years and the results are compiled into flows of costs and benefits, and summarised as a single rate of return.
 - **Multi Criteria Analysis (MCA)**, where the results of analysing each factor are presented in a summary table setting out all the criteria identified for assessment. This is a more qualitative methodology, although quantitative measures are used wherever possible.
- CBA forms the main approach for major transport project appraisal; more often now in conjunction with some measure of MCA as well. For example, the approved UK methodology for transport plans and projects, the New Approach to Transport Appraisal (NATA), involves presentation of results in an Appraisal Summary Table (AST), which includes measures of economic, environmental and social factors as well. Environmental Impact Analysis (EIA), which is obligatory for major projects, and Sustainability Appraisal (SA), which is now required for plans, are in effect MCA techniques.
- All these appraisal methodologies rely on the compilation and use of information in the various fields which need to be covered if the project is truly aimed at sustainable development. This can be of variable quality. In overall terms, environmental information is reasonably straightforward to deal with, especially in relation to purely ecological data; not least because environmental assessment has been of growing importance for many years and much of it is increasingly quantifiable. Information on social factors, however, is far weaker; and social assessment has lagged behind environmental in formal appraisals, in good part because the former implicitly concerns more political issues and are often not easily quantifiable.
- A major issue of concern is that appraisal decisions regarding each major project are ultimately in the hands of the project promoters (governments, major project investors or some combination of these), whose prime aim is typically a financial return on the project. Thus, the development of the project and the application of appraisal methods are typically designed ultimately to suit this aim. Major projects will also impact on areas of public interest, in terms of the environment and society, and so receive some degree of formal attention from public bodies. These can influence the project's development and appraisal; but the extent to which they can control outcomes varies greatly.

The appraisal processes for major transport projects continue to evolve in form and coverage, as does the research work to assess their potential and actual effectiveness. Some argue that this evolution has been too slow, follows existing technical paths and remains too piecemeal and insufficiently holistic in outlook; this makes the incorporation of sustainability in the appraisal approach very difficult indeed. There are, however, some positive features emerging from this evolution:

- **The extent to which environmental and social factors can be monetized** for use in CBA techniques continues to widen slowly. For those professionals engaged in using CBA techniques, this means that it is increasingly possible to compare projects, within the transport and other fields, through the single common indicator of money value.
- **The widening use of MCA** and related processes in fields such as SEAs and EIAs means that a more disciplined approach to appraisal beyond CBA is available for decision makers where it is not feasible to attribute money values.
- **The growing requirement for formal consultation** is accompanied by a greater interest in more participatory methods of involving a wider range of the project stakeholders who may be affected by a major transport project.

There are though several important areas where there remains serious doubt, and perhaps even controversy as to how best to move ahead. Some of these reflect differences between types of appraisal methodology; others reflect issues of complexity and context which are common to most forms of project appraisal:

- **Project appraisal concerns future impacts and results.** Forecasting is thus an essential part of the process. It is, nonetheless liable to error in any one factor and to serious error through the compounding of forecasts for several factors. In particular, major projects require forecasts of many factors and areas for a long period of time and are thus more liable compound error.
- **Appraisal must take into account a complete range of factors** if it is to provide a sound basis for a holistic and sustainable approach. Most appraisal methods do not do this; some are very limited in their coverage/scope (sometimes intentionally).
- **CBA appraisal processes bring together all aspects into a single return on monetary value.** This involves attribution of monetary values to all aspects. The single value may form an apparently simpler basis for decisions but it relies on a 'black box' of processes that some would claim are dishonest in that they are often founded on unchallenged and unrealistic assumptions.
- **MCA appraisal processes present results as a table of indicator values, both quantitative and qualitative.** This provides a much clearer picture of the range of factors considered in a project appraisal but a less clear measure of the impact for each. It leaves key decision makers to weigh up and select (sometimes by default) the relationships of these various factors and their priorities. This requires of them applying judgement in a transparent manner; something that many politicians and public officials in administrative positions are less keen to do and less practiced in too.

- **Compiling relevant information on a valid basis** and, where needed, subjecting it to sensitivity analysis, is required expertise of the appraisal process and a feature of all project assessment procedures. Making available sufficient resources and time to this is also very important. Professional judgements need to be made, not only in qualified assessments but also in attributing values in the case of quantified methods.
- **There are serious differences where environmental and social factors are considered** in project appraisal for major schemes. For those professions primarily engaged in using CBA methodologies, such factors are developed principally through attribution of suitable (monetized) values. However, this rarely admits the complexity of such factors. In particular, it is weak in terms of social factors, especially over the equity (distributional) issues which are crucial in their case. This is recognised in the questions that are left in such methodologies as the UK NATA system. MCA methodologies provide a good opportunity to give a fuller picture; but even they require some quantification and selection of criteria and results.
- **Participation in appraisal exercises** makes the issue of context, especially institutional and policy context, of major significance. Appraisal methodologies in the recent past have been primarily set by project promoters looking to improve rates of return, albeit within broad policy guidance by governments. Their approach to projects, including the requirements for their appraisal, thus has a significant influence on the factors that are addressed and how they are covered – for the better or worse. The question that needs to be posed here is: In a context where market values are insufficient and where rate of returns are important but not most important, how else should these projects be appraised and what degree of consultation should this entail?
- **All project appraisal methodologies essentially seek to reduce uncertainty and minimise or mitigate risk.** Strangely, this is not actually stated by any of the working papers except that prepared from the actuary perspective. This implies a tendency not to explicitly define what cannot be handled through appraisal methodologies; this perhaps is too complacent a standpoint? The question that arises here is: Whose risks should the project appraisers reduce or mitigate against – the project promoters or those parties impact on by the project – or some mix of these?

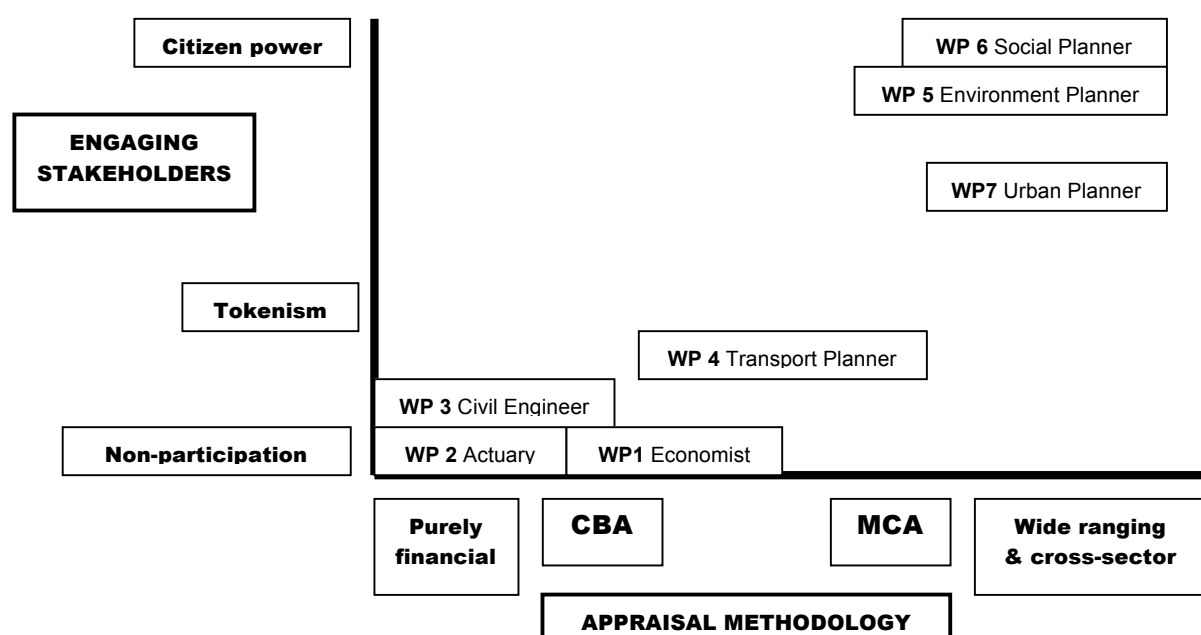
For those professions who work more closely with CBA and similar methodologies, more geared to a desk based approach that emphasizes the quantitative rather than the qualitative, the current situation provides (for them) a generally satisfactory basis for appraisal, with piecemeal ‘add-on’ considerations given to social concerns and new perceptions of sustainability ‘where appropriate and/or feasible’.

However, for environmental and social planners, and many urban and regional planners too (i.e. for those parties wishing to move beyond the rhetoric of sustainability), there remains considerable dissatisfaction with the current weaknesses of CBA and its failure to reflect wider stakeholder interests. These

groups prefer project appraisal to be driven far more by policy frameworks that inform MCA frameworks, which are in turn informed by CBA findings, and that rely on transparent decision-making by politicians and technocrats as to which priorities are applied when, where and why. These priorities should be drawn from a strong participation of stakeholder groups that goes beyond project sponsors and their commissioned professionals.

From the review of the working papers contained herewith, it is possible to place how the various professions might fit in overall in relation to the types of project appraisal methodology preferred and stakeholder engagement undertaken. A suggested structure is set out in Figure 5, as a basis for discussion and possible further exploration.

Figure 5: Professions' place in appraisal methodologies and stakeholder engagement



Moving to a much more participative approach will change the fundamental nature of the project appraisal process from a largely desk bound one to one where engagement (as opposed to consultation) with stakeholders becomes a key feature, and where transparency is offered as to who is ultimately determining the priorities of the project appraisal and how the conflicts are resolved between efforts to enhance transport project efficiency and efforts to mitigate against the negative project impacts on the territories and communities the project traverses and serves framed, for example, by a policy framework offered by the Millennium Development Goals or some other similar evaluative framework.

The core vision of the Institution of Civil Engineers, 'Civil engineers at the heart of society, delivering sustainable development through knowledge, skills and professional expertise.' indicates a mission to become more sensitive to the requirements of sustainable development in project appraisal so as, among other things, to place the civil engineering profession, together with its partners such as the Actuary Profession, in a more influential role in the planning, appraisal and delivery of major projects. It requires issues of sustainability to be dealt with in a manner that goes beyond the rhetoric and in a form that firmly acknowledges project appraisal to be not just a technical process but ultimately a political process that is critically dependent on a full understanding of project context and purpose.

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Appendix 1: NATA and DaSTS objectives and criteria

| <i>New Approach to Appraisal (NATA)</i> | <i>Developing a Sustainable Transport System</i> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • environment - to protect the built and natural environment <ul style="list-style-type: none"> ○ to reduce noise ○ to improve local air quality ○ to reduce greenhouse gases ○ to protect and enhance the landscape ○ to protect and enhance the townscape ○ to protect the heritage of historic resources ○ to support biodiversity ○ to protect the water environment ○ to encourage physical fitness ○ to improve journey ambience | <ul style="list-style-type: none"> • To reduce transport's emissions of carbon dioxide and other greenhouse gases, with the desired outcome of tackling climate change |
| <ul style="list-style-type: none"> • safety - to improve safety <ul style="list-style-type: none"> ○ to reduce accidents ○ to improve security | <ul style="list-style-type: none"> • To contribute to better safety security and health and longer life-expectancy by reducing the risk of death, injury or illness arising from transport and by promoting travel modes that are beneficial to health |
| <ul style="list-style-type: none"> • economy - to support sustainable economic activity and get good value for money <ul style="list-style-type: none"> ○ to get good value for money in relation to impacts on public accounts ○ to improve transport economic efficiency for business users and transport providers ○ to improve transport economic efficiency for consumer users ○ to improve reliability ○ to provide beneficial wider economic impacts | <ul style="list-style-type: none"> • To support national economic competitiveness and growth, by delivering reliable and efficient transport networks |
| <ul style="list-style-type: none"> • accessibility - to improve access to facilities for those without a car and to reduce severance <ul style="list-style-type: none"> ○ to improve access to the transport system ○ to increase option values ○ to reduce severance | <ul style="list-style-type: none"> • To promote greater equality of opportunity for all citizens, with the desired outcome of achieving a fairer society |
| <ul style="list-style-type: none"> • integration - to ensure that all decisions are taken in the context of the Government's integrated transport policy <ul style="list-style-type: none"> ○ to improve transport interchange ○ to integrate transport policy with land-use policy ○ to integrate transport policy with other Government policies | <ul style="list-style-type: none"> • To improve quality of life for transport users and non-transport users, and to promote a healthy natural environment |