A Rapid Evaluation Method to Improve Project Decision-Making Associated with Natural Resources

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ABSTRACT

Today Multiple Criteria Analyses (MCAs) are widely used for project appraisals. In order to include the short and long term consequences that a project can have, most MCA models are built on a project specific basis. In addition, there is a proliferation of projects being put forward for consideration, thus the work of decision makers has become extremely time and resource consuming. The aim of this research is to develop and test an integrated method for project appraisal which can be used by decision makers to evaluate a diverse range of project proposals in a timely and resource efficient manner.

This led to the creation of a generic method that could be applied to all projects in the first instance. The research employed a modified Leopold matrix to create a checklist to be used as an initial tool to select key attributes for inclusion in the decision making analysis. This standardized approach allows decision makers to work with available data in the first instance to avoid excessive time and resource expenditure. MCA forms the basis of this rapid evaluation method (REM), as it can accommodate the integration of heterogeneous criteria that are measured by differing metrics. The explicit expression of preferences for certain decision attributes, a key element in the MCA process, is utilized here and a modified Delphi approach, using independent experts is employed to determine attribute weightings. From these, utility scores are calculated, sensitivity analyses conducted and recommendations made regarding the proposed project. At this point an ‘accept’ or ‘reject’ decision might be made or, alternatively there is a recommendation that a full independent MCA be executed. Taking this approach means that a unique and independent MCA will only be required for some projects. Therefore, this method accelerates the project decision-making process and reduces the overall resources needed for the appraisals.

Three diverse case studies are used to test and refine the REM. One is an energy project situated in New Zealand, another, a proposal for a privately owned abattoir in Chile and the third is a decision between two proposals relevant to the salmon farming industry in Chile. From this research it is clear that the application of the

REM can aggregate complex data into a pragmatic multi-criteria framework, improving the ability of agencies to estimate the trade-off between environmental, economic, and social impacts of a development project. The REM provides a benchmark for managers to determine whether a project should be accepted, rejected or requires more detailed analysis. This method has the potential to significantly reduce the time and cost involved in project evaluation.

Keywords: Multiple criteria analysis, analytical hierarchy process, project evaluation, integrated analysis, rapid evaluation method.

STATEMENT OF ORIGINALITY

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I declare that:

- This is an original thesis and is entirely my own work.
- Where I have made use of ideas of others writers, I have acknowledged the source.
- Where I have used any diagrams or visuals I have acknowledged the source in every instance.
- This thesis will not be submitted as assessed work in any other academic course.

Student´s signature: ……………………………………………………………………..…..

Date: ………………………………………………………………………………...…………

For my family

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LIST OF ACRONYMS

AHP	:	Analytic Hierarchy Process
CBA	:	Cost-Benefit Analysis
CDP	:	Criterion Decision Plus
CV	:	Coefficient of Variation
DSS	:	Decision Support Systems
EIA	:	Environmental Impact Assessment
EIAS	:	Environmental Impact Assessment System
EPS	:	Environmental Priority Strategies
ESE	:	Economic, Social and Environmental
LDW	:	Logical Decisions for Windows™
LM	:	Leopold Matrix
MAUT	:	Multi-Attribute Utility Theory
MCA	:	Multiple Criteria Analysis
MUF	:	Multi-measure Utility Function
NRM	:	Natural Resource Management
REM	:	Rapid Evaluation Method
SIA	:	Social Impact Assessment
SMART	:	Simple Multi-Attribute Rating Technique
SMARTER:	:	Simple Multi-Attribute Rating Technique Exploiting Ranks
SUF:	:	Single-measure Utility Function
UNCED	:	United Nations Conference on Environment and Development
UNEP	:	United Nations Environment Programme
WCED:	:	World Commission for Environment and Development

DEFINITIONS OF TERMS USED

The following terms have precise meanings in this thesis and are drawn from Logical Decision for Window (LDW) (Logical Decision, 2010, p 12-1 to 12-10), the MCA software employed to run REM.

Alternative - Alternatives are the choices which will be ranked by the analysis. There is no limit on how many alternatives can be defined in Logical Decision software. Alternatives consist of a name and a level for each measure. Levels may be point estimates (single numbers), text labels or probabilistic.

Analytic Hierarchy Process - A process for computing the relative importance of a set of alternatives or goal members. The decision maker is asked to provide the ratios of the performances (or importance) of all the possible pairs of objects in the set. A method, based on linear algebra, is used to compute the relative utilities or weights for the objects in the set.

Attribute - Attributes are the criteria which quantify the achievement of the objectives. They describe the consequences of the alternatives and make value trade-offs. Attributes are expressed in measures and these may be qualitative or quantitative. The decision analysis literature uses many aliases for attributes, including ‘criteria’, ‘measures’, ‘scales’, ‘components’ and ‘indicators’ (Keeney & Gregory, 2005).

Goal - A set of measures (and possibly other sub-goals) treated as a unit for ranking purposes. The goals form a hierarchy ranging from most to least general. Each analysis is required to have at least one goal, called ‘overall’. If no other sub-goals have been defined, all of the measures are members of the overall goal. A measure or sub-goal can be a member of only one goal.

Level - An alternative's level on a measure is the number on the measure's scale (having the proper units) that indicates how the alternative performs on that measure. Levels can also be probabilistic, so that the level is defined by a probability distribution instead of a single number. Levels can be text labels, where each alternative is assigned one of a limited number of text descriptors. Levels can also be defined as the weighted sum of a group of measure categories. Levels should not have a value or preference content. Levels are just data. Preference information is added when the levels are converted to utility.

Measure - Evaluation measures are the variables that are used to rank the alternatives. A measure consists of a name, a three letter abbreviation, units and most and least preferred levels. Logical Decision software puts no restrictions on the most and least preferred levels. The most preferred level can be greater or less than the least preferred level. There is also no requirement that the ranges on different measures be comparable. The ranges are made comparable when levels on the measures are converted to utility.

Weight - Weights are a casual term for the scaling constants (small *k*s) associated with the members of a goal in the Multi-measure Utility Function (MUF) of a goal. Weights provide an indication of the relative importance of the measures given the ranges found for a set of alternatives. The weights in a MUF are determined by the trade-offs that define the MUF. The trade-offs define a unique set of weights that will allow all of the equally preferred alternatives in the trade-offs to get the same overall utility.

Trade-off - A trade-off is a pair of equally preferred hypothetical alternatives that differ on only two measures: Alternative B has a more preferred level on measure 1 and a less preferred level on measure 2, while alternative A has a less preferred level on measure 1 and a more preferred level for measure 2. The levels of the measures are set so that a change in measure 1 just compensates for a corresponding change in measure 2. Equally preferred alternatives should have equal overall utilities, and since alternatives A and B differ only in measures 1 and 2, these compensating changes can be used to compute the relative weights for measures 1 and 2.

Utility - Utility is a standardized measure of the relative desirability of a given level or set of levels for an alternative. Utilities are the output of a Multi-measure Utility

Function (MUF) or Single-measure Utility Function (SUF). They are used to convert the levels of measures, which are based on scales with potentially different units, into a comparable scale with a range defined to go from 0.0 to 1.0. Utility functions generally assign a utility of 0.0 to the least preferred level for a measure, and assign 1.0 to the most preferable level for a measure. Alternatives with utilities closer to 1.0 are preferred.