

A multi-factor approach to evaluate environmental impact statements

L. Laivina, J. Pubule* and M. Rosa

Riga Technical University, Institute of Energy Systems and Environment, Kronvalda boulv. 1, LV-1010 Riga, Latvia; *Correspondence: jelena.pubule@rtu.lv

Abstract. The goal of this study is to develop a method for assessing Environmental Impact Statement (EIS) according to various criteria, and to develop recommendations to improve statements and the EIA procedure. To develop a method to assess report quality, the most significant current methods were examined. Their advantages and disadvantages were analyzed and, as a result, the most appropriate method structure was defined – a control list with quality criteria. To determine the quality criteria of an EIA, the effective basic principles of the EIA were formulated based on sources in the literature. During the study, the three most significant elements of a quality EIA were defined. These have been incorporated into the method developed in this project as the most significant criteria. As a result, a systematic method to assess an individual EIS was developed. The method includes quality criteria, which have been determined to be the most significant as a result of an analysis of the efficiency of the EIA procedure. The method has been adapted to the planned amendments in the EIA directive, incorporating these criteria. The structure of the method adheres to another fundamental goal of the directive's amendments – to decrease the administrative load of the EIA procedure. It is anticipated that with the aid of this method, by assessing only the most important report elements in depth, that the time necessary for a competent institution to evaluate a report will be reduced.

Key words: environmental impact assessment, sustainability, evaluation methodology, environmental impact statement.

QUALITY OF THE EIS

EIA is a systematic, technical tool of environmental policy which is currently in use in more than one hundred countries around the world, including Latvia. Until now, no studies have been conducted in Latvia on the quality of the final EIA report – the Environmental Impact Statement (EIS), and the efficiency of the process as a whole. Latvian legislation will be obliged to apply the planned amendments to the European Union EIA directive in the near future. Before applying these amendments, it is practical to assess the current EIA procedure. As an EIS reflects the assessment process, one method to assess the EIA as a policy tool is to assess the quality of the EIS. A report assessment is essential during the EIA process to confirm the quality of the information provided, and following the end of the assessment, to assess the efficiency of the EIA system as a whole. For report assessments to have a valid basis, and for them to be comparable, they must be evaluated systematically by using a specific algorithm or method.

A report evaluation is essential both during the EIA process, to confirm the quality of information provided, and after the assessment has been completed, to evaluate the efficiency of the EIA system as a whole. For the report evaluation to be supported and comparable, it must be conducted systematically by applying a specific algorithm or method. The first definition of the evaluation methods for an EIS is generally considered to be a Canadian study from 1987 which is based on a literature review and interviews with organizations and individual experts in order to determine how to evaluate an EIA. It was also used to formulate some basic principles for an evaluation (Sadler, 1996; Canter & Sadler, 1997).

Criteria for an efficient EIA

EIA efficiency has several definitions and formulations. To evaluate measure and compare EIA efficiency, various factors or criteria describing their efficiency must be proposed. As basic characteristic quantities, the efficiency of implementing the report or procedure can be selected. EIA efficiency can be split into four aspects:

- 1) Report quality;
- 2) Influence of EIA in decision-making;
- 3) Efficiency of predicting impact and of preventative actions;
- 4) Monitoring and audits following project implementation.

Within the literature, many authors define EIA efficiency as a level at which the EIA has reached its defined goals, results, and reasons for implementation. A basic goal of the EIA procedure is usually defined specifically as the identification and prevention of environmental damage, and in this case EIA efficiency can be defined as the level at which it identifies, assesses, and seeks out methods to prevent or reduce the negative impact of the planned activity (Glasson, 2005; Peterson, 2010).

By defining the criteria of EIA efficiency, they must, firstly, adhere to procedural goals and, secondly, include the most important elements of the process. To evaluate the total efficiency of an EIA, it is necessary to include environmental monitoring within the procedure before beginning the project, as well as once it has been implemented. This is done so that it can be determined how valid the predictions of the project's environmental impact were and how efficient the activities selected to reduce this impact were. This will allow for the reasonable assessment of the efficiency of these parts (Munn, 1970).

The theoretical efficiency of the EIA is much higher than in practice, especially when emphasizing an alternative evaluation, and activities following the approval of a decision – monitoring and auditing.

The basic elements of an efficient EIA can be divided into five groups:

- 1) EIA goals;
- 2) Public participation;
- 3) Quality of reports and other documents;
- 4) Efficiency of EIA expenses;
- 5) Influence of the procedure's conclusions on the decision-making process.

EIA efficiency is dependent on public participation in the process, in EIA documentation, in the initial transformation of the project at the EIA level, as well as in the evaluation of the influence of the assessment in the decision-making process. EIA

goals must be reached efficiently, with respect to time and money, and EIA efficiency must be verified following project implementation with the aid of monitoring and auditing.

Based on the literature review conducted on the elements and criteria characterising the efficiency of an effective EIS and the process involved, the following criteria were determined to be the most important:

1) The trust placed in the objectivity and quality of the EIA by the public and other parties involved – the process is understood by all parties involved, information is clear and available, the goal of the procedure is clearly defined, all parties involved trust that the process is not influenced by its strongest proponents;

2) It is integrative (incorporates planning documents, legislative standard, etc.) and is connected to decision-making – that is, the results of the EIA process correspond to legislative standards and other corresponding documents, and all are taken into account during the decision-making process;

3) Long-term benefits of environmental quality are encouraged, as well as improvements in the planned activities of the project, including monitoring, to ensure adherence to environmental demands to ascertain the efficiency of predictions and preventive actions made during the process;

4) The report is comprehensible – the report includes information that is easily understood by readers without specific knowledge in the specific field, the significance of various aspects is explained, the reader is able to compare them;

5) The participation of the public and other interested parties is included in the consideration segments, information about the opportunity for interested parties to participate is easily available. The goal of public participation is to improve procedural quality, public consideration does not limit the participation of other interested parties (the location and time of consideration is acceptable to most parties involved), the public view and how it will be incorporated is explained during the decision-making process;

6) It is legal – corresponds to legislative standards;

7) It is all-encompassing – it includes all significant information related to environmental, social, cultural and biophysical aspects, if there is enough reason to consider an aspect insignificant, it is not widely analyzed; an evaluation of valid alternatives is included, cumulative and indirect influences are evaluated;

8) Appropriate human resources and innovations – the EIA administrative process is performed by competent specialists, modern technology and forms of communication are used for accessibility, and during other EIA segments;

9) Assumptions, predictions, evaluations, and decisions are based on true (provable) information, decisions are based on information acquired, information sources are indicated. Undefined information and assumptions are explained.

Appropriate, modern alternatives are analyzed, this is to be completed in the early stages of the project in order to make improvements in the planned activities of the project (Lee & Colley, 1990; Canelas et al., 2005; Androulidakis & Karakassis, 2006; Polonen, 2006; Polonen et al., 2011).

This study has selected three EIS elements as the most essential – an evaluation of alternatives, public participation, and monitoring. Each of these three elements ensures the basic functions of the EIA, and the realization of its goals – firstly, a selection of

alternatives guarantees the selection of the best project locations, technology, solutions. Secondly, a basic function of the EIA is performed through public participation – to ensure information for all parties involved. Also, public consideration guarantees a more complete evaluation and identification of the environmental issues. Thirdly, monitoring is an important EIA component to verify the validity of predictions, the project's actual impact and project implementation with respect to the permit received. In addition, monitoring data guarantees a binding database for all parties involved in the EIA (Morrison-Saunders & Arts, 2006).

Methodology

The EIA procedure incorporates the evaluation of the report's quality, and in Latvia this is currently conducted before a decision is made on issuing a permit for project implementation by the competent institution – the State Bureau of Environmental Inspection. In addition, reports may be evaluated following acceptance, to evaluate the overall quality of reports, and, correspondingly, the quality of the EIA procedure, the advantages of the corresponding legislation, weaknesses, and EIA tendencies as a whole. The evaluation of EISs has an important role in the quality control of an EIA, in the development of guidelines and sample practices, and it is also binding for the preparation of further EIA developed reports as well as for the project implementer, who may use information on the EIA process for the further development of planned activities.

A systematic method for evaluating individual reports has been developed in this project. The method includes quality criteria, which have been proposed as the most significant in the analysis as well as other methods of the EIA procedure. The method has been adapted to the proposed amendments in the EIA directive, including such criteria to ensure that reports adhere to the updated requirements of the directive. This approach has been selected due to the fact that the fundamental goal of the directive's amendments is to increase EIA efficiency and quality.

RESULTS

The criteria of the method have been arranged into four groups (see Fig. 1). The significance of criteria in each group increases, and, analogously, the subjectivity of the possible evaluator increases.

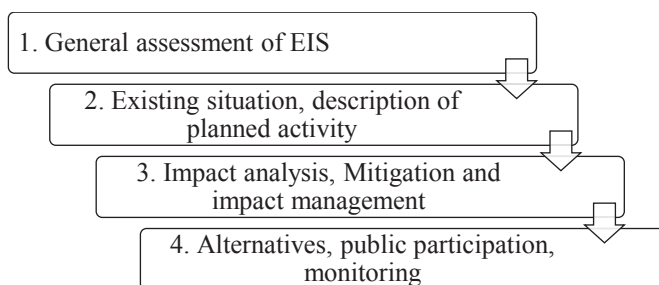


Figure 1. Structure of the method developed.

The first group summarizes criteria which guarantee the correspondence of the EIS to minimal requirements, that is, legislative standards. As several authors have indicated, the correspondence of the report to legislative demands does not always signify that it has been prepared qualitatively. The EIA procedure can be completed so as to reach one of two goals:

- 1) Adherence of all planned activity to all legislative standards;
- 2) With the goal to have the smallest environmental impact possible in a rational, valid fashion.

By evaluating the report only by the adherence to legislative standards, it is impossible to determine if it is inclined towards the most efficient and rational solution in environmental issues. The criteria characterising report quality have been summarized in the following chapters of the method.

The second part of the method includes criteria that characterise the description of the current situation and planned activities. Thus, an analysis of the selected location of the project, its environmental condition and dynamics, pre-project implementation and the characteristic quantity of the planned activities. The information of the second part in the report aids in the identification of the criteria of the third part – identification of impacts, their prevention, reduction or compensation. The fourth part of the evaluation must assess the most essential identified elements – alternatives selected, public participation and monitoring.

If the report is consistent with the requirements of the method's first part, that is to the directive and legislation, then it meets minimal requirements. If the criteria of this section have been evaluated as unsatisfactory, then it cannot be considered to be consistent because it does not correspond to standard requirements, but consistency with the first section of the method does not indicate the quality of the EIS. This structure to the method has been selected because the following section derives from the previous – accordingly, if the report contains qualitative and all-encompassing information about the location of the planned activities, project scope, and its specifications (Part 2 of the method), then it is easier to identify potential impacts and their respective actions (Part 3). At the close of the evaluation, the correspondence of alternatives and monitoring to all previous conclusions, as well as the quality of public participation to evaluate report quality and efficiency, or the degree to which it has reached the goals of the EIA procedure. A full method chart can be viewed in Appendix 1, and each of the four sections, their criteria and the basis for criteria selection are elaborated upon in the following sub-chapters.

Methodological criteria, the basis of selection

The evaluator of the first section should, firstly, evaluate the criteria dichotomously as either 'yes' or 'no'. If any of these section points is missing, then the report does not adhere to legislation and the minimal requirements, and cannot be accepted (see Table 1).

Table 1. Criteria of the method's first section

Correspondence to legislation (minimal requirements)	Evaluation
1.1. Description of project location	
1.2. Description of planned activities	
1.3. Description of potential impact(s)	
1.4. Activities to reduce or prevent significant impact	
1.5. Summary	
1.6. Adheres to the program issued by the responsible institution	
Final evaluation	

The criteria of the method's second section (Table 2) are proposed in a manner that allows for the verification of the completeness and quality of the information used, to determine the project's impact on the environment. In addition to the information on the direct influences in the report, information on indirect activities related to the project must be included, for example, infrastructural expansion.

Table 2. Criteria of the method's second section

Description of the current situation and planned activities	Evaluation
2.1. Project goal and its necessity have been explained and supported	
2.2. Specifications, size, location of the planned project	
2.3. Description of construction process, materials used, amount	
2.4. Life cycle of project construction, operation, dismantling time	
2.5. Description of operational process (incl. Raw materials, if such are used)	
2.6. Transportation of raw materials, products, labour, etc.	
2.7. Type of waste, amount	
Characterisation of environmental factors and processes of selected	
2.8. location, their dynamics	
2.9. Description of the project's socio-economic environment	
2.10. Description of indirectly affected territories	
2.11. Data sources, their quality, age, correspondence	
Final evaluation	

Criteria in Table 3 describe the prediction of impact, its assessment and preventive measures. In this section, it is important to identify whether all significant impacts have been described in detail, whether they each have appropriate, modern reduction activities recommended. In adherence to the criteria in this section, the report should not describe in detail those effects with insignificant consequences. The methods and/or programs according to which the potential amount of influence are modelled and predicted must be evaluated. Impact reduction activities must adhere to the principles of preventive measures, wherever possible, in order to reduce the source of pollution, and not the consequences created (that is, end-of-the-line activities are not used).

The fourth section of the method (criteria in Table 4) is the most significant of the assessment system because the most important EIA efficiency indicators are evaluated according to the criteria in this section – assessment of alternatives, public participation, and monitoring. These criteria define the fundamental principles of assessment efficiency, also incorporating those basic functions of the report which often contain vital inconsistencies in the evaluation of both reports from European

countries, and the EIA system as a whole. Alternatives are evaluated in a way that the best solution of the planned activity can be applied, corresponding to the best possible technology, and to select the most appropriate location for project implementation. Alternatives can be consciously selected so that the project initiator's first option is the most appropriate, by evaluating the quality of these criteria, the appropriateness of alternatives must be weighed.

Table 3. Criteria of the method's third section

Identifying impact, assessment, risk analysis	Evaluation
3.1. Potential environmental impact of the project	
Impact has been defined clearly, comparably, measurably, prediction methods and models are used	
3.2. Most significant effects have been described in detail	
3.3. Environmental impact has been assessed over the entire life cycle of the project	
3.4. Selection of impact prevention/reduction/compensation activities are adequate, corresponding to best practice and available technology, the principle of caution is observed	
3.5. Impact reduction activities include improvements to the project	
3.6. The effect of impacts to be reduced following reduction activities is described	
3.7. Risk analysis	
Final evaluation	

Table 4. Criteria of the method's fourth section

Description of the current situation and planned activities	Evaluation
4.1. A basis for selected alternatives (their type – location and/or technologies), consistent with most significant impact. Alternative selection begun in the initial stages of the EIA process.	
Selected alternatives include the principle of best possible technology, in accordance with project goals, if the selected alternative is the selection of a different territory, the selection is valid, adequate, comparable	
4.2. Participants of public consideration, submitted proposals	
4.3. Availability and conformity of publicly available information	
4.4. A monitoring plan is including, corresponding to the most significant potential effects	
Final evaluation	

The terms of correspondence of the method criteria developed in the project may change, through the application to specific types of projects, and due to the most significant current environmental issues. The criteria of the method are such that they can be applied to all types of projects (for example, wind turbines, roadwork, etc.). The method can be adapted to different types of projects by specifying the kind of information to be included in the report, to make it consistent with each criterion, through the use of information in the respective guidelines and practical examples. This type of modification of the method could increase its ease of use, and would facilitate its use by evaluators with a low level of competence in the field of the respective project.

CALCULATION OF THE ASSESSMENT RESULT

When evaluating a report using the method developed in this project, the evaluator must first evaluate the criteria of each section by applying a number of points on a scale of 0 to 5; explanations of these rankings are summarized in Table 5.

Table 5. Explanation of rankings of the method developed

Ranking	Explanation
5	Excellent, information is clear, understandable, complete, and of good quality
4	Good, overall satisfactory, with insignificant shortcomings
3	Satisfactory, with shortcomings and inconsistencies
2	Unsatisfactory, significant inconsistencies
1	Poor, significant shortcomings and inconsistencies
0	Very poor or information corresponding to criteria non-existent

Once each criterion has been evaluated with its corresponding ranking, each of the four sections is evaluated. The final evaluation of the section can be expressed mathematically, as the average arithmetic value of the criteria values using equation (1). The method may also be used where the evaluator selects the final evaluation of each section subjectively, by selecting the most significant project criteria of the specific report. These are then given a greater weight in the section's final evaluation

$$x = \frac{a_1 + a_2 + \dots + a_n}{n} \quad (1)$$

The EIA is a cyclic process, its sections are interconnected, and the EIS itself reflects the process. This means that the information contained in the first chapters of the report is also analysed in all further chapters. As a result, key conclusions are reached. While all report information is significant, the most essential for guaranteeing the functions of the EIA process are qualitative conclusions. For this reason, when developing a calculation diagram for method evaluation, specific sections in the final evaluation have been given a perceptibly larger weight. The sections of method criteria have been arranged in increasing order by significance in the evaluation of the report quality, and their significance is expressed as a percentage; this hierarchy can be seen in Fig. 2.

The final evaluation of the report is calculated using equation (2), by multiplying each section's final evaluation with its respective perceptual value according to Fig. 2:

- 1) Adherence to legislation – 10%;
- 2) Description of current situation and planned activities – 20%;
- 3) Identification of impact, assessment, risk analysis – 30%;
- 4) Monitoring, alternatives, public participation – 40%.

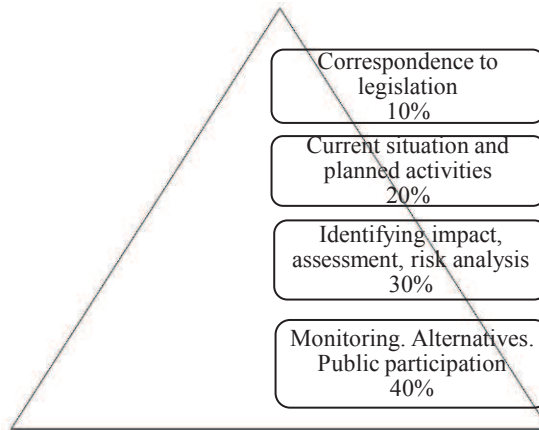


Figure 2. Division of section impact in the final evaluation.

Formula to calculate final evaluation of the report:

$$y = x_1 \cdot 10\% + x_2 \cdot 20\% + x_3 \cdot 30\% + x_4 \cdot 40\% \quad (2)$$

where: y – report assessment; x_1, x_2, x_3, x_4 – final evaluation of respective section.

As a result, the evaluator acquires the report evaluation on a scale from 1 to 5, and the result gained is an indicator. To achieve a comparable evaluation, the evaluation of each section must also be presented, and the evaluator should prepare a short summary discussing the main deficiencies in the quality, and other significant factors of the report.

CONCLUSIONS

1) This study has developed a method for EISs which can be used for the evaluation of the quality of reports. The goal of the method is to assess report quality with the least amount of criteria, but with those that encompass the most significant sections of the report. The method is binding to the initiator of the anticipated activity, and to the report's authors, in order to avert deficiencies during the development of the report, as well as for the competent institution, in order to be able to evaluate EISs systematically to obtain a comparable result, and to decrease the amount of time used in the evaluation of reports. The method can be applied to EISs already evaluated, to evaluate the overall quality and efficiency in the country of the EIA procedure.

2) In Latvia, the deficiencies in EISs are similar to those found in studies of other European countries. The most significant deficiencies are an incomplete assessment of alternatives, a lack of validity of selected alternatives, the degree of detail in measures to prevent, decrease and compensate for impact.

3) In comparing the evaluation of EISs by using the method developed in the project, and its evaluation according to the guidelines of the European Commission, it can be concluded that:

- In order to determine the most significant deficiencies of the report, a method with multiple questions need not be used;
- By using the method developed in the project, the report may be evaluated in a comparatively shorter period of time;
- The method developed in the project does not include all report elements that need to be corrected or supplemented, which means that it is not beneficial to the report author. However, the method indicates the most significant deficiencies in the report's quality.

ACKNOWLEDGEMENTS. This work has been supported by the European Social Fund project 'Involvement of Human Resources for Development of Integrated Renewable Energy Resources Energy Production System' (project No. 2013/0014/1DP/1.1.1.2.0/13/APIA/VIAA/026).



IEGULDĪJUMS TAVĀ NĀKOTNĒ

REFERENCES

- Androulidakis, I. & Karakassis, I. 2006. Evaluation of the EIA system performance in Greece, using quality indicators. *Environmental Impact Assessment Review* **26**(3), 242–256.
- Canelas, L., Almansa, P., Merchan, M. & Cifuentes, P. 2005. Quality of environmental impact statements in Portugal and Spain. *Environ Impact Asses.* **25**, 217–225.
- Canter, L. & Sadler, B. 1997. *A Tool Kit for Effective EIA Practice – Review of Methods and Perspectives on Their Application*. International Association for Impact Assessment. Lincoln, 157.
- Glasson, J., Therivel, R. & Chadwick A. 2005. *Introduction to Environmental Impact Assessment, Third Edition*, Routledge, London, 492.
- Lee, N. & Colley, R. 1990. *Reviewing the Quality of Environmental Statements*, University of Manchester, Manchester, 65.
- Morrison-Saunders, A. & Arts, J. 2006. *Assessing Impact: Handbook of EIA and SEA Follow-up*, Earthscan, London, 360.
- Munn, R.E. 1970. *Environmental Impact Assessment: Principles and procedures*, Wiley, New York, 190.
- Peterson, K. 2010. *Drivers of Effectiveness of Environmental Assessment*. Tallinn University. Tallinn, 56.
- Polonen, I. 2006. Quality control and the substantive influence of environmental impact assessment in Finland. *Environ Impact Asses.* **26**, 481–491.
- Polonen, I., Hokkanen, P. & Jalava, K. 2011. The effectiveness of the Finnish EIA system – What works, what doesn't, and what could be improved? *Environ Impact Asses.* **31**, 120–128.
- Sadler, B. 1996. *Environmental assessment in a changing world: evaluating practice to improve performance*. Canadian Environmental Assessment Agency. Ottawa, 263.