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EIA AUDITING TO DETERMINE ENVIRONMENTAL MANAGEMENT PERFORMANCE

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ABSTRACT

Environmental auditing is an important tool for providing an account of post-development environmental impact assessment (EIA) activities. In the past much EIA auditing has focussed on predictive techniques and prediction accuracy which provide little information on actual environmental outcomes. However, of central interest in determining the effectiveness of EIA is the extent to which the environment is managed and protected as a result of the EIA process as it is intended. This paper presents a framework for EIA auditing which focuses on the environmental management outcomes of projects that have undergone EIA. The audit methodology for determining EIA effectiveness focuses on several distinct EIA components: impact prediction, occurrence of actual impacts and the management of potential and actual environmental impacts. These are examined with particular attention to impact and environmental management outcomes. Results are stored in a computerised database which can be used as an implementation record for individual projects that have undergone EIA or for the statistical analysis of large numbers of projects collectively to present an overall picture of EIA environmental management performance. This approach to EIA auditing has applications for project managers, EIA assessment authorities, policy makers and academics alike. Some preliminary results of an EIA audit of six case studies in Western Australia are presented. Results indicate that the EIA process has focussed attention on significant issues. Correlation exists between issue identification and implementation of environmental management actions irrespective of predictive accuracy. Some management activities have avoided impacts occurring. Many impacts have been responded to irrespective of whether they were predicted accurately or even considered in predictions. Overall, an effective environmental management regime was established by the EIA process utilised for the six case studies.

INTRODUCTION

Recently there has been considerable interest in examining the effectiveness of environmental impact assessment (EIA), including the need for feedback mechanisms to enable learning from experience to occur (see for example Gibson, 1993; Ortolano, 1993; Sadler, 1994). Environmental auditing, which has evolved to include a wide range of specific EIA follow-up activities, is an important tool for providing an account of post-development EIA activities (Munro, 1987). The term environmental auditing has also been applied to a wide range of other environmental planning and management activities. This paper is confined to the consideration of EIA auditing specifically as an evaluative tool of EIA.

In determining the effectiveness of EIA, of central interest is the extent to which the environment is managed and protected as a result of the EIA process as it is intended. The author is presently seeking to examine this by documenting the consequences of EIA for individual development projects in terms of their environmental management and determining how and why this management came about. This approach differs from many previous post-development EIA audits which have focussed on predictive techniques and prediction accuracy auditing (eg. Bisset, 1984; Buckley, 1991; Canter, 1985; Tomlinson & Atkinson, 1987) whereby impact predictions from EIA documents are treated like hypotheses and tested with empirical data. The

outcomes of these audits can be used to improve prediction formulation and decision-making for future environmental impact assessments.

Bailey & Hobbs (1990) suggested that auditing was more useful if it evaluated predictions in terms of whether appropriate management action resulted rather than the scientific evaluation of prediction content and accuracy. Predictive accuracy itself was not found to be useful in determining the actual environmental outcomes of the projects audited. This was because predictions that did not expect an impact to occur that were found to be "accurate" and predictions that expected an impact to occur but were found to be "inaccurate", provide little information about the actual environmental impacts (Bailey et al., 1992). Furthermore, the significance of the impact being predicted requires some consideration. A focus on predictive accuracy alone may be misleading in terms of environmental performance if a suite of minor or short-term impacts that are reversible are accurately predicted while a single major, long-term or irreversible impact is not adequately addressed. In this instance, a prediction audit would indicate a high level of success for EIA prediction, while actual environmental performance may not in fact be adequate or desirable.

I have attempted to address these limitations in environmental auditing through the design of a new approach to post-development EIA evaluation. I present a description of some of the key features of this approach and how it relates to the EIA process. I briefly describe a computerised database which I have developed through applying this approach to six development projects that have undergone EIA in Western Australia. I then show how my methodological approach forms a basis for determining EIA effectiveness in terms of environmental management outcomes and providing a useful information base for EIA practitioners.

ENVIRONMENTAL MANAGEMENT APPROACH TO EIA AUDITING

In order to learn from experience, it is necessary to collect data from projects which have undergone EIA and analyse this in such a way that derives information about the functioning of the EIA process itself. Due to the complexity of most projects for which an EIA is required, a large volume of data can be generated for each project. Consequently, the methodology for determining EIA effectiveness utilises a computerised database which enables this data to be organised and evaluated efficiently. A complete detailed description and explanation of the database will not be given here but is available upon request from the author.

Database Design in Relation to EIA Procedures

The database has been designed to be adaptable to any EIA system. The database captures data that reflects several distinct components of EIA as follows:

- the identification and prediction of potential impacts in pre-development EIA documents;
- the occurrence of actual impacts as a result of project implementation; and
- the design and implementation of project environmental management activities to address potential and actual impacts. This occurs during both the pre-development and post-development stages of EIA.

Key features of the database are discussed and how it can be applied to projects to determine EIA effectiveness in terms of environmental management performance.

Key Database Components

Individual impact predictions made during the pre-development stages of EIA are recorded plus whether or not individual predictions had an associated

management action related to them. The significance of predicted impacts is rated by comparison of the subject matter of the prediction with a list of issues identified by EIA decision makers as being of particular importance or concern for individual projects. A similar assessment of significance is made in relation recording actual environmental impacts in the database.

An additional function of the database, with respect to impact predictions, is to distinguish between those predictions that were associated with the occurrence of an actual environmental impact and those that were not. For the predictions where no impact was recorded it is important to know why; eg. whether this was a result of good project management, inaccurate predictive technique or some other reason. The effectiveness of EIA at protecting the environment can be determined by comparing final environmental quality with the predicted results (Duinker, 1989). In this context, it is very important to understand how impacts that were expected to occur were avoided.

The environmental management activities proposed for projects are documented in terms of their origin and implementation status. The relationship between issue identification/prediction and the implementation of appropriate management actions is also examined. It may be that, irrespective of predictive capabilities and success, an important outcome of the requirement to address potential impacts in the EIA documents is that environmental management strategies are identified and implemented during the early stages of project planning and development, resulting in improved environmental performance.

Project induced environmental impacts are recorded and how these impacts were responded to in terms of any ongoing management. Whether or not impacts had been previously considered in impact predictions is also recorded in order to enable predictive success in relation to impact outcomes to be determined.

Overall, the database provides a useful summary of the status and outcomes of each project examined in terms of the specific EIA process experienced by that project. Hence, environmental outcomes in the form of the impacts recorded and the environmental management actions undertaken can be understood in the context of original EIA predictions. The considerable level of information detail recorded in the database provides a useful account of projects that have undergone EIA in terms of being able to better understand how the EIA process achieves its outcomes. The inclusion of multiple projects in the database enables statistical testing of the distribution of results (using a Chi-squared analysis - χ^2) to test for significance of association. This provides an overall account of EIA functions. Some preliminary results are now presented.

PRELIMINARY FINDINGS

A total of 340 predictions were recorded for the six case studies. More than half addressed issues of perceived significance at the time of assessment in some way with 43% directly representing a significant issue, 25% being indirectly related to a significant issue and 32% not being related to a significant issue at all. Only slightly more than half (56%) had a corresponding management action related to them. However predictions addressing significant issues directly were found to be more likely to have a corresponding management action than those either indirectly or not related at all ($\chi^2=29.981$, $P<0.001$, $df=2$). This suggests that EIA practitioners focussed on the significant environmental issues when proposing and implementing environmental management programmes, whilst largely ignoring trivial and lesser important issues. In other words, the

EIA process would appear to be effective in channelling effort onto issues of significant concern.

Some 38% of predictions had some sort of corresponding impact, 44% did not and for the remainder (18%) there was no information available to determine whether or not an impact related to these predictions (ie. monitoring programmes were not sufficiently comprehensive to provide information on these potential outcomes). Approximately one third of the 150 predictions (44%) for which an impact did not occur (ie 14% overall) had some sort of environmental management or mitigating action related which avoided the occurrence of an impact. This result provides a measure of the effectiveness of EIA in terms of successfully implementing environmental management activities in order to prevent the occurrence of environmental impacts.

An example of the implementation of mitigation measures successfully preventing adverse impacts from occurring was apparent for a mineral sands processing plant case study. The plant, which converts mined mineral sand feed stock into synthetic rutile for export, was built in two stages, each of which was subject to EIA. A major concern for this project was the release of waste gases and odours (hydrogen sulphide) associated with the production process. Soon after the first stage of the plant was completed, problems were found with odour emissions relating to the unexpected poor performance of the installed pollution control equipment. The second stage of the plant, proposed two years later, involved the duplication of production processes and output capacity. During the EIA process, the proponents proposed to upgrade the pollution control equipment on the first stage plant as well as installing the improved equipment on the second stage. It was predicted that the overall waste emissions from the second stage plant would be less than that of the initial stage despite a doubling of plant capacity. During the audit, it was found that while the occasional odour complaint is still sometimes recorded in the vicinity of the plant, on the whole there have been no odour problems with the new plant operations. Hence the proposed EIA management strategy to reduce the waste emissions has successfully ensured that a known impact does not occur.

A total of 284 management actions were recorded for the six case studies. The majority of these management actions were proposed in the pre-development EIA documentation with only 14 (5%) being classified as new actions (ie originating in the post-development stage of projects). The vast majority of management actions (91%) were found to be related to an impact prediction in some way. This indicates that a strong relationship existed between the identification of potential impacts and the establishment of management actions to address identified concerns (or vice versa) during the EIA process for each of the case studies. The implementation status of the management actions (bearing in mind that most were proposed during the pre-development stage) was very high with 92% being implemented as planned. Combining these two sets of results indicates that post-development management programmes have consistently upheld the proposed actions developed in conjunction with impact identification during the pre-development stages of EIA. In other words, the EIA process has successfully identified potential issues of concern and provided the mechanism to implement an appropriate management or mitigating response to these during project implementation.

A total of 75 environmental impacts were recorded for the six case study projects. In comparing the nature of the recorded impacts with the list of significant issues identified for each project, it was found that 46% represented significant issues with 43% representing non-significant issues and 11% representing new issues not previously identified during the pre-development EIA process. It is important to note that the 46% of impacts

related to significant issues may not in themselves be major adverse environmental impacts (ie. this relationship does not necessarily mean that catastrophic effects resulted), they are simply related to potential issues of significance. In terms of predictive accuracy, it was found that 57% of the recorded impacts were accurately predicted, 29% were inaccurately predicted and the remaining 14% were unexpected impacts.

A management response was not required for 44 (58%) of the observed impacts. These impacts represent a combination of beneficial outcomes of the projects for which no management is necessary, plus the inevitable and/or accepted adverse outcomes of the project which cannot be avoided in any way. For the remaining 31 impacts, a management response was implemented for 28 of them (37% overall) with the remaining 3 not being responded to. The management responses varied from actions taken to minimise the extent of the impact in the first place, to post-impact rectification and compensation measures. Of the impacts that had a management response, 18 represented impacts that were either inaccurately predicted or were unexpected. This result indicates that management systems were in place to respond to the majority of impacts as they arose even if they were inaccurately predicted. This may be linked to the fact that 86% of the impacts were in some way related to impact predictions. This implies that the predictive process during pre-development EIA had alerted managers to the possibility of certain impacts occurring which enabled appropriate management responses to be put in place. In addition, the fact that even unexpected impacts were also responded to suggests that by establishing management systems in the first place, the EIA process also provided the opportunity to address unexpected events as they occurred. It is apparent that the management regime created during the pre-development stages of EIA has been extended beyond the scope of issues identified at this time, during the subsequent post-development stages of EIA.

A good example of early issue identification assisting in ongoing environmental management related to a water supply dam project on a seasonal brook. One of the concerns relating to the construction of this 7 metre high earth and concrete embankment was the interruption of upstream fish migration and in particular lampreys which travel from the sea to the upper reaches of the brook to spawn. It was predicted that the barrier problems created by the dam and a downstream gauging weir would be overcome by overland migration of lampreys at these points. In terms of environmental management strategies, it was proposed to maintain suitable vegetation adjacent to these structures to facilitate this. In practice it was found that the dam wall design, including adjacent earthworks and landscaping treatment, was not conducive to lamprey movement. Having directly observed the failure of the migration, the project managers made appropriate cosmetic changes to the dam wall (filling expansion cracks and smoothing sharp corners) and provided a guided movement mesh to direct overland migration. Subsequent monitoring has indicated that these additional management measures have been successful.

CONCLUSION

When undertaking EIA audits to determine the effectiveness of EIA, a key concern is the extent to which the environment is managed and protected as a result of the EIA process. I have developed a new approach to EIA auditing that focuses on the effectiveness of EIA by documenting the consequences of EIA for development projects in terms of environmental management and determining how and why this management came about. This approach to EIA auditing has applications for project managers, EIA assessment authorities, policy makers and academics alike. Application of the EIA audit methodology to six case studies in Western Australia suggests that the EIA process been effective in focussing effort onto issues of

significant concern. A strong correlation exists between issue identification and subsequent environmental management irrespective of predictive accuracy itself. Some environmental management activities have successfully avoided the occurrence of environmental impacts. A high level of implementation of proposed management actions was found with the vast majority being related to the impact prediction process in some way. Many impacts have been responded to by project managers irrespective of whether they were accurately predicted or even considered in predictions in the first place. The management regime has extended beyond the scope of issues identified in the pre-development stages of EIA alone during the subsequent post-development stages of EIA. Hence overall, it would appear that the EIA process utilised in Western Australia for the six case studies has successfully established an effective environmental management regime for these development projects.

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