Environmental Impact Assesment (EIA) as a tool of sustainable infrastructure planning

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1 Theoretical background of EIA

Environmental impact assessment is considered to be one of main instruments of international environmental policy of sustainable development. In developed countries it has been implemented for more than three decades already. EIA is based on following principles:

- complexity of the assessment of expected impacts of a given activity and a strategic document on the environment before the decision on their permission,
- impacts assessment is carried out by experts from various spheres,
- wide and active public participation in the assessment process,
- alternative solutions,
- assessment process does not replace the permission process of the given activity.

Slovak government has signed the EU documents concerning environmental policy[1]. Following them, the Slovak Republic has to implement EIA process into the state environmental policy. To build an environmental sensibilisation of the society, is a long lasting process, reflected in the evolution of the environmental policy of Slovak Republic as well as EU policy.

Basic definitions

Environmental Impact (EI) is any direct or indirect environmental impact, including the impact on human health, fauna, flora, biodiversity, soil, climate factors, air, water, landscape, natural localities, tangible property, cultural heritage and the interrelationship between the above factors.

Environmental Impact Assessment (EIA) is a comprehensive identification, description and evaluation of the likely environmental impact of a strategic document and a proposed activity, including the comparison with the existing state of the environment in the place of their performance and in the area of the likely effect, including the preparation of the environmental impact statement, the carrying out of consultations, the taking into account of the final record, the environmental impact statement and the results of consultations in case of decision-making and the provision of information about the decision.

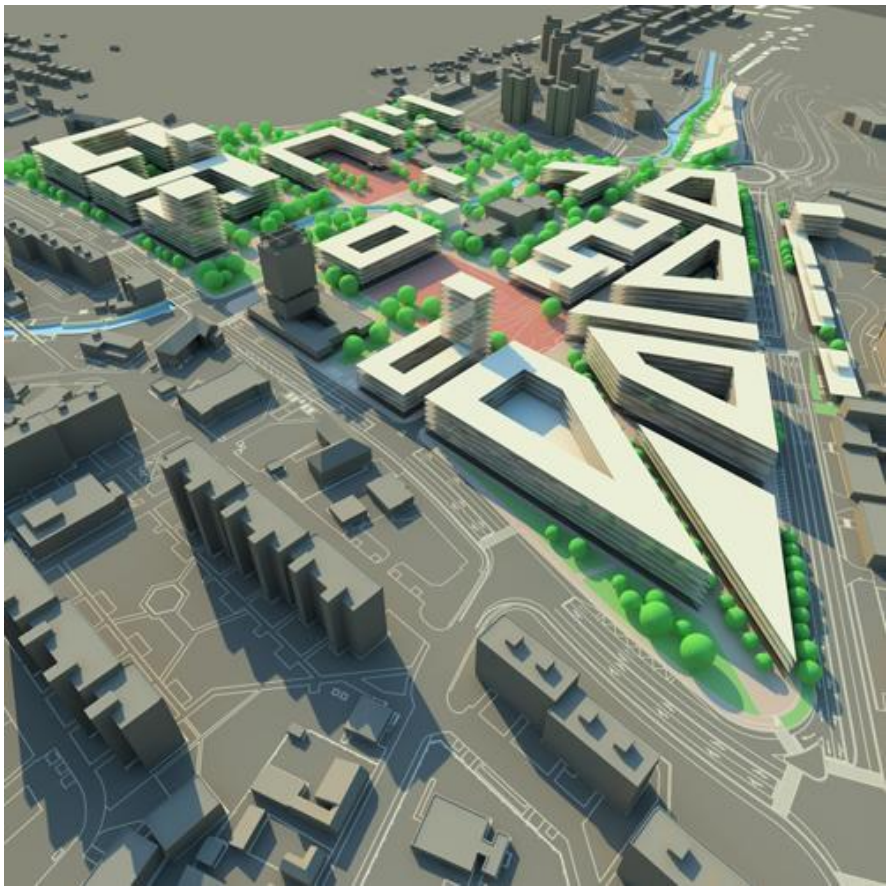
[1] Directive 2001/42/ES of the European parliament and of the council on the assessment of the effects of certain plans and programmes on the environment

Directive 2014/52/EU of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment

Strategic Document according to the Act No. 24/2006 Coll. on environmental impact assessment and on amendments to certain acts is a proposal of a policy, a development conception, a plan and a programme, including strategic documents, which are co-financed by the European Union, as well as their modifications, which are subject to preparation and approval by an authority at the national, regional or local level, or those prepared for adoption through a legislative procedure by Parliament or Government, which are required by regulations and which are likely to have the impact on the environment, including the impact on the areas protected according to special provisions, except for documents of a legislative character.

In Slovak republic a strategic document is a key document in general. EIA concerns mostly building industry, mining and Land Use Plans documentations (Figure 1).

Figure 17: Building structures has to be assessed according the Act No. 24/2006 Coll.



Source: G-atelier, 2007.

Assessment Process Goals

The assessment process contributes:

- to ensure a high standard of environmental protection and to contribute to the integration of environmental aspects into the preparation and adoption of strategic documents, with a view of promoting sustainable development,
- to ascertain, describe and evaluate direct and indirect impacts of a strategic document and a proposed activity on the environment,

- to explain and compare the advantages and disadvantages of a proposed strategic document and a proposed activity, including their alternatives, and this also in comparison with the zero alternative,
- to define the measures that will prevent the environmental pollution, mitigate the environmental pollution or prevent a damage to the environment,
- to obtain an expert ground for the adoption of a strategic document and for the issue of a decision for the permission of the activity under special regulations.

2 Legislative background

Slovak regulative

In the Slovak Republic the assessment has been carried out since 1994 when the Act No. 127/1994 Coll. of the National Council of the Slovak Republic on environmental impact assessment came into force. In order to provide for the full harmonisation of the Slovak legislation in the field of environmental impact assessment with the legislation of the European Union, the Act No. 391/2000 Coll. amending the Act No. 127/1994 Coll. of the National Council of the Slovak Republic on environmental impact assessment was adopted in 2000. This Act regulates in detail the process of impact assessment of constructions, installations and other activities on the environment. It simplifies substantially the impact assessment of draft principal development conceptions, territorial planning documentations and generally binding legal regulations (Strategic Impact Assessment - SEA).

At present the Act No. 24/2006 Coll. on environmental impact assessment and on amendments to certain acts applies, which entered into force on 1st February 2006. It regulates comprehensively the environmental impact assessment, strategic documents assessment and impact assessment of constructions, installations and other activities on the environment. The Decree No. 113/2006 Coll. of the Ministry of Environment, regulates the details of the professional qualification for the purposes of environmental impact assessment.

EU regulative

The requirement to adopt the Act No. 24/2006 Coll. on environmental impact assessment and on amendments to certain acts ensued from the fact that the European Union has adopted recently other directives concerning environmental impact assessment:

- Directive of the European Parliament and of the Council 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment
- Directive 2003/35/EC of the European Parliament and of the Council providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice
- Directive 2003/4/EC of the European Parliament and of the Council on public access to environmental information and the Slovak Republic as the Member State is obliged to harmonise the Slovak legislation with the above-mentioned directives.

3 EIA process

Assessment Process participants

Competent authority is an authority of the state administration governing the environmental impact assessment process, which is the Ministry of Environment of the Slovak Republic, the Regional Environmental Office and the District Environmental Office
Departmental authority present central authority of the state administration, to whose competence the proposed activity belongs; in case of the assessment of strategic documents of a nationwide effect it is the body, which submits the proposal of such strategic document for the negotiations of the Government of the Slovak Republic
Procurer a legal person or a natural person that provides for the elaboration of a strategic document
Proponent is a legal person or a natural person intending to carry out an activity to be assessed according to this Act
Approving authority is a public administration body competent to approve a strategic document
Permitting authority is a state administration body competent to issue the permitting decision on the proposed activity under special regulations
Affected authority is a municipality, on whose cadastral area the activity is to be carried out and whose area will be affected by the activity
Public consist of other participants, understood in the widest sense, including the public concerned (a civic initiative, a civic association, a non-governmental organisation)
Professionally qualified persons are experts from various fields of science, technology and practice registered in the list of professionally qualified persons.

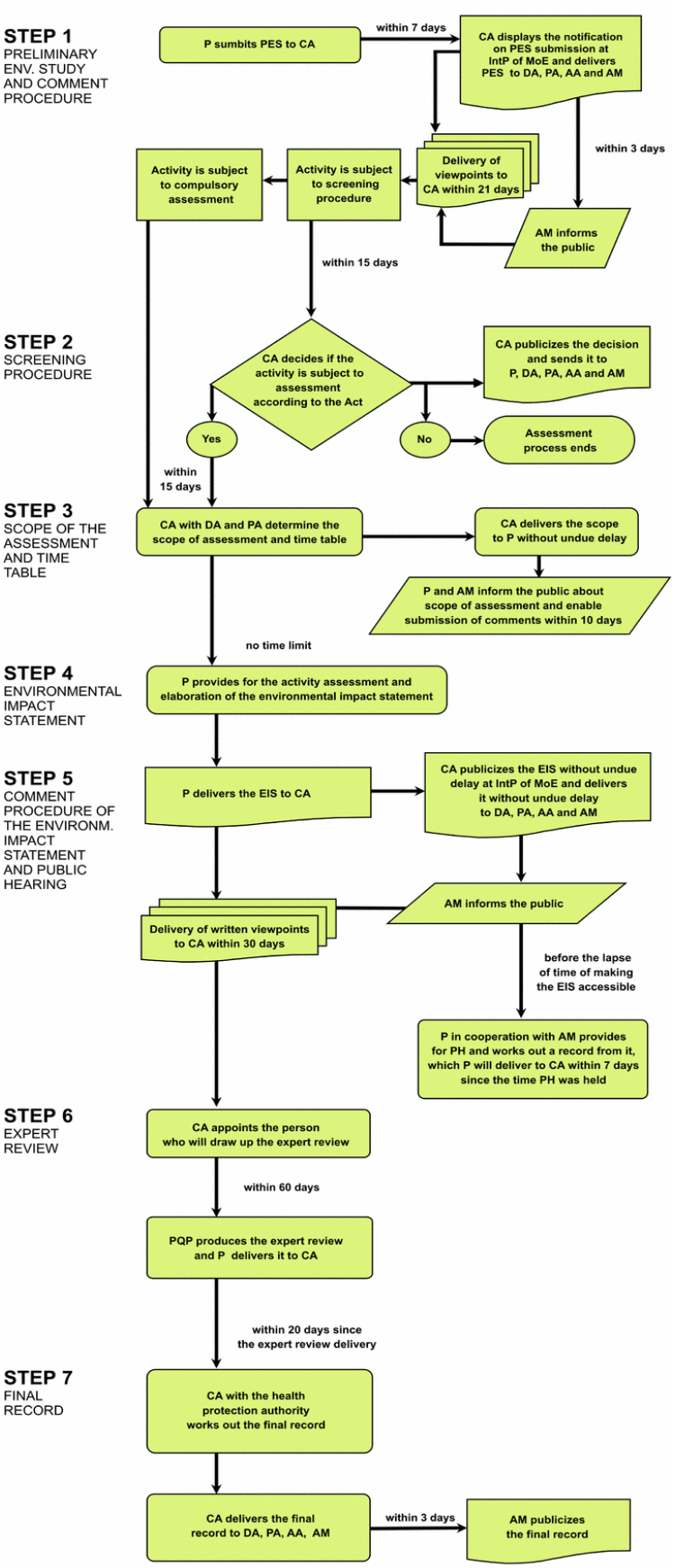
EIA steps

EIA steps diagram shows the EIA process, that can take few months - couple of years. EIA process should be a guarantee, the selected alternative is the best from different aspects, mostly the environmental and public is involved in Decision making process[2] (Říha, 1995). 2 Surely these two aspects are usually not convenient with the intentions of investor. The existence of suitable method of assessment can be useful and easy aid during the planning of the action.

The standard EIA process consist of following steps (Figure 2).

[2] The two most important contributions of EIA is, it is an instrument of environmental protection and involve the public in the decision process.

Figure 18: Diagram of EIA steps diagram



EIA control mechanism

Screening
is the process of deciding on whether an EIA is required. This may be determined by size (e.g. greater than a predetermined surface area of irrigated land that would be affected, more than a certain percentage or flow to be diverted or more than a certain capital expenditure). Alternatively, it may be based on site-specific information. For example, the repair of a recently destroyed diversion structure is unlikely to require an EIA whilst a major new headwork structure may. Guidelines for whether or not an EIA is required will be country specific depending on the laws or norms in operation. Legislation often specifies the criteria for screening and full EIA. All major donors screen projects presented for financing to decide whether an EIA is required.

Scoping
occurs early in the project cycle at the same time as outline planning and pre-feasibility studies. Scoping is the process of identifying the key environmental issues and is perhaps the most important step in an EIA. Several groups, particularly decision makers, the local population and the scientific community, have an interest in helping to deliberate the issues which should be considered, and scoping is designed to canvass their views. Scoping is important for two reasons. First, so that problems can be pinpointed early allowing mitigating design changes to be made before expensive detailed work is carried out. Second, to ensure that detailed prediction work is only carried out for important issues. It is not the purpose of an EIA to carry out exhaustive studies on all environmental impacts for all projects. If key issues are identified and a full scale EIA considered necessary, then the scoping should include terms of reference for these further studies.

Mentioned mechanisms requires time and finances. According the to the Decree No 113/2006 Coll. Only a professionally qualified person/organisation can prepare EIA documentation. (The list of professionally qualified persons is available for public).

Prediction and mitigation
Once the scoping exercise is complete and the major impacts to be studied have been identified, prediction work can start. This stage forms the central part of an EIA. Several major options are likely to have been proposed either at the scoping stage or before and each option may require separate prediction studies. Realistic and affordable mitigating measures cannot be proposed without first estimating the scope of the impacts, which should be in monetary terms wherever possible. It then becomes important to quantify the impact of the suggested improvements by further prediction work. Clearly, options need to be discarded as soon as their unsuitability can be proved or alternatives shown to be superior in environmental or economic terms, or both. It is also important to test the "without project" scenario.

Management and monitoring
The part of the EIS covering monitoring and management is often referred to as the Environmental Action Plan or Environmental Management Plan. This section not only sets out the mitigation measures needed for environmental management, both in the short and long term, but also the institutional requirements for implementation. The term 'institutional' is used here in its broadest context to encompass relationships:

- established by law between individuals and government;
- between individuals and groups involved in economic transactions;
- developed to articulate legal, financial and administrative links among public agencies;
- motivated by socio-psychological stimuli among groups and individuals.

Audit
is provided in order to capitalise on the experience and knowledge gained. Audit should by the last control stage of EIA process that help to check the completion of the project or implementation of a programme. It will therefore usually be done by a separate team of specialists to that working on the bulk of the EIA. The audit should include an analysis of the technical, procedural and decision-making aspects of the EIA.

Methods of Assessment process

A number of methods have been developed to compare impacts by applying values to them. The relative importance of impacts, e.g. wetlands loss versus rare species loss, or the relative importance of criteria, e.g. economic vulnerability versus probability of occurrence, will depend on the local environment and priorities. Ranking, and therefore implicitly value, can be determined by using the pair-wise comparison technique described above, except that, rather than comparing options, criteria are compared instead. This can enable a series of weightings to be developed which will be entirely site-specific and dependent upon the subjective choices of those participating in the group which develops the weightings.

Assessment can be provided by different methods and their combinations, like: Baseline studies, Check-list, Matrices, Networks diagrams, Overlays, Mathematical modelling, Expert advice, Economic techniques and others[3].

Assessment methods should to help to choose an optimal alternative. Usually assessment process uses the combination of different method. You can recognise all of them have strong sides but the weaknesses as well. For optimisation the human control is essential.

4 Application

EIA documentation

EIA is provided more than two decades in Slovak republic. According to Act. Act No. 24/2006 Coll. hundreds of projects have been already assessed. Results of assessment are published in documents - Preliminary Environmental Study (PES) and Environmental Impact Statement (EIS). The main difference between them is, that PES is a brief study, containing less details about the planed action like EIS. Slovak regulative about EIA dictates compulsory structure of the both of the documents (PES and PIS). There have been provide an analysis of its structure and classified into five types (Figures 3, 4, 5):

[3] Checklists, matrices, networks diagrams, graphical comparisons and overlays, are all techniques developed to help carry out an EIA and present the results of an EIA in a format useful for comparing options. The main quantifiable methods of comparing options are by applying weightings, to environmental impacts or using economic cost-benefit analysis or a combination of the two. Numerical values, or weightings, can be applied to different environmental impacts to (subjectively) define their relative importance. Assigning economic values to all environmental impacts is not recommended as the issues are obscured by the single, final answer. However, economic techniques, can provide insight into comparative importance where different environmental impacts are to be compared, such as either losing more wetlands or resettling a greater number of people.

Figure 19: Documentation content

mark	type
	general information
	descriptive part
	monitoring and plan of mitigation of negative impacts
	summarising part
	assessment of the planned action

Figure 20: Structure of Preliminary Environmental Study (Act 24/2006 Coll., attachment n°9) and classifying of the content into five types

Structure of Preliminary Environmental Study (Act 24/2006 Coll., attachment n°9)		**type**		
I.	General infornation about the proponent	general information		
II.	General infornation about the planned action	general information		
III.	Description of current environmental state of the touched area	descriptive part		
IV.	General information about the assumed impacts of the planned action, plan of mitigation of negative impacts	monitoring and plan of mitigation of negative impacts	summarising part	descriptive part
V.	Comparison of alternatives of planned activity and optimal alternative	**assessment of the planned action**		
VI.	Maps and figures	general information		
VII.	Attachments	general information		
VIII.	General informations about the statement	general information		

Figure 21: Structure of Environmental Impact Statement (Act 24/2006 Coll., attachment n°11) and classifying of the content into five types

part	Structure of Environmental Impact Statement (Act 24/2006 Coll., attachment n°11)		type	
A.	GENERAL INFORNATION			
	I.	General infornation about the proponent	general information	
	II.	General infornation about the planned action	general information	
B.	INFORMATION ABOUT DIRECT IMPACTS OF PLANNED ACTION			
	I.	Requirement inputs	descriptive part	
	II.	Outputs characteristics	descriptive part	
C.	KOMPLEX DESCRIPTION AND EVALUATION OF ASSUMED IMPACTS OF PLANNED ACTION			
	I.	Touched area borders	descriptive part	
	II.	Description of current environmental state of the touched area	descriptive part	
	III.	Assessment of assumed impacts of planned action and its signification	descriptive part	summarising part
	IV.	Plan of mitigation of impact of planned action	monitoring and plan of mitigation of negative	
	V.	Comparison of alternatives of planned activity and optimal alternative	**assesment of the planned action**	
	VI.	Plan of monitoring and audit	monitoring and plan of mitigation of negative	
	VII.	Description of assessment methods and ways of collecting of information	**assessment of the planned action**	
	VIII.	Analysis of weeknesses of assessment methods, lack of important informations, risks	**assessment of the planned action**	
	IX.	Attachments	general information	
	X.	General summary	summarising part	
	XI.	List of qualified persons and organisations preparing the documentation	general information	
	XII.	List of supplementary documentation	general information	
	XIII.	General informations about the statement	general information	

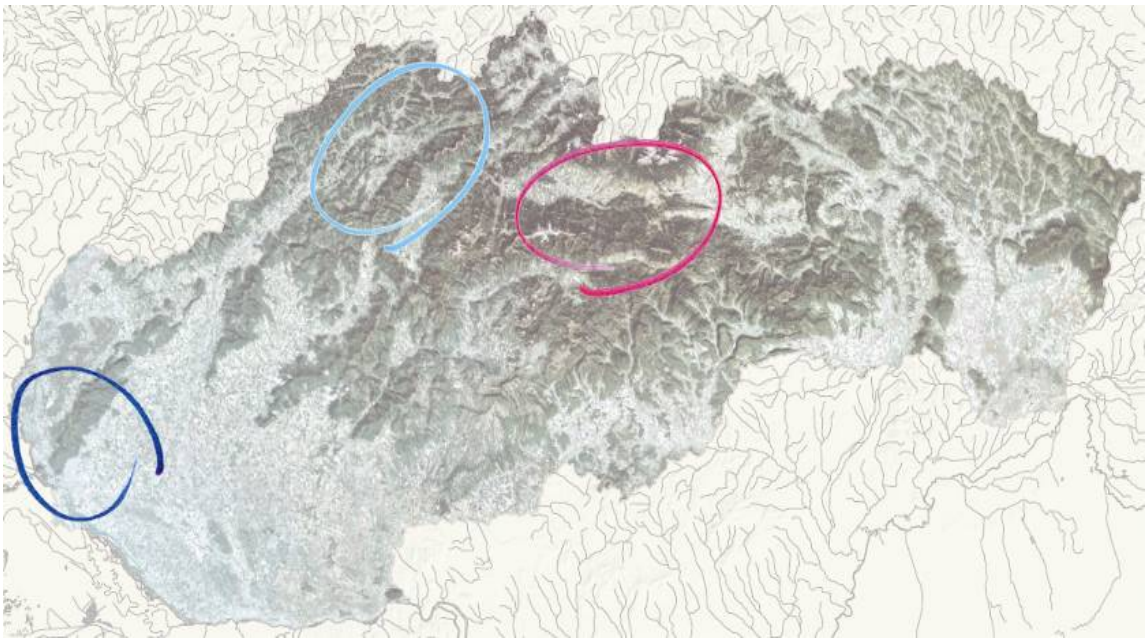
Analysis of the structure of documentation shows the types of content of documentation. The most important part considering the assessment process, assessment methods and way of choosing the most appropriate alternative is classified as "Assessment of the planned action" (yellow part).

Representative sample

To analyze, how EIA has been provided in practise, there have been chosen a representative sample (RS). The representative sample consist of six documents - Preliminary environmental studies or Environmental Impact Statements.

In chosen representative sample there have been assessed linear structures - railway or highway segments. These segments are placed in three different Slovak regions (Figure 6).

Figure 22: Representative sample was chosen from three different Slovak regions



The analysed documentation provides the assessment of these linear structures:

a) highway segment - D1, Važec - Mengusovce (12,225 km), (EKOPED, 1996)
b) railway segment - Kráľova lehota – Važec – Lučivná (33,05 km), (REMINGCONSULT, 2006)
c) highway segment - D3, Hričovské Podhradie – ZA /Strážov /- ZA /Brodno/ - Kysucké Nové Mesto (23,000 km) (ENVICONSULT, 1997)
d) railway segment - Žilina – Krásno nad Kysucou (19,884 km)[4], (ENVICONSULT, 2001)
e) highway segment - D4, Jarovce – Ivanka /Sever/ (12,225 km), (GEOCONSULT, 2007)
f) railway segment - TEN-T Bratislava (6,900 km)

[4]Chosen assessment method in this case was the check-list.
Procedure of selecting the best alternative starts with:

1. selection of criteria - they were grouped into technical-economical (realisation costs, time of realisation, technical standards need, exigency of modernisation), impact on inhabitants and urbanized zones - social impacts (socio-economic impacts, noise and pollution), environmental impacts (water, soil, landscape).
2. comparison of alternatives - there were assessed two alternatives (new and the zero alternative)
3. final evaluation

From the technical-economical point of view the zero alternative is naturally the better solution than the modernisation, because it does not evoke new costs. But it represents short-term solution.
Social impacts of modernization will be positive, because the modernization will decrease noise (about 0,6 dB/A) in comparison with zero alternative. In condition the noise amendments (noise barriers), noise can decrease about 4,9 dB/A after the modernization. The number of inhabitants exposing to noise from transport will reduce as well (from 2% to 13%).
Environmental impacts seem to be similar with a slight preference of the zero alternative.

The analysis of documentation was focused on assessment of the planned action, way of the selection of proposed alternatives and assessment methods. There was provided four types of analyses:

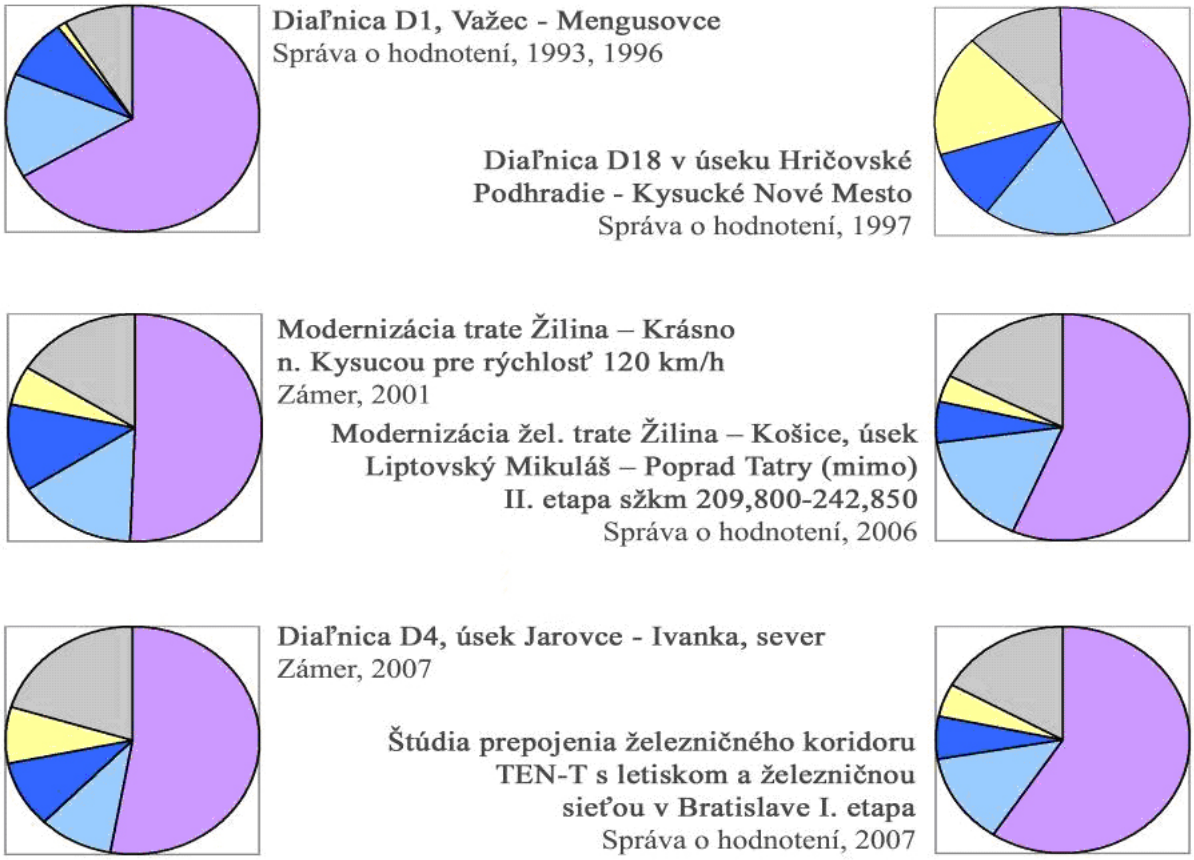
- analysis of the Structure of documentation
- description of alternatives
- analysis of assessment methods and results summary

Analysis of the Structure of EIA documentation of RS

Analysis of the documentation structure shows what types of information does it contain (Figure 7).

Figure 23: Analysis of documentation structure

mark	type
	general information
	descriptive part
	monitoring and plan of mitigation of negative impacts
	summarising part
	assessment of the planned action



Analysis shows the hugest part in representative sample is usually the descriptive part (violet), general information (grey), summarising part (light blue), monitoring and plan of mitigation of

negative impacts (dark blue). The assessment of planned action involving the method of choosing the optimal alternative is in general the briefest part (yellow).

It is evident the hugest part of documentation is focused on descriptions. On the opposite side, syntheses and assessment and final evaluation represents just a fragment of documentation. This increases the time and financial needs and the documentation becomes less transparent and comprehensible.

Short description of the alternatives

There were analysed six case studies. According the Act 24/2006 Coll. there has to be assessed at least two different alternatives and zero alternative. Usually the number of assessed alternatives was three (two new and the zero alternative). The description is a huge part of the research, not involved in this chapter.

Analysis of assessment methods and results

Analysis of the reference sample confirm, that the chosen list of assessment criteria is related to landscape typology[5]. Number of criteria varied from 12 to 25, usually ranged into the groups (economical, social, environmental, technical). Confusion of terms is very typical.

Reference sample analysis discovered, that the more complicated the method of assessment is, the less usable in the praxis gets.

Professionally qualified person pays a great attention to descriptive part and collecting the information about the environment and the planned action. They elaborate their own list of assessment criteria. The analysis and evaluation is controlled during the assessment process and the decision of professionally qualified person is the most decisive criterion.

Landscape typology

The research has confirmed the hypothesis, that the character of landscape has significant impact on assessment process (MÜCHER, 2003). Landscape typology has to be elaborated and the landscape types has to be specified.

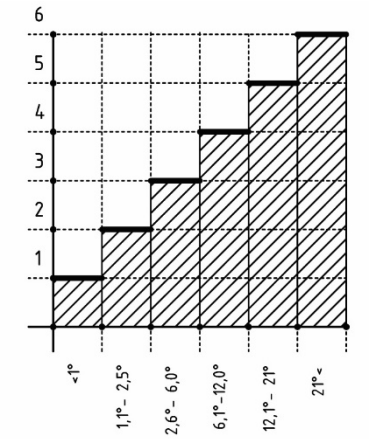
In Slovak republic there are elaborated different types of landscape classification (OŤAHEĽ, 2008), (SAŽP, 2002). For assessment process EIA, some of them were selected and appropriated for our needs (MATULA, 1988). There we selected some of the features of the landscape /criteria of assessment EIA, essential in the assessment process, among them:

- Terrain type
- Geology
- Risks (flooding, landslides...)
- Land use (urbanized area, arable soil, pastures, forest lands...)
- Landscape types according to the environmental protection
- Water sources in the landscape
- Cultural heritage

Each of the group has its subgroups. For example, there are six levels of evaluation the terrain types, according with the slope (Figure 8).

[5] The case study serves to show the applying of one of the assessment method. This method prerequisite the elaboration of landscape typology (MEEUS, 1995).

Figure 24: Classification of terrain types according the slope



According to mentioned criteria each of them represents specific condition for providing an action (for example to build a highway segment there).

Model example

Model example shows the application of the assessment method. Selected criteria of assessment EIA (terrain type, geology, risks, land use, landscape types according to environmental protection, water sources in the landscape, cultural heritage) are classified. There is a real example of modernisation of the railway segment passing through High Tatras (Figure 9).

Figure 25: Railway segment passing through High Tatras Kráľová Lehota - Lučivná

Assessment is providing on three proposed alternatives - "Red", "Green" and "Zero" alternative (the existing one) (Figure 10).

Figure 26: Assessed alternatives of planed modernisation of railway segment

Three different alternatives have different impacts on the environment. Each of the alternative has differed features. Results were calculated after the analysis of all the selected criteria (terrain type, geology, risks, land use, landscape types according to environmental protection, water sources in the landscape, cultural heritage).

Assessment was provided on three alternatives of railway segment. They pass through different landscape types (classified). The length of the segment was an important factor influenced the final evaluation.

5 Conclusion

Research deals with environmental assessment process of linear types of structures (highways and railways segments). The focus is on method of selection of an ideal alternative, to help EIA process be more effective. Proposed method can be applicable in the most of cases. The base for research stands on analyses of existing mathematical models of assessment and methods of assessment applied in praxis. Proposed method is based on landscape typology, an important factor of assessment. There have been formulated a list of assessment indicators and their rating scale:

- Terrain type
- Geology
- Risks (flooding, landslides...)
- Land use (urbanized area, arable soil, pastures, forest lands...)
- Landscape types according to the environmental protection
- Water sources in the landscape
- Cultural heritage

General use of proposed method is documented by application on a real existing segment of linear structure.

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