

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

Final Report

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1.0 Introduction

1.1 Background

This report sets out the main findings of a commissioned Study carried out by the OMEGA Centre at University College London (UCL) for the Institution of Civil Engineers (ICE) and the Actuarial Profession (AP). The Study was undertaken with the purpose of developing recommendations for updating the sponsors' RAMP (Risk Analysis and Management for Projects) Handbook (ICE and AP, 2005) on how better to incorporate environmental and social dimensions of sustainable development in the appraisal of major projects.¹

The assignment was commissioned in light of the growing international importance given to the concept of sustainable development to infrastructure development as reflected in the new ICE Mission Statement. This has the overall vision of civil engineers as being “at the heart of society, delivering sustainable development through knowledge, skills and professional expertise.” This challenging mission statement, among other things, looks toward practice that is more sensitive to the requirements of sustainable development in all activities involving civil engineering, and related actuarial expertise, in the planning, appraisal and implementation of major projects.

1.2 The OMEGA Centre

The OMEGA Centre is a global centre of excellence in the study of mega projects in transport and development funded by the Volvo Research and Education Foundations (VREF) based at the Bartlett School of Planning in UCL. The Centre was established in 2006 by a five year grant from VREF and is one of seven such centres for the study of future urban transport worldwide. It is at present the only centre of its kind in Europe.

The focus of the OMEGA Centre's current research (see www.omegacentre.bartlett.ucl.ac.uk) is on Mega Urban Transport Projects (MUTPs). The aim has been to investigate 'what constitutes a “successful” Mega Urban Transport Project in the face of the new emerging agenda for sustainable development in the 21st Century.'² The Centre and its International OMEGA Academic Partner Network (comprising some 40 researchers from nine highly regarded academic institutions throughout the developed world in Europe, Asia, North America and Australia) are presently analysing and synthesizing the case study findings regarding decision-making in the planning, appraisal and delivery of

¹ This work has been partially supported by a Volvo Research and Education Foundation (VREF) Centre of Excellence (CoE) Grant awarded to the OMEGA Centre to fund its research into the planning, appraisal and delivery of Mega Urban Transport Projects.

² The OMEGA Centre is launching a new MSc Programme in Mega Infrastructure Planning, Appraisal and Delivery in 2010/2011 in association with the Department of Civil, Geomatics and Environmental Engineering at UCL. This draws extensively from the VREF funded research as well as from some aspects of the research findings of the Study reported here.

some 30 projects with a view to arriving at generic and context-specific lessons for future MUTPs and the retrofitting of existing projects. More specifically, the aim of this international comparative study is to:

- arrive at conclusions which provide an understanding of what it takes for MUTPs to better deliver their objectives (and visions); and
- examine more closely the criteria by which they should be judged 'successful' in the context of :
 - the increasingly uncertain, complex and changing environments of the 21st Century, and
 - vision(s) of sustainability promoted both locally and globally.

1.3 Structure of the report

The rest of this report is essentially structured into eight parts:

- The Study aims and work programme.
- A discussion of sustainable development and of principles and practices of project appraisal.
- A review of basic types of project appraisal.
- An international review of challenges and responses in addressing sustainability in the appraisal of major infrastructure projects
- An approach for developing a MCA framework for appraising major infrastructure projects
- Assessing and managing risks in the RAMP process through an MCA Framework
- The sustainable business case as a new context for project appraisal
- Conclusions and recommendations derived from the Study.

It draws on the various strands of work carried out to examine the implications of global challenges and the continually growing interest in sustainable development and the operationalisation of this concept, especially with regard to the appraisal of major projects. The findings of the Study work programme have been complemented by the emerging results of the Omega Centre' work at the time of writing (Dimitriou et al, 2010).

More details of the Study's work and research findings are available in the various papers commissioned or prepared by the Study team. (These are listed in a separate part of the Bibliography.)

2.0 Study aims and work programme

2.1 Background and objectives for RAMP Study

The RAMP Study was commissioned by the Institution of Civil Engineers (ICE) and the Actuarial Profession (AP) at the end of 2008. The two organisations had in 1997 jointly produced the Risk Analysis & Management for Projects (RAMP) Handbook, which aimed to provide detailed guidance for project managers and others involved on how to identify, assess and manage potential risks to project implementation. The Handbook was revised in 2005 (ICE and AP, 2005) but ICE and AP felt that it did not adequately address the issues raised by sustainable development concerns. In particular, it omitted specific reference to environmental and social factors, which were seen to have an ever increasing influence on policies and projects, bringing potentially increased levels of risk to them if such aspects remained inadequately addressed.

The principal aims of the RAMP Study were therefore defined (OMEGA Centre, 2009a) as:

- **To identify and understand the strengths and weaknesses of current practices** regarding the methods employed to address social and environmental considerations in the appraisal³ of major projects in the UK and elsewhere.
- **To develop and recommend a ‘good practice’⁴ appraisal framework** which takes into account the weaknesses and strengths of past appraisal methodologies and which incorporates new concerns of the 21st Century that set financial and economic risks and returns firmly against social and environmental risks and opportunities.
- **To examine the applicability of the principles contained in the RAMP Handbook to the recommended ‘good practice’ framework** developed with emphasis paid to risk management dimensions of the conception and development (planning), delivery and operation of major projects.
- **To pay particular attention in the new appraisal approach to expressing social and environmental considerations and risks in financial terms** (as far as this may be possible), taking into account the precautionary principle and possible conflicts of interests, so that they may be included in investment models with the assistance of scenario planning methodologies.
- **To prepare a new draft chapter for the next edition of the RAMP Handbook** setting out lessons and guidelines for major project appraisal which focuses on the challenges of better incorporating sustainable environmental and social considerations in line with the preceding Study aims.

2.2 Stages of Study work programme

³ ‘Appraisal’ here refers to pre-project completion assessments undertaken to inform decision making in the planning and implementation of projects.

⁴ ‘Good practice’ avoids the use of the term ‘best practice’. This can lead to insensitivity to varying circumstances, through applying standard a templates of professional practice irrespective of context. ‘Good practice’ offers generic lessons that take account of different contextual circumstances.

To address these aims, a Study work programme consisting of four main stages plus a supporting Seminar was agreed. This work programme was carried out between January 2009 and June 2010. It was based in good part on the approach and methodologies being used for the OMEGA Centre in its international study of MUTPs. This pays particular attention to the treatment of risk, uncertainty and complexity (and the importance of context) in decision making in the planning, appraisal and delivery of such projects.

The five stages of the work programme reported on here were as follows (this is set out diagrammatically in [Appendix 1](#)):

- **Stage 1:** A set of eight working papers based on review of relevant research literature was commissioned. Seven of these considered traditional and non-traditional practices of project appraisal as undertaken by different professions and disciplines. The eighth paper provided a review and critique of the application of the sustainable development visions to MUTPs and the challenges these pose. These papers were synthesized together in a ninth paper, which formed the Literature Review Report.
- **Stage 2:** A set of questionnaire surveys was undertaken among key decision makers and professionals, using survey methodologies developed for the OMEGA Centre. These interviews were carried out with 42 people; these covered a range of experienced and senior politicians and professionals within international and national agencies (government departments, public agencies, consultancies, research organisations, commercial bodies); and also representatives from four OMEGA case studies (in the UK, France, Sweden and the USA). All 42 interviewees answered a hypothesis-led questionnaire (i.e. following a structured set of questions), focused by four hypotheses about project development, appraisal and sustainability; and the 16 case study interviewees also first answered a separate pre-hypothesis questionnaire (i.e. open discussions, with limited guidance). In total this generated 58 survey interviews. (The list of interviewees is set out in [Appendix 2](#), the questionnaire for the hypothesis-led interviews in [Appendix 3](#)). The surveys were recorded and transcribed. A description of the survey operation and a summary of the main findings, including the statistics of answers for the main questions, were drafted to form the Survey Report.
- **Stage 3:** The material from these two stages, especially the more focused points from the questionnaire survey transcriptions, was analysed in relation to the RAMP Handbook principles and structure. The aim of this stage was to develop a new framework for incorporating environmental and social aspects of sustainable development within the RAMP process. This stage also drew findings from the OMEGA Centre's other on-going work of relevance to this Study plus other references where appropriate. This work investigated some areas in particular, including:
 - the principles and roles of infrastructure project appraisal systems in the UK and elsewhere in the world,
 - current practices and scope for monetizing non-monetary factors in project appraisal, and

- the significance and implications for project appraisal of the transition of the business case premised on the 'business as usual' ethos to one seen to represent a 'sustainable business case'.
- **Stage 4:** The follow-up Seminar which was held on 1 April 2010. It was attended by two dozen invited delegates, all of them experienced and influential professionals in the field of major projects in the UK and overseas. The main findings of the Study at the time were presented together with the Study team's emerging thoughts on possible recommendations. Discussions were held in both small groups and in a plenary session. These were summarised and included in a short Seminar Report.
- **Stage 5:** The final stage has involved preparation of two documents. These are:
 - A Draft New Chapter for the RAMP Handbook, which aims at offering guidance on incorporating environmental and social dimensions of sustainable development in the analysis and management of risks for the appraisal of major projects.
 - This Final Report, which reviews fully the findings from the various stages of work and draws out conclusions and recommendations for addressing environmental and social dimensions of sustainable development within project management.

2.3 Deliverables of Study work programme

The deliverables from the Study include (see Bibliography for full list of papers):

- **An Inception Report** (OMEGA Centre, 2009a).
- **A Literature Review Report**, drawn from the eight commissioned literature review papers (OMEGA Centre, 2009b).
- **A Survey Report**, describing the operation and results of the questionnaire surveys and outlining the main findings (OMEGA Centre, 2009c).
- **Several supporting papers** on specific aspects of appraisal, monetization and sustainable business cases.
- **The Seminar Report**, setting out the organisation, activities and results of the seminar (OMEGA Centre, 2010).
- **The draft new chapter for the RAMP Handbook.**
- **This Final Report.**

In the following sections of this document, the above material is used as follows:

- Sections 3 and 4 draw primarily on the literature review, with some material from background papers.
- Section 5 primarily reflects the findings of the questionnaire surveys but also draws on the literature review and the Seminar proceedings.

3.0 Sustainable development and principles and practices of project appraisal

3.1 Principles of sustainable development

Traditionally, the underlying *principal aim* of most major projects⁵ has been the delivery of economic growth – often *above all else* - on the basis of the trickle-down economic benefits they are predicted to generate. Today this premise is challenged, compromised and conditioned (at least in the rhetoric) by a broader agenda of multiple development aims as reflected in the Sustainable Development Concept cum vision which *in effect* re-defines the order of development priorities that major projects should contribute to and *even* the manner they should serve such goals.

Discussion of sustainable development in major project appraisal *must* start from a clear and accepted definition of the term. One which is very widely accepted and which is employed here for this report is that 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 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 dimensions of development - underlining the need to balance all three dimensions of sustainability: economic, environmental and social. More recently, a fourth pillar of sustainability has been introduced, namely the institutional dimension (see Brinkerhoff and Goldsmith, 1992; Dimitriou and Thompson, 2001). Here the premise is that *without* adequately resourced sustainable institutions to promote, govern and regulate the delivery of sustainable visions, the delivery of sustainability is highly restricted.

Furthermore, because there is *nothing* definite about the future, any forward looking decision-making *must* involve consideration and acceptance of uncertainty, and thereby the necessity of taking calculated risks in decision making – a consideration that is especially significant in the planning, appraisal and delivery of such projects. This concern for uncertainty has been well expressed as the ‘precautionary principle’, which was incorporated into the 1992 Rio Declaration on Environment and Development (as Principle 15). This states that:

⁵ Reference to major projects made here essentially allude to infrastructure projects (especially, transportation projects) since the expertise of those interviewed for the Study was overwhelmingly as infrastructure specialists. The relevancy of the transfer of these lessons to non-infrastructure projects should thus be presented with a ‘health warning’ until such time their application to non-infrastructure fields is empirically tested.

"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 declaration is that of the 'polluter pays': in other words, anyone causing pollution (or negative outcomes) *should* pay for the environmental (and other) damage they have created and that the burden of proof for demonstrating that a particular technology, practice or product is safe should lie with the (project) developer, and not with the general public. This principle has manifested itself in the form of a plethora of impact assessment procedures instituted across the world for projects (see later discussion). It is, however, often very unclear when and how much the polluter should pay. What these developments have done is to increasingly oblige project investors to think much more in terms of presenting a 'sustainable business case' rather than undertaking a 'business as usual' approach to project investment which focuses on short term gains.

3.2 Environmental and social factors and risks

Environmental and social factors, and their associated risks, as the key dimensions of sustainable development, may be described in the following terms. (Appendix 6 lists and defines the main groups of factors.)

Environmental factors relate primarily to physical elements. These include some more tangible items, such as air pollution and noise, which relate particularly to the immediate impact of human activities. There are also less clear-cut ones, which have a physical dimension, such as landscape quality, where assessment leans more towards judgement rather than measurement. Most environmental factors have been subject to attention and assessment for many years, through such processes as Environmental Impact Assessment (EIA), now a statutory requirement for project approval across much of the world.

Social factors concern the quality of life for individuals and communities. These include aspects such as equity in access to services. Much less specific attention has been paid to these concerns. In part this is because they often have political connotations. They are also less easy to define; especially as judgement is required, even where measurement is possible (e.g. in terms of access to goods and services). Treatment of social factors must particularly address the concept of poverty alleviation; this forms a core element of sustainable development in the Brundtland Report and a key objective of international funding agencies such as the World Bank.

There are in fact close links between environmental and social factors. In overall terms, the maintenance of eco-systems is critical to maintaining human economic and social well-being (Millennium Ecosystems Assessment, 2005); this is regularly highlighted by news reports of catastrophes and failures across the world). At a specific level, attributes such as landscape have physical form but involve human (social) judgement (e.g. changes to a piece of landscape through construction of a

new road or railway line might be considered highly destructive by some communities, i.e. those who live there, but relatively unimportant by others, i.e. those travelling through the area).

Environmental and social factors form key risks for any project. Although a comprehensive appraisal process should identify and weigh up all potentially relevant factors, this process can never achieve total certainty. Risks can arise in terms of any of the environmental and social aspects. Examples might include:

- The combined effects of routeing, materials and extreme weather might create run-off which causes serious deterioration of water quality over an area, creating problems with farming, industry and health.
- The scale of objections over the landscape implications of the project require redesign and rerouteing of a section, adding to development and construction costs and causing significant delay.
- Enhancement in the activities of a main town through improved travel causes reductions in the activities of local centres, worsening job opportunities and access to facilities by poorer groups around those centres. This adds to the costs of public authority sponsors of the project.

Some factors may seem to be remote and very difficult to value anyway. The chance may also be extremely low of a risk arising in connection with them. But if they do come into the equation, they could have a grave impact. What value, for example, might be attributed to a highly reputed early Norman church? What extra capital might be justified to avoid demolishing it? Or to leave it undisturbed? Such examples may prove very difficult to handle. But there can be major risks associated with not appraising correctly environmental and social factors; e.g. losing the support of key stakeholders, failing to identify the best way to achieve stakeholder objectives or creating unacceptable impacts that subsequently prove very costly to cure.

3.3 Sustainability frameworks for project appraisal⁶

There are today a number of sustainability frameworks for major project appraisal that complement the more traditional methodologies such as Cost Benefit Analysis (CBA) and the analysis of Internal Rates of Return. Some of the most important sustainability frameworks are summarized below.

3.3.1 Agenda 21

Arguably the most fundamental overarching and influential policy document regarding sustainability adopted at the Rio World Summit in 1992 was Agenda 21⁷. This described a global programme for the achievement of sustainable development and called on all countries to develop sustainable development strategies. These strategies are required to incorporate a clear policy framework, including goals and objectives, with sustainability indicators to monitor the achievement of the policies,

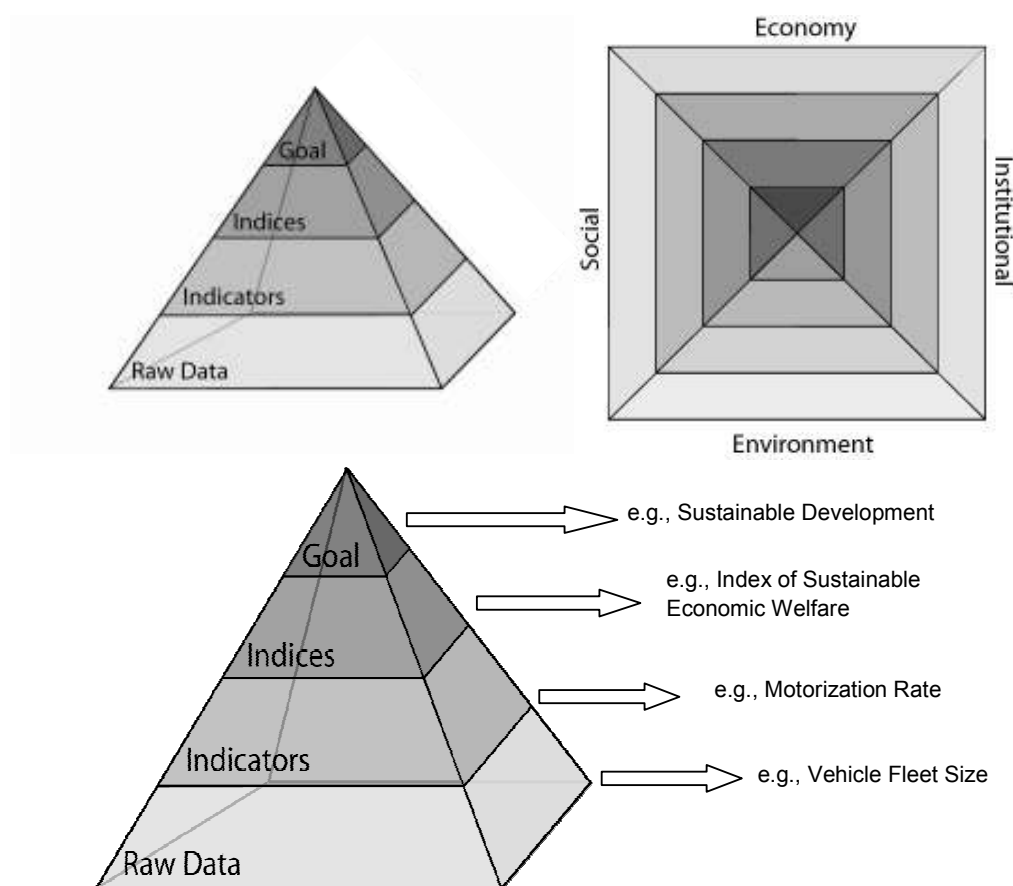
⁶ Much of the material in this section is drawn from Pediati (2009).

⁷ <http://www.un.org/esa/dsd/agenda21/>

goals and objectives, with achievements judged through the implementation of projects that need to be appraised against these goals/objectives and their related criteria/performance indicators.

As a result of the above developments, over the last decade and more, many different institutions, sectors and governments have sought to provide their own definitions of sustainability or sustainable development. These are typically characterized by similar visions, goals and objectives, presented in strategies which subsequently form the basis of indicator frameworks (see Figure 1). The extent these visions justifiably differ from place to place or culture to culture, and to what extent they influence or facilitate sustainable decision making across sectors remains unclear in many instances. This because the concept of sustainability is still in its infancy and its operationalisation is very much in its early stages.

Figure 1: Zegras' Information hierarchy of sustainability goals, policies and indicators through the sustainable indicator prism



[Source: Zegras, 2011]

3.3.2 Millennium Development Goals (MDGs)

While the MDGs do *not* explicitly refer to sustainable development, this concept underlies all the eight goals to be achieved by 2015. The MDGs were designed to respond to the world's main development challenges and are drawn from the actions and targets contained in the Millennium Declaration that was adopted and signed during the UN Millennium Summit in September 2000⁸. The MDGs are influential goals of policy relevance that are expected to be taken into account by committed organizations (i.e., signed up nations, donor agencies, etc.) when deciding whether to fund investment, aid, development projects and programmes. In this regard, the MDGs offer an invaluable overarching policy framework for infrastructure planning, appraisal and delivery, for although they do not explicitly include infrastructure goals they do highlight the critical ends that infrastructure developments must serve.

3.3.3 EU Sustainable Development Strategy

The EU Sustainable Development Strategy (Council of European Union, 2006) 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 has a more binding (yet still guiding) role for EU member states' policy development and offers a sound basis for national sustainability strategy development. The EU Sustainable Development Strategy makes explicit reference to sustainable infrastructure (transport in particular) and thus could be perceived as a vision for the development of major infrastructure investment.

3.3.4 UK principles of Sustainable Development

As part of the EU Sustainable Development Strategy, the UK has set out its 'Principles of Sustainable Development.' These, it should be noted, lack explicit mention of infrastructure (transport in particular) in the strategy advanced. The conventional framing of the sustainability concept, as reflected in the *Shared UK Principles of Sustainable Development*⁹, emphasises that it has three main dimensions: economic, environmental and social. At the heart of the official discourse on sustainable development, lies the idea that these three dimensions can be reached or fulfilled *jointly*. In other words, 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'. Critics of the concept of sustainable development (or at least of its applicability), however, stress that inevitably trade-offs have to be made between the three components of sustainable development (see [Figure 2](#)): to fully reach the goals of one of the three sustainability dimensions, concessions have to be made regarding the other two (Colomb, 2009). Here then arises the critical (and often omitted) question of whether the objectives of sustainable development involve complementarity or conflict?

⁸ <http://www.un.org/millenniumgoals/>

⁹ <http://www.defra.gov.uk/sustainable/government/what/principles.htm>

Figure 2: Triangle of conflicting goals for planning and the three associated conflicts

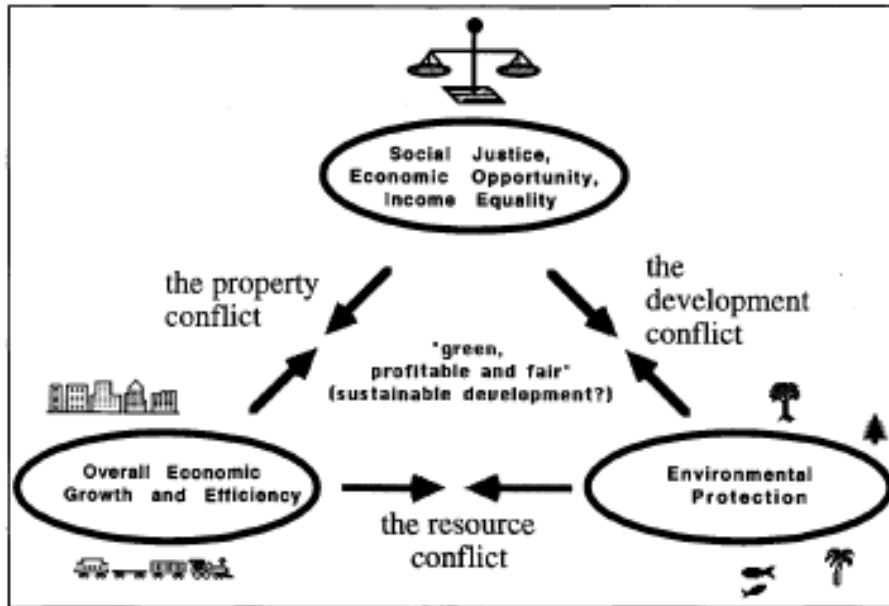


FIGURE 1. The triangle of conflicting goals for planning, and the three associated conflicts. Planners define themselves, implicitly, by where they stand on the triangle. The elusive ideal of sustainable development leads one to the center.

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

3.3.5 Sustainability and economic growth¹⁰

The above mentioned potential conflict among goals of sustainable development is sharpened by the fact that the world's economic structure is built primarily on continuing unsustainable economic growth, essentially on a 'business as usual' basis that tends to focus on measurable gains in the shorter term. This approach therefore tends to become the core determinant of much policy action, *whatever* the policy statements may be and irrespective of the rhetoric, although developments are changing. This has led factors for appraising policy action and infrastructure project development largely reflects the practices of past experience (and values) which can often be at odds with the concept of sustainable development.

There is now growing international and local pressure for genuinely sustainable development. This has led to much discussion about sustainable economic growth but too often *without* a clear definition of what this involves. The term sustainability is used through a myriad of policy documents and statements, but frequently without any clear definition of what is intended in the particular context the concept is to be operationalized; this has been termed by critics 'green wash' or just plain rhetoric. A crucial factor in economic growth is innovation (i.e., the continuing evolution of knowledge, technology, techniques and new ideas). These provide for more effective

¹⁰ This sub-section has drawn heavily from Colomb, 2009.

ways of doing things but are also too often used as a basis for raising expectations and create demand rather than generating a more sustainable way of life, leading to increased consumption, including the consumption of more travel.

3.4 Putting sustainable development visions into practice

3.4.1 Hierarchy of actions

If sustainable development visions are to provide for effective ways forward they need to be translated into practice. For infrastructure development this means that there has to be a sustainable business plan for every project investor as well as a sustainable development framework to provide the policy and regulative frameworks for the planning, appraisal and delivery of such projects with assessments on how best to achieve this grounded in truly sustainable policy objectives. This requires the development of hierarchy of appropriate strategies and plans, entailing suitably focused programmes and projects. The appraisal of these strategies, plans and programmes should establish whether and how far they achieve sustainability – or fail to do so.

3.4.2 Institutional sustainability

On-going research at the OMEGA Centre at UCL has shown that it is particularly significant to understand the importance of institutional sustainability. This alludes to institutional structures and processes that have the capacity to function effectively over the long term, passing on decade to decade, even generation to generation cherished visions and aims of sustainable development. They can also ensure a continuing provision of resources on a sustainable basis. These institutions include the administrative and legal systems through which government develops and implements policy, the operational capacity and approach of public and private organizations at all levels throughout society, and the effectiveness with which they engage together in planning and project development on a sustainable basis.

As already indicated, the three pillars of sustainability are traditionally deemed to be its environmental, social and economic dimensions. The uncertainties, risks and complexities of incorporating these dimensions into the appraisal of major projects (particularly infrastructure projects) pose a new and very important challenge for the RAMP Steering Group, as its RAMP Handbook has paid less attention to environmental and social dimensions of project appraisal than economic. Furthermore it has not so far sought to incorporate institutional factors either. Achieving sustainable development through project appraisal requires all *four* dimensions of 'sustainability - environmental, economic, social and institutional – to be incorporated into its appraisal process.

3.4.3 Participation and engagement

Institutional sustainability calls for transparency and meaningful stakeholder participation and engagement, especially in the face of fast changing contexts and

influences for project developments. It has to be recognized nonetheless that individual organizations and businesses often have very differing cultures; especially in the case of non-government agencies (NGOs) when compared to organizations of both the public and private sectors. This makes for exceedingly difficult and complex institutional frameworks for project development which, not surprisingly, sees institutional sustainability rarely achieved even though the need for it is rapidly being acknowledged.

Participation in decision making regarding infrastructure project development that produces effective results *must* include open dialogue between expert and non-expert stakeholders. This interface, however, frequently spawns a clash of the linear thinking of the technocrat and the sometimes more lateral thinking of the politician, policy maker and civil society representative, following arguments that move from one step to another sometimes in a seemingly disordered manner. This can, nevertheless, often lead to compromise agreements which for some offer what are seen to be 'sub-optimal solutions', whereas for others they represents realpolitik progress toward more sustainable outcomes..

3.5 The case for broader appraisal frameworks

3.5.1 The World Bank experience

While the World Bank uses economic analysis 'to help design and select infrastructure projects that contribute to the welfare of a country', in recent decades it has employed a much broader approach than that offered by traditional (social) CBA in full. The Bank examines ten questions in its economic analyses of projects seeking funding (Belli et. al., 1998), namely:

- What is the objective of the project?
- What will happen if the project is undertaken? (What if it is not?)
- Is the project the best alternative?
- Are there any separable components? (How good are they?)
- Winners and losers: Who enjoys the music? Who pays the piper?
- What is the project's fiscal impact?
- Is the project financially sustainable?
- What is the project's environmental impact?
- What techniques are used for assessment. (Is the project worthwhile?)
- Is this a risky project?

It, however, also places a great deal of emphasis on the institutional and regulatory environment into which the bank is lending. Project lending which contributes to improvement of that environment is of particular interest. These include:

- avoidance of environmentally damaging investments,
- widespread distribution of the benefits of projects throughout the national recipient community, and

- 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 and to the resettlement and involuntary employment severance. The requirement to consider distributional aspects is increasing as the Bank concentrates further on its poverty reduction objective but remains less prominent. (Hartley, 2009)

3.5.2 The EU experience

The EU has similarly sought to establish a strong focus on achieving environmental goals in project appraisal practice through policy instruments establishing the requirements for Environmental Impact Analysis (EIA) and Strategic Environmental Analysis (SEA) (see Glasson et al, 2005). It is, however, 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's appraisal processes are aimed more at achieving primarily social goals among poorer nations.

3.5.3 The call for a holistic approach

Focusing on goals for sustainable communities, Sir John Egan (Egan, 2004) recommended a structured and more holistic view to the work of the UK Government in 2004, in the form of the Egan Wheel (see [Figure 3](#)). This links eight principal areas of attention to build sustainable communities – all requiring some form of appraisal when making infrastructure investments (Gopaul, 2009). This acknowledgement of the need for multi-criteria analysis which the report will extensively return to later, poses several key questions for the RAMP handbook which premises the guidance it offers on more traditional economic and financial concerns and outcomes.

Figure 3: The Egan Wheel



[Source: Egan, 2004]

3.6 Summary of findings

The principal findings that emerge from this section may be summarised as follows:

- **Traditionally projects have been primarily appraised against targets of economic growth** without examination of what this implies for the future of society. But over the last twenty years there has been increasing concern over the sustainability of current development patterns and hence over the validity of conventional economic growth models. This has led to the practice of assessing the environmental and social impact of projects; this has not necessarily changed the basic approach of developing projects to bring returns on conventional economic terms.
- **Environmental and social factors should be seen together in a holistic fashion.** They are very closely linked. The maintenance of eco-systems is critical to maintaining human economic and social well-being, at all levels, from international to local.
- **Institutional sustainability is also an essential dimension of sustainable development,** which thus needs to reflect four sets of factors together: economic, environmental, social and institutional.
- **International debate over sustainable development has led to the creation of international policy indicators** such as Agenda 21 and the Millennium Development Goals and of complementary national sets of targets. These are

widely accepted in principle but in practice have not achieved major change in the approach to project evolution and appraisal.

- **Recognition is now increasing that environmental and social factors are actually fundamental components of development** on an integral basis with economic factors. It is rarely possible to address all three sets of factors equally with one project and thus decision making frequently requires compromises.
- **In order to incorporate the environmental and social factors of sustainability effectively within a project, it is essential to develop an approach to appraisal that provides understanding and clarity as a basis for decision making.** This needs a sound reflection of the policy context, long term stability among the public and other bodies setting and managing policy (institutional sustainability) and full engagement of all stakeholders in any project. The approach must be a holistic one, following the principles set by such bodies as the World Bank and the European Union.

4.0 A review of basic types of project appraisal

4.1 The scope of project appraisal

A project as defined by RAMP involves a complete cycle of activity, which includes planning, appraisal (as a pre-project construction assessment), implementation, evaluation (as post-project construction assessment) and monitoring; it also includes termination (i.e. when the project is closed down). Project appraisal forms a key element of this and should in principle address the whole project cycle. It is crucial to the decision making process on whether to proceed with the project or not and on the form of the project. 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.

4.2 Key types of project appraisal methodologies

There exists a range of methodologies for infrastructure project appraisal. These can be differentiated by their purpose, coverage and intended output. For commercial investors the crucial focus must be on the financial results, in terms of forecast flows of expenditure and income, to assess whether their investment will provide an acceptable return (this may be referred to as Financial Cost Benefit Analysis). The results are usually summarised in terms of the Net Present Value (NPV) of the project.

Beyond this, there is a wide range of methodologies, especially for wider planning (see Lichfield, 1996). For project appraisal the methodologies currently in use to assess all factors can ultimately be considered as falling within two main types: Cost Benefit Analysis (CBA) (sometimes referred to as Social Cost Benefit Analysis) and Multi Criteria Analysis (MCA). An examination of the principal features of both provide a useful *starting point* for considering how environmental and social (as well as institutional) factors can be better incorporated into the project appraisal methodology promoted by the RAMP Handbook so as to better achieve the aims of sustainable development. In summary:

4.1.1 Cost Benefit Analysis (CBA)

Cost Benefit Analysis is an appraisal approach in which all the factors considered are measured in money or proxy monetary terms – the common medium of exchange - over a defined period of years. In principle this is very similar to a Financial CBA, but in addition to forecast cash flows it incorporates attributed monetary values for non-monetary items. This aims to reflect economic, environmental and social factors which do not have an identifiable effect on the project's costs and incomes. It too calculates the overall rate of return to measure the project, usually Benefit:Cost Ratio (BCR) (this may be used together with other measures). This in principle offers simplicity to the decision makers, who can in principle simply compare projects through matching a single figure for each. It is

essentially a quantitative-based methodology, sharing many of the same principles as those employed by the RAMP process. It is used especially employed by particular infrastructure sectors, notably transport.

4.1.2 Multi Criteria Analysis (MCA)

Multi Criteria Analysis is a much broader appraisal approach that explicitly considers both monetary and non-monetary costs and benefits expressed in quantitative and qualitative terms (see Department of Communities and Local Government, 2009). Here 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, enabling trade-offs to be made transparently. The intention is that MCA should provide the framework for a more holistic and transparent approach to developing and appraising projects that is *preferably* directed by policy. It can accommodate Financial CBA and Social CBA appraisals within its framework.

Throughout this report, the references to Cost Benefit Analysis (CBA) are specifically addressed to *Social CBA* and not to purely financial assessments, unless otherwise indicated.

4.3 Features of Cost Benefit Analysis (CBA)

As already inferred, (Social) CBA generally forms the principal basis for most traditional project appraisal, particularly for infrastructure developments. All projects require funding and large projects obviously demand very large sums, which may come from governments and international agencies as well as commercial sources. While commercial funding bodies will be primarily interested in obtaining a good return from funds invested, non-commercial organisations, including governments, wish to identify that the expenditure of funding brings a return that offers 'value for money'; i.e. something beyond purely conventional economic dimensions. Typically, all projects looking beyond a purely commercial return involve some element of public money and thus there will be competition between projects for public funds; a serious issue for major projects, especially at times of restricted public funding.

Although it is rarely identified in specific terms, the use of CBA is effectively generic: i.e. it is often claimed by its advocates that it can be used on a similar basis in *any* circumstances, regardless of context. In this way, it becomes a simpler and thus more attractive appraisal tool to use in that it is presented as being implicitly free of value judgements. The RAMP process is based on similar principles. It is actually questionable whether CBA is value free, given that the ultimate figure in the CBA process for any one project is based in part on monetary values that are derived from assumptions and attributions adopted by the modeller and presumably from the context to which the method is applied.

A hallmark of CBA is that *all* benefits and all costs are ultimately expressed in monetary terms, and are adjusted for the time value of money at which they occur.

Thus 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 Benefit:Cost Ratio - BCR). So the central feature of preparing a CBA appraisal is setting prices and costs on all factors: i.e., monetization. There are various techniques for doing this, including:

- **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 (see Brent, 2006; DfT, 2009). 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; although in many respects much of the continuing research on CBA addresses the practical situation of ‘market failure’ (see Muller, 2003). Many economists consider that it is either still possible to establish sound figures despite such market failures or that such efforts at CBA are superior to other alternative appraisal methods available. A closer examination of the views of some other professions in the following section, however, challenges the validity of the data derived from this approach and points to other potential opportunities (Colomb, 2009).

Establishing monetary values for environmental and social factors of development (sustainable or otherwise) gives rise to several issues:

- It requires analysis and interpretation of what are often sensitive variables, but it also assumes reasonable accuracy. In practice there is always a possible margin of error with every variable. Since a (Social) CBA uses several factors in compilation, there is a risk that these may be compounded and lead to a significant error in the final figure. A single set of numerical data leaves open concerns over how it was calculated: the ‘black box’ issue.
- The values developed so far tend to be easier ones to measure confidently. Thus the factors considered in a (Social) CBA are really limited to those where some form of numerical interpretation is possible and by implication other factors, however important in principle, are omitted. Improvements in this are, despite continuing research, moving very slowly.
- The monetary values established reflect the current behaviour patterns of various groups in society and hence generally reflect current patterns of income distribution. Therefore the resulting sets of values may reinforce current patterns of inequality in society rather than redressing them.
- Pricing the quality of life involves ethical factors and concerns, which are typically very difficult to quantify.

4.4 Features of Multi Criteria Analysis (MCA)

MCA is an appraisal framework used primarily where decision makers are required to openly address a range of quantitative *and* qualitative based criteria and values from which conclusions are derived that reflect these multiple judgements rather than having them all wound up in one concluding (monetized) figure. It is thus deemed more relevant to the use of project appraisal efforts that seek to assess infrastructure project contributions to sustainable development outcomes. It is also more conducive to facilitating the engagement of project sponsors and investors with other stakeholders, including community groups, in ways that can provide valuable inputs into project design and appraisal. MCA thus contrasts with the CBA approach quite significantly, although there is clear acknowledgement by advocates of MCA that CBA plays an important role within MCA; quite how, however, is the topic of discussion and analysis of the following sections of the report and its conclusions.

MCA is more commonly used for appraisal (and monitoring) processes that do *not* require a single monetary return or where such a measure is considered impossible or lacking in any useful validity. It is aimed at supporting decision makers who are faced with making numerous and conflicting evaluations that involve monetary *and* non-monetary assessments. It aims at highlighting conflicts of multiple goal pursuit and seeking compromise among choices in a *transparent* process. It is especially important for environmental and social assessments of projects, such as Environmental Impact Analysis (EIA), Social Impact Analysis (SIA) and Sustainability Appraisal (SA).

MCA offers a valuable discipline in ensuring that that non-quantifiable project appraisal concerns are included and assessed. It furthermore benefits considerably from having as much of the criteria quantified to the maximum extent *realistically* possible and even monetized where this may be done soundly, without ignoring those aspects that do not lend themselves to quantification or where efforts of quantification incur costs beyond what is affordable.

The potential scope and use of MCA are explored more fully in Section 7.

4.5 Project appraisal trends and sectors

Project appraisal methodologies have developed over time, in line with economic and social developments and have been influenced by passing phases of different schools of economic thought. Recent experiences in confronting international development challenges and the global credit crisis have more recently led toward a re-appraisal of the validity of the premise that all costs and benefits of project outcomes can be monetized and even quantified in proxy terms (see later discussion in Section 5). This has led to a return to Keynesian welfare economic values. This follows a period of experimentation with increasingly unregulated neo-liberal approaches that place a higher value on the leadership offered by the market.

The last two decades have seen a growing international emphasis on project 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 global challenges such as climate change; energy use; unequal health among countries and of communities; and rising levels of poverty, deprivation and inequity in certain areas of the world as reflected in the Millennium Global Development Goals (MDGs) (see 3.2.2 above). These different perspectives, especially in the case of large scale infrastructure projects, can increase local opposition to such projects, especially those which bring major changes but *only* with 'trickle-down effects' to project non-users or benefits accruing to the infrastructure user more than non-user. Such circumstances require project appraisal approaches that more understand the context of the project and their multi-dimensional aims – a view now more readily acknowledged by international development agencies and government alike (see World Bank, 2007). Areas of concern that were in the past deemed to be external to the project are now recognised to need internalisation in the project's appraisal process. This development makes MCA a more suitable framework for project appraisal than efforts solely based on CBA.

4.6 Setting objectives for projects

The Study's investigation of the different methodologies used in the appraisal of major transport projects (see following Section) suggest that their different emphasis tend to be associated with the different foci of the professional groups involved. The more specifically numerate disciplines, such as economists, civil engineers and transport planners, primarily employ CBA methodologies. MCA methodologies, on the other hand, are generally employed and led by groups associated with the environment, society and urban and regional planning concerns.

Research of the OMEGA Centre and others involved in the critical review of decision making in the planning, appraisal and delivery of major infrastructure projects (see Hall, 1980; Altshuler and Luberoft, 2003; Flyvbjerg et al, 2003; Dimitriou, 2005) confirm that much project appraisal is essentially a political process because of the way it (the appraisal process) is situated within the overall project decision making context. Major projects, particularly in the developing world, are furthermore often seen as agents of change, with the result that their objectives focus on their performance in the wider community beyond achievements at generating economic growth. This is especially the case where the main project promoter is within the public sector. Even where the project is primarily promoted by the private sector, the project's defined objectives typically address wider goals where these form the basis of market demand or affect areas where the promoter wishes to influence public support. Recognition of this tight relationship with government and other public agency processes is not adequately covered in the RAMP Handbook, which places greater emphasis on the role of the private sector's role in project appraisal and delivery.

The right to set the project appraisal framework typically lies ultimately with the body providing the funding for the project. As already indicated, with mega projects there

is likely to be a significant degree of involvement of bodies wholly or partly in the public sector: national and regional governments, and even international bodies, such as the European Union or World Bank. Some European countries, such as France, Germany and the Netherlands, as well as many developing countries, place great emphasis on national planning frameworks. Other countries, such as the UK and USA, place more emphasis on market-led strategies. Whatever the approach, 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 these aspects. In short, in such circumstances, what is left unsaid in policies is *not* likely to come on to the agenda.

What is very apparent is that ultimately, in any circumstance, the principal promoters' aims (sometimes vision) are likely to be crucial for any project. While these may well incorporate national policy statements, in practice the weight applied to these aims and visions through the appraisal process vary (and change over time) according to the relevance applied to them by key promoters. They may remain as external influences which are internalised *only* as far as is necessary. This is complicated by the fact that the key stakeholders who control the project appraisal overall can change over time, especially in the case of major infrastructure projects which typically have a lengthy period between conception and implementation.

4.7 Aims and structures of project appraisal methodologies

All project appraisal methodologies have a firmly developed structure, usually setting out a series of steps within a defined overall planning process. This is likely to include break points, where the results reached by one stage of an appraisal are submitted to all stakeholders for consultation or to the decision makers for a decision on the next stage; or sometimes both. (In this they match the RAMP processes.)

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. In fact, the EIA process may be defined 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 (i.e. screening, scoping and impact prediction). The post decision stage, assuming consent has been granted, is the follow-up stage during various stages of the project life cycle (i.e. final design, construction, operation, and management). In the UK, however, post-auditing activities are not widespread and this limits the cyclical nature of the appraisal 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. 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 much less consideration than might have been anticipated (Knight and Rydin, 2009). Yet option generation forms a vital part of project planning. 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 *New Approach to Transport Appraisal* (NATA) process for appraising transport plans and projects is made up of 15 steps (see TAG Unit 1.1¹¹). The process commences 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 summarized in text form together with any relevant quantified information. A summary assessment is then 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 and the scales for different objectives are not comparable with each other). 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) (Doubts exist, however, over the emphasis on the monetized economic result normally found in NATA appraisals: a critique of NATA appears below, in Section 7.3.)

4.8 Range of criteria, indicators and information

The ranges of criteria and indicators which may be used in a project appraisal are determined by a number of factors considered together. These include:

- **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**;
- **the statutory requirements**; and
- **conventionally accepted items**.

The choice of indicators and the level of information used may well be influenced by the availability of data, the cost of obtaining it and the extent to which it is judged valid. 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.

As an example of the approach in the transport sector, projects appraised by the NATA systems should all be set against the five key objectives defined in the 2008 White Paper *Delivering a Sustainable Transport System (DaSTS)* (DfT, 2008). (Previously they were set against five objectives in the 1998 White Paper entitled *A*

¹¹ <http://www.dft.gov.uk/webtag/documents/overview/unit1.1.php>

New Deal for Transport.) For each of these objectives several indicators are required. But the results of these are then aggregated 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 can 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. 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.

4.9 Project scoping and consultation

The scoping stage is arguably the most important of the appraisal process for a project. This stage 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.

It is particularly important to give adequate attention to the choice and outline design of the project. Too often a project comes forward and is appraised *without* any clear concept of whether, in the context it is the most suitable project to address the issues requiring a solution, or whether the appraisal framework and inputs are the most appropriate to provide a sound judgment on the project’s true value. To do this, it is important that the project has been evolved from a filtering exercise undertaken as part of the planning exercise. This usually involves outlining a wide range of projects which might address the issues being considered and then appraising them all against the main policy objectives. In this way, those that clearly do not fit can be removed and attention concentrated on those which appear more suitable. These can then be developed as fuller designs and more carefully appraised, in order to produce one project for full development and appraisal.

Research from the OMEGA Centre has also shown that public consultation in major project infrastructure appraisal (for mega urban transport projects in particular) is sporadic and limited, even though it is *supposed* to occur at every stage of the process (Dimitriou et al, 2010). In most UK cases, public consultation *only* happens when the findings outlined in the environmental studies are presented. All these have a significant impact to the quality of an EIA Study. The scoping stage here involves the interpretation and evaluation of the concept of ‘significant effects’ involved in any

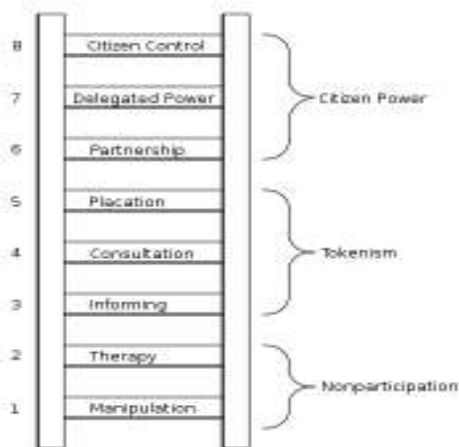
given project, as well as initiates early contact between the developer and competent authority. There is a tight time frame for this process and the emphasis is usually on the 'significant' effects rather than on all effects, as other issues may be of little concern for that particular development (Knight and Rydin, 2009).

Consultation with project stakeholders is a required part of the project planning and appraisal processes of major infrastructure 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 project 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. It requires a 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 project appraisal process and the increasing seemingly sophisticated and complex methodologies involved in CBA, MCA and modelling approaches used by professionals.

The range of types of involvement is shown in [Figure 4](#) below.

Figure 4: The ladder of public participation



[Source: Colomb, 2009, from Arnstein (1969)]

Promoters of major infrastructure projects often fail to develop ‘real’ alternatives, i.e. options that are radically different from each other. Too often, the appraisal gives decision makers the simple option of approving the project or of accepting a ‘do-nothing’ (or sometimes ‘do-minimum’) situation; there is no scope here for considering a wider range of actions. Yet formulating alternative scenarios for assessment can play a vital role in the ultimate outcomes of project appraisal (see Vreeker and Nijkamp, 2006). According to Hartley (2009), 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.

4.10 Summary of findings

The principal findings that emerge from this section may be summarised as follows:

- **(Social) Cost Benefit Analysis (CBA) forms the traditional approach to project appraisal.** It provides an interpretation in money terms of most factors and presents a single rate of return figure that is equally attractive for decisions on both private and public funding. Research continues to develop sounder expression of non-monetary factors in monetary terms. There is however growing concern that its ‘black box’ approach prevents decision makers from properly understanding the nature and balance of all the factors involved.
- **Multi Criteria Analysis (MCA) provides a framework for measuring and presenting all relevant factors together as a basis for decisions.** It is primarily used in the development of policies and plans. It can be used in a variety of formats. It offers the essential discipline that it ensures that all criteria are included clearly, quantified to the maximum extent possible and even monetized where realistic; but not omitted if quantification is not practical.
- **The last two decades have seen growing interest in appraisal methodologies that properly address the widening range of environmental and social concerns.** This interest reflects international concerns over global challenges and also growing opposition among regions and communities to major projects where key regional and local issues have not been taken into account.
- **Sound objectives are an essential basis for any project.** These must take cognisance of international and national objectives, including those for environmental and social factors. Ultimately a project’s objectives are the responsibility of its sponsors and they determine how far national objectives are included, including those for environmental and social factors. This is particularly important for a major project, which itself may bring significant change.
- **Most project methodologies have a clear structure, usually involving several stages.** They require the input of ranges of criteria and indicators. The choice of indicators and the level of information used may well be influenced by the availability of data, the cost of obtaining it and the extent to which it is judged valid. 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, especially if this adds to the cost and time for appraisal.

- **In consequence it is essential to give adequate time and attention to engagement of stakeholders in the process.** This allows generation of issues and information and understanding of the importance of various factors. It also guides the choice and outline design of the project. Failure to approach the project's development in this way can mean that the project fails to reflect key issues and thus may generate increased risks of delay and loss.

5.0 A review of challenges and responses involved in addressing sustainability in the appraisal of major urban transport projects

5.1 Background

In order to establish how practitioners and researchers perceive and address the reality of incorporating environmental and social considerations of sustainability in infrastructure project appraisal, as part of the commissioned Study process (see [Appendix 1](#)), a set of questionnaire surveys was undertaken among key decision makers and senior professionals in the UK and overseas involved in the planning, appraisal and delivery of major urban transport projects (see Omega Centre, 2009c). This set of questionnaires comprised 16 pre-hypothesis surveys and 42 hypothesis-led surveys, as outlined in Section 2.2 of this report. The questionnaire interviews for the hypotheses-led investigations covered a range of senior persons within international and UK national agencies (government departments, public agencies, consultancies, research organisations, commercial bodies); and also representatives from four OMEGA case studies (in the UK, France, Sweden and the USA). The surveys were recorded and then transcribed, and the resulting texts used as the basis for analysis, including summaries of the patterns of response.

The pre-hypothesis surveys involved open discussions, with limited guidance from probing questions. The hypothesis-led interviews followed a structured set of questions focused on four hypotheses about project appraisal and sustainability, developed from consideration of the literature review findings as set out in the Study's commissioned Working Papers (Omega Centre, 2009c). The questionnaire offered four differing statements (as hypotheses) on sustainable development and project appraisal. Each one offered a key statement for respondents to agree or not; in each case coupled with three or four complementary questions. The four key statements were:

- Economic growth is essential, sustainability is not;
- Monetization is essential to sound (project) appraisal;
- Objectives (and visions) are more important than economic rationalism; and
- Engagement of all stakeholders in the appraisal process is essential.

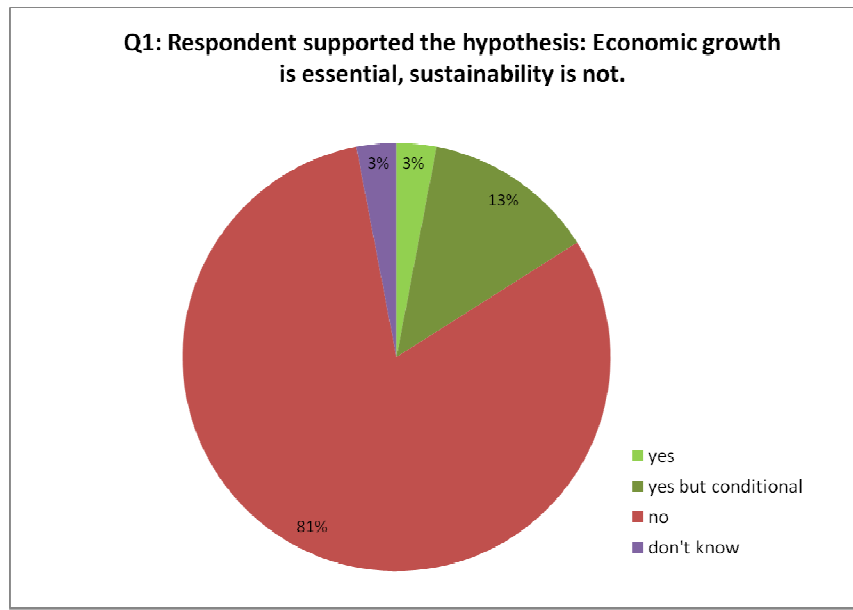
The following discussion sets out the patterns of responses to the questions and review the issues raised by the surveys. Where relevant, the discussion about the responses also reflects on points raised by the pre-hypothesis interviews, complimented by points emanating from break-out group discussions that took place at the Study Seminar held towards the end of the Study to which senior professionals, government officials and academics were invited to comment on the Study findings presented. The review of these discussions is framed under the four hypotheses followed by comments on other issues which arose.

Appendix 2 lists the interviewees and the hypothesis-led survey questionnaire is set out in [Appendix 3](#). [Appendix 4](#) lists the Seminar delegates.

5.2 Economic growth is essential, sustainability is not

The pattern of response to this first hypothesis is shown in [Figure 5](#). Four out of five respondents (81%) disagreed with its premise - while 13% gave conditional rather than full agreement to it. This emphasizes the extent to which there is now widespread acknowledgement that economic growth is not 'king' of all appraisal criteria and the widespread support for sustainable development as a more important outcome.

Figure 5: Response to Hypothesis 1



There was, however, much less definite direction over the topics raised by complementary questions. Responses to these brought out the following:

- **Q2 - Is it possible to conceive of a truly sustainable mega infrastructure project?**
 - One third of respondents supported this fully.
 - Stress was, however, laid on the need to understand fully the aims and potential gains from each project and hence why they should be regarded as sustainable.
 - Of the remaining responses, a good proportion supported the principle but with grave doubts as to whether it could be actually achieved in practice.
 - Some respondents considered such projects were just not feasible.
- **Q3a - Is environmental and social enhancement *only* worthwhile if such aims can be appraised realistically against other key aspects of mega transport project development? Doesn't this require relevant public authorities to set clear and firm indications of priorities for different contexts within which projects are developed?**

- There were mixed views on the first part of this question, with no firm pattern emerging.
- For the second part, 41% of respondents agreed fully and 28% agreed conditionally.
- Only 3% disagreed with the proposition expressed in the second part of the question.
- **Q3b - How significant is it for the appraisal of mega urban transport projects to have a firm spatial planning (geographic) dimension?**
 - Spatial planning was seen by most respondents as highly significant for project development.

The overall indication that emerged from the responses to this first hypothesis was that sustainability is now seen as *fundamental* by most people involved in major projects. However, views differed - sometimes quite widely - on what it (sustainable development) means in terms of strategic priorities and of practical expression. Attitudes to environmental and social factors have furthermore been changing over a long period of time. Environmental factors are now far more important than they were ten or twenty years ago; in fact the views now held on both environmental and social aspect of sustainability were not usually held one or two decades ago.

There has also been a significant shift in appraisal objectives and methodologies, at least in formally recognised terms. How effectively these deal with the key issues involved in operationalizing sustainable development, however, is unclear and hence it is somewhat questionable whether they have really led to changed decisions or positions. The terminology is changing too: though that does not necessarily indicate changing intentions and actions. This shift toward embracing sustainable development as a vision for the future is continuing, albeit at a slower pace than the global challenges demand. The pace of change of accepting the importance of social and environmental dimensions of sustainability differs, furthermore, for different industries and professions (e.g. building as against transport). With concerns about climate change, we may now be in a more hurried time, with accelerating speed of change.

There is little clarity over future scenarios for our societies, although many have been offered. In all scenarios sustainability needs to be considered against long term impact *as well as* short term. Economic growth is thus *only* a valid concept if it is achieved within a sustainable development; otherwise the level of economic activity *cannot* be maintained. For this reason, it is almost impossible to fully understand the longer term impact of mega infrastructure projects, even though they have a very long time cycle. This is particularly significant for such projects, as they generally take a long time to move from the original idea to a fully established project. During this time the shape and purpose may change even though they may also remain consistent with the original vision they serve. Major projects may affect the context of the region in which they are built as well as being affected by it (e.g. by either changing or reinforcing existing movement patterns and hence economic and social activities).

Economic growth is *not* necessarily an end in itself. The objectives of growth are often not clearly defined: more is assumed to be what people want but this may not necessarily make life better. Economic development can be seen to address several ultimate aims: improving social engagement and living conditions and supporting the environment. It does *not* follow, however, that sustainability and economic growth are in conflict. This is so because it may well be possible to achieve recognisably higher quality lifestyles for whole communities, while pursuing policy directions that are clearly sustainable in their use of resources. In fact economic growth in the long term needs to be sustainable growth. But this requires a high level of careful understanding and strategic thinking, and a need to interpret a wide range of views on many aspects.

Focusing on economic growth in conventional terms can prevent externalities being adequately addressed, and yet external effects can constrain growth. For example, the likely peaking and decline of world oil supplies could have a very severe impact on the global economy as well as local economies. Similarly, poor social conditions in a city may reduce the effectiveness of those living and working there and thus reduce urban economic activity and productivity. This reflects the principle adopted that sustainable development consists of integrated advance in economic, environmental and social terms (facilitated or hindered, we contend, by institutional considerations). Thus economic success should properly be seen as achieved *only* within a sustainable framework. If a project fails to consider on a cohesive basis all the factors of sustainability (i.e. economic, environmental, social and institutional – and the interrelationships among them), it may prove to be a poor investment.

In view of this, it is *always* relevant to ask who gains from projects and the plans that spawn them? Are the benefits of identified growth opportunities achieved by society as a whole, by particular communities or primarily by the project promoters – and over what timescale? Or are benefits gained by all of them but over different timescales? For a particular project, the promoters' attitudes and approach will normally have a strong influence here. This is made clear in the RAMP Handbook. Companies are bound by the competitiveness of the commercial world to follow conventional growth criteria so far as possible in order to maximise financial returns. It is therefore up to public bodies, especially governments, to take the lead and set standards of a different more sustainable future in which a sustainable business case can flourish rather than 'business as usual' practices.

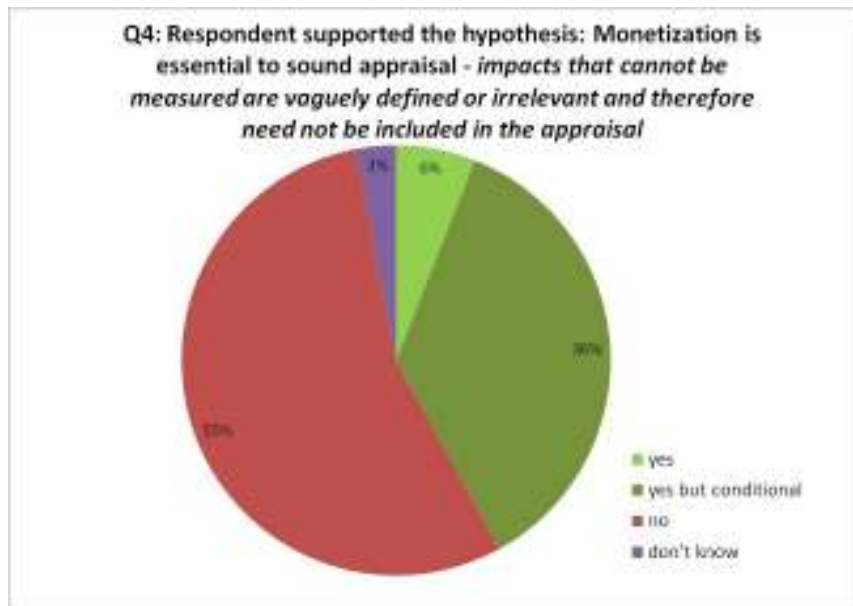
Effects and values can also be inter-generational, especially for a major project. Benefits now might be gained at the expense of future generations. Equally spending now might benefit future generations. Furthermore everyone is moving through the life cycles: today's young people will be the elderly in half a century.

Sustainability is a global issue, thus international consensus on ways to achieve it is also essential. However, different countries have different positions, reflecting their national and regional cultures, and this is little understood.

5.3 Monetization is essential to sound appraisal

The pattern of response for the second hypothesis is shown in [Figure 6](#). Slightly over half of all respondents (55%) disagreed with this hypothesis. Just over one third (36%) agreed only with reservations. This suggests that monetization of factors is *not* seen as the fundamental basis for appraisal that it once was. This represents a major finding that certain parties long involved in project appraisal may find uncomfortable to accept. It is critically important for the RAMP Handbook.

Figure 6: Response to Hypothesis 2:



A summary of the responses to the complementary questions are as follows:

- **Q5 - Should the appraisal of mega urban transport projects be primarily focused on the Cost Benefit Analysis (CBA) approach?** How well do you consider this approach addresses the environmental and social dimensions of sustainable development?
 - Four fifths of respondents considered that the CBA approach to environmental and social dimensions gave them poor treatment.
 - Responses to the first part of this question were very evenly balanced: 42% agreed that CBA should be the primary focus, but nearly half of these agreed only with conditions; 52% disagreed..
- **Q6a - Which environmental risks and opportunities can be converted into monetary terms** and incorporated into project appraisal?
 - Relatively few specific items were listed by respondents. These included physical aspects of the environment such as air pollution, carbon, noise, climate, and land impact.

- **Q6b - What might be the best way to take into account those environmental factors which cannot be monetized?** Or should they be omitted from the main appraisal?
 - Hardly any specific comments were offered by respondents.
- **Q7a - Which social risks and opportunities can be converted into monetary terms** and incorporated into project appraisal?
 - Relatively few specific items were listed by respondents. These included definable social measures such as relocation, education, and jobs.
- **Q7b - What might be the best way to take into account those social factors which cannot be monetized?** Or should they be omitted from the main appraisal?
 - Hardly any specific comments were offered by respondents.

The overall indications to emerge from the responses to this hypothesis are threefold:

- There is wide knowledge among infrastructure professionals and academics in the UK and internationally of CBA methods, and the related processes of quantification in project appraisal.
- There is also a general acceptance of the role of CBA in project appraisal and a recognition by most people interviewed that as a tool it offers a secure economic reference point for project appraisal, notwithstanding any shortcomings it may display.
- Most importantly, there exist considerable doubts as to the effectiveness of CBA for assessing sustainable outcomes. This last observation is highly relevant finding for the RAMP Handbook.

The choice of embarking upon an infrastructure project is itself a crucial step. Taking a narrow view of projects within one specific field (such as transport) or even a subfield (such as highways) *may* limit the amount of thought given to different possible schemes. But if consideration is given to the wider context within which improvements are being sought, then a range of possible schemes, not necessarily all in the same field, must be generated. This choice process requires consideration of a selection of possible futures, perhaps through scenario analysis, in order to establish a clear context for selecting a project. If this is done in coordination with an early assessment of issues and the engagement of stakeholders, then it is more likely that a project can be developed that can be appraised as positive in sustainable terms and taken forward. Projects which lose money may, nonetheless, still reflect the correct priorities *if* there are clearly valid reasons for selecting them and alternative resources with which to subsidise them.

Establishing monetary values for analysis requires substantial amount of work and understanding; proper monetization needs sensitive variables. Considerable research has been undertaken over the last two or three decades in this field (see Bein, 1997); how far this has moved towards more certainty is another matter. There are parties in project development who consider that *everything* can be ultimately monetized (but at a cost) and that it is just a matter of the affordability of doing this as to whether such exercises should be undertaken. Others are more sanguine and

claim that while the monetization should be pursued wherever possible, and quantification of proxy measures should be examined where possible, ultimately, there are areas of appraisal that just do not lend themselves to either monetization or quantification and that in such situation one can only choose among options based on policy guidance and directives.

It does *not* follow then that measuring factors necessarily allows a useable monetary value to be obtained (see Adams, 1995). (However, the resultant measure may still be used in assessment). Furthermore, the values developed for infrastructure project appraisal so far tend to be the easier ones to establish on a measurable basis, and these are (in transport projects) mostly the straightforward ones of cost, time and revenue; thus the environmental and social costs and benefits (and any institutional considerations) tend to get left out and therefore undervalued. There is also the vexed question of what might be the 'right' value. ("... the bits that can be monetized ... may not be the same as the bits that are actually important to people.")

Even monetisation of some environmental factors offers grave problems. How can one measure a breach of absolute scientific limits? What value might be placed on particular examples of losing landscape, townscape and community severance, and how might these match up with other examples? Monetary values are often derived from assessments against current patterns of income distribution. However, since these are not equal, using the resulting sets of values in appraisal may generate inequitable outcomes. Pricing the quality of life, furthermore, involves ethical factors. The simple principle of compensation built into economic models may be highly inappropriate in many cases. For one thing, it is often not possible in practice to compensate some groups who lose out, and is very unlikely that those who benefit could be charged directly to provide this compensation. In any event, those who lose from the project's implementation might not find compensation acceptable in any case.

From this it can be concluded that decisions in some fields might better be driven by adherence to particular standards or actions determined as 'essential' to quality of life (such as basic needs). This concerns, for example, achieving formally adopted safety levels or keeping within established recognised levels of pollutant emission. Once these have been adopted, seeking to value them has no point. Projects or parts of them may be assessed on a simple pass/fail basis: if a project cannot address a particular regulatory constraint established to protect or enhance standards of life, then it cannot proceed. For example, causing the extinction of a rare animal or imposing major degradation on a lively urban area. Climate change may offer particular examples of this approach; i.e. any increase in carbon generation might be an *automatic* cause of rejection. In more localised examples, there may be opportunities to seek a balance between absolute achievement and its cost.

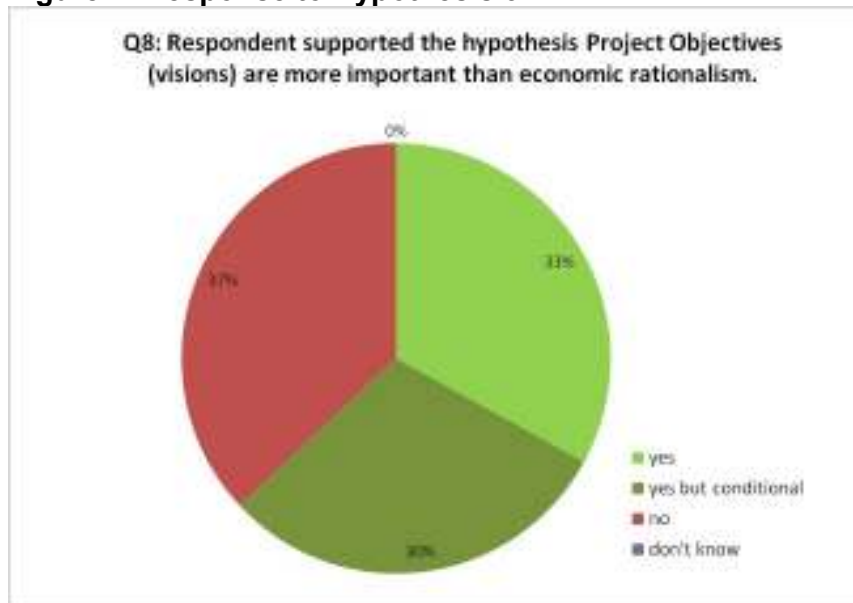
While the two main aspects of sustainability have been treated as equal throughout, there remains generally a wide difference between the approaches to environmental and social factors respectively. As regards the institutional dimension, this is even

less addressed. Environmental factors tend to be seen as physical attributes that can be measured and assessed in neutral terms. This particularly applies to the most discussed ones, such as air quality, water and land attributes. Social factors are mostly far more difficult to deal with, as they imply social and perhaps political choice of priorities; effectively they concern quality of life rather than simple matters of time saving. Institutional dimensions can be even more problematic to appraise. They involve assessing impacts of power, influence and containment and enablement – all too often very difficult if not impossible to measure. Some environmental factors which require more judgement, such as landscape and heritage, also pose more difficult and potentially political issues of choice. Even some measurable ones, such as noise, actually have a primarily social impact, affecting people's well-being. Once again, these findings are most relevant to the RAMP Handbook.

5.4 Objectives (and visions) are more important than economic rationalism

The pattern of response for the third hypothesis is shown in [Figure 7](#). This shows a even balance of about one third each agreeing fully, agreeing conditionally and disagreeing. However, combining the respondents agreeing (whether conditionally or unconditionally) gives nearly two thirds (63%) in favour of the hypothesis. This represents an important implicit acknowledgement that achieving the overall vision/objectives of a project often has greater priority than any narrow economic evaluation, notwithstanding the fact that this does not *de facto* imply economic prudence should be thrown to the wind. These findings are once again of considerable importance for the RAMP Handbook.

Figure 7: Response to Hypothesis 3



The responses to the complementary questions of this hypothesis followed this are as follows:

- **Q9a - What are the key factors which need to be covered in environmental and social appraisal of a mega urban transport project? Are they readily measurable? How do you decide which ones might be included and prioritised?**
 - 54% of all respondents thought that some environmental and social factors are measurable.
 - However, few suggested which factors they saw as key ones, implying some degree of uncertainty or ambiguity.
 - 11% thought that all factors could be measured and another 11% thought that *none* could be measured.
- **Q9b - How valuable are the current Environmental Impact Assessment and Social Impact Assessment processes as set out in official documentation?**
 - 56% saw such processes as of some value.
 - 20% thought they were of no value.
 - Only 12% saw them as very valuable.
- **Q10a - Would the appraisal of a mega transport project more effectively employ the use of Multiple Criteria Analysis (MCA), to cover all factors (both quantitative and qualitative) within a single framework? How well do you consider this approach addresses the environmental and social dimensions of sustainable development, particularly those that cannot be monetized?**
 - 76% of respondents thought that appraisal could more effectively employ MCA to cover all factors.
 - 41% fully agreed with the preferred use of MCA.
 - 25% had some reservations. Only 7% disagreed.
 - Likewise 76% thought that MCA covers social and environmental factors well. Although over half of these (40% of the total) expressed reservations, no-one expressed disagreement with the concept.
- **Q10b - Should CBA be used to inform MCA based appraisal, rather than as a principal tool for decision making?**
 - 70%, thought that CBA should definitely be used to inform MCA.
 - Only 19% disagreed.
- **Q11 - How important is context – cultural, political, commercial, temporal - in (a) planning, appraisal and delivery and (b) judgements about success? How does it influence judgements regarding the value of a mega project and its treatment of risk, uncertainty and complexity? Or are decisions context free?**
 - Almost all respondents (92%) thought that context was important for mega project planning, appraisal *and* delivery.
 - Just over half (59%) thought that it was actually influential, but no respondents claimed that context is unimportant.

Overall, there emerged serious doubts over the effectiveness of current processes for environmental and social project appraisal. There was, however, a strong preference for a clear framework for assessing indicators for a range of relevant objectives. The key issue appears to be how far the MCA approach can be used in a way that provides a sound basis for decision making. This call requires a disciplined approach even though the relevant criteria still need to be quantified wherever possible; if they cannot be, then other means for comparing them need to be found.

The value of quantification as far as is possible remains then the preferred option notwithstanding the recognition that some such efforts yield limited or misleading outcomes. In this context, it is most important to establish the scale of any one factor of concern in a project, in relation to other factors (as far as this is possible) and also in relation to the same factor in other projects.

It is argued by a significant number of those professions closely associated with the appraisal and delivery of infrastructure projects (economists, civil engineers, actuary specialists and infrastructure planners) that most things can be quantified to a certain degree. But that this always has a cost and that this cost needs to be justified against the usefulness of the values generated. More sceptical parties argue that the excessive use of measurement can lead to the interpretation of results being geared to the items quantified (i.e. what gets measured gets done). This becomes potentially even more problematic when quantitative measures are converted to money values and decisions are (mistakenly) focused on cash values, while other factors are largely ignored.

Attribution of specific values, especially monetary ones, also implies that all items are tradable. This is rarely the case and indeed many would say it should *never* be the case. It may be (indeed it is typically) necessary for decision makers to trade off one factor against another in their decisions. However, in order to do this, it is very important that they have a clear understanding of *all* the factors involved and what they mean. Furthermore, if a value is attributed to a factor, this may cause decision makers to focus on the value itself rather than giving careful consideration to how that factor should be addressed in the decision making (“... put in a value, that then absolves you from still needing to think about that issue”).

As already indicated, the role of (Social) CBA in producing a disciplined valuation of a project is generally recognised as very important but it is mostly seen as *only* offering part of the answer to the overall appraisal exercise. In practice, current project appraisal approaches in the UK and the USA, especially, at least involve producing a CBA. They also increasingly look more widely at other factors which cannot be realistically covered in a CBA valuation, especially those associated with the vision of sustainability. For this reason, there is now wide recognition of the value of using both MCA and CBA for appraisal. There are, however, very differing views on how exactly this should be done. This is an area we return to in Section 6 of this report.

Using an MCA approach allows risks with absolute limits or standards to be clearly identified (e.g. likelihood of severe degradation to a rare animal's only surviving habitat or a lively or reputed inner city area). This can include standards or regulations set to guard against potential impacts in the longer term, which are particularly important for achieving sustainable outcomes over time. Short term gains may be attractive for a financial return on a project and easy to identify but it is *essential* to look beyond these. Otherwise projects themselves become focused on ‘low hanging fruit’ and do not address major issues with long term implications (“... the low-hanging fruit is of interest primarily to fruit-thieves ...”).

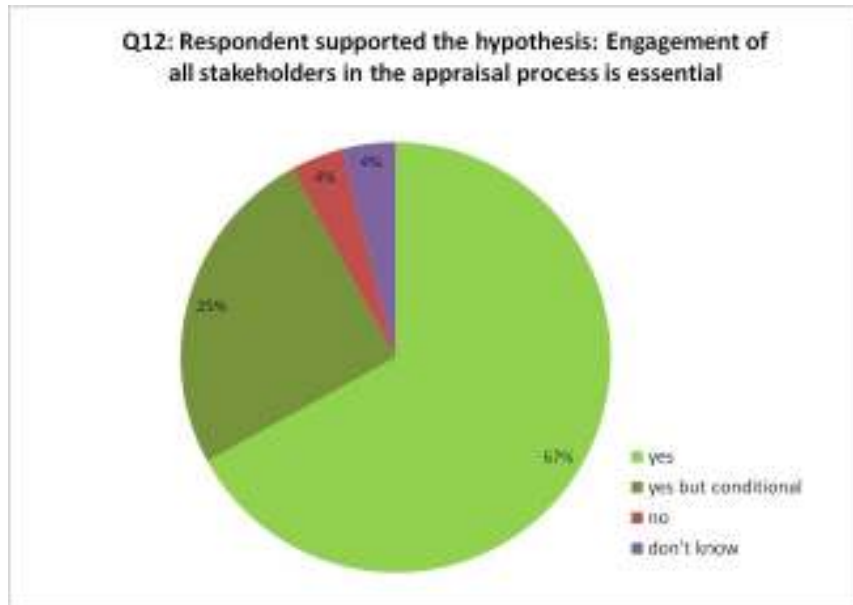
MCA can play a valuable role in the development of projects, in conjunction with stakeholder engagement and in their monitoring too, once completed. Projects need to be evolved from consideration of *all* factors in a given situation, avoiding any assumption early on that a particular type (e.g. a road) will be the solution. Building the MCA framework as a basis for considering the usefulness and possible impacts of different types of project allows a disciplined approach to the selection process (see section 6 following). It also acts as a basis for posing questions about implied objectives (e.g. why consider a transport project if there are other ways of improving accessibility for the community to goods and services?). Thus it can underpin the whole process from understanding the situation to be addressed through to design of the preferred project.

In mega infrastructure projects there is necessarily a great deal of supporting work in development of potential appraisal criteria for MUTPs (see work of OMEGA International Partnership Network – www.omegacentre.bartlett.ucl.ac.uk). This requires continual involvement with all stakeholders, including not only community groups and public bodies but other partners in the promoting group too. Even these may have positions and priorities which differ from the principal promoter. Relationships between and within decision making bodies involved in new project developments are not always straightforward. It does *not* follow that all individuals or groups wholeheartedly support a project that their organisation is promoting. Understanding of the relationships between transport and social factors, for example, remains generally weak.

Changing the focus and responsibility for a project can alter the priorities for appraisal and the outcome. Establishing and maintaining a strongly consistent view is thus likely to be a dominant factor in project development. This applies particularly to the promotion of the project. It can also apply to the strength of the role played by other parties supporting or opposing the project. Using an MCA process as the framework for better project stakeholder engagement and establishing shared concerns for critical factors and criteria provides a sound basis for carrying this out effectively and moving a project forward. This is an aspect that the RAMP Handbook readily acknowledges.

5.5 Engagement of all stakeholders in the appraisal process is essential

The pattern of response for the fourth hypothesis is illustrated in [Figure 8](#). As this shows, almost all respondents (92%) supported this hypothesis; two thirds (67%) unconditionally. There was hardly any disagreement.

Figure 8: Response to Hypothesis 4

The responses to the complementary questions associated with this positive support for stakeholder engagement are as follows:

- **Q13a - To what extent do you think that the various different stakeholder groups should be engaged in the environmental aspects of the appraisal process?**
- **Q13b - To what extent do you think that the various different stakeholder groups should be engaged in the social equity aspects of the appraisal process?**
 - The response to both these questions was very similar, and most respondents addressed them together, considering that project stakeholders should be engaged in both environmental and social aspects of appraisal. (No mention was made either in the questionnaire or in the responses to concerns of institutional sustainability). Half the respondents thought project stakeholder groups should be fully engaged, and a third thought they should be partially engaged.
- **Q14 - Is there scope for mega transport project stakeholders, including promoters, to modify their assessment criteria for appraisal of their projects in light of their own concerns?** And, if so, do you know of mega transport projects for which such forms of assessments have been used in the appraisal process where this was helpful to the final outcome?
 - Over a third of all respondents fully agreed that promoters' assessment criteria should be changed in the light of concerns generated by the engagement.
 - Two fifths thought that they might be so changed.
- **Q15 - How do you conclude the debate raised by the engagement of stakeholders in the appraisal process and so bring the considerations to the point of decision?**

- Almost all respondents considered that there should be a clear timetable identifying the points at which periods of engagement were finished so that specific decisions could be taken.

Overall there was clear support for stakeholder engagement being open and effective. This has important implications for the RAMP Handbook.

With the scale and distances involved with mega transport projects, many organisations and individuals are affected by its construction with the result that there are typically *many* stakeholders involved with many differing views. Even smaller projects can raise complex project stakeholder issues and relationships. Evidence from Scandinavia and elsewhere suggests that ‘real’ consultation, initiated at a very early stage, can play a strong role in addressing these issues and better incorporating local values as a basis for development and appraisal.

Having said this, some groups may *not* be able to engage in the project appraisal processes effectively because of their unequal powers, influence and resources at their disposal. A proper and fruitful engagement thus requires an open (transparent) approach to stakeholders irrespective of these influences, including with members of the general public, involving trust. Understanding who the stakeholders are and what defines them are essential steps. Bringing the relevant parties on board in a project appraisal process and contributing to the assessment of the multiple effects of major infrastructure projects *can be* very complex. It can spawn major benefits, especially later in the project life cycle, in terms of its public acceptability and incorporation in daily lives.

Project stakeholder engagement can though be painful for promoters as well as for other project stakeholders. As already indicated, it is *most* likely to be effective if it is started early; in this way it also allows local values to come forward. However well they understand each other, disagreement is bound to remain between project stakeholders on account of the very different interests they often pursue. Furthermore, project stakeholder viewpoints may change over time if the potential benefits or disbenefits to a group are also understood to change. Ultimately, a satisfactory resolution of key issues of project appraisal *may* rest on compromises being achieved. There is, however, *always* a risk that consultation may polarise opinion rather than lead to consensus.

Management of the project appraisal processes and the identification of possible costs and benefits, and the values employed in these exercises places a great deal of responsibility on the professional analysts, who have a substantial and important role in defining project inputs and values and thus determining project outcomes. How their skills are developed to better undertake these tasks is a critical capacity building question? How is ‘good practice’ evolved and how it is defined both generically and in context-specific terms is critical? What is the relationship between the infrastructure project specialists and the policy makers and politicians and other representatives of civil society? What should it be to meet the need for inspired leadership, which can play a major part in guiding and bringing views together and

influencing final decisions? Work undertaken by Sussex University's Science Policy Research Unit (SPRU) (Stirling, 2006) suggests that MCA can not only prove an invaluable tool in the technical tasks of project appraisal but also as a framework for project stakeholder dialogue about project alternatives and outcomes where different stakeholder perspectives are shared, developed and better understood. This potential value of MCA resonates well with the stakeholder concerns of the RAMP Handbook.

5.6 Other issues

Respondents also raised a number of points which were not directly related to the set of questions.

Institutional frameworks are very important because they set the context for the project. They include the sponsoring and investing bodies, which are responsible for objectives and criteria for appraisal and for the final decision: these include private bodies and public ones, such as governments and others) and private. They also include public (regulatory) bodies which set and supervise the policy framework. Stability in institutional frameworks is essential to effective project development and appraisal, as this ensures that there is a sound basis for establishing objectives clearly. Lack of institutional sustainability can lead to a project lacking a firm basis for development and thus failing to meet goals for sustainable development, even where these are proposed.

Forecasting is a fundamental component of the appraisal process. However, the significance of sound forecasting is rarely debated. This is of concern, as forecasting is generally not done well; financial forecasts are particularly likely to be in error. The extent of such errors increases with the time over which forecasts are projected.

The principal focus of environmental impact studies is usually on the extent to which a project might cause damage and how this can be mitigated. But this leaves open the question of whether mitigation is sufficient. Furthermore, mitigation is usually defined from the sponsors' viewpoint, and this is likely to focus on the minimum necessary not to worsen the environmental conditions. Additionally the conditions to be mitigated are usually those in the forecast future; if some aspects of that future are forecast to be worse, then the mitigation is acceptable if it leads to the project not worsening things further. If a project is really aimed at creating a more sustainable future, then it might better be designed so as to contribute significantly to an improved quality of environment. The same principles apply to social factors. (See World Bank, 2007)

Language can be all important but at the same time ignored. The use of particular terminology in policies may be firmly intended to create particular (enhanced) conditions. But it may then be used in the objectives for a project which actually generates quite different environmental and social conditions. Different groups in society – legislators, project sponsors, community groups – may attach significantly different visions in practice to the same set of policy words.

5.7 Summary of findings

The principal findings that emerge from this section may be summarised as follows:

- **The conventional view that economic growth should be dominant in project appraisal is held by hardly anyone.** Sustainability is now seen as fundamental by most people involved in project development, while economic growth is no longer accepted as an end in itself. However, there are differing views on what sustainability actually involves and how projects might be framed to achieve it. There was clear agreement that environmental and social objectives should be set by public authorities and that the spatial dimension is very important.
- **Sustainable development has been increasing in importance over the last twenty years.** Global and national policies have developed to focus on it and appraisal methodologies have gradually taken it into account. But it still remains questionable how far projects address environmental and social dimensions of sustainability. Long term success for projects in economic terms has to reflect long term issues of sustainability, not least because some factors which appear to be externalities may actually have a significant impact over time. But this is not yet widely recognised.
- **Very few practitioners now see monetization of factors as essential to sound appraisal.** But views remain divided on its significance; a large minority think that it has some role and also consider that (Social) Cost Benefit Analysis should be the primary focus for project appraisal. Views are clearly divided between those who think that everything can be expressed in monetary values and those who consider that this practice cannot produce sound figures and may actually prevent decision makers from properly understanding the balance of the various factors.
- **Substantial research continues on establishing sound monetary values for environmental and social factors.** However, practical difficulties exist, even over some of the simpler physical environmental factors. For social factors, even where monetary values can be attributed, there remain questions over distributional effects.
- **Firm objectives for projects are seen as important by a majority of practitioners** but there is some caution over their role. There are also differences over the extent to which environmental and social criteria can be measured and which ones should have priority. Some practitioners envisage that most can be measured but accept that cost of securing viable figures can prove inhibiting. Others consider that items should certainly be quantified wherever reasonably possible but that focusing too much attention on this can lead to the real significance of some factors being ignored.
- **Although the spread of processes such as environmental impact appraisal is widely recognised, there remain doubts** over the effectiveness of these in achieving sustainable outcomes for projects.
- **Using Multi Criteria Analysis in project appraisal is widely supported,** as this is seen to offer scope for addressing a range of objectives in a structured way. It is seen to allow clear identification of factors and issues in a way that is not

possible with CBA and may even be difficult with Environmental Impact Analyses and similar processes. It is also seen as valuable in supporting good project development and design, in conjunction with good involvement of stakeholders

- **There is very strong support for stakeholders being involved in the development and appraisal of projects from an early stage.** It is recognised that not all stakeholders can play an equal role and that careful management of the process is thus essential. The process of stakeholder engagement can also prove difficult for project sponsors. Nonetheless it offers potential benefits that justify carrying it out thoroughly.
- **Engaging stakeholders does not mean that all their aspirations can be met.** Indeed, since different groups are likely to have different aims, it is very likely that some will be disappointed by the final outcome of the decision process. There may need to be compromises to achieve a good project outcome. This might also involve compromise by the promoters themselves over certain of their objectives.

6.0 The sustainable business case as a new context for project appraisal

6.1 Commercial businesses and sustainable development

There are both widespread aspirations for sustainable development and a clear case in terms of long term economic stability. But focusing on sustainability in the processes of appraising a major infrastructure project, and bringing them into the RAMP process, may generate serious tensions because it frequently seeks to bridge the policy-project interface. For example, why should a commercial or funding body commit resources and energies to incorporate non-business dimensions in their project appraisal if they are not compensated for this? What in fact are the ingredients of a 'sustainable business case', as distinct from a business case based strictly on the assumption of economic growth assumptions based on a 'business as usual' viewpoint? And how does one incorporate principles and criteria into the development of a business case that lead to sustainable outcomes?

The practice of aiming to develop a business in a sustainable fashion is probably ancient. Profits have to be made through employing resources in particular ways if companies are to remain in business. The key issue is to establish how far this can be done in ways which are beneficial or at least not harmful for the communities affected and where the effects are properly understood by those communities. This has become of far more concern over recent decades.

Major business interests have responded through seeking to promote sustainable business development. Examples include

- **The World Business Council for Sustainable Development (WBCSD)** (www.wbcsd.org) is a global association of some 200 major companies, whose membership is drawn from more than 35 countries and 20 major industrial sectors. At any one time it has a range of initiatives and studies under way. The organization has published many reports.
- **The International Institute for Sustainable Development (IISD)** champions sustainable development throughout the world across all sectors. Through its business sector BSDglobal (www.iisd.org/business) it has developed a set of strategies and tools that companies can draw on to translate an aspiration of sustainability into practical, effective solutions, drawn from and supported by case studies from around the world. It has developed or endorsed sustainability indicators for businesses, training programmes, etc. Most of the BSDglobal case studies are operating companies which have committed themselves to certain sustainable principles and practices or to follow defined codes of conduct in this field: e.g. IKEA, ICI.

These examples still throw up some important issues for the difficulties and the potential of developing a sustainable business case:

- **The primary responsibility for leading on sustainability in practice lies with public authorities.** The tensions between policy and practice can be seen in the

dichotomy between the core aims of commercial operating bodies and those responsible for public policy.

- **Commercial companies have ultimately to make a profit to stay in business.** They need to attract funds in order to implement their projects. These imperatives place limits on how far any one organization or activity may go to address environmental and social goals; in effect, to internalize in their decision making what might be seen as external factors. If they go too far, then they risk going out of business.
- **Companies are heavily influenced by policy rules and guidelines set by public bodies** to establish standards which must be met. But setting a standard implies that this is sufficient to be acceptable (lowest common denominator). Companies are constrained in how much further they go by the factors of competition that lie at the heart of commercial activities.
- **Regulations and guidance may in some aspects be imprecise rather than specific, failing to offer firm guidance.** For example, some consider that statutorily defined forms of sustainability appraisal (EIAs, SEAs) are separate exercises which have little real relationship with the project and hence little effect on its actual achievement of sustainability goals.
- **In principle a company can go some way beyond the requirements of regulations,** through working to higher standards or putting resources into a more soundly based achievement of the required levels. This may earn them support – and more investment – for their soundness. So they need to judge what non-quantifiable benefits are worth to the balance sheet. However, there is also the risk that they may be seen as going too far and hence being unsound, leading to loss of investment.
- **Strategic business assessments have to take account of timescales.** Potential goals, including those in environmental and social fields, can be moving targets. Some key standards are set well in advance and remain the topic of regular discussions and review at international level, so that interested companies may take stock of trends and identify how the standards could progress over the coming years. In this way project standards could be set to levels generally expected to be in place when the project reaches implementation. Significant change in regulatory context normally appears to take around twenty years. However, this does not always follow. Standards could be raised unexpectedly, or expected raises might not take place. Any large project will take considerable time from its initial evolution through development, appraisal, decision, and implementation to become operational.
- **To identify how a project can be truly visionary and yet attract investment** project sponsors and investors need to study issues and situations and to address them with care and focus. This may be easier for large companies.
- **Large corporations and trade groups will also seek to influence government and other public policy instruments and regulations.** There are various ways in which they may do this, including seeking to set the agenda or putting forward a vision which reflects their own industry's priorities. These approaches might be less far reaching than the public aspire to or some politicians might wish.

- **Companies also draw guidance and target values from standards developed and recommended by non-regulatory bodies.** These may include bodies established by governments and public agencies; trade groups set up by industry. Publicly adhering to standards set by these bodies indicates a positive approach to sustainability but does not necessarily form an obligation.
- **Public bodies sponsoring and procuring projects may also work to de facto ‘best practice’** in setting the standards for the project, to form examples of the public policies which they have set down.
- **Companies should identify risk and opportunity at a strategic level as well as for projects** (ICE and AP, 2006). It follows that this should cover sustainability factors as well as other aspects. Thus a company which has sought to address environmental and social factors of sustainable development should be able to carry this through into its projects as well as its operations.

6.2 Outline of a sustainable business case approach

To address the various issues inherent in this topic, the following outline approach is suggested. This involves a set of steps that might in principle be taken to develop a sustainable business case to incorporate the environmental and social dimensions of sustainability. This approach is essentially integral with the revised approach to appraisal through an MCA framework, set out in Section 7, and the recommended structure for using this within the RAMP process, set out in Section 8; its place is indicated especially in [Figure 15](#).

The nine suggested steps are as follows:

- **Step 1:** Establish clearly the context for the project in relation to sustainable development, taking into account formal regulatory structures for environmental and social factors, current issues and concerns over them and which appear to be most important for the project.
- **Step 2:** Establish the objectives for the environmental and social aspects of the project, in parallel with economic and operational ones.
- **Step 3:** Clearly identify how far the project could of itself change the context in which it is working. (Much more likely with a major project.) This might be in positive ways as well as negative.
- **Step 4:** Set up a good system of stakeholder engagement from the start. This should be as open as possible in terms of who are included and what is discussed. It should enable environmental and social factors, especially non-quantifiable ones, to be listed from early on, so that they are not lost, and the relative significance of factors to be drawn out, so that they can be weighted properly in assessment stages.
- **Step 5:** Define how the various environmental and social factors are to be addressed. It is important to decide which ones will be given priority attention and which ones might not need much consideration.
- **Step 6:** Use background analysis and stakeholder engagement to generate objectives and provide criteria for appraisal of the environmental and social objectives. Focus on the factors with potentially high influence (too many detailed

targets may constrain the project up by preventing its developers keeping it on track).

- **Step 7:** Carry out project appraisals at initial and later stages through a methodology that incorporates the environmental and social factors. While financial appraisal is essential to provide indications to sponsors, appraisal methodologies based solely on monetization of factors do not provide a reasonable basis for including environmental and social factors properly. The principal means of including this is through Multi Criteria Analysis. The MCA appraisal must incorporate any financial appraisal (Financial CBA) and Social CBA, with the project description, objectives, assumptions and forecasts shared between the MCA and these financial and economic appraisals. Effective appraisal covering all aspects is essential to any good business case.
- **Step 8:** Consider a variety of plausible alternatives, through a filtering process. This should help move towards a project that meets the various objectives, including environmental and social ones. This might include revisiting the project aims and definition where initial appraisal suggests that it would not offer a good business case.
- **Step 9:** Ensure that the environmental, social and institutional goals adopted in the design and appraisal processes are firmly embedded in arranging the funding, procuring the contract team for construction and setting up the operation. This requires a collaborative approach to procurement, to ensure shared values and shared risks between sponsors and contractors. This should be integrated with the continuing stakeholder engagement process. It needs to recognise the 'transactional costs' involved in continuing to meet the established environmental and social goals.

7.0 Developing a MCA framework for appraising major infrastructure projects

7.1 Background

The findings and discussions in the previous sections clearly establish some valuable principles about operationalizing sustainable development in the project appraisal process for major infrastructure projects. The point has already been made that while the concept of sustainable development is recognised world-wide, and is incorporated into numerous policy documents at international, national and local levels of governance, as well as within much of the corporate world. But, although it is also strongly supported by many practitioners implementing these policies, it is proving *very* challenging indeed to translate the vision in a consistent manner into different contexts, sectors and cultures - notwithstanding the general international acceptance of the overarching vision sustainability promotes. This is because the operationalization of this concept is “work still in progress” with much new knowledge being acquired from on-going research and development investigations seeking to better understand and measure the various dimensions of sustainability. This steep knowledge building exercise will it is anticipated continue for some time to come given that the concept’s application is still very much in its infancy.

The findings of the survey conducted in support of this Study confirm, among other things, that there is *widespread* agreement globally among key decision makers and professionals engaged in major infrastructure project development that the environmental and social dimensions of sustainable development all too often receive inadequate attention and *cannot* always be soundly monetized despite their perceived importance by certain stakeholders. This is in spite of the fact that on occasions they can represent the overriding concerns for certain projects from a policy or political perspective. Reflecting the above challenges, the findings of the same survey clearly demonstrates that what the concept of sustainability implies for projects *can* often vary according to stakeholder perceptions with the result that such parties are often at variance with each other across multiple stakeholder groups of the same project and this often leads to different priorities being promoted. The relative importance of these priorities are *ultimately* decided politically with the real power being vested in the party that has the ability to define the kind of sustainability to be serviced and pursued for the project in question.

In principle, formal processes such as Environmental Impact Analysis (EIA) require environmental and social factors to be brought into the assessment of a project. In practice an EIA is usually presented as part of the appraisal documentation but its findings are not necessarily incorporated into the overall decision process. Thus the tendency is for such processes to remain as separate technical exercises rather than bringing environmental and social factors into the heart of the appraisal.

7.2 The case for MCA

Taking into account the above and all preceding concerns, it follows that a project appraisal assessment method that is to adequately incorporate the social, environmental, economic and institutional dimensions of sustainability is required to allow for decisions based on the assessment of *both* monetized and non-monetized values, quantitative as well as qualitative dimensions, and recognise the serious limits (and costs) to establishing sound monetary values for those aspects that can be quantified. An approach of this kind should be structured in a manner that it is also able to capture the different priorities of multiple stakeholder groups, ideally over different horizon dates (see Munda, 2004). This is important since the evidence gathered by the Study, both in the literature reviews undertaken and the Survey conducted, confirm that CBA *on its own* cannot provide an adequate basis for the holistic assessment of major infrastructure project contributions to the sustainability vision (see Vickerman, 2009).

These shortcomings imply that some form of Multi Criteria Analysis (MCA) framework is more suited to the appraisal of major infrastructure projects, because it can provide a focus for identifying all relevant appraisal factors (both qualitative and quantitative). In parallel it can accommodate more traditional project appraisal techniques (such as CBA), indicating more clearly where in the appraisal process the latter are most relevant but also where they have a tendency to misrepresent outcomes (see Shefer and Shiftan, 2009). Using an MCA framework fits very well with the sustainable business case approach to project development outlined in Section 6.

As outlined in Section 2, MCA involve structures which allow both quantified and non-quantified indicators to be set out together in a tabulated form, with the aim that decision makers can then gain a more complete picture of the implications of a project across all possible fields of importance and impact. MCA has been applied to projects in different sectors as a basis for making decisions on their implementation. Stirling (2006) has argued that MCA can also assist public consultation processes while the OMEGA Centre sees it as a potentially invaluable tool in project monitoring and evaluation, particularly in the tracking of changes in policies that impact of major project developments post construction, thereby enhancing transparency in public decision making. A standard characteristic of MCA is its employment of the performance or consequence table. Here, each row of the table or matrix presents one option and each column describes the performance of the options against each parameter, with the decision criteria presented either in numerical form or expressed as bullet point scores or colour codes (DCLG, 2009).

Means by which the number of MCA steps can be reduced or refined is thus important. Here the role (and choice) of policy directives (and associated visions and plans) can be particularly important as a filtering process to assist project appraisers and policy makers which project criteria matter more (and when and why). This aspect will be returned to later in the discussion when providing a worked MCA example.

Despite the inevitable reliance upon ‘informed judgment’ in choosing amongst options, MCA remains a fundamentally sound approach to project appraisal of major projects seeking to contribute to sustainability goals, because it can accommodate political considerations and stakeholder differences in a transparent manner; whereas CBA on its own cannot. There are also numerous computer software applications developed to assist the approach which has the potential to deliver much more holistic decisions and more participatory outcomes than those typically associated with CBA.

7.3 Some applications of MCA

As already inferred, one of the most well know appraisal methodologies that adopts a form of MCA framework is the NATA Highway investment appraisal framework employed by DfT (see Section 4.7) which uses MCA techniques to take into account a project’s impacts in terms of *both* monetary values and non-monetary assessments. The former include travel time savings, the latter social and environmental impacts (such as noise impacts and blight) which may be quantified but *not* valued or assessed only in qualitative terms. An examination of this framework by the Study Team revealed that in reality the NATA system, while incorporating a multi criteria framework, ultimately employs a prioritization of appraisal criteria that reflect traditional appraisal criteria employed by transport specialists, such as monetized travel time savings. The approach, in other words, addresses social and environmental concerns as *secondary* to those criteria that matter most to the Department for Transport which has as its mandate the optimization of the operational efficiency and the capacity of its infrastructure investments. The social and environmental dimensions of sustainability in other words become subservient to economic growth concerns with the result that in essence we have a ‘business as usual’ model operating or some form of ‘green-wash’ which fits all too comfortably with the rhetoric of sustainable development rather than its practice.

The above outcome can *only* be avoided when MCA appraisal is policy led by broader priorities that are integrated within the overall government development and decision making process by virtue of the adoption of international policy guidance and targets regarding for example the Millennium Development Goals (MDGs) or Climate Change challenges, and imposed/overseen by a powerful centralized agency that has overarching responsibility for achieving sustainable development outcomes across all sectors and agencies and private sector interests. This requires regulative and enablement measures from an overarching body that has the power and resources to impose and pursue these ends. To date the all powerful centralized agency in the UK has been the Treasury which *ultimately* is driven by its own priorities expressed in monetized measures and assessments and thus *unable* to take on the holistic approach advocated by sustainable development whatever the rhetoric.

Until such time a centralized government agency or ministry with overarching powers is set up to promote and implement the holistic vision of sustainability the realities are that all departmental or sectoral project appraisals will *ultimately* be driven by their own concerns taking on board ‘other’ concerns of sustainable development only where and when they do *not* impinge on their own aims. Alternatively, they will only incorporate sustainability where the cost of this is subsidized by another party. Given the realities of this situation, project managers and planners will understandably look to the priorities and biases of their clients whatever the appraisal methodologies available.

Despite the difficulties indicated by this *realpolitik* analysis, MCA can also play a major role as an early framework for attaining an enhanced mutual understanding of multiple project objectives and outcomes from the perspective of different agencies and stakeholders, as well as monitoring and evaluating the outcomes of projects once built and tracking changes in policies that impact on the performance of projects. Both exercises – one in the early stages of project development, the other following project construction - contribute to enhanced transparency and holistic decision making and a better appreciation of achievements (as well lessons derived from failures).

Projects developed in this way have the potential to contribute to a broader set of development goals that go well beyond economic development and financial rates of return (though these do remain of critical significance) and move more deeply into environmental and social concerns that represent more sincere efforts at achieving sustainable development. What this argument highlights, however, is that *unless* institutional reforms are introduced to assign the appropriate powers and resources to an overarching agency responsible for the delivery of sustainable development and until such time it itself is sustainable and is capable of assisting the translation of the vision into different sectors, the trade-offs involved in project appraisal decision making will be *always* excessively influenced – perhaps biased - by specialist or sectoral interest perspectives that do *not* have sustainability as a priority.

The above discussion highlights then the need to differentiate among MCA methodologies between those which are essentially policy led and those which are not. This is important for while advocates of CBA largely made no real claims at comprehensively addressing sustainability challenges, there is a misplaced premise among many that MCA approaches automatically yield more holistic appraisal outcomes. This may be true in relative terms (if compared with CBA) but in absolute terms, as we have seen in the case of NATA, their priorities can be driven individual sectoral interests that conflict with sustainable development goals. There is then merit in differentiating among those MCA methodologies which are:

- **non policy led** but instead led by the values imbued with the CBA methodology and cherished by the specialist agency undertaking the exercise. Here, ultimately, CBA remains ‘king’ of appraisal notwithstanding their use of the MCA framework; and
- **policy led** which fall into two categories, those which pursue sustainability as a overarching development vision and those which do not. Here CBA and other

more specialized appraisal techniques still play an important vital role but are deemed subservient to wider policy guidance/appraisal.

7.4 Steps of the MCA process

The literature review conducted for this Study suggests the consideration of three distinct phases in MCA development; namely:

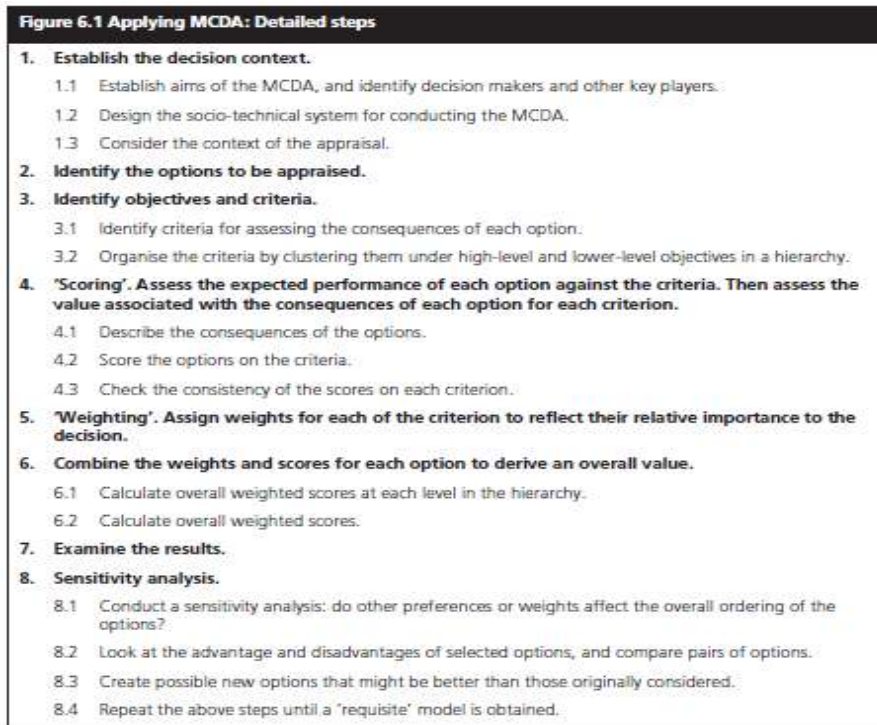
- problem structuring,
- model building, and
- the use of the model for informing and challenging thinking.

These steps are generically outlined below as follows (after Belton and Steward, 2002):

- **The problem structuring phase.** This is used to define the terms under which a decision making problem is considered and stakeholders are to be included into the decision making process. It also involves the collection of information regarding the options and related criteria for decision making to be considered. A combination of deliberative techniques can be used for the active involvement of relevant actors.
- **The model building phase.** This is a phase that is dedicated to the tasks of defining the criteria and deciding on their relative importance or the values attributed to each of the criteria by different stakeholders.
- **The application of the model.** This entails using targets or weights to determine the value of each criterion within the framework or model and scores. It seeks to determine the performance of each alternative with regards to each criterion. It may lead directly to a decision or result in feedbacks to the previous phases that revise the definition of the problem, the choice of criteria, etc.

Reflecting the above phases, Figure 9 below illustrates the generic MCA process advocated by the Department for Communities and Local Government (DCLG, 2009) in its manual for the MCA process which is presented as a series of eight steps.

Figure 9: A Generic MCA Process



[Source: Multi-Criteria Analysis Manual (DCLG, 2009).]

While the NATA methodology promoted by DfT as a basis for transport project appraisal in England and Wales employs some principles of MCA, it omits (rather significantly) Steps 5 and 6 of the DCLG methodology. The NATA structure itself, as already explained, also does *not* adequately address environmental and social dimensions of sustainability since its key decision making tool with regards to these aspects is the Appraisal Summary Table (AST). This displays the degree to which the five Central Government challenges for transport, as set out in *Delivering a Sustainable Transport System (DaSTS)* (DfT, 2008) would be achieved. These challenges are to:

- tackle climate change,
- support economic growth,
- promote equality of opportunity, and
- improve quality of life and promote a healthy, natural environment as well as achieve better safety, security and health.

The information provided in the AST and its more detailed supporting documents are designed to enable a consistent view to be taken about the value of the strategies and plans developed for the different study areas. However, no weighting information is provided in NATA guidance. In consequence, decision-makers must apply their own judgement when weighing the impacts to reach an assessment of the overall

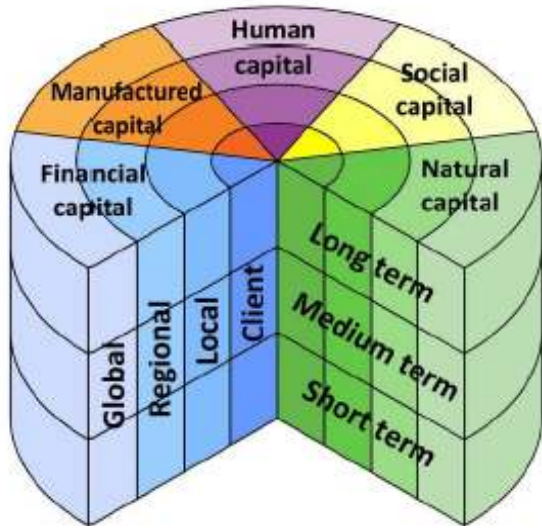
value of a proposal. On this basis, we contend that the AST does *not* automatically provide a method for estimating value for money. It does, however, offer a summary of the effects in each area so that decision-takers have a clearer and more transparent basis on which to make judgements. Quite separately from this issue, NATA's key role in implementing transport policy has attracted some criticism over the adequacy of the *DaSTS* objectives, which are considered too narrow for a truly sustainable transport strategy). We concur with this position and conclude that this inadequacy may be attributed more generally to the fact that *DaSTS* does not incorporate the social and environmental dimensions of sustainability required for a comprehensive Sustainable Development Vision to be pursued and attained.

7.5 HalSTAR sustainability multi-criteria framework and adaptations to it

To provide a more suitable framework for the incorporation of social, environmental, as well as institutional dimensions of sustainability, to compliment concerns about sustainable economic development in the appraisal of major infrastructure projects, the preceding survey findings, analyses and related discussions points to the necessity to look for a more widely based and established model than those hitherto considered. A strong candidate for this we contend is the HalSTAR Systems Model developed by Halcrow (Pearce 2008)¹². Figure 10 shows an overview of the HalSTAR Systems Model. Its core structure is its balanced division of sustainability criteria into five key fields or 'capitals' related to a nested system of stakeholders (socio-geographic representation) over the project lifecycle (short, medium and long term). An adaptation of this model by the OMEGA Centre team is provided in Figure 11. The revisions were undertaken to better reflect the conceptual framework the OMEGA Centre has employed in its on-going research in decision making in the planning, appraisal and delivery of mega urban transport projects (MUTPs) (see Figure 12).

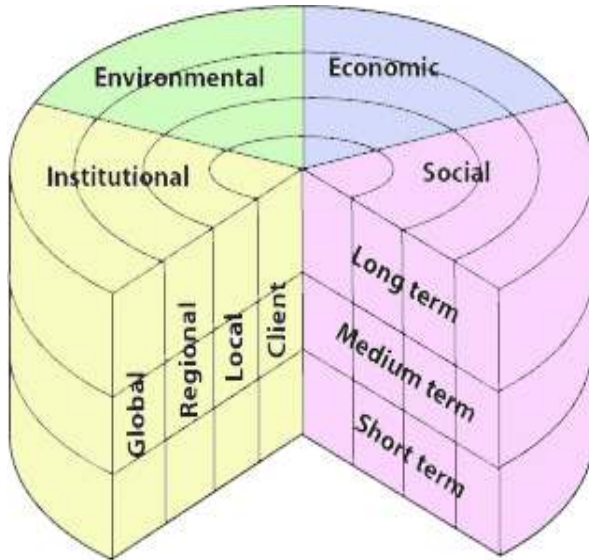
¹² This model is still under development with the result that its presentation here is solely for purposes of presentation to the RAMP Steering Group and subject to the approval of Halcrow regarding the system's copyrights and associated use in any subsequent publications emanating from this report.

Figure 10: The original HalSTAR Systems model of sustainability



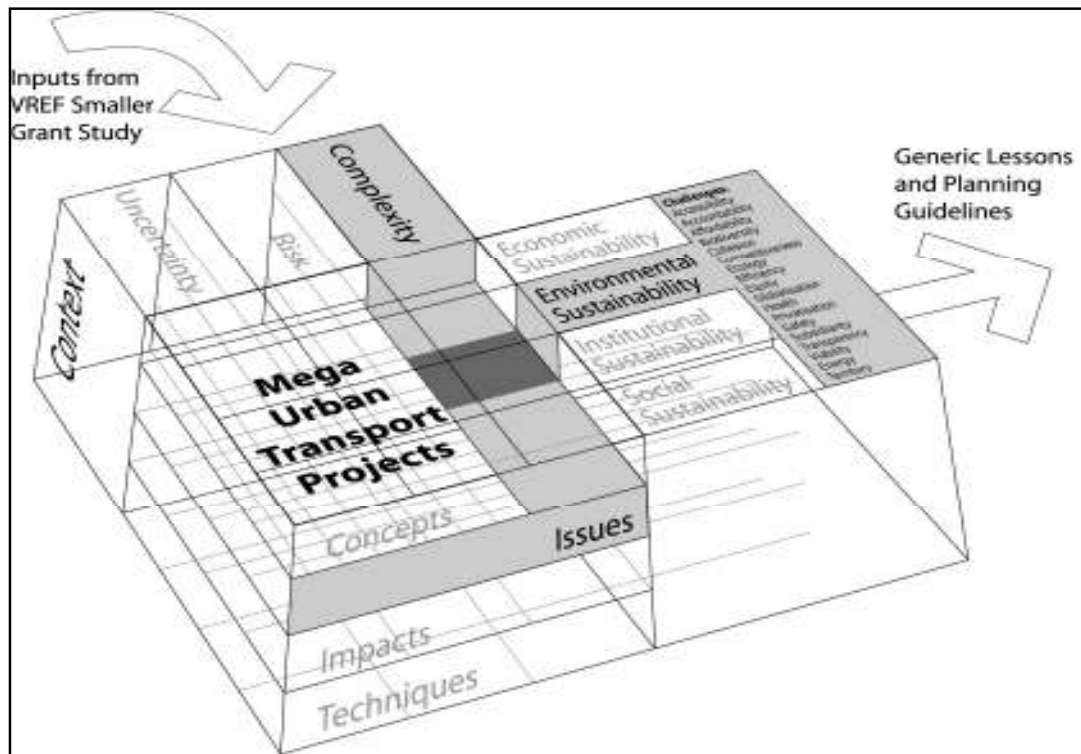
[Source: Pearce, 2008]

Figure 11: OMEGA Centre's adaptation of the HalSTAR systems model of sustainability



[Source: OMEGA Centre, UCL, 2010 – adapted from Pearce, 2008]

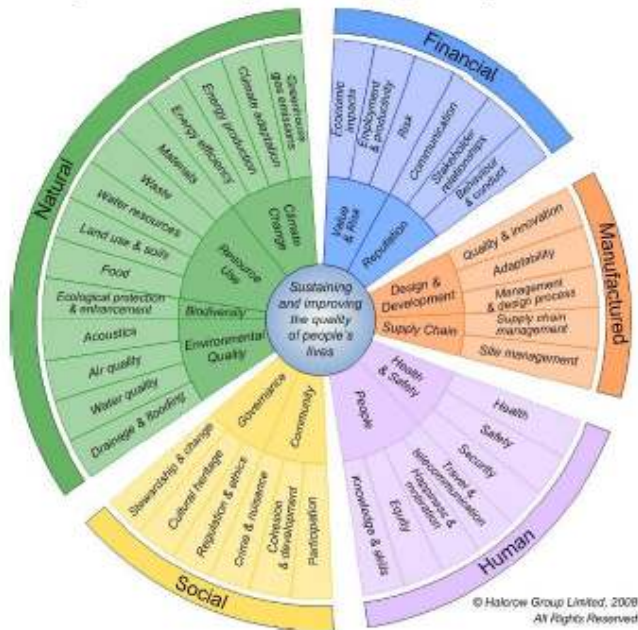
Figure 12: OMEGA Centre's analytical framework for the study of decision making in the planning, appraisal and delivery of MUTPs



[Source: www.omegacentre.bartlett.ucl.ac.uk]

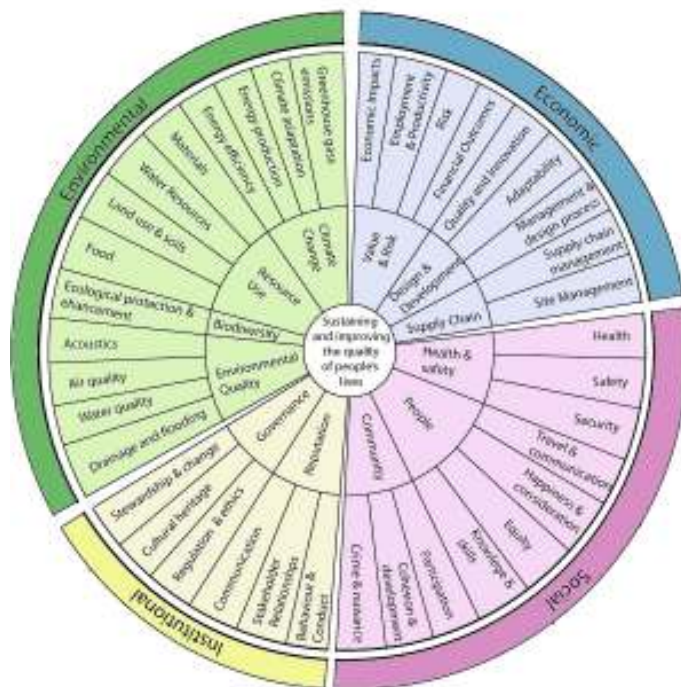
Central to the HalSTAR model analysis is its sustainability wheel (see [Figure 13](#)). This provides a generic framework of sustainability criteria derived from the definitions implicit in over 400 reviewed existing approaches to sustainability. These include assessment methods, indicator sets, legislation, planning policies, corporate responsibility reports, and the requirements of key stakeholder groups. The HalSTAR approach affords a clear picture of the multiple criteria mostly associated with assessing progress toward achieving sustainability which in turn enables conflicts and trade-offs to be drawn out much more easily thus facilitating transparency. The HalSTAR sustainability wheel has also been modified (in [Figure 14](#)) to highlight the four (rather than three dimensions) of sustainability that the OMEGA Centre has employed in its research programme and to bring out the importance of the treatment of risk, uncertainty, complexity and the importance of context. It also alludes to the impact on project appraisal of values imbedded in perceptions about particular sector concepts, issues and techniques.

Figure 13: The original HalSTAR sustainability wheel



[Source: Pearce, 2008]

Figure 14: OMEGA Centre's adaptation of the HalSTAR sustainability wheel



[Source: OMEGA Centre, UCL, 2010 - adapted from Pearce, 2008]

7.6 Financial appraisal of projects and MCA

Notwithstanding the value of MCA, it should be stressed that the financial appraisal of projects costs and benefits remains *crucial* as part of the overall approach to major infrastructure project appraisal. Commercial sector investors provide a significant part of funding for many projects and sometime the sole funding. Even where public bodies contribute very significantly to a project, commercial funding may be a major part determinant of whether it proceeds.

In consequence financial appraisal methodologies (such as Financial CBA) have to be used. However, it is in the interests even of commercial investors that the project contributes to sustainable development and thus provides a return over the project life. This means that the method of financial appraisal must be conducted within the overall MCA process.

The usual approach of financial appraisal is through a Financial Cost Benefit Analysis. This assesses the projected flows of cash for the project: capital spending, operational costs and revenues. It includes only directly attributable expenditures and incomes. From these it calculates the overall rate of return as a single figure, usually Net Present Value (NPV). The results of the Financial CBA then become a key component in the overall MCA appraisal.

In some fields of public finance, Cost Effectiveness Analysis (CEA) is used to compare the relative costs of two or more projects against expected outcomes. CEA is particularly used for assessment of projects and programmes in health services, where it may be inappropriate to monetize health effect. Typically, the results are expressed in terms of a cost per unit of outcome: the denominator is a gain in health from a measure (e.g. years of life gained) and the numerator is the cost associated with the health gain. CEA uses *only* assessment of actual funds needed but avoids mixing this with assigned values in the way that CBA does. CEA does *not* normally include income streams for activities: but these could be included as a reduction in costs to give net cost.

One final important point that needs to be raised at this juncture is the fact that for sustainability to be fully translated into the project from the policy level, the business case of the project presented for investment needs itself to be conceived as a 'sustainable business case' as opposed to one that yields short term gains to the initial investors with the long run costs left to other project partners in later generations. Failure to do this presents a very uncomfortable fit of the project's aims and intentions with the MCA criteria of sustainability it is supposed to comply with. At best this mis-fit can lead to some effort at shoe-horning the project into the sustainability framework with many compromises being made in the interim. At worst, it can lead to pretence that the project's aims are consistent with the principles of sustainability and lead to a 'business as usual' practice shrouded in much rhetoric. In the case of infrastructure investment, this latter outcome potentially raises very important issues with, for example, some private equity partners which invest in

infrastructure with a view to selling their investments in the short run to maximise returns as opposed to making a long term investment. The scope and issues for a sustainable business case are explored further in Section 8.

7.7 Summary of findings

Because it offers potentially a very wide coverage, the use of MCA in project appraisal raises aspects with both positive and negative connotations. This is, however, a characteristic of the MCA structure overall as a toolbox where careful choice and data handling is required in to obtain sound results. The approach has both then advantages and disadvantages. These are summarized as follows:

- **Context matters in MCA appraisal.** It is important to establish clearly the context for a project in relation to sustainable development and where the appraisal boundaries should lie. This should take into account formal regulatory and institutional structures for environmental and social factors of sustainable development, and current issues and concerns over them. It should then draw out which appear to be most important for a project from a number of important policy priority perspectives.
- **MCA is useful for classification, determining priorities or selecting between alternatives.** There is a degree of judgement that always has to be employed in MCA based appraisal. This has been cited as a matter of concern, but MCA can bring structure, analysis and openness to the appraisal decision making process. The application of CBA, when critically investigated, also entails judgements of concern. They are, however, more disguised by virtue of the monetary emphasis on costs and benefits, making them appear more objective.
- **The use of MCA tools is particularly valuable for the direct participation of stakeholders.** This is so as it allows different perceptions of the relative importance of the criteria by different groups to be clearly identified. This can highlight how results can change if different stakeholders' interests and perceptions are taken into account. MCA techniques thus provide a platform for reaching consensus. For example, MCA enables a balance to be had between the long term priorities of board members, and shorter term goals of analysts working on the same project.
- **MCA can be sensitive to the choice and involvement of stakeholders.** Their selection and management during the MCA process must be considered carefully.
- **MCA techniques give the decision-makers the opportunity to learn about their own preferences (and those of others)** when appraising the preferences of the involved stakeholders in developing a multi-faceted project. MCA can thus prove invaluable in helping to assess sustainability as a broad multi-faceted vision and also for carrying out the decision process in a 'sustainably sound' way.
- **The MCA approach can be used with considerable flexibility.** It allows engagement of all interested parties and dialogue between them. It should encourage thinking (rather than provide a simplistic guide to the 'right' answer). It can focus trade-offs, between groups and between priorities. However the adoption of a robust approach to stakeholder identification and management at

this phase is crucial. The work of Stirling (2006) provides a framework for mapping and comparison of criteria from multiple stakeholder groups.

- **MCA techniques require the disciplined use of analysis** and measurement as far as these may usefully be employed.
- **The MCA methodology is vulnerable to prejudicial ranking of options and irrational tradeoffs.** The weightings given to objectives by decision makers *can* lead to their being dominated by a particular stakeholder or specialist interest to focus on measurements and monetization concerns above all else, especially where projects are commercially driven. (In the context of CBA, this accusation has been presented in terms of ‘optimism bias’ in project forecasts and cost estimates.)
- **The weightings for MCA objectives should be informed by environmental and social policy at the national level where possible.** However, weightings regarding these concerns can change over time and are somewhat also related to context (and changing contexts). The effects of alternative weightings can be assessed through non-trivial sensitivity testing it is suggested.
- **Where quantification is used, the figures employed should be sound rather than precise.** Spurious accuracy can bring too close a focus on the figures (“what gets measured gets done”).
- **Early application of MCA is important.** Because MCA is a decision making tool which aids the decision making process by helping to improve the *understanding* of the problems and opportunities, it should be applied very early on in the project appraisal procedure (whether in the context of RAMP or not). It should take place, in other words, before any significant sums of money have been spent on the project and key decisions already made.
- **Application of MCA in monitoring.** Due to the flexible nature of MCA procedures they can be used to monitor project implementation and thus contribute to project evaluation, providing a tool to help manage the project transition from an open to closed system, and back again.

Discussions with project stakeholders can create a pool of social and environmental objectives for the MCA procedure and in so doing identify risks which can be communicated to the quantitative risk analysis stage of project appraisal (whether within the RAMP procedures or not). Failure to define the project objectives fully at an early stage *may* result in failure to identify the risks properly. As already indicated, MCA has a potentially very useful role to play when employed with a diverse range of stakeholders in brainstorming to identify objectives from a number of perspectives. These can include objectives to achieve certain environmental and social goals as part of the project development.

While some environmental and social factors can be readily assessed in quantifiable terms, a good proportion of these factors are non-quantifiable as the survey results of this Study confirm. This poses problems for putting quantifiable and especially monetary values onto some identified risks. Using the MCA approach, however, should allow a much clearer understanding to be obtained of what these risks are and what their potential effect might be. This offers scope for expressing these risks

(where feasible) in more quantifiable terms with a clear 'audit trail' of how such values have been derived/altered and why.

8.0 Assessing and managing risks in the RAMP process through an MCA framework

8.1 When to start the MCA in relation to the RAMP procedure

The section below details the application of the MCA framework through the project life cycle and especially how it enables the identification, analysis and management of risks within the RAMP process. It focuses on addressing aspects of social, environmental, economic and institutional sustainability to aid decision makers; especially for major infrastructure projects. The worked example provided in [Appendix 5](#) highlights how this MCA methodology interfaces with the RAMP process.

As already attested, MCA forms a decision making framework which not only helps arrive at decision outcomes across multiple concerns but also aids the decision making process to better comply with policy led directives (where employed) by helping decision makers to understand better the problems needing to be addressed against criteria presented by these policy directives. The methodology provides opportunities to explore the possible alternatives available to decision-makers in the early stages of project appraisal. To do this, the MCA framework should ideally be employed very early on in the project life cycle (during Activity A of the RAMP Procedure: the Process Launch Stage). Here it can make the largest overall impact on the project by facilitating a shared understanding among different project stakeholders of the project's boundaries, context(s), underlying visions and objectives, plus the criteria that might be used to score project options or scenarios.

The MCA framework also provides for robust risk monitoring, decision making and evaluation processes for application during subsequent stages of the project life cycle. It presents key inputs to RAMP Activity B (the Risk Review Stage) and RAMP Activity C (Risk Management) at various stages of the project life cycle, including risk monitoring during the post construction phases.

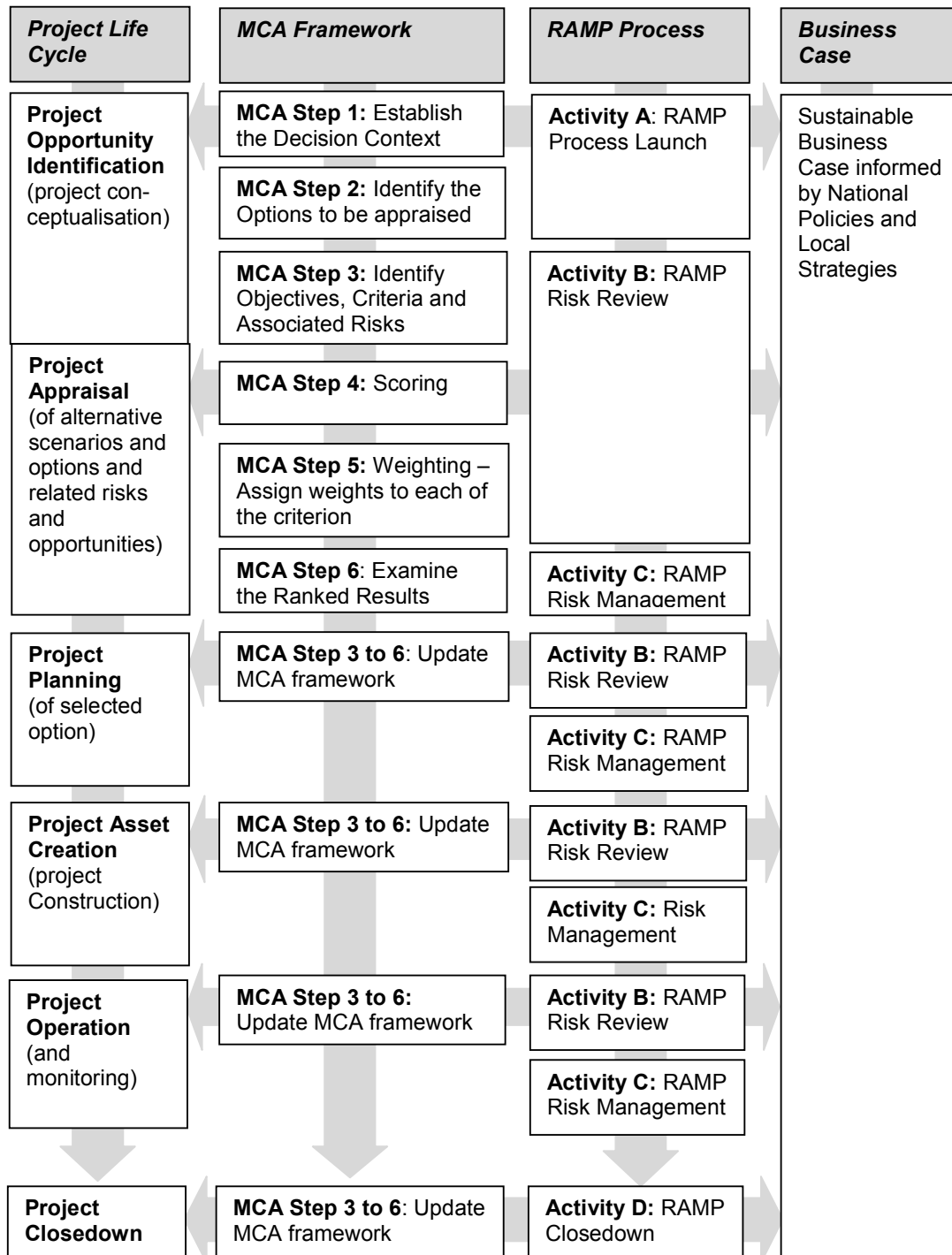
8.2 Prerequisites of MCA for the RAMP Process

There are two key prerequisites required before MCA can be developed as part of the RAMP process. These are as follows:

- **The development of a sustainable business case.** Incorporating social, environmental and institutional aspects of sustainable development into the RAMP process to compliment the treatment of sustainable economic development considerations requires project promoters to present their sustainable business case along the lines outlined below in Section 8 (below). This is seen as *imperative* to avoid the problems highlighted earlier in the document in the latter part of Section 6.6 of this document.
- **Conduct of a policy study.** The transparent selection of the principal policy guidance for the project appraisal is of utmost importance to avoid the pitfalls for MCA appraisal frameworks of a lack of policy focus or adoption of implicit values from specialist interest groups inconsistent with the concept of sustainability. This exercise is best commenced with the undertaking of a comprehensive study of

existing policies and regulations that the infrastructure project is to comply with or contribute to. This is particularly important for social, environmental and institutional aspects of sustainability which, as considered earlier, are among the most difficult aspects to appraise; in the past these have all too often been implicitly treated by many as of secondary importance to economic and financial concerns. As evidence from the project literature review and interview surveys (Sections 3 and 5) demonstrated, achieving sustainable economic and business outcomes does *not* contradict with simultaneously contributions to meeting social, environmental and institutionally sustainable goals.

Figure 15: Interaction of MCA framework and RAMP process within the project lifecycle



8.3 MCA Step 1: Establishing the decision context

Establishing an understanding of the context and boundaries of the project is one of the most critical early stages in the project development process for all stakeholders involved. Project decisions made without a full understanding of project definition and of project contexts (political, legislative, spatial, temporal, cultural, etc.) can be costly or in some cases disastrous. For example:

- A project for a new refinery which goes ahead without a full appreciation of the recent updates to emissions legislation may require costly alterations before it can start operations.
- An international consultancy that undertakes a project in another country without taking consideration of local climate and how it may impact on project delivery can result in large delays due to accelerated equipment failure.
- A project that goes ahead without addressing the concerns of a powerful lobby group who subsequently file for an injunction to stop the project can incur serious delays and expense.

The task of establishing the project context and project boundaries can be broken down into three sub-steps. It should be noted that this process will also contribute strongly to RAMP Activity A (The Process Launch), where the preliminary brief of the objectives, scope and timing of the investment are considered along with the formation of the RAMP baseline which forms the context and basis for the risk analysis.

Sub-step 1.1: Establish aims of MCA and identify key project stakeholders for the Steering Group

Major project development requires clarity about the key stakeholders and their motivations. It is imperative to establish a shared understanding of the aims of the decision making process for both the MCA and RAMP processes as soon as possible in the project life cycle (or if not a shared understanding, at least an appreciation of the varied concerns different stakeholders may have). Typical stakeholder objectives for an infrastructure project of national significance might include:

- Project Promoter (e.g. property developer): key infrastructure improvement to sustain business expansion.
- Project Client (e.g. central government): social and economic impacts of project via regeneration.
- Project Financier (e.g. mix of central government and private banks): financial viability and rate of return on investment
- Local Stakeholders (e.g. residents and local businesses): possibility of employment in realisation and operation phases, and potential negative impacts on local environment during construction.

The overall process of project appraisal will be managed by a stakeholder Steering Group, drawn from the key stakeholders. Choosing a balanced group of stakeholders to participate in the project appraisal process is critical to the effective

identification of project risks and opportunities, and to avoid bias during the development of project objectives. This is especially important during the selection and weighting of the project appraisal criteria.

There is a variety of techniques that can be used to identify which stakeholders should be invited to join the project Steering Group. These include, for example, the use of a Power Influence Matrix as shown in [Appendix 5](#). During the selection of project stakeholders there remains the need for wise and ethical judgments if public value is to be created and maintained and the common good advanced.

During the stakeholder identification and selection process, it is important to consider if the following are represented or expressed effectively by the Steering Group:

- The objectives to ideally include a desire to holistically incorporate social, environmental, economic and institutional aspects of sustainability within the decision making process.
- The details that determine the key administrative, legislative, governance and regulative contexts of the area(s) that the project traverses.
- The spatial, territorial, geographical, and topographical features of the context of the areas that the project serves.
- The project historical context, timeline and pivotal decisions.
- The stakeholders who will be ultimately affected by the decision.

Sub-step 1.2: The design of the social technical system

Once the choice of who should be involved in the MCA process is underway, the MCA stakeholder Steering Group must decide how, when and where the project stakeholders should be involved in the process. These are all key strategic choices for the MCA framework. For the application of MCA to RAMP, it is assumed that the entire MCA methodology will be driven by the project Steering Group. It will be required to make appraisal decisions against a common acknowledged set of policy led directives and informed priorities; policy here can be international, national, or institution-specific; or a defined combination. (Various guidelines exist for the management of stakeholder groups during a collaborative decision making process.) The MCA Steering Group will meet at key stages in the project lifecycle as indicated in the RAMP handbook.

Sub-step 1.3: Consideration of the context of the appraisal

Example 1: Defining the temporal and spatial boundaries of the project for appraisal, monitoring and evaluation is critically important. For example, a new metro line may have direct local transport corridor impacts in the short term. However, over time a metro system influences a city's geographical and its ecological footprint in ways which can catalyse more sustainable development initiatives. If the boundaries of the MCA are set too tight in terms of their spatial and temporal impacts, then these wider and longer term impacts can be lost.

Once the decision context has been fully described and appraised, and the risks and opportunities they pose are highlighted, this information can be passed on to RAMP Activity A.

8.4 MCA Step 2: Identify options to be appraised (and preliminary project appraisal if required)

Having established the decision-making context for project development and appraisal, the next step of the MCA process is to establish the set of options or scenarios to be appraised. If there are many options (which is normally the case), an important role of the MCA is to perform a structured sifting of these options to identify a short list, using simple data and quick procedures, such as a cut-down version of Steps 3 to 6 of the formal MCA process outlined here. It may be that during this formal sifting process, none of the options are acceptable, in which case the MCA Steering Group may be able to identify the strongest points from each option to create a new set of hybrid options, or completely new options may be sought.

8.5 MCA Step 3: Identify visions, objectives and criteria of project

The project objectives spawn the appraisal criteria (measures of performance) by which the project options are to be judged during appraisal, and by which the selected project may ultimately be assessed. Project appraisal criteria may be specific measurable indicators of objectives, partially measurable indicators or criteria of informed qualitative judgement. (“A large proportion of the value added by a formal MCA process derives from establishing a soundly based set of criteria against which to judge the options”, DCLG, 2009: p.32).

Project stakeholders should define and agree a series of project criteria for each decision objective or sub-objective. Project appraisal criteria must be operational to be usable throughout the project appraisal, monitoring and (post project completion) evaluation stages. Criteria for the financial appraisal of projects are more common and well developed than social and environmental factors required for a holistic sustainable development appraisal. A number of procedures can be used to arrive at workable holistic criteria which better incorporate aspects of social and environmental sustainability, alongside more traditional financial concerns. One suggested process could be:

- Project stakeholders undertake brainstorming sessions. These include consideration of national and international policy statements, such as the Millennium Development Goals, and secondary information sources. This leads to agreement on MCA criteria which reflect their (various) concerns.
- The identified criteria can then be displayed on the (adapted) HalSTAR wheel as earlier proposed. The adapted HalSTAR wheel is a useful MCA tool to check the degree of comprehensiveness of the sustainability criteria coverage indicated as important via the project Steering Group and related project policy documents. If serious omissions are discovered relative to the project objectives, earlier project appraisal criteria can be revised by the project's Steering Group.

The choice of which policy umbrella to direct the MCA appraisal is clearly 'context sensitive' to the project under consideration, although requirements to fulfil sustainability concerns clearly limit the scope of appraisal toward certain ends. When incorporating policy into an MCA, a hierarchical system of policy identification and selection is highly recommended. (See worked example, [Appendix 5.](#))

A critical factor affecting sustainable policy choice may simply be the extent to which applicable policies are known or available, or in some cases the applicability of such policies where they exist. For example, a project being planned in a developing country may not have access to clearly developed policy guidelines. In contrast a developed country may have a large number of sustainable policy guidelines, although their applicability to 'real project situations' or their consistency with current government thinking sometimes may be open to question..

Where no workable policy framework (or vision) exists to provide overall guidance to project appraisal, the MCA framework can be used to inform policy development. If reasons why some aspects of a policy or planning guidance are deemed 'unworkable' from the perspective of the project Steering Group, they are recorded within the MCA process and made transparent to policy makers.

Once project appraisal criteria have been derived, it is desirable to group them into a series of sets which relate to separate and distinguishable components of the overall project objectives. Grouping project appraisal criteria is then an important part of the MCA process. It helps to check the relevance of the criteria, eases the process of calculating criteria weights and facilitates the emergence of higher level views of various important issues, especially regarding trade-offs between key objectives - be they financial, economic, social, environmental, institutional or political.

Before finalising project appraisal criteria, the provisional set should be assessed against a range of qualities (see DCLG, 2009, for further details).

Once a set of project criteria has been developed, it can be passed onto the RAMP process to form the RAMP project baseline. A series of identical performance matrices are then created and applied to each option. Both quantitative and qualitative data can be collected and inserted into the relevant part of the table.

Table 1: Example of an appraisal performance matrix

Option 1						
Criteria		Impacts			Scoring	
Criteria	Sub- criteria	Qualitative Impacts	Quantitative Impacts	Risks	Impact Assessment	RISK Assessment
Criteria 1	Criteria 1.1	Qualitative Description	Quant Description	Risk Description	Score	Score
	Criteria 1.2	Qualitative Description	Quant Description	Risk Description	Score	Score
Criteria 2	Criteria 2.1	Qualitative Description	Quant Description	Risk Description	Score	Score
	Criteria 2.2	Qualitative Description	Quant Description	Risk Description	Score	Score

8.6 MCA Step 4: Scoring - describe the expected performance of each option against the project criteria and then score accordingly

The first stage here is to describe the consequence of the project options against each criterion. For example, to express each project option in terms of how it impacts on noise pollution during the asset creation stage. For this application of the MCA process, the description of 'project performance' can be recorded via the kind of performance matrix shown above. Here, both qualitative and quantitative impacts can be recorded under the relevant headings for each of the criteria and sub criteria. This could, for example, include a verbal 'no worse than' description of the noise level and a quantification of the number or properties it will impact.

Project performance matrices often collect project risk information related to different stages of the project life cycle mixed within the qualitative and quantitative impacts information within the same column. This can cause confusion and inconsistencies in the appraisal process. In order to avoid this, it is recommended that project risk information relating to impacts should be dealt with explicitly in a separate column of the performance matrix (with a sub-division to record the risk as it relates to the stages of the project life cycle). The risk column of the performance matrix should allow the impacts to be expressed as both quantifiable and non-quantifiable risks. The impact columns of the matrix should hold two types of risk information:

- Identification of key quantitative information, regarding social, environmental, institutional or economic risks of sustainable development as they relate to each project objective, at each stage of the project life cycle and as they relate to each key stakeholder group. These can be fed into the RAMP process and used to update the RAMP investment model.
- Identification of key qualitative information, regarding social, environmental, institutional or economic risks as they relate to each project objective at each stage of the project life cycle and each stakeholder group.

The matrix is thus effectively acting as a Risk Register as found in RAMP which allows both quantifiable and non-quantifiable risks to be made transparent to the decision makers for each project objective over each stage of the project life cycle. These risks could subsequently require varying mitigation strategies over the period. (See [Appendix 5](#) for examples.)

Example 2: The cost of damage done by destroying a Roman castle site to make way for a new road could be expressed in narrow financial terms as the demolition costs, costs incurred in gaining the relevant formal permission and statutory instruments to carry out the work, plus insurance to cover the risk of legal costs mounted by potential objectors to the action and similar problems. This monetary quantification could be passed onto the project investment model to inform financial and other relevant project stakeholders and be deemed 'acceptable' because of the financial gains it might produce. However, the cost of such an action to the heritage of the area - and country - is deemed to be immense by those who value heritage (normally governments, certain community groups and selected international agencies concerned with heritage). This is despite the fact that one cannot apply a monetary value that reflects the loss of this heritage. At best one may be able to assess the income lost to the

local area from tourism related to the site over the future life of the historic site. But this does not reflect the cultural heritage loss or the long term detrimental effect on the local wellbeing of the local community from the loss of an enjoyable place to visit for relaxation or study.

Note that the amount of detail held by the impacts columns is related to the amount of resources available to collect the information. It is suggested the effort expended to gather data should be roughly proportional to the weights given to individual criteria in Step 5 below. As the project proceeds through the lifecycle certain project criteria may be identified as particularly important and further data can be gathered if the Steering Group deem this necessary.

Once impacts and related risks have been registered, the second stage of MCA step 4 is to score the performance of an option against each of the criteria taking account of risks. As the performance matrix will often contain a variety of performance indicators for different criteria (including both quantifiable and non-quantifiable) these different units of measurement cannot be combined directly to achieve an overall evaluation. Therefore, scales are constructed to represent preferences for the projects performance against each criterion.

Scoring must consider firstly the project's ability to achieve the desired appraisal criteria, by using a scale which shows if the project's contribution to a particular objective is positive, negative or something in between. A common five point scale expressing the performance of an option against a particular criterion could be expressed as follows: Positive, Slightly Positive, Neutral, Slightly Negative, Negative (see Table A4 of worked example, [Appendix 5](#)). The assignment of a score is a subjective process and should be undertaken by a group of decision makers under general agreement. Scores are inserted into the assessment column of the table.

Secondly, the scoring must take account of the risks associated with the performance of the project criteria as recorded in the matrix. It is suggested here that a confidence scale is used to score the risk as: acceptable; acceptable with minor mitigation; acceptable with major mitigation; or unacceptable. Definitions for this might be as follows:

- Acceptable: the risk of occurrence is seen as acceptable without any mitigation required.
- Minor mitigation required: definition of minor mitigation to be supplied by stakeholders.
- Major mitigation required: definition of minor mitigation to be supplied by stakeholders.
- Not acceptable: the occurrence of the risk is not acceptable under any circumstances.

The scoring of the risks indicates the stakeholders' assessment of each risk and the proposed level of mitigation required. Mitigation techniques are suggested in [Table 2](#) below. The overall score for performance against each project criterion is derived from the combination of the Impact Assessment and Risk Assessment scores. This raises some complications when more than one risk is identified as relevant for any

impact. In such cases, an average value is suggested of all risk assessment scores relevant for any one criterion. A table of scores can now be built to compare scores for each criterion as they relate to each option. This table will be referred to as the decision matrix.

Table 2: A decision matrix

Option	Criterion 1.1	Criterion 1.2	Criterion 2.1	Criterion 2.2
Option 1	Score	Score	Score	Score
Option 2	Score	Score	Score	Score
Option 3	Score	Score	Score	Score

8.7 Mitigation of social and environmental risks and subsequent management

One important contribution of the MCA framework is its capability of exposing risks early-on in the project lifecycle and its potential for allowing decision-makers to make early judgements concerning the acceptability of such risks. The project can then be shaped by an understanding of these potential risks (and opportunities), and avoiding those which could adversely affect the project before completion whilst fully exploiting relevant opportunities. During the above scoring process it may be decided to introduce a series of risk mitigations. (Common factors, risks and mitigations for a number of social and environmental factors are set out in [Appendix 6.](#))

Any mitigation steps identified during the MCA process can be passed to the RAMP process for inclusion in the RAMP financial model.

Example 3: A new railway may have large social impacts during the project operations phase due to severance caused by the line. The severance may cause a risk of economic disbenefits to local residents. This risk, when evaluated by the project's Steering Group, may be seen as 'acceptable' providing minor mitigation is undertaken. The relevant mitigation measures can be discussed by the Steering Group, recorded in the MCA and passed onto the RAMP process for inclusion in the investment model.

8.8 Step 5: Weighting

The preference scales (scores) for each project criterion derived by Step 4 of the MCA process above cannot be combined at this stage because a unit of preference for one criterion does not necessarily equal a unit of preference on another. A weighting system is therefore required to make the decision making process reasonable. Weighting systems are often numeric. For this application of the MCA it is suggested that a simple hierarchical scoring system is used from 1 to 100 to indicate the relative importance of each criteria.

The setting of weights brings to the fore the question of whose preferences may count most, and the fact that MCA weightings (as in the case of weightings employed in CBA) are vulnerable to stakeholder bias. While it is important that the preferences of the project promoter(s) and project client are respected, a biased weighting system can undo much of the previous effort which has been expended to arrive at equitable criteria, especially when considering social and environmental aspects. It is all too often the case that quantified data presented in a MCA framework or included in a MCA methodology can take precedent in weighted decision making, be it explicit or implicit. In a project with narrow financial objectives, this may be more justified, but with a project required to strongly service social and environmental objectives of sustainable development this would be unwise.

Weighting and the choice of weights is an area of contention within the MCA processes (as indeed it is in any appraisal process or methodology). It is suggested here that weights for individual project appraisal criteria are informed by policy wherever possible. However, although policies can imply priorities for key objectives, they can sometimes be vague regarding the priority amongst such objectives. Once weights have been agreed, these can be added to the decision matrix - [Table 3](#). The decision making process which resulted in the choice of weights should be recorded in full – recent work by Stirling and Mayer (2009) has developed a transparent system for deriving weightings from multiple stakeholders.

Table 3: Decision matrix with weights

Option	Criterion 1.1	Criterion 1.2	Criterion 2.1	Criterion 2.2
Weights	100	75	75	75
Option 1	Score	Score	Score	Score
Option 2	Score	Score	Score	Score

8.9 MCA Step 6: Examine the ranked results as a basis for decision maker

The outputs from application of the MCA methodology during project appraisal may range from a clear decision regarding a preferable project option – [Table 4](#) - which would then trigger Activity C of the RAMP process. It may alternatively suggest a need for more information to inform the performance matrix (and RAMP Activity B), or even the necessity to go back to the beginning of the process and consider new options (RAMP Activity A).

Table 4: Decision matrix showing option preference

Option	Criterion 1.1	Criterion 1.2	Criterion 2.1	Criterion 2.2	Option Preference
Weights	100	75	75	75	
Option 1	Score	Score	Score	Score	1st
Option 2	Score	Score	Score	Score	2nd

Other experiences of MCA application and guidance on its use for project appraisal suggest it: "... can yield surprising results that need to be digested before decisions are taken (and that) It may be necessary to establish a temporary decision system to deal with unexpected results and to consider the implications of new perspectives revealed by the MCA" (DCLG, 2009: p.67). This source suggests that a series of working meetings can eventually produce recommendations to the final decision making body – project Steering Group – where members are given the opportunity of examining the MCA results, testing them for their validity, assessing possible impacts for the implementation organisation, and ultimately preparing proposals for the way forward.

8.10. Risk management during the project life cycle

Application of the RAMP process during the appraisal stage generates not only the assessment of risks but also the indicators of what actions need to be undertaken to manage risks. This continues beyond the project appraisal, where the MCA framework provides a basis for the monitoring of risks through and beyond construction. It also allows identification of the potential impacts of significant changes in risk on the key project objectives (even in terms of its overall project viability).

There are key RAMP process stages following project completion when Risk Review and Risk Management mitigation efforts should be undertaken, to continue assessing environmental and social risks as part of the total RAMP process. These include:

- **Investment Planning and Appraisal:** Here one updates project performance against criteria and risks. For example, a government policy may change to move in line with one of the projects key objectives. This may increase the project funding options available and allow substantial financial risk to be offloaded whilst reducing the financial risk associated with some social factors which could not be adequately funded under the existing financial arrangement. Such a change would be flagged by constant context monitoring against the proceeding options objectives and criteria.
- **Asset Creation:** Here one, once again, updates project performance against criteria and risks. For example, new legislation regarding passenger safety may be brought in during the asset creation stage. Rapid detection and response to such legislation may significantly reduce the risk of project delays.
- **Operation:** Here yet again one updates project performance against criteria and risks. For example, a step change in a competing market may make the project's operation uneconomical. Rapid detection and review of pricing structure may reduce the risk reduced patronage.
- **Closedown:** Here the MCA can be used primarily as a framework and appraisal methodology for both monitoring and project evaluation upon which to base a project close-down decision. For example, changes in legislation may make closedown considerably more expensive than originally anticipated. Whereas a rapid detection of such measures and a rapid

response to such legislation may significantly reduce the risk of increased expenditure closedown.

9.0 Conclusions and recommendations

9.1 Conclusions of overall Study

The findings drawn from the Study offer a considerable number of insights that could prove of significant value to development of project appraisal as well as to revision of the RAMP handbook. These include:

- **Sustainable development has been increasing in importance over the last twenty years.** This interest reflects international concerns over global challenges, which has led to evolution of policies at national and international level designed to focus action on tackling these challenges. These include international policy indicators such as Agenda 21 and the Millennium Development Goals. These are widely accepted in principle but in practice have not achieved major change in the approach to project evolution and appraisal. There has also been growing opposition among regions and communities to major projects where key regional and local issues have not been taken into account.
- **In consequence there has been growing interest in establishing appraisal methodologies that properly address the widening range of environmental and social concerns.** This is also driven by the recognition that environmental and social factors are actually fundamental components of development on an integral basis with economic factors. It is rarely possible to address all three sets of factors equally with one project and thus decision making frequently requires compromises. But there remain doubts over how far projects address environmental and social dimensions of sustainability.
- **Institutional factors are also of crucial importance. These form the fourth dimension of sustainable development.** These institutions include the administrative and legal systems through which government develops and implements policy, the operational capacity and approach of public and private organizations at all levels throughout society. To ensure that development projects are truly sustainable, the various institutes must engage together in policy formation and in planning processes.
- **However, long term economic success for projects must also reflect long term issues of sustainability.** Some factors which appear to be externalities may actually have a significant impact over time. But this is not yet widely recognised. While few practitioners now share the conventional view that economic growth should be dominant in project appraisal, there remain differing views on what sustainability actually involves and how projects might be framed to achieve it.
- **Projects have continued to be primarily appraised against the traditional targets of economic growth.** The increasing concern over the sustainability of current development patterns has led to the formal practices of environmental and latterly social impact studies into projects. But this has not necessarily changed the basic approach of developing projects to bring returns on conventional economic terms.
- **Financial appraisal (Financial Cost Benefit Analysis) is essential for commercial investors.** Financial appraisal requires assessment of (forecast)

cash flows, expenditure and income, to create a single figure, usually Net Present Value (NPV). This dominates investment in some projects and is likely to be a determining factor in many. While financial appraisal does not environmental and social factors, it has to be integrated into the overall appraisal of projects.

- **(Social) Cost Benefit Analysis (CBA) forms the traditional approach to project appraisal.** It provides an interpretation in money terms of most factors and presents a single rate of return figure that is attractive for decisions in public funding. Substantial research continues on establishing sound monetary values for environmental and social factors. However, practical difficulties exist, even over some of the simpler physical environmental factors. For social factors, even where monetary values can be attributed, there remain questions over distributional effects. And there is growing concern that its 'black box' approach prevents decision makers from properly understanding the nature and balance of all the factors involved. Furthermore, views remain divided between those who think that everything can be expressed in monetary values and those who consider that this practice cannot produce sound figures. Some consider that the single figures provided CBA alone may actually prevent decision makers from properly understanding the balance of the various factors.
- **It follows that incorporating the environmental and social factors of sustainability within a project requires an approach to appraisal that provides effective understanding and clarity as a basis for decision making.** Such an approach should reflect the policy context in project objectives, provide a clear understanding of all issues, ensure their measurement so far as possible, and allow full engagement of all stakeholders. The approach must be a holistic one, following the principles set by such bodies as the World Bank and the European Union. It is important that it is supported by long term stability among the public and other bodies setting and managing policy, as well as the sponsoring bodies themselves.
- **Multi Criteria Analysis (MCA) provides the most suitable framework for measuring and presenting all relevant factors together as a basis for decisions.** It offers the essential discipline that it ensures that all criteria are included clearly, quantified to the maximum extent possible and even monetized where realistic; but not omitted if quantification is not practical. Thus it can offer scope for addressing a range of objectives in a structured way and allow clear identification of issues. It is also seen as valuable in supporting good project development and design, in conjunction with good involvement of stakeholders. It can incorporate financial appraisals and (social) CBA appraisals.
- **Sound objectives are an essential basis for any project.** These must take cognisance of international and national objectives, including those for environmental and social factors. Ultimately a project's objectives are the responsibility of its sponsors and they determine how far national objectives are included, including those for environmental and social factors. This is particularly important for a major project, which itself may bring significant change. There is general agreement that environmental and social objectives should be set by public authorities. There remain differences of opinion about the extent to which environmental and social criteria can be measured and which ones should have priority.

- **It is essential to give adequate time and attention to engagement of stakeholders in the process and to involve them from the very earliest stage.** This allows generation of issues and information and understanding of the importance of various factors. It also guides the choice and outline design of the project. Failure to approach the project's development in this way can mean that the project fails to reflect key issues and thus may generate increased risks of delay and loss. It is recognised that not all stakeholders can play an equal role and that careful management of the process is thus essential. The process of stakeholder engagement, albeit a very valuable one, can also prove difficult for project sponsors.
- **Engaging stakeholders does not mean that all their aspirations can be met.** Indeed, since different groups are likely to have different aims, it is very likely that some will be disappointed by the final outcome of the decision process. There may need to be compromises to achieve a good project outcome. This might also involve compromise by the promoters themselves over certain of their objectives.

9.2 Recommendations for the RAMP Handbook

The principal aims of this Study have focused on providing recommendations for incorporating risks from environmental and social aspects of sustainability in the RAMP Handbook. Following the findings of the Study and in line with discussions with the sponsors, a draft new chapter for the Handbook has been prepared which takes the MCA methodology and establishes it as a simple process for identifying and quantifying project risks, within the overall framework of a sustainable business case approach. **(This forms a separate document.)**

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¹³ The formal title for the study is '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'. The title *RAMP Study* is used as a simplified title for the various Study reports and documents.

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RAMP Study - Generic Lessons for Improving the Treatment of Risk, Uncertainty and Complexity in the Planning and Appraisal of Mega Urban Transport Projects

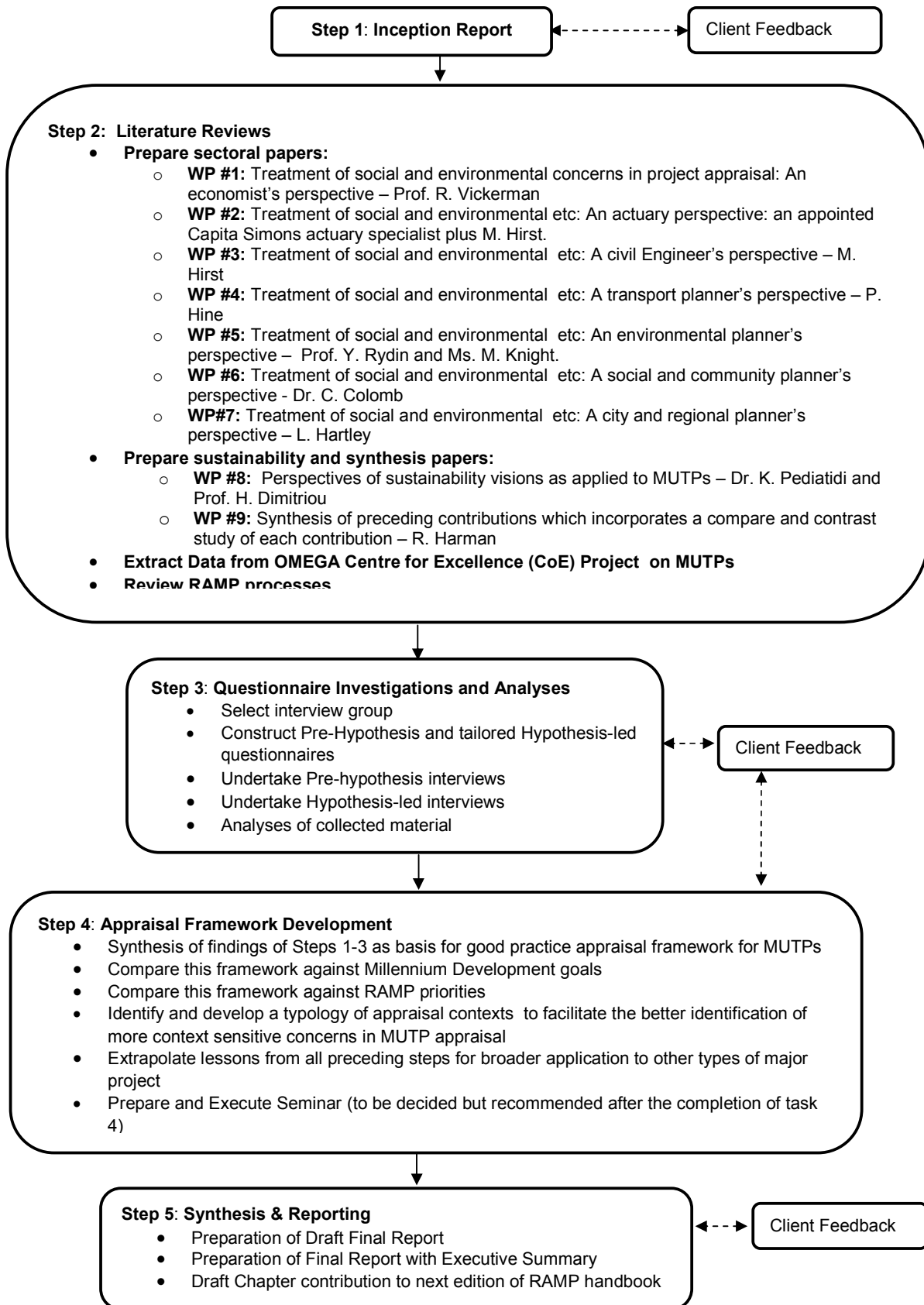
RAMP Study - International appraisal systems for transport and other projects

RAMP Study - Monetization of environmental and social factors in appraisal

RAMP Study - Multi Criteria Analysis

RAMP Study - The sustainable business case

Appendix 1: The RAMP Study work programme



Appendix 2: List of Survey Interviewees

Notes:

1. All interviewees provided a Hypothesis-led interview.
2. All case Study interviewees also first provided a separate Pre-hypothesis interview.
3. Interviewees' contributions reflect their own professional views and not necessarily those of the organisation with whom they are affiliated or employed.
4. All interviews remain confidential to the Study team and the interviewee.

Title	First Name	Surname	Position	Organisation
			UK agency	
Mr	Stephen	Joseph	Director	Campaign for Better Transport
Mr	Tom	Worsley	Deputy Director, Network Analysis & Modelling	Department for Transport
Ms	Chris	Dewey	Associate	Forum for the Future
Mr	Joseph	Lowe	[Author, the Green Book]	HM Treasury
Mr	Lewis	Neil	Director, Infrastructure	HM Treasury
Ms	Rachael	Hamilton	Head of Railways	HM Treasury
Ms	Fiona	Lee		HM Treasury
Mr	Derek	Turner	Director of Network Operations	Highways Agency
Mr	Iain	Coucher	Chief Executive	Network Rail
Ms	Alex	Elson	Project Finance Environment and Sustainability Adviser	Shell
Mr	Jim	Steer	Director	Steer Davies Gleave / Greengauge21
Mr	Bernie	Bulkin	Commissioner	Sustainable Development Commission
Prof	Phil	Goodwin	Centre for Transport & Society	UWE
Dr.	Peter	Jones	Professor of Sustainable Transport	UCL
			International agency	
Mr	Todd	Litman	Principal	Victoria Transport Policy Institute, CANADA
Mr	Marcel	Rommerts	Transport Directorate	European Commission, BELGIUM
Ms	Eva	Mayerhofer	Environmentalism, ESO	European

				Investment Bank, LUXEMBOURG
Ms	Evelin	Lehis	Head of Social Assessment, ESO	European Investment Bank, LUXEMBOURG
Mr	Piers	Vickers	Transport Division	European Investment Bank, LUXEMBOURG
Dr.	Elliot	Sclar	Professor	Columbia University, USA
Dr.	Walter	Hook	Executive Director	Institute for Transport and Development Policy (IDTP), USA
Mr	Peter	Freeman	Lead Evaluation Officer	World Bank, USA
Dr.	Suzanne	Fainstein	Professor Urban Planning, Graduate School of Design	Harvard University, USA
Dr		John	Director	Volpe Centre for Transport, Cambridge, USA
Dr.	Ralph	Gakenheimer	Professor of Urban Planning & Transportation	Massachusetts Institute of Technology, USA
Mr	Naison	Moutizwa- Mangiza	Head of Policy Analysis Branch	United Nations- HABITAT, KENYA
			Case studies	
Mr.	Ingvar	Carlsson	Former Prime Minister of Sweden	Retired, SWEDEN
Mr.	Stig	Larsson	Director General of the Swedish State Railways (1988-98)	Retired, SWEDEN
Mr.	Lars	Tobisson	Former Member of Parliament / Parliamentary coordinator for planning and implementation of Oresund Link	Retired, SWEDEN
Mr	Ulf	Dahlsten	Former advisor to 2 Swedish Prime Ministers with special responsibility for Oresund Link	Retired, SWEDEN
Mr	Jean	Bethier	Formerly Director of Roads, Chairman CNISF	Ministry of Construction & Transport, FRANCE
Mr	Michel	Deffayet	Director, Centre d'Etudes des Tunnels	Lyon, FRANCE
Mr	Jean- Pierre	Coste	Formerly National Roads Directorate	Lyon, FRANCE
-	-	-	Formerly Deputy Director, Aveyrope department / Director, Millau Chamber of Commerce	Millau, FRANCE
Mr	Frederick	Salvucci	Godfather of Big Dig & Advisor to Mayor, then State Secy of Transn & Constn for 3 gubernatorial terms	Senior Lecturer, Massachusetts Institute of Technology, USA
Mr.	Glen	Weisbrod	President	Economic Development Research Group

				Inc., USA
Mr.	Steven	Landau	Director of Strategy Planning	Economic Development Research Group Inc., USA
Dr.	Alan	Altshuler	Professor of Urban Planning & Government - Past Sec. of Transportation for State of Mass.	Harvard University, USA
Mr.	Chris	Haynes	Head of Transportation Strategy	Birmingham City Council, UK
Mr.	Chris	Crean	Campaigner	Friends of the Earth, West Midlands, UK
Mr.	Stephen	Kelly	Head of Policy	FTA Midlands & South-West, UK
Mr.	Colin	Mercer	Planning Manager	Highways Agency, Regional Office, West Midlands, UK

Appendix 3: Hypothesis-Led questions

HYPOTHESIS 1 – Economic growth is essential, sustainability is not

Sustainability visions should not affect ‘real investment decisions’ for mega transport projects¹⁵. These must by necessity be led by meeting demand and supporting economic growth. In circumstances where sustainability visions matter enough to take precedence over demand growth, this priority should be established solely by governments. Governments and other public authorities should then set clear and firm policies and targets for environmental and social factors of sustainable development to establish how they might be treated in the appraisal of mega transport projects.

Q.1 Do you support this hypothesis? If yes, why? If no, why not?

RELATED QUESTIONS

Q.2 Do sustainable mega projects exist?

Is it possible to conceive of a truly sustainable mega transport project? Or, among the main aims that must be addressed for such projects, are there always going to be potential contradictions that are too great to be readily overcome?

Q.3 Policy context for appraisals

3a *Much is said about the desirability of environmental and social enhancement. But is environmental and social enhancement only worthwhile if such aims can be appraised realistically against other key aspects of mega transport project development? Doesn't this require relevant public authorities to set clear and firm indications of priorities for different contexts within which projects are developed?*

3b *How significant is it for the appraisal of mega transport projects to have a firm spatial planning (geographic) dimension? If so, why? If not, why not?*

HYPOTHESIS 2 – Monetization is essential to sound appraisal

Environmental and social factors of sustainability are important because ultimately they impact on everyone, directly or indirectly (through climate change or degradation of city life, for example). If these impacts are real, they can be measured and therefore they can be expressed in monetary terms. This enables them to be properly accounted for within the project appraisal. In contrast, impacts that cannot be measured are vaguely defined or irrelevant and therefore need not be included in the appraisal.

¹⁵ For the purposes of this Study, MTPs are defined as large-scale (typically complex) land-based transport infrastructure link projects (and any services they may incorporate), including: bridges, tunnels, highways, rail links and their related transport terminals, within or connecting urban areas, plus combinations of such projects; with construction costs in excess of US\$ 0.5 billion at 1999 prices.

Q.4 Do you support this hypothesis? If yes, why? If no, why not?

RELATED QUESTIONS

Q.5 The economic basis of project appraisal (CBA)

Should the appraisal of mega transport projects be primarily focused on the Cost Benefit Analysis (CBA) approach? How well do you consider this approach addresses the environmental and social dimensions of sustainable development?

Q.6 Monetizing environmental factors

- 6a Which environmental risks and opportunities can be converted into monetary terms and incorporated into project appraisal?
- 6b What might be the best way to take into account those environmental factors which cannot be monetized? Or should they be omitted from the main appraisal?

Q.7 Monetizing social factors

- 7a Which social risks and opportunities can be converted into monetary terms and incorporated into project appraisal?
- 7b What might be the best way to take into account those social factors which cannot be monetized? Or should they be omitted from the main appraisal?

HYPOTHESIS 3 – Objectives are more important than economic rationalism

Achieving sustainability in environmental and social terms should be a crucial aim of mega transport projects. However, it is usually impossible to obtain all the information necessary for a reasonable assessment of most of the factors that matter. Project appraisal becomes more straightforward and easier to implement if the objectives for a mega transport project can be set firmly within the framework of established spatial and economic strategies.

Q.8 Do you support this hypothesis? If yes, why? If no, why not?

RELATED QUESTIONS

Q.9 Assessing the key environmental and social factors of sustainable development

- 9a What are the key factors which need to be covered in environmental and social appraisal of a mega transport project? Are they readily measurable? How do you decide which ones might be included and prioritised?
- 9b How valuable are the current Environmental Impact Assessment and Social Impact Assessment processes as set out in official documentation?

Q.10 Appraisal through Multi Criteria Analysis

- 10a Would the appraisal of a mega transport project more effectively employ the use of Multiple Criteria Analysis (MCA), to cover all factors (both quantitative and qualitative) within a single framework? How well do you consider this approach addresses the environmental and social dimensions of sustainable development, particularly those that cannot be monetized?
- 10b Should CBA be used to inform MCA based appraisal, rather than as a principal tool for decision making?

Q.11 The significance of context

How important is context – cultural, political, commercial, temporal - in (a) planning, appraisal and delivery and (b) judgements about success? How does it influence judgements regarding the value of a mega project and its treatment of risk, uncertainty and complexity? Or are decisions context free?

HYPOTHESIS 4 – Engagement of all stakeholders in the appraisal process is essential

In the appraisal of a mega transport project, open engagement of all stakeholders is more likely to create understanding on all sides of the project's aims and design and to generate information which otherwise might not have been available. In this way such engagement can lead to a project succeeding far more in meeting its commercial and operational objectives.

Q.12 Do you support this hypothesis? If yes, why? If no, why not?

RELATED QUESTIONS

Q.13 Engagement of stakeholder groups in the appraisal process

- 13a To what extent do you think that the various different stakeholder groups should be engaged in the environmental aspects of the appraisal process?
- 13b To what extent do you think that the various different stakeholder groups should be engaged in the social equity aspects of the appraisal process?

Q.14 Modification of promoters' criteria

Is there scope for mega transport project stakeholders, including promoters, to modify their assessment criteria for appraisal of their projects in light of their own concerns? And, if so, do you know of mega transport projects for which such forms of assessments have been used in the appraisal process where this was helpful to the final outcome?

Q.15 Concluding the engagement process

How do you conclude the debate raised by the engagement of stakeholders in the appraisal process and so bring the considerations to the point of decision?

CONCLUDING QUESTION

Q.16 What lessons could be learned about the environmental and social dimensions of the sustainable development process?

Appendix 4: RAMP Seminar – List of Delegates

Dr	Roger	Allport		
Mr	Bernie	Bulkin	Commissioner	Sustainable Development Commission
Professor	Elisabeth	Campagnac	Director of Research	Ecole Nationale des Ponts & Chaussees [France]
Mr	Roger	Cooper		Capita Symonds
Mr	Jerry	Greenhalgh		RAMP Working Party
Ms	Liane	Hartley		Capita Symonds
Mr	John	Hawkins	Head of Management, Procurement and Law	Institution of Civil Engineers
Mr.	Chris	Haynes	Head of Transportation Strategy	Birmingham City Council
Mr	Peter	Head	Head of Planning	Ove Arup Partnership
Mr	Terry	Hill	Head of Transportation	Ove Arup Partnership
Mr	Peter	Hine	Associate Director	Capita Symonds
Mr	Clive	Hopkins		RAMP Working Party
Mr	Gordon	Hutchinson	Associate	Forum for the Future
Dr.	Peter	Jones	Professor of Sustainable Transport	Centre for Transport Studies, UCL
Mr	Stephen	Joseph	Director	Campaign for Better Transport
Mr	Malcolm	Kemp	Chairman of the ERM Practice Executive Committee	Actuarial Profession
Dr	Marianne	Knight	Deputy Director, UCL Environment Unit	UCL
Mr	Trevor	Llanwarne		Government Actuaries Dept
Dr	Tim	Marshall		Oxford Brookes University
Mr	Doug	Oakervee		Laing O'Rourke HK
Mr	Ian	Short	Director of Sustainability	London Thames Gateway Development Corporation
Mr	Jim	Steer	Director	Steer Davies Gleave / Greengauge21
Mr	Alan	Stillwell		Merseytravel
Mr	Colin	Wilson		Government Actuary's Department.
Mr	Tom	Worsley	Deputy Director, Network Analysis & Modelling	Department for Transport
Mr	Chris	Lewin	Chairman	RAMP Steering Group
Mr	Mike	Nichols		RAMP Steering Group
Mr	Michael	Clark		RAMP Steering Group
Ms	Alison	Brown	Secretary	RAMP Steering Group

Prof	Harry	Dimitriou	Director, RAMP Study	Omega Centre, UCL
Mr	Reg	Harman	Project Manager, RAMP Study	Omega Centre, UCL
Dr	John	Ward	Assistant Project Manager, RAMP Study	Omega Centre, UCL
Ms	Yen-Ning	Tseng	Research Assistant	Omega Centre, UCL

Appendix 5:

Worked example of proposed MCA framework for RAMP

1. Introduction

This Appendix briefly sets out an illustrative application of the Multi Criteria Analysis (MCA) decision making framework and process steps linked with the RAMP procedures (as set out in Section 7). It describes the sustainable appraisal of a hypothetical high speed rail link. The example particularly aims to illustrate key elements of the MCA process, and as a result, it is heavily simplified. (It is assumed here that MCA would also be used as a monitoring approach throughout the construction and operation stages of the project lifecycle.)

The MCA process is overseen and guided by the main sponsors' project manager but all activities and results are properly documented and are fully open to all the parties involved.

2. MCA Step 1 – Establish MCA Framework as the Decision Context

Sub-step 1.1: Establish aims of the MCA and identify key project stakeholders

Problem: How best to increase rail capacity between two regional cities within UK?

The aim of this example is to use MCA as the basis for appraising two potential alternative project routes and associated technology options for a high speed rail link and to determine which option reflects the best choice according to the principles of environmental, social and institutional sustainability.

For this example, it is assumed a project stakeholder power vs. interest matrix (see [Table A1](#) below) has been used by the main project sponsor to identify an initial list of key stakeholders. A further iteration involving the initially selected panel will determine the final project Steering Group that will be charged to make trade-off decisions among project options and criteria. The key stakeholders for this project have been identified as:

- Central Government departments and agencies
- The Department of Transport
- The Department for Communities & Local Government
- Local authorities
- Network Rail (Project Sponsor)
- Community and environmental pressure groups
- Contractors

Table A1 – Example of a Stakeholder Power vs. Interest Matrix

	Power (Low)	Power (High)
Interest (Low)	General public as transport users	Business interests
Interest (High)	<ul style="list-style-type: none"> • Community & environmental pressure groups • Local authorities • Department for Communities & Local Government 	<ul style="list-style-type: none"> • Central Government agencies • Contractors • Network Rail (Project Sponsor) • Department for Transport

Sub-step 1.2: Design the social technical system

For this example it is assumed the MCA process will be driven by a project Steering Group of key stakeholders during a series of meetings. This group will draw out the aims, views and priorities of the various groups involved, including the key project stakeholders.

Sub-step 1.3: Consider the context of the appraisal

The goal of this example is to prioritise two route options for a new high speed line. The key aims of the appraisal are to ensure the long term sustainability of the chosen route option by considering not only short term financial goals and viability, but also longer term economic, environmental, institutional and social factors of sustainability.

Key promoter aims for the project are:

- To boost rail capacity between the two cities to meet forecast future demand.
- To deliver a step change in improvement of journey times.
- To provide an environmentally friendly solution to the UKs travel needs including land use effects.
- To boost the economic development both within the two regional cities and beyond.

To meet these aims the project must incorporate sustainability good practice. This is drawn from national and international guidance on sustainability, the sponsors' and contractors' experience and the stakeholders' perspectives.

3. MCA Step 2 - Identify options to be appraised

For this example it will be assumed that two key route options for the high speed rail project emerged over time, each with a number of variations which have been excluded from this example to simplify this analysis.

The two route options are as follows:

- Option 1 (focussing on Journey Time): Dedicated High Speed Link between the two cities which will reduce travel time between the two cities by one hour.
- Option 2 (focussing on regeneration): High Speed Link between the two cities with one intermediate station to encourage regeneration in a once prospering, but now run-down town. This option will reduce travel time between the two cities by 30 minutes.

At this stage there is an outline review of the two options, indicating proposed route and operations, plus reason for choice.

4. MCA Step 3 – Identify visions, objectives and criteria for project

The first task is to identify the project objectives as defined by the stakeholders. The project objectives should then be agreed with by the stakeholder Steering Group. For this example it is assumed that identifying the project objectives has been undertaken through a series of interviews with stakeholders.

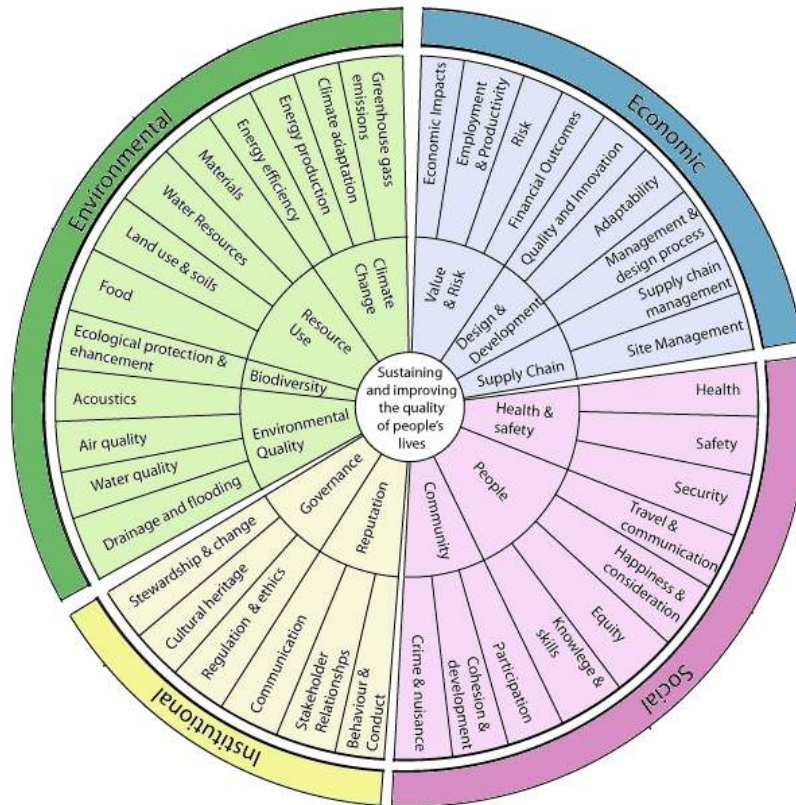
The principal project stakeholder objectives have been derived from the promoter's initial aims and have been then subjected to discussion and examination by the stakeholder group. This has finally resulted in their being as follows:

- a 50 per cent increase in link capacity between the two cities;
- a significant decrease in travel times;
- regeneration and redevelopment values should be maximised by the design of the route and location of the station; and
- the route should be developed according to relevant sustainability policies.

For this example it is assumed that three main national policy documents related to sustainability will be identified as the core references: *Developing a Sustainable Transport System* (2008), *Securing the future: delivering UK sustainable development strategy* (2005) and *Principles of Sustainable Development* (2008). The key objectives of these three policy documents are defined in the project documentation, as agreed by the project Stakeholder Group. At local level, strategies in the relevant Local Development Framework are also reflected (these should reflect national policies in terms of local circumstances, needs and aims).

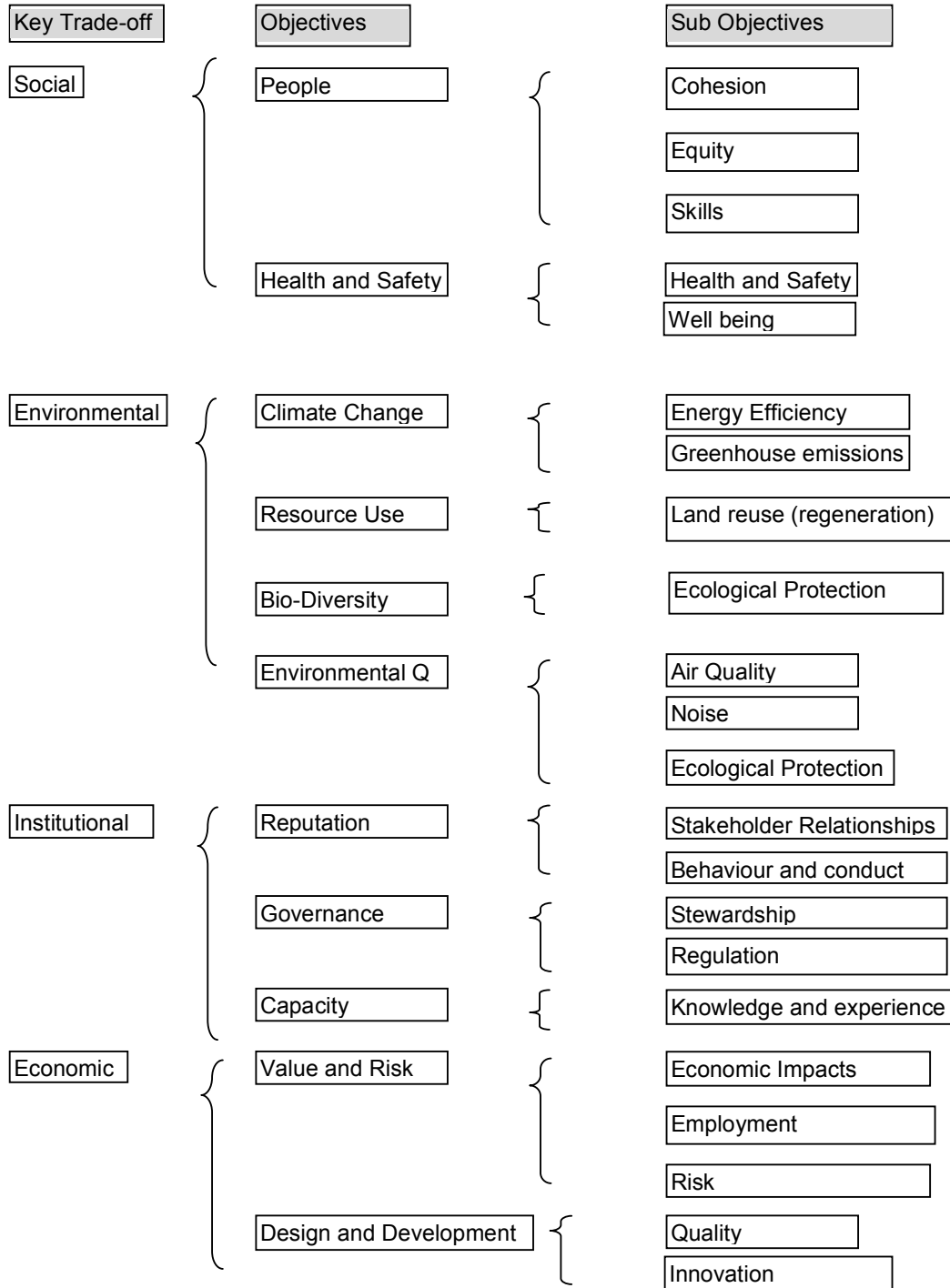
Through consultation and discussion between stakeholders, a series of objectives is drawn up. These should be structured into a hierarchy where the most generic objectives are at the highest level and the most specific are at the bottom. This has been done for this example using the OMEGA adaptation of the HalSTAR model and wheel. [Figure A3](#) and [Figure A4](#) below illustrate the main project objectives derived by mapping the above three policy documents onto the adapted HalSTAR wheel, and the objectives ordered according to hierarchy.

Figure A3: Examples of UK sustainability policy mapped onto the adapted HalSTAR wheel



Following the adapted HalSTAR model, these criteria can vary in spatial and temporal scale and the impacts registered in the MCA performance matrix can be recorded accordingly.

Figure A4: Prioritisation of the high speed line's stakeholder objectives using categories from the adapted HaSTAR wheel informed by sustainable policy



5. MCA Step 4 - Scoring - describe expected performance of each option against criteria and then score accordingly.

The route options will by this stage have been identified by full descriptions of route, reason for choice, and operational performance, supported by maps, tables and graphs.

Once the project's objectives and sub-objectives have been identified, stakeholders define and agree a series of criteria for each objective or sub objective. In some instances objectives or sub objectives may form criteria or sub criteria directly as is the case for this example. It is assumed that there will be some tension and conflicts in this process, with the final selection being in part through consensus.

Once a set of criteria has been developed, they are used by the project Steering Group to assess the two route options. A performance matrix is created for each route option, set out in Table A2 and in Table A3 (appended at end). Here both quantitative and qualitative data can be collected and inserted into the relevant part of the table.

For the MCA to incorporate the RAMP process, the performance matrix collects both project impact and risk information. The project impact column records how the option under investigation performs against each criterion. The project risk columns identify the key risks associated with the impact information collected. Data for both impacts and risks can be of both a quantitative and qualitative nature.

The process of collecting project impact and risk information is seen as iterative subject to resources and output from the decision matrix (see MCA Step 5 below). Decision makers may identify key impacts or risks which require further research and subsequent iteration before final project decisions can be made. Risks identified as part of the performance matrix have the advantage of being linked directly to the projects principle objectives. These risks can be passed on to the RAMP Risk Register, and RAMP Activity B.

Once the impact and risk information has been collected for each criteria with sufficient detail (as decided by the stakeholders), the performance of the route option against that criteria can be assessed by the stakeholder steering group by taking into consideration both the impacts and related risks. Table A2 and Table A3 show each option scored against each criteria using the following scale: Negative, Slightly Negative, Neutral, Slightly Positive, Positive. A score has also been included to indicate the acceptable level of mitigation required for each risk.

6. MCA Step 5 - Weighting the criteria

The decision matrix in Table A4 below shows the output from the scoring process for the two route options. Negative, Slightly Negative, Neutral, Slightly Positive and Positive scores have been converted into a scale from 1 to 5 respectively. For this

example the weights for each criterion have been assumed as equal for simplicity. During a live application of this technique alternative weighting schemes could be handled during this stage by means of a sensitivity analysis.

In this example, the analysis was conducted in two stages. Firstly an analysis was conducted on each of the four main classes of criteria (economic, environmental, institutional and social) and these were combined to give the overall final score for each project.

Table A4 – Decision Matrix for the two project options

	Criteria	Sub- Criteria	Option 1	Option 2
Social	People	Cohesion	1	5
		Equity	1	5
		Skills	4	4
	Health and Safety	Health and Safety	5	5
		Well being	4	4
	Social Score		3	4.6
Environmental	Climate Change	Energy Efficiency	5	5
		Greenhouse emissions	2	2
	Resource Use	Land reuse (regen)	3	3
	Bio-Diversity	Ecological Protection	3	3
	Environmental Quality	Air Quality	5	5
		Noise	5	5
		Ecological Protection	3	3
		Water	3	3
Environmental Score			3.6	3.6
Institutional	Reputation	Stakeholder Relationships	4	4
		Behaviour and conduct	2	2
	Governance	Stewardship	4	4
		Regulation	4	4
	Capacity	Knowledge and experience	2	2
Institutional Score			3.2	3.2
Economic	Economic Impacts	Journey times	5	4
		Cost	5	3
		Reliability	4	4
		Regeneration	4	5
		Employment	5	5
		Capacity	5	5
	Design and Development	Quality	5	5
		Innovation	5	5
	Accessibility	Public Transport	1	5
		Severance	3	3
Economic Score			4.2	4.4
Total			3.5	3.9

7. MCA Step 6 - Examine the ranked risks as basis for decision makers

By the end of the MCA process project options will have been ranked according to their performance (expressed both in quantifiable and non quantifiable form) and against appropriately weighted economic, environmental, institutional and social criteria. For this high speed train example, Option 2 is preferable over Option 1, due to its superior contributions to social and economic aspects of sustainability.

The appraisal will also take on board the key project risks relating to the performance of each option. These have been identified within the MCA framework, with an understanding of the priorities placed on them by stakeholders but developed within RAMP Activity B. This outputs a schedule of risks, with definition and measures as far as possible, and the performance matrix for each option is revised with this risk information. The MCA Step 4 scoring is then performed a second time. The incorporation of the data returned from the RAMP process will help refine the route option ranking and can provide a form of sensitivity testing.

The schedule is then used to develop financial values for each risk, following the RAMP principles, as part of RAMP activity B. These values are used in the investment financial appraisal. Assuming the project is partly sponsored and funded by Government, there will be a social CBA (NATA) to undertake which will also use monetized risk factors in line with the RAMP process.

The schedule of risks also then acts as a basis for planning the necessary mitigation measures as part of the further stages: Asset Creation and Operation.

References – Policy documents

DEFRA (2005) *Securing the future: delivering UK sustainable development strategy*, London

DEFRA (2008) *Shared UK Principles of Sustainable Development*, London

Department for Transport (2008) *Developing a Sustainable Transport System*, London

Table A2: Option 1 - Dedicated High Speed Link

	Criteria	Sub- criteria	Qualitative Impacts	Quantitative Impacts	Risk Qualitative	Risk Quantitative	Impact Assessment	Risk Assessment
SOCIAL	People	Cohesion	Main market will be commuters so overall the user base will not be cohesive		Loss or revenue from other potential user groups		Negative	Acceptable with minor mitigation
		Equity	The high speed link is predominantly targeted to commuters in the higher earning bracket The stations and trains will have full wheel chair access		Rural and small down village dwellers who gain most of the impacts, but few of the benefits may form organised resistance against project		Negative	Acceptable with minor mitigation
		Skills	Local workforce will trained for non specialist jobs	Estimated +100 trainees created by project	Contractors will reject local workforce in favour of trusted specialists		Slightly Positive	Acceptable with minor mitigation
	Health and Safety	Health and Safety	Substantial improvements to safety as commuter traffic on motorway will be reduced by 20%	Accidents per year: -75 Deaths: - 0	Model is inaccurate	Probability of 30% error = 0.2.	Positive	Acceptable with minor mitigation
		Well being	Reduction in automotive related stress, improvement in public spaces around stations				Slightly Positive	
ENVIRONMENTAL	Climate Change	Energy Efficiency	Aluminium trains with regenerative braking and electromagnetic turbo to increase energy efficiency		New breaking technology for high speed trains is not tried and tested	Probability of 6 month delay to project = 0.2	Positive	Acceptable with major mitigation
		Greenhouse emissions	Overall reduction in CO2 per passenger expected as train will be highly competitive with existing air routes and motorway.	12% increase forecast + 12,000 tonnes of CO2	Model is inaccurate		Slightly Negative	Acceptable with minor mitigation
	Resource Use	Land reuse (regeneration)	Rail maintenance depot will be located on brown field site Consistent with policies in Local Development Framework strategy		Land ownership of depot site is under multiple owners. Settlements for land may overrun on time and cost.		Neutral	Acceptable with minor mitigation
	Bio-Diversity	Ecological Protection	No significant direct impact	-			Neutral	
	Environmental Quality	Air Quality	NAQS NO2 objective expected to be realised as motorway traffic reduced	Number of properties experiencing improved air quality - improved 600 - worse 0			Positive	
		Noise	2500 properties would experience a slight increase in noise without scheme	No. of properties: experiencing increase in noise:200 experiencing decrease in noise:680	Estimates are incorrect due to acoustic effect of terrain		Positive	Acceptable with minor mitigation
		Ecological Protection	Substantial agricultural landscape with small pockets of woodland will be affected during works – insignificant long term impact expected		Desk search may not include all second tier nature conserve sites	Fine of £100,000	Neutral	Acceptable with minor mitigation
		Water	There are several high quality water courses providing abstraction and dilution of discharges for the area		Assuming effective mitigation, risk of damage to water environment is		Neutral	Acceptable with minor mitigation

Final Report

			which will be effected by the scheme.		negligible			
INSTITUTIONAL	Reputation	Stakeholder Relationships	Stakeholder consultation will be undertaken at 6 month intervals during the				Slightly Positive	
		Behaviour and conduct	Contractors have shown signs of exploitation as project reaches fixed deadline		City B is bidding to be world city of culture in 2020. This may impose political deadline on project		Slightly Negative	Acceptable with major mitigation
	Governance	Stewardship	An independent team of inspectors is to be set up to ensure the project is performed according to relevant policies				Slightly Positive	
		Regulation	The project will monitor government regulations and a fund will be provided to accommodate regulatory changes		Significant uncertainty over effect of regulatory review over the life of the project		Slightly Positive	Acceptable with major mitigation
	Capacity	Knowledge and experience	Main contractors have experience of implementing high speed line in Asia		Risk of UK standards and regulations interfering with cost estimates based on experience in Asia		Slightly Negative	Acceptable with major mitigation
ECONOMIC	Economic Impacts	Journey times	Significant travel time savings	Peak saving: 1 hour Inter peak saving: 1.1 hours	Assumption relies on full operation of moving block system at project completion		Positive	Acceptable with major mitigation
		Cost	-	[to be specified]				
		Reliability	High specification of track and rolling stock will attain high reliability		Signalling system causes delays in first year of running		Slightly Positive	Acceptable with major mitigation
		Regeneration	Project will contribute to regeneration of stations		Regeneration is linked to health of broader economy which is currently very uncertain		Slightly Positive	Acceptable with major mitigation
		Employment	Local workforce will be used where possible	Estimated +100 local jobs for duration of project +100 permanent jobs due to refitting of stations			Positive	
		Capacity	50% increase in capacity will be obtained from high speed link and new signalling system	12,000 passengers per hour in each direction compared to 6,000	Significant uncertainties surrounding signalling system		Positive	Acceptable with major mitigation
	Design and Development	Quality	Stations will be fitted out to a high quality	£300k increase in budget	Cost overrun in early stages could reduce quality of stations		Positive	Acceptable
		Innovation	The scheme is innovative with the type of signalling system and train set		Significant uncertainties related to such technology		Positive	Acceptable with major mitigation
	Accessibility	Public Transport	No intermediate stations limit potential benefit		Local stakeholders may resist line haul route where no immediate benefit is gained by them		Negative	Acceptable with minor mitigation
		Severance	No severe severance effects expected		Opportunity to reduce severance of existing line lost		Neutral	Acceptable with minor mitigation
NPV =£1200m BCR: 1.5								

Table A3: Option 2 - High Speed Link with one intermediate station

	Criteria	Sub- criteria	Qualitative Impacts	Quantitative Impacts	Risk Qualitative	Risk Quantitative	Impact Assessment	Risk Assessment
SOCIAL	People	Cohesion	Cohesion is increased as a wide variety of customers will be attracted by the route				Positive	
		Equity	The high speed link will target commuters in the higher earning bracket but will also increase access for town and local village dwellers The stations and trains will have full wheel chair access				Positive	
		Skills	Local workforce will trained for non specialist jobs	Estimated +150 trainees created by project	Contractors will reject local workforce in favour of trusted specialists		Slightly Positive	Acceptable with minor mitigation
	Health and Safety	Health and Safety	Substantial improvements to safety as commuter traffic on motorway will be reduced by 40%	Accidents per year: -75 Deaths: - 0	Model is inaccurate	30% tolerance	Positive	Acceptable with minor mitigation
		Well being	Reduction in automotive related stress, improvement in public spaces around stations				Slightly Positive	
ENVIRONMENTAL	Climate Change	Energy Efficiency	Aluminium trains with regenerative braking and electromagnetic turbo to increase energy efficiency		New breaking technology for high speed trains is not tried and tested	6 month delay to project	Positive	Acceptable with major mitigation
		Greenhouse emissions	Overall reduction in CO2 per passenger expected as train will be highly competitive with existing air routes and motorway.	12% increase forecast + 12,000 tonnes of CO2	Model is inaccurate		Slightly Negative	Acceptable with minor mitigation
	Resource Use	Land reuse (regeneration)	Rail maintenance depot will be located on brown field site Consistent with policies in Local Development Framework strategy		Land ownership of depot site is under multiple owners. Settlements for land may overrun on time and cost.		Neutral	Acceptable with minor mitigation
	Bio-Diversity	Ecological Protection	No significant direct impact	-			Neutral	
	Environmental Quality	Air Quality	NAQS NO2 objective expected to be realised as motorway traffic reduced	Number of properties experiencing improved air quality - improved 600 - worse 0			Positive	
		Noise	2500 properties would experience a slight increase in noise without scheme	No. of properties: experiencing increase in noise:200 experiencing decrease in noise:680	Estimates are incorrect due to acoustic effect of terrain		Positive	Acceptable with minor mitigation
		Ecological Protection	Substantial agricultural landscape with small pockets of woodland will be affected during works – insignificant long term impact expected		Desk search may not include all second tier nature conserve sites	Fine of £100,000	Neutral	Acceptable with minor mitigation
		Water	There are several high quality water courses providing abstraction and		Assuming effective mitigation, risk of damage to		Neutral	Acceptable with minor mitigation

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			dilution of discharges for the area which will be effected by the scheme.		water environment is negligible			
INSTITUTIONAL	Reputation	Stakeholder Relationships	Stakeholder consultation will be undertaken at 6 month intervals during the				Slightly Positive	
		Behaviour and conduct	Contractors have shown signs of exploitation as project reaches fixed deadline		City B is bidding to be world city of culture in 2020. This may impose political deadline on project		Slightly Negative	Acceptable with major mitigation
	Governance	Stewardship	An independent team of inspectors is to be set up to ensure the project is performed according to relevant policies				Slightly Positive	
		Regulation	The project will monitor government regulations and a fund will be provided to accommodate regulatory changes		Significant uncertainty over effect of regulatory review over the life of the project		Slightly Positive	Acceptable with major mitigation
	Capacity	Knowledge and experience	Main contractors have experience of implementing high speed line in Asia		Risk of UK standards and regulations interfering with cost estimates based on experience in Asia		Slightly Negative	Acceptable with major mitigation
ECONOMIC	Economic Impacts	Journey times	Significant travel time savings	Peak saving: 0.5 hour Inter peak saving: .6 hours	Assumption relies on full operation of moving block system at project completion		Slightly Positive	Acceptable with major mitigation
		Cost	-	[to be specified]				
		Reliability	High specification of track and rolling stock will attain high reliability		Signalling system causes delays in first year of running		Slightly Positive	Acceptable with major mitigation
		Regeneration	Project will contribute to regeneration of city stations and the newly constructed town station will provide a significant boost to the town economy		Regeneration is linked to health of broader economy which is currently very uncertain		Positive	Acceptable with major mitigation
		Employment	Local workforce will be used where possible	Estimated +150 local jobs for duration of project +150 permanent jobs due to refitting of stations			Positive	
		Capacity	50% increase in capacity will be obtained from high speed link and new signalling system	12,000 passengers per hour in each direction compared to 6,000	Significant uncertainties surrounding signalling system		Positive	Acceptable with major mitigation
	Design and Development	Quality	Stations will be fitted out to a high quality	£600k increase in budget	Cost overrun in early stages could reduce quality of stations		Positive	Acceptable
		Innovation	The scheme is innovative with the type of signalling system and train set		Significant uncertainties related to such technology		Positive	Acceptable with major mitigation
	Accessibility	Public Transport	The town stations will significantly increase accessibility for a wide number of inhabitants		Local stakeholders may resist line haul route where no immediate benefit is gained by them		Positive	Acceptable with minor mitigation
		Severance	No severe severance effects expected		Opportunity to reduce severance of existing line lost		Neutral	Acceptable
	NPV =£1800m BCR: 2.0							

Appendix 6:

Environmental and social factors – identification and mitigation

Substantial experience already exists in identifying and mitigating environmental and social factors and the risks associated with them. This has built up in various fields over many years, on national and international scales. This note examines some aspects and sets out (at the end) some tables of possible environmental and social factors, risks and their possible mitigation.

Risk is defined by RAMP as the potential impact of all the threats (and opportunities) which can affect the achievement of the objectives for an investment. Mitigation is defined by RAMP as an action either to reduce the probability of an adverse event occurring or to reduce the adverse consequences if it does occur.

The risk analysis and mitigation process for a particular technological action (e.g. tunnelling) can be summarised as follows: a particular cause (e.g. unforeseen geological conditions) is identified as likely to produce a risk event (e.g. delay in tunnelling) which may well have a series of possible outcomes or project impacts (e.g. late project completion, increased cost). Risk mitigation can take place at any one of the above three stages. For example, either to reduce the uncertainty of unforeseen geological conditions, minimise the impact of the risk event through alternative choice of technology, or to insure against financial loss if the risk event occurs.

Many of the potential risk events and mitigations related to social and environmental factors may be specific to the type of project, the range of stakeholders or the phase of the project life cycle. (For example a transport project may pose a completely different set of risks and opportunities to the water environment than an oil refinery and as a consequence different mitigation measures would be required.)

The approach to understanding and addressing environmental aspects and their associated risks has been particularly developed under the aegis of formal requirements to study the effects of plans and projects. These include:

- European Union statutes to carry out Environmental Impact Analysis (EIA – projects) and Strategic Environmental Analysis (SEA – plans).
- The World Bank, in its *Environmental Assessment Guidelines* and the accompanying *Environmental Assessment Sourcebook* (both of 2003).
- DCLG *A Practical Guide to the Strategic Environmental Assessment Directive* (2005).

None of these of themselves set out a rigid set of directions. But they each define a structured process, complementing the MCA approach recommended for RAMP. In this they generate wide consensus on the practices and the information that is to be used. From this it is possible to draw up a list of the environmental factors most typically covered and to outline what they involve. Table 1 sets out some of the main

environmental factors that are likely to need attention and it suggests possible mitigation approaches; some generic, others specific to particular contexts.

It must be appreciated that the level of direct impact and the complexity of understanding can vary widely. Two examples may be suggested:

- Air pollution consists primarily of certain identifiable noxious elements (NO_x, SO, particulates). The levels currently present in a defined area may be measured and then projections made for those likely with the intended project. The differences between current and projected levels indicate what the project's impact is most likely to be. This direct assessment can be complicated by such aspects as technical changes in equipment (e.g. better vehicle engines), behavioural changes (e.g. people travel less) or other factors (e.g. changes in weather and hence the extent to which pollutants are dispersed). These would all form risks needing to be assessed and possibly managed.
- Climate change is now a major concern. Direct effects are conventionally measured in terms of carbon dioxide (CO₂) output as the key indicator. As for air pollutants, it is possible to assess the likely impact of a project through simple measurements and forecasts and to then identify possible variations which would need to be treated as risks. However, climate change is a far wider concept of the physical environment and thus the benefits of one project may have an impact only if it is part of a large number of projects and programmes. Assessing the risk of variations may thus be irrelevant unless there are direct penalties for failing to meet CO₂ targets.

Some factors are much less amenable to direct measurement. For example, townscape and heritage are extremely important but require application of judgement. Some options may be obvious; e.g. a project design that demolishes a zone of Georgian buildings would normally seem definitely unacceptable against any objectives. But what about demolishing part of a run down Victorian housing area (a common place practice in the recent past)? Or placing a generally desired project in an older centre but with a modern building? And how would the likely risk factors be determined?

In broad terms, environmental factors become less amenable to easy measurement as they move from simple physical measurement to the need for complex understanding and judgement. Some of this may be political: who decides what quality and form of townscape is to be preferred and retained? Social factors are much more fully an area for judgement, by implication political. This even applies to the choice of factors and how they are approached. There is a growing body of experience and practical literature. Examples include:

- The research and guidance from the UK Government Social Exclusion Task Force, formerly the Social Exclusion Unit.
- The publications of Engineers Against Poverty (EAP), mainly focused on developing countries but with a wide application in practice.

Table 2 sets out some of the main social factors that are likely to need attention and suggests possible mitigation approaches; some generic, others specific to particular contexts.

Table 3 presents a set of examples and poverty and Table 4 a schedule of social risk and opportunities; both from an EAP guidance note on transport projects in developing countries.

Table 1: Outline of environmental factors

<i>Factor</i>	<i>Element</i>	<i>Description</i>	<i>Causes</i>	<i>Risk Event</i>	<i>Outcomes</i>	<i>Improvement / Mitigation</i>	<i>Comments</i>
Climate change	Greenhouse gas (carbon)	Airborne carbon dioxide (CO2)	Combustion of fossil fuels	Build up of carbon dioxide levels to a hazard level	Sea level rising Climate patterns changing Mass negative impacts on human race (all project stakeholders throughout life cycle of project)	Reduce outputs of carbon by scrubbing emissions or reducing dependence on fossil fuels	Carbon levels (=CO2) taken as key indicator of climate change instrument
Air quality	Nitrogen Oxide (NOx)	Airborne pollutant	Combustion of fossil fuels	Poor air quality effects health of local stakeholders during operations phase	Complaints Court settlements for bad health	Technology options Route options Screening options	Targets exist in public & other policy documents for acceptable & dangerous levels
	Particulates	Airborne pollutant	Combustion of fossil fuels Construction Activities	Poor air quality effects health of local stakeholders during construction phase	Complaints Court settlements for bad health	Technology options Route options Screening options	
	Sulphur Oxide (SO)	Airborne pollutant	Combustion of fossil fuels	Poor air quality effects health of local stakeholders during operations phase	Complaints Court settlements for bad health	Technology options Route options Screening options	
Noise	Audibility	Noise levels measured in decibels (dB) – on log scale –	Construction Activities	High noise levels effects quality of life (and health)of local stakeholders	Complaints Court settlements for bad health	Reduce noise output in construction and operation	Targets exist in public & other policy documents for acceptable

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		impact on quality of life (annoyance) and health		during construction and operations phase		Change route or location to reduce households impacted	levels & limits
Water Environment	Purity of water from any pollutant	Waterborne pollutant		Poor water quality effects health of local stakeholders during operations phase	Complaints Court settlements for bad health	Technology options Route options Screening options	
Landscape	Quality of landscape	Concept to be defined for each occurrence	Project specific	Landscape damaged during construction and operation phase	Complaints Court settlements Quality of life impacts	Project specific	'In the eye of the beholder' – Judgement by stakeholders? - Overlaps with social impact?
Townscape	Quality of townscape	Concept to be defined for each occurrence	Project specific	Landscape damaged during construction and operation phase	Complaints Court settlements Quality of life impacts	Project specific	'In the eye of the beholder' – Judgement by stakeholders? - Overlaps with social impact?
Heritage	Nature and quality of heritage elements of built environment	Concept to be defined for each occurrence	Project specific	Project specific	Complaints Court settlements Quality of life impacts	Project specific	'In the eye of the beholder' – Judgement by stakeholders? - Overlaps with social impact?
Biodiversity	Quality						

Table 2: Outline of social factors

<i>Factor</i>	<i>Element</i>	<i>Description</i>	<i>Causes</i>	<i>Risk Event</i>	<i>Outcomes</i>	<i>Improvement / Mitigation</i>	<i>Comments</i>
Health and Safety	Physical fitness	Improve health through physical activity	Project specific provisions	Project encourages less physical exercise during operations phase	Increased health care cost for population over operations phase	Increase walking mode share	
	Access to health care	Access to healthcare is influenced by features both of the supply and use of services	Project specific provisions	Project increases demand on existing healthcare	Lower quality of life for population	Service provision options, revised location	'In the eye of the beholder' – Judgement by stakeholders?
Accessibility	Option Values	Experience of travel	Project specific provisions	Travel times increase	Quality of life impacts		
	Severance	The creation of physical or social barriers to natural movement	Project specific provisions	Segregation of communities	Quality of life impacts Local Economic impacts	revised location revised technology	'In the eye of the beholder' – Judgement by stakeholders?
	Access to public transport	Influenced by features both of the supply and use of services	Project specific provisions	Project increases demand on existing resources	Quality of life impacts	Service provision options, revised location	'In the eye of the beholder' – Judgement by stakeholders?
Accidents	Onsite accidents	Death or injury	Project specific provisions	Increased risk of death or injury	Legal Action Quality of life impacts	Revised design, revised technology	
	Accidents during operations phase	Death or injury	Project specific provisions	Increased risk of death or injury	Legal Action Quality of life impacts	Revised design, revised technology	

Security	Vulnerability to crime	Official crime statistics are proxy for vulnerability	Project specific provisions	Project encourages crime	Quality of life impacts	initiatives to design out crime	A perfect empirical measure of vulnerability is unlikely to be achieved
	Household economic resilience	Ability to cope or recover from an economic shock	Project specific provisions	Project increases demand on existing resources	Quality of life impacts	Service provision options, revised location	'In the eye of the beholder' – Judgement by stakeholders?
Opportunity	Access to labour markets	Influenced by features both of the supply and use of services	Project specific provisions	Project increases demand on existing resources	Quality of life impacts	Service provision options, revised location	'In the eye of the beholder' – Judgement by stakeholders?
Empowerment and Participation	Stakeholders without voice to influence decisions	Process of enabling an individual to take action, and control decision making in autonomous ways	Project specific provisions	Minority stakeholder groups are not consulted	Complaints Court settlements Quality of life impacts	Increased public consultation throughout project lifecycle	'In the eye of the beholder' – Judgement by stakeholders?
Cohesion and development – material conditions	Access to education	Influenced by features both of the supply and use of services	Project specific provisions	Project increases demand on existing resources	Quality of life impacts	Service provision options, revised location	'In the eye of the beholder' – Judgement by stakeholders?
	Access to housing	Influenced by features both of the supply and use of services	Project specific provisions	Project increases demand on existing resources	Quality of life impacts	Service provision options, revised location	'In the eye of the beholder' – Judgement by stakeholders?

Table 3: The four dimensions of poverty, and the impact of improved transport

Dimension of Poverty	Expression of Poverty	Impact of improved transport
Opportunity	Lack of access to: labour markets, employment opportunities and productive resources Constraints on mobility Time burdens, especially for women	Improved access to markets and resources Efficient transport networks save time that can be used for productive activity
Capability	Lack of access to public services such as education and health	Provides a means of access to public services
Security	Vulnerability to economic risks and civil and domestic violence	Reduces insecurity due to isolation However, can also be a source of vulnerability as creates a location and environment for harassment
Empowerment	Being without voice and without power at the household, community, and national levels to influence decisions that affect one's livelihood	Enables participation in social and political gatherings and networks

[Source: Engineers Against Poverty: *Maximising the Social Development Outcomes of Roads and Transport Projects*]

Table 4: Transport Project Social Risks and Opportunities

Project social risks	Project social opportunities
<ul style="list-style-type: none"> ■ Project delays or abandonment ■ Reputational damage ■ Lack of user acceptance ■ Decreased operational revenues ■ Consumer boycotts ■ Major modifications due to stakeholder pressure ■ Exposure to legal action ■ Security problems 	<ul style="list-style-type: none"> ■ Better project outcomes through stakeholder input ■ Streamlined approval processes ■ Government and regulatory support ■ Timely project completion ■ Easier access to project finance ■ Improved operational revenues through customer support ■ Increased likelihood of support for subsequent projects or future expansions ■ Value creation for proponent organisation ■ Enhanced contribution to sustainable development

[Source: Engineers Against Poverty: *Maximising the Social Development Outcomes of Roads and Transport Projects*]