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Developing the RIAM method (rapid impact assessment matrix) in the context of impact significance assessment

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ABSTRACT

In this paper the applicability of the RIAM method (rapid impact assessment matrix) is evaluated in the context of impact significance assessment. The methodological issues considered in the study are: 1) to test the possibilities of enlarging the scoring system used in the method, and 2) to compare the significance classifications of RIAM and unaided decision-making to estimate the consistency between these methods. The data used consisted of projects for which funding had been applied for via the European Union's Regional Development Trust in the area of Central Finland. Cases were evaluated with respect to their environmental, social and economic impacts using an assessment panel. The results showed the scoring framework used in RIAM could be modified according to the problem situation at hand, which enhances its application potential. However the changes made in criteria B did not significantly affect the final ratings of the method, which indicates the high importance of criteria A1 (importance) and A2 (magnitude) to the overall results. The significance classes obtained by the two methods diverged notably. In general the ratings given by RIAM tended to be smaller compared to intuitive judgement implying that the RIAM method may be somewhat conservative in character.

1. Introduction

In environmental impact assessment (EIA) the potential environmental and social impacts of a proposed project are identified and evaluated by the project executives in association with the responsible environmental authorities and different interest groups (Sadler, 1996; Wathern, 1988). In particular the assessment seeks to determine the key issues responsible for the overall environmental burden of the project so as to plan suitable measures to mitigate these impacts. To achieve this goal the essential question to be answered is whether a project is likely to cause significant environmental change, which can then be used as a trigger for authoritative actions relative to the project (Kjellerup, 1999). Judgements about impact significance are often made throughout the EIA process starting from the early phases of impact identification until the final stage of the assessment, when the feasibility of the project is judged by the environmental authorities (Kjellerup, 1999), further increasing the importance of this element.

Despite its vital role in EIA, and in environmental management, the evaluation of impact significance is still widely considered as one of the most difficult and least understood elements of the process mainly due to its subjective and value-full nature (Duinker and Beanlands, 1986; Lawrence, 2007). Subjectivity complicates the evaluation process since views about the importance of particular environmental impacts often diverge among stakeholders in accordance with their personal values and attitudes (Sadler, 1996). A unanimous resolution to the problem is thus seldom possible, which emphasises the need to carefully define the methods used in the assessment and to justify the results obtained (Sadler, 1996; Wood, 2003). However the methodology employed to make significance determinations continues to vary substantially among EIA practitioners hindering comparison of assessments made not only between projects but also inside a single project. The methods commonly used rely substantially on the inconsistent judgements of environmental experts despite the fact that more explicit methods might already exist in the scientific literature (Wood et al., 2006). In many studies on the effectiveness of EIA (Hilden et al., 1997; Sadler, 1996; Sandham and Pretorius, 2008) impact significance determination, or impact evaluation in general, is widely stressed as one of the key areas in need of further development to enhance the overall performance of EIA. Based on these studies two issues in particular can be underlined as the main objectives of future research: 1) the standardisation of the general theory of the determination of impact significance, and impact evaluation in general and 2) the development of transparent and consistent frameworks to assist EIA practitioners in conducting and documenting impact significance judgements.

RIAM (rapid impact assessment matrix) is a matrix method developed to bring subjective judgements in a transparent way into the EIA process. The method was developed by Cristopher Pastakia (Pastakia, 1998; Pastakia and Jensen, 1998) at the end of the 1990s, and since then it has been widely tested in many assessment

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situations and case studies (e.g. Al Malek and Mohamed, 2005; El-Naqa, 2005; Haie, 2006; Pastakia and Jensen, 1998). RIAM is based on the standard definition of concepts used in the EIA process. With the help of the method different impacts and their significance can be evaluated using commonly defined criteria, each of which has its own ordinal scales. Thus notably varied expressions used in the evaluation phase of EIA can be translated into a numerical form, which can be easily compared and reviewed by stakeholders not involved in the actual evaluation process. The results of the assessment are placed on a simple matrix, which leaves permanent and reasoned records about the judgements made. In RIAM impact significance is modelled as a multicriteria problem, in which the complex nature of the concept is broken down into smaller, more accessible attributes (criteria) for the decision-makers to work with. Evaluating the significance of impacts this way is a widely used approach in the literature on environmental decision-making, when constructing systematic methods for impact evaluation (Bojórquez-Tapia et al., 1998; Cloquell-Ballester et al., 2007; European Comission, 1999; Thompson, 1990). In the original RIAM method five evaluation criteria are used, namely impact importance (A1), magnitude (A2), permanence (B1), reversibility (B2) and cumulativity (B3) (Pastakia, 1998).

During recent decades there has been a growth of interest in the application of multicriteria assessment (MCA) methods to support complex environmental decision-making (Hajkowicz and Higgins, 2008; Janssen, 2001; Kiker et al., 2005), which highlights the need to better understand these methods and how they actually improve the decisions made (Hajkowicz, 2007). In this paper RIAM is examined from a methodological point of view to evaluate the applicability of the method as a tool for EIA and for the determination of impact significance. In practice the study had two main goals. The first was to test the possibilities of enlarging the scoring system used in RIAM and this way increasing the adjustability of the method to different assessment situations and environmental contexts. To do this, the scoring system of RIAM was modified by adding one extra criterion to the framework and extending the ordinal scales used. Secondly the significance classifications of RIAM were compared to the results of unaided decision-making in order to test the validity and accuracy of the results given by RIAM and the amount of consistency shared by these two methods. Regardless of its evident weaknesses unaided decision-making continues to be a commonly used method in the field of environmental management, especially in the context of significance evaluations (Wood et al., 2006), which is why it was chosen as a reference point in the present study. In this paper RIAM is used to evaluate and classify different projects on the grounds of their overall environmental impacts. A similar approach has earlier been used by Kuitunen et al. (2008), who concluded that RIAM can effectively be used to compare the environmental and social impacts of projects even when the cases assessed are different and share only a few common characteristics.

2. Assessment design and methods

The case data used in the study consisted of plans and projects for which funding had been applied via the European Union's Regional Development Trust (RDT) in the area of Central Finland during the half-year period January–June 2004. The main aim of this funding programme is to improve social and economic cohesion, especially in the underdeveloped areas of the member nations, and so enhance sustainability and regional equality in the EU area (Council Regulation (EC) No 1260/1999). The sample consisted of 37 cases varying from simple construction and renovation projects to more substantial education provision plans (Table 1). In the sampling the main intention was to obtain a representative set of cases for which the funding had been applied via the RDT program. The cases were evaluated by an assessment panel of three people (the authors of this article), who were all familiar with the RIAM method. A specific orientation phase was therefore not needed before the first panel meeting. By means of the panel approach different viewpoints can be brought into the evaluation process thereby diminishing the chance that the decisions represent only the views of just one person. When evaluating impact significance this issue can assume to have exceptionally high importance due to the subjective nature of the concept. The case information, on which we based the significance evaluations in the present study, included 1) a preview of the project and its environmental impacts written by the applicant and 2) a statement by the Central Finland official EIA team, which was consulted before the decision about the possible project funding was made in the Central Finland Regional Council. Full EIAs were not carried out for the sample projects, which is the reason why a more detailed analysis of their environmental impacts could not be used to assist the evaluation process.

Table 1
General categories of the assessed projects.

Categories of projects	*n* of cases
Environmental conservation and restoration	3
Tourism and leisure time	10
Water and waste management	10
Development of countryside	5
Development of populated areas	6
Education and information sharing	3
Total	37

In the scoring process the environmental impacts of the projects were categorised into three components, which were then used to evaluate the overall significance of the impacts of each project. The components used were 1) environmental impacts (including both physical and ecological impacts), 2) social impacts (e.g. impacts on local people's health and safety), and 3) socio-economic impacts (e.g. impacts on employment and economic welfare). For each component a single score was given using two different methods, an unaided evaluation approach and a modified RIAM. The evaluation methods are presented in Sections 2.1 and 2.2. The same assessment panel was used in both methods to enable a rational comparison of the evaluation procedures. Before the actual scoring, discussion about the project being assessed and its features were discussed by the panellists to reach a consensus about the environmental impacts on which the scoring was mainly to be based. Because most of the projects were rather small and technically simple, one or two dominant impacts were often found to characterise the entire project, which was also the reason why more a specific characterisation of the impact of the cases was not considered necessary in the study. The assessment panel met four times, during which the projects were systematically assessed and evaluated by the two different methods. The unaided judgement was conducted during the first meeting, after which the RIAM method was applied.

The assessment data were analysed using non-parametric testing, as RIAM does not give continuous scores. When assessing the applicability of the method, the analysis focused particularly on the changes made in the RIAM framework and how these influenced the results yielded by the method. The weight of the different criteria on the final ES scores was assessed by comparing the ranking of the cases given by the RIAM method as a whole and those given by the different criteria categories separately. For this Spearman's rank correlation coefficients were applied. Differences between the unaided judgement and RIAM were tested separately for each impact component using Wilcoxon's rank test (Zar, 1999). Statistical analysis was conducted in relation to class 0 (“no impact”) to combine both positive and negative impacts. Before the analysis the cases judged inconsistently (one method indicating a positive impact and the other negative one) were excluded from the data on the grounds that the differences were due more to the panel's difficulties in identifying the main environmental impacts than to the method itself. Proportion of