# 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

## Multi Criteria Analysis

**Omega centre**
**Centre for Mega Projects in Transport and Development**

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## 1.0 Context

If the RAMP process is to take in social and environmental aspects of sustainable development which cannot be soundly monetized, and the definitions of which vary across multiple stakeholder groups, then a method of presenting results for decisions on a basis which includes monetized and non-monetary values is required, alongside one which is structured to capture the different priorities of multiple stakeholder groups.

This implies some form of Multi Criteria Analysis (MCA) as favoured by 65% of respondents to the hypothesis led questionnaire (Omega Centre 2009b) who considered the appraisal of mega transport projects would more effectively employ the use of MCA to cover all factors, rather than an exclusive use of CBA. Indeed 84% of respondents felt the CBA approach did not addresses well the environmental and social dimensions of sustainable development.

This paper looks at the methodology applied by MCA systems, reviews the issues raised by them and suggests how they might be applied to the RAMP process.

## 2.0 Current approaches to Multi Criteria Analysis

Multi Criteria Analysis (MCA) systems are widely used as methodologies of appraising projects as a basis for decisions on their implementation. MCA systems involve structures which allow quantified and non-quantified indicators to be set out together in a tabulated form, with the aim that decision makers can then gain a complete picture of the implications of a project across all possible fields of impact. Highway investments have been for many years appraised using MCA techniques which take into account impacts with both monetary values (such as travel time savings), and social and environmental impacts (noise impacts and blight) which may be quantified but not valued, or assessed only in qualitative terms.

MCA is usually contrasted with Cost Benefit Analysis (CBA) and Cost Effectiveness Analysis (CEA). In CBA systems all the factors considered are measured in money terms – the common medium of exchange - over a defined period of years. Both marketable and non marketable factors are included in the analysis. CBA enables the results to be summarised into overall flows of costs and benefits, from which a single rate of return can be defined. CEA compares the costs (on a market basis) involved with alternative ways of providing similar kinds of output. Both these methods in principle offer simplicity to the decision makers, compared to the judgement they have to apply in interpreting MCA results. CBA and CEA are strictly quantitative methodologies, essentially on the same principles as the RAMP process. CBA in particular is subject to the central criticisms that (a) many of the monetary values it assigns have an uncertain basis (e.g. hedonic pricing and stated preference) and (b) it omits those factors which cannot be monetised; thus it can be seriously misleading.

From the DTLR manual (2001) MCA aims to establish preferences between options by reference to an explicit set of objectives that the decision making body has identified, and for which it has established measurable criteria to assess the extent to which the objectives have been reached. Unlike CBA, which has a more unified body of techniques, MCA, in its broadest sense, can include a wide range of distinct approaches. For example, Lichfield (1996) provides, in section 3.6, a substantial list of approaches, which includes MCA but also other ways of similarly bringing together a range of values. The DTLR also manual suggests a number of MCA methodologies chiefly for application to government policy decisions, but is selective in its exploration of techniques as the authors found some of them to be overly complex and untested in practice, whilst others lack sound theoretical foundations.

Lichfield's recommended approach is community impact evaluation, focused on appraisal in this case on urban planning strategies rather than projects but which also aims to use a comprehensive set of indicators to assess the overall impacts.

As Lichfield shows, the MCA approach needs to be wider than merely pulling together information. It is likely to be most effective when appraisal is integrated within the overall development and decision making process for a project. Belton & Steward (2002), quoted by Hartley (2009), suggest the consideration of three distinct phases: problem structuring, model building and use of the model for informing and challenging thinking.

- The problem structuring phase is used to define the terms under which a decision making problem is considered, stakeholders to be included into the decision making process, 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 is dedicated at the definition of criteria and of the relative importance or value attributed to each of the criteria by different stakeholders.
- The application of the model using weights to determine the value of each criterion within the framework or model and scores to determine the performance of each alternative with regards to each criterion may bring directly to a decision or result in feedbacks to the previous phases to revise the definition of the problem, the choice of criteria, etc.

DTLR (2001) highlights that a standard feature of most MCAs, and key point of departure for the varying methodologies, is the performance matrix, sometime referred to as the consequence table. The table is usually laid out in such a way that each row describes an option for decision making and each column describes the performance of each option against a set of criteria. In a basic MCA the performance matrix may be the end product of the analysis, where decision makers are left with the task of assessing the extent to which their objectives are met by the entries in the matrix (section 4.3 DTRL). More advanced applications of MCA include scoring and weighting to arrive at a ranking of options.

The full application of an MCA usually incorporates 9 steps which are outline below.

- Step 1: Establish the decision context – what are the aims of the MCA and who are the decision makers and other key players.

  Establish a shared understanding of the decision context (technical, administrative, political, social, and environmental structures that surround the decision being made). It is important to consider the objectives of the decision making body, the administrative and historical context, the set of people who will be affected by the decision and an identification of those responsible for the decision.

- Step 2: Identify the options.

  Once the decision context is established the following step is to list the options to be considered. It may be necessary to carry out some informal sifting of options as it may not be worth data collection/effort for clearly infeasible propositions.

- Step 3: Identify the objectives and criteria that reflect the value associated with the consequences of each option.

  The criteria and sub criteria are the measures of performance by which the options will be judged. “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” DTLR (2001). The criteria must be operational and a number of procedures are arrive at workable criteria. One option suggested is a brainstorming session (of key decision makers, and possibly affected parties in some stages of the MCA). Another approach may be to examine policy statements and secondary information sources from the various interest groups and to derive criteria to reflect their concerns.

  Once criteria are derived it is desirable to group them into a series of sets which related to separate and distinguishable components of the overall objective of the decision. Grouping criteria is an important part of the MCA process, helping to check the relevance of the criteria, ease the process of calculating criteria weights and facilitates the emergence of higher level views of the issues, especially regarding tradeoffs between key objectives.

  Before finalising the criteria the provisional set of criteria must be assessed against a range of qualities:
  - Completeness – all important criteria included?
  - Redundancy – are there unnecessary criteria?
  - Operationality - it is important that each option can be judged against each criterion
  - Mutual independence – preferences associated with the consequences of options are independent of each other from one criterion to the next

- Double Counting – it is quite easy for some basic impact to be recorded more than once in a performance matrix
- Size – avoid an excessive number of criteria
- Impacts occurring over time – attention should be drawn to time differential impacts

- Step 4: Scoring - Describe the expected performance of each option against the criteria and then score accordingly.

  The first step is to describe the consequence of the options, and then to score the options against the criteria. For simple problems the description of performance could be via a performance matrix (see above) whilst more complex problems guidance recommends the use of decision trees.

  The second step is to score the performance of an option against each of the criteria. As the performance matrix will often contain variety of performance indicators for different criteria (including both quantifiable and non-quantifiable aspects) these different units of measurement cannot be combined directly to achieve an overall evaluation. Therefore scales are constructed to represent preferences for the consequences.

  The third step is to check the consistency of the scores for each criterion.

- Step 5: Weighting – Assign weights for each of the criteria to reflect their relative importance to the decision.

  The preference scales derived in step 4 still cannot be combined because a unit of preference for one criteria does not necessarily equate to a unit of preference for another criteria. Equating the units of preference is equivalent to judging the relative performance of the scales, so with the right weighting procedure, the process is meaningful to those making the judgements. ‘Swing weighting’ is a common approach applied to MCA.

- Step 6: Combine the weights and scores for each of the options to derive the overall value.

  Mutliply an options score on a criterion by the importance weight of the criterion, do that for all criteria, then sum the products to give the overall preference score for that option. Then repeat the process for the remaining options. This step usually relies on computer programmes to combine the weighted scores.

- Step 7: Examine the results.

  The output from step 6 should be a top level ordering of options given by weighted average. The results of the MCA could be surprising, so it may be necessary to establish a temporary decision system to deal with unexpected results. It is important to leave time for this stage of the analysis.

- Step 8: Sensititvy Analysis. Conduct a sensitivity analysis of the results to changes in scores or weights.

- Step 9: Iterate if required – the MCA is essentially an iterative process. There is no need to get all the inputs to the model correct with the first go. Additional information can be gathered in-between iterations, and values and weights can be refined throughout the process.

Belton and Steward define MCA as a framework for a decision analysis, consisting of steps and procedures for a conceptualisation of a problem involving multiple objectives and criteria, and as a set of techniques aiming at elicitation, introspection and aggregation of decision preferences. Consequently, MCA represents added value to both:

- the decision process, by helping the decision-maker know more about the decision problem and explore the alternatives available; and
- the decision outcome, by helping elicit value judgements about trade-offs between conflicting objectives.

MCA is therefore useful for classification, determining priorities or selecting between alternatives. There is a degree of judgement which can be a matter of concern, but MCA can bring a degree of structure, analysis and openness to classes of decision which lie beyond the practical reach of CBA (DTLR, 2001). The use of MCA tools is particularly interesting for the direct participation of stakeholders, as it allows for visualizing different perceptions of the relative importance of the criteria by different groups, highlighting how results can change if different stakeholders' interests and perceptions are taken into account. MCA techniques thus provide a platform for consensus reaching.

So MCA techniques help illustrate the solution to a multicriteria problem. But they also give the decision-makers the opportunity to learn about their own preferences and those of the involved stakeholders. In consequence the MCA approach can prove a valuable instrument for assessing sustainability and also for carrying out the decision process in a 'sustainably sound' way. It does this particularly through allowing the direct participation of stakeholders in the evaluation of alternatives, and the identification and discussion of trade-offs and conflicts of interests in order to build consensus. Given the high flexibility of the tool, its application is possible at both the planning and the project levels.

It follows that the MCA approach can be used with considerable flexibility. It allows engagement of all interested parties and should encourage thinking rather than provide a simplistic guide to the 'right' answer. This sets it in contrast to the use of CBA techniques alone. But it is essential to recognise that MCA techniques too require disciplined use of analysis and measurement as far as these may usefully be employed. The use of these techniques is in important ways more demanding of experience and good training than the use of CBA or CEA.

A well known example of an MCA approach in current use in the UK is the New Approach to Transport Assessment (NATA), used as a basis for transport project appraisal in England and Wales (A broadly similar system, ScoTAG, is used in Scotland). The process illustrates the general principles and steps one to four and seven of the generic MCA process outlined above, however practical application of the NATA application appear to give very high weighting to the CBA output at the expense of other factors and its use could be improved through consideration of some of the issues outlined in section 3 below. The appraisal process is described (TAG unit 2.1, paragraph 1.2.4) as having four appraisal strands, of which the main one is

- An Appraisal Summary Table (AST) (NATA's term for an MCA performance matrix) that displays the degree to which the five Central Government objectives for transport would be achieved. It is from this AST that a judgement should be made about the overall value-for-money of the option or options in achieving the Government's objectives. The information provided in the AST and its more detailed supporting documents will enable a consistent view to be taken about the value of the strategies and plans developed for the different study areas.

The other three appraisal strands are:

- An assessment of the degree to which the local and regional objectives of the study would be achieved.
- An assessment of the extent to which the problems identified would be ameliorated by the option or options achieved.
- Supporting analyses of distribution and equity, affordability and financial sustainability, and practicality.

The AST main objectives now reflect those in the Government's policy document *Developing a Sustainable Transport Strategy* (DaSTS). These include five main challenges (objectives), with one or more goals for each (TAG unit 2.5 consultation). The challenges are to:

- tackle climate change
- support economic growth
- promote equality of opportunity
- improve quality of life & promote a healthy, natural environment
- better safety, security & health

The methodology is summarised as:

- 1.2.11 The key points (criteria) in relation to each of the challenges (objectives) are briefly summarised in text with any relevant quantified information. A summary assessment (performance to criteria) is then given 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 these values. Where impacts can be quantified but not monetised, the summary assessment is quantitative. Impacts that cannot be quantified are assessed on a (usually) seven point scale (note that these scales are not

necessarily cardinal in nature), but because each seven point scale measures a very different objective, they cannot be compared with each other. Where appropriate – and especially where the summary assessment is a monetary value, a supplementary assessment in 'real world' units should be recorded under the Metrics heading. The way in which the impacts under each challenge should be assessed is explained in Unit 3.2, Appraisal.

- 1.2.13 The information presented in the Appraisal Summary Table is, where possible, based on the results provided by established techniques to assess the environmental, economic and social consequences of options. The approach is largely based on the Cost Benefit Analysis (CBA) and the Environmental Impact Assessment (EIA). The Appraisal Summary Table brings information from these together to give a fair and unbiased overall description, without giving prominence to any one type of effect or to benefits expressed in monetary terms compared with those which cannot be monetised.

The AST includes both qualitative and quantitative information, the latter of which is expressed in monetary terms or other units. Monetized items currently include direct effects (travel time benefits, providers' revenues and costs), accidents, carbon emissions and noise impacts, and are input for a partial CBA to estimate a benefit/cost ratio, which, in turn, is input for an MCA. However, no weighting information is provided, and decision-makers must apply their own judgement when weighing the impacts to reach an assessment of the overall monetary value of a proposal. Providing the information in this way enables a consistent view to be taken about the value of projects although the DfT have indicated further research might consider weighting, especially when decisions are to be made where Ministers are not involved. The AST does not automatically provide a mechanistic way of estimating value for money, but summarises the effects in each area so that decision-takers have a clearer and more transparent basis on which to make a judgement. The inclusion of any sub-objective in the AST, with the associated qualitative and quantitative analyses, cannot be used to imply weightings between objectives in forming decisions (Hine, 2009; Hartley, 2009).

In the last 10-15 years, the requirement of further quantification of environmental management as a direct result of European Legislation, an increase in the size and complexity of projects, and increased public participation in the decision making process have created the need to communicate large amounts of information in a straight forward and transparent way. This has stimulated a dramatic use of MCA for Environmental Assessments at both the strategic and project levels within Europe (Janssen, 2001).

- The two pieces of EU legislation which have spurred the use of MCA are as follows: the EIA Directive, which became active throughout EU member states in 1999 requires an Environmental Impact Assessment to be undertaken for individual projects such as a dams, motorways, airports or factories
- the SEA Directive ('Strategic Environmental Assessment'), which became active in 2001, for application to plans, programmes and policies.

## 3.0 Issues in use of MCA systems

Because of its potentially wider implications, the possible use of MCA gives rise to a number of issues. Some aspects which need to be considered can offer both positive and negative connotations. A good part of this may reflect the way in which MCA is used. It is a system of techniques but it forms a toolbox where careful choice and handling is required to obtain sound results.

Many of the entries into an MCA appraisal framework, such as the NATA AST, reflect attributed values rather than measured numbers. Some may be quantified but most are likely involve description. Gaining these values can form a valuable part of the process, especially where this is done through deriving them from stakeholders. In this way the use of MCA can be integrated with a stakeholder engagement programme. Because such a programme in this case would lead directly to the setting of appraisal criteria, it should prove more focused and effective, for the project appraisal team and for stakeholders.

It does not follow that this can be done easily or that stakeholders will agree. Indeed they may differ, either over a range of suggested values or in putting forward two diametrically opposite valuations. ("One person's importance is next door's irrelevance.") However, drawing out and recording them should help establish what values to attribute to each factor. A sound technique is then required to establish the agreed value – or values. Approaches which might be considered include:

- Weighting the values obtained, to identify a single measure. This does require careful calibration.
- Setting two or more different values, reflecting the principal views expressed by stakeholders, and used in sensitivity tests to see the implications.
- Using different groups' values in appraisal tests to establish the implications for the project of giving priority to some as against others (e.g. maximising equity by addressing the values of more dependent groups, measured by income or other factors).

Whilst these approaches can be taken for single factors,it is equally possible to assess a project against sets of values for the main factors derived from different stakeholder groups. Furthermore these approaches involve both the stakeholders and the appraisal analysts. Ultimately the analysts must use figures in the appraisal and thus there will always be a degree of tension between stakeholders' views and the analysts' attribution of values.

Indeed, whilst MCA provides a transparent approach which increases objectivity and generates results that can be reproduced, it's open nature can leave it prone to manipulation and autocracy, which could result in a false sense of accuracy (Janssen 2001).

The MCA process could be manipulated either through the choice of representative stakeholder groups, which may not be inclusive or balanced in proportion to the project objectives. Or the stakeholder groups may have a prior agenda which unduly influences the outcome of the MCA. One important lesson from the current application of the NATA MCA is that the weightings given to objectives by decision makers are left open, and tend to be dominated by CBA concerns. This leads to the question of who is best place to define such weightings? As DETR (2001) suggest, the MCA objectives can be set by national policy, in this case sustainability policy, whilst weightings for each objective (or sets of sub criteria) should be established at the national level by politicians and represented in policy to inform MCA weightings. This is the view reinforced by the 69% of respondents from the hypothesis led questionnaire survey (OMEGA 2009b) who felt public authorities should set clear and firm priorities for appraisal of environmental and social enhancement.

For effective appraisal, it is important that, where quantification is used, the figures are sound rather than precise. Excessive reliance on CBA alone can bring too close a focus on the figures ("what gets measured gets done"), sometimes leading to spurious accuracy. It does not follow that the things that can be quantified are necessarily the most important. It is essential for good use of MCA that this remains in focus: though equally it should not prevent quantification being used wherever possible to ensure a disciplined approach.

Because it includes non-quantitative measures, there is a risk that MCA may include double counting effects. For example, a public transport project may lead to far more low income people travelling along a corridor to a centre, leading to (a) the operator gaining more revenue (specifically quantified) and (b) the accessibility of the centre for employment and services for poorer people rising significantly (assessed as an unquantified positive change). This is also an issue for CBA (as continuing research and debate indicate).

The same example may illustrate the significance of understanding how far the impact may reach and the significance of seeking understanding and agreement. If poorer groups can reach the centre more easily for employment and services, then employers and service providers in their area may lose out, causing a decline. Alternatively, the extra resources and quality of life for the area's residents through being able to reach the centre may also lead to better local services and more good employment locally as well.

This indicates why MCA is also described as a valuable "aide memoire". The act of setting out objectives and factors acts as a reminder of what the project must be appraised against throughout its development. Where MCA is tied in with the engagement of stakeholders, their contributions of factors and of values for these factors helps build a fuller picture of what may be important for the project. While there is an attractive simplicity in MCA structures such as the NATA AST, MCA requires levels of thinking at all stages that makes it far from simple. In this respect it does mirror projects themselves.

Essentially it is important to consider the application of appraisal methods in the context of a larger decision framework. In this respect MCA processes are developed from the earliest evolution of a project or indeed from the identification of issues which the project might address. In fact it is by no means always clear where projects have evolved from. Application of MCA techniques at the earliest stages is thus important to establish how the project – or a group of projects – might fit with defined policy goals.

The application of MCA must guard against path dependency which could become locked into a MCA methodology. The introduction of NATA represents an attempt to improve the decision making process, but in doing so it takes a long established decision contexts, that of determining priorities for transport infrastructure investment, and appraises options largely identified, as in the past, by transport engineers. NATA then clearly identifies objectives and measurable criteria to assess these options expected performance. Both of these templating procedures may make the process easier to apply within the decision context, but make the process less sensitive to important variations in context which may occur between one transportation project and another.

One limitation of MCA is that it cannot show that an action adds more to welfare than it detracts. Unlike CBA, there is no explicit rationale or necessity for a Pareto Improvement rule that benefits should exceed costs. Thus in MCA, and also in CEA, the best option can be inconsistent in improving welfare, so doing nothing could be in principle be preferable (DTLR, 2000).

For simple applications of an MCA, such as NATA, where explicit weights are not used, there is no prior certainty the procedure will lead to consistent results. The problems which can arise due to inconsistency of MCA are well documented by Sperling (1999) and care must be taken in steps 1 to 3 of the generic MCA process as outlined above.

## 4.0 Possible use of MCA in RAMP handbook

The Multi Criteria Analysis approach forms a valuable methodology for incorporating environmental and social factors into the project appraisal and thus ensuring that the project has a sustainable business case (see complementary paper on this topic). As part of this, the MCA process as outlined above can be an effective aid in decision making in the RAMP process at the strategic level during the Opportunity identification stage of the investment life cycle, and at a more operational level during the Appraisal stage. Hence MCA activities could be seen to coincide with Activities A and B of the RAMP process.

Table 1 below show the Activities, Key Parameters and RAMP process in each stage of the Project investment life cycle indicating stages with possible application of MCA tools and techniques.

Ramp Activity A - Process Launch

As outlined above MCA is a decision making tool which not only helps arrive at a decision outcome, but aids the decision process by helping the decision making know more about the decision problem, and to help explore the alternatives available. For this reason MCA should be applied very early on in the RAMP procedure:

- Activity A1.1 of the RAMP manual Organise and define RAMP strategy contains a requirement to confirm the perspective from with the analysis is to be carried out, and the principle stakeholders interested in the outcome. This early stage is a good opportunity to set up the MCA structure by considering stakeholders who can enhance the social and environmental aspects of the projects decision making, and introduce them to the wider RAMP process.
- Activity A1.3 calls for a preliminary brief of the project objectives, scope and timing of the investment, including an assessment of the importance of the project to the sponsoring organisation. Activity A1.4 defines the purpose of the RAMP, level of risk analysis to be carried out and scope of the review. As with A1.1, these two stages provide further opportunities to define the scope of the MCA by identifying the social and environmental objectives to be included in the review. Discussions with stakeholders can identify a pool of S&E objectives and establish which can be passed onto the quantitative risk analysis, and which qualitative aspects should remain within the MCA.
- Activity A2.1 Establish baseline**.** The baseline consists of the objectives, underlying assumptions, information and plans which underpin the evaluation of the project risk and subsequent management. To construct the baseline the RAMP process lists the information required, many of the critical project objectives will have already been discussed in Activity A1, but the baseline calls for the formal expression of these decisions. Below are suggestions as to how the MCA can integrate with various aspects of the RAMP Baseline procedure.
  - Investment Definition: derive aims, scope and timing of investment
    This relates to the first step of an MCA process which is to establish the decision context, the aims of the MCA and the stakeholder perspectives to be examined. Much of this work will have already been undertaken in Step A1.
  - Determine the project objectives
    RAMP calls for the specific objectives and key deliverables of the investment to be defined. RAMP notes a failure to define the objectives fully may result in a failure to identify the risks properly. MCA can be used with a diverse range of stakeholders brainstorming to identify objectives (from a number of perspectives). The early identification of environmental and social aspects of the project may help to reduce the overall project risk.
  - Key parameters
    RAMP seeks to determine financial and other parameters which define and affect the objectives in each stage of the investment life cycle. Again there is read across to the MCA where criteria are identified to express the project objectives. Whereas in RAMP the key parameters (criteria in MCA

terms) go on to be used to calculate the NPV of the project as a basis for appraisal, with the use of an MCA those social and environmental parameters which are non quantifiable can be collected and held in the MCA for comparison by decision makers against the quantifiable parameters returned during the quantitative risk assessment.

RAMP Activity B – Risk Review

RAMP Activity B3 – Evaluate risks
Multi-stakeholder participating and brainstorming can help to identify risks which are relevant to the project objectives and subsequent criteria as outline during the use of MCA in Activity A above.

- Identification of key quantitative social and environmental risks as they relate to each MCA objective. These can be fed into the investment model.
- Identification of key qualitative social and environmental risks as they relate to each MCA objective,
- Creation of performance matrix (risk matrix?) including quantitative values of risks (such as NPV) as output from the investment model against non-quantifiable criteria (including social and environmental factors).
- Feed risks into risk register.

RAMP Activity B3 – Evaluate risks

- Where possible quantify social and environmental risks as they relate to each MCA objective. Update investment model accordingly.
- Update MCA.

RAMP Activity B4 – Respond to risks

- Where possible quantify options to mitigate social and environmental risks as they relate to each MCA objective. Update investment model accordingly.
- Update MCA.

RAMP Activity B7 – Communicate strategy and plans

- Updated MCA is presented to decision making stakeholders to evaluate project options in terms of quantifiable and non quantifiable criteria. Serious issues may feed data back into B6.

## 5.0 Conclusions

The broad conclusions that might be drawn out of this review are as follows.

- From the literature review report and survey report already undertaken for this project by the OMEGA centre it can be concluded there is much uncertainty concerning the nature of social and environmental visions and their underlying values. Subsequently quantification of such aspects proves a major challenge and appraisal needs to be opened up beyond narrow technical concerns.

- Current appraisal methods are narrow and do not adequately capture non-quantifiable benefits. Decisions making based on non-quantifiable factors are often opaque and non-inclusionary.
- Multiple Criteria Analysis gives an effective framework for decision makers both to understand more about the decision problem at hand and to combine both quantitative and qualitative information when making a choice against a series of options.
- To guard against autocratic ranking of options, the weightings for MCA objectives should be informed by environmental and social policy.
- The MCA methodology is transparent, rigorous and participative.
- MCA has been applied both at the strategic and tactical levels, therefore is highly relevant to the RAMP process.
- Aspects of the current RAMP process can be mounted into an MCA procedure.

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## Web sites


WebTag – www.dft..gov.uk/webtag

## Table 1: Sustainability within the investment life-cycle

| *Investment stage / Objectives* | *Principal activities* | *Key parameters* | *RAMP process* | ***Incorporating sustainability*** |
|---|---|---|---|---|
| **Opportunity identification**<br>To identify opportunity and decide whether it is worthwhile conducting a full appraisal | Identify business need<br>Define investment opportunity<br>Make initial assessment<br>Decide whether to proceed with appraisal | Broad estimate of capital cost and cash flows<br>Cost appraisal | • Preliminary review | • **Define context for sustainability factors**<br>• **Establish stakeholder engagement**<br>• **Develop environmental and social objectives & criteria**<br>• **Appraise project options through Multi Criteria Assessment format**<br>• **Gather further information highlighted by MCA and iterate process** |
| **Appraisal**<br>To decide whether the investment should be made | Define investment objectives, scope and requirements<br>Define project structure and strategy<br>Develop business case<br>Identify funding options<br>Conduct feasibility study<br>Decide (in principle) whether to proceed with investment | Refined estimates of capital cost and cash flows<br>Cost of investment planning phase | • Full risk review | • **Establish risks from environmental and social aspects**<br>• **Evaluate risks from environmental and social aspects and update MCA**<br>• **Respond to risks from environmental and social aspects and update MCA** |
| **Investment planning**<br>To prepare for effective implementation of the project | Procure funding<br>Obtain planning consents<br>Preliminary design work<br>Compile project implementation plan | Financing cost<br>Refined estimates of capital cost and cash flows | Risk review (priori to final decision) | |

| | | | | |
|---|---|---|---|---|
| | Place advance contracts (e.g. site preparation)<br>Make final decision to proceed with investment | | | |
| **Asset creation**<br>To design, construct and commission the asset, and prepare for operation | Mobilise the project team<br>Detailed planning and design<br>Procurement / tendering<br>Construction<br>Testing, commissioning and hand-over<br>Ensure safety<br>Prepare for operation | Project objectives:<br>- scope<br>- performance / quality<br>- timing<br>- capital cost | Risk reviews (during or towards end of each activity) and risk management between risk reviews | |
| **Operation**<br>To operate the asset to obtain optimum benefits for sponsor and other principal stakeholders (including investors and customers) | Operate the service<br>Derive revenue and other benefits<br>Maintain and renew the asset | Operating cost<br>Maintenance cost<br>Cost of renewals<br>Revenue<br>Non-revenue benefits | Risk reviews (periodically) | |
| **Close-down**<br>To complete investment, dispose of asset and related business, and review its success | Sale, transfer, decommissioning or termination of asset and related business<br>Post-investment review | Decommissioning cost<br>Cost of staff redundancies<br>Disposal cost<br>Resale or residual value | Final risk review and RAMP close-down | |

Source: RAMP Handbook Table 1