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The importance of environmental risk assessment in infrastructure projects

MAŠA MAJKIĆ, ANA CERK, URŠA FLEŽAR, URŠKA KUGONIČ, RUDI VONČINA, MAKS BABUDER
Elektroinštitut Milan Vidmar, Hajdrihova 2, 1000 Ljubljana
Slovenia

SUMMARY

Environmental risks, in particular the risks associated with environmental protection regimes and risks arising from the social unacceptability of infrastructure projects largely affect their planning. In order to avoid possible conflicts, it is recommended that the environmental risks are recognized accurately in the early stage of the formal procedure of the project and respected throughout the entire life span of an energy facility.
This paper presents an example of the approach implemented to improve infrastructure planning and environmental assessment procedure. The approach is based on preliminary studies of local characteristics and on sensitivity models of the study area and serves to assess the risks arising from protection regimes and local environmental resources. It highlights the importance of considering spatial planning stakeholders and local communities in the earliest phases, and throughout the whole planning process.
Finally, we give recommendations on the implementation of the suggested risk assessment approach in the planning process.

KEYWORDS

Risk assessment, sensitivity analysis, environmental protection, infrastructure planning.

masa.majkic@eimv.si

Introduction

Risk assessment is a quantitative or qualitative determination of the risk associated with a specific situation and with recognized threat or danger in this situation. Risk assessment requires consideration of two main components of an identified risk: the magnitude of a potentially negative effect and the probability that this effect would occur. Risk is acceptable when the benefit of an implementation of a particular measure is greater than the expected loss [1].

When discussing risk assessment of power lines, the aspects of operational safety, system reliability and public health are particularly emphasized. On the other hand, consideration of environmental risks, especially risks associated with protection regimes and risks arising from social unacceptability of the projects are sometimes underestimated, although they can largely affect the business processes and spatial planning.

During the planning process of infrastructure projects, it is necessary to ensure compliance with environmental legislation and assess the potential environmental risks accurately. Legal documents, such as Directive 2014/52/EU, define the scope of the assessment, defining the thresholds and the limit values for different environmental components. However, the scope of the legal documents sometimes fails to address all the possible environmental effects of a proposed project plan. Despite being included in the national Constitution, those overlooked risks can remain excluded from the sectoral legislation. Thus, we need to decide whether the recognized risks are of legitimate or of legislative nature and consider them appropriately during the assessment process.

Implementation of risk assessment in the planning process

Before the official start of a decision making process, spatial planning stakeholders get acquainted with the initiative for spatial plan, which is based on publicly available data. The initiative presents the environmental protection regimes, but does not discuss them in detail. Through a formal consultation, stakeholders present different legislative risks for the initiative document. They can express their development needs and spatial planning requirements in relation to the proposed plan, provide guidelines for the further planning process and define the acceptability of a plan from their perspective during the final stages of the planning process. Stakeholder consultation is necessary during the preparation of national spatial plans for infrastructure projects and may subsequently affect the activities in the following process.
On the other hand, public participation is weak and consultation with local communities often entirely omitted. However, it is the local communities that lay an emphasis on the legitimate risks for the proposed project plan. Legitimate risks act as a valuable addition to the legislative measures and have a potential to improve the prescribed process of the environmental risk assessment. These risks are mostly associated with the impacts of public infrastructure on human well-being, the quality of the living environment and the impacts on private property values. If not tackled carefully, the legitimate constrains represented by the local communities can significantly impede the project planning.

Overall, both legislative and legitimate environmental constraints are often inadequately addressed during the spatial planning, often due to the inflexibility of the infrastructure project planners. Sometimes, environmental constraints are even disregarded completely in the early phases of the spatial planning and only addressed at the later planning phases.

Meanwhile, stakeholders may act individually or even counteractively and the wider public may develop a strong negative attitude towards a particular spatial plan. In case the environmental constraints are considered too late, serious conflicts between project planners and different stakeholders and local communities may arise. In turn, conflict mitigation can severely delay the siting of the spatial arrangements.

It is thus crucial to establish an honest relationship among all stakeholders, with a special focus on the local communities, from the beginning of the planning process. Cooperation and exchange of experiences between different stakeholders plays an important role when deciding about the most appropriate location and most suitable technology for the local area. Improving the dialogue between the project planners and the stakeholders also helps to reduce the environmental risks in spatial planning to the lowest possible level. In order to succeed, both legislative and legitimate environmental constraints should be recognized in the earliest stages of the formal procedure of the project. Furthermore, in order to maintain the positive relationship between the project investors and other participants, the identified constraints should remain respected throughout the whole process and during the entire life span of an energy facility.

With such an approach, the project planner will be able to reduce the environmental risks for the project to the lowest possible level [2]. It can also help to design a "Disaster Resilient Spatial Plan [3]" which can considerably shorten the implementation procedure of infrastructure facilities.

Addressing the issues presented above we performed a study that considers the sensitivity of the local environmental attributes and aims to reduce the environmental risks for a planned transmission infrastructure [4]. Our study complements risk assessment approach by focusing on the appropriate integration of both spatial planning stakeholders and local communities already at the earliest phases of the formal project planning process.

Methodology

In the earliest phases of a proposed plan for a new high-voltage transmission line, we performed a study based on the analysis of local characteristics of the project area and the sensitivity models representing these risks. The study was made in two main steps:

1. Evaluating environmental risks of the area; i) assessing the risks that arise from the restrictions of protection regimes (Table 1) and ii) identifying the least sensitive areas for the realization of the spatial arrangements in a simple sensitivity model (Figure 1) [4]
2. Building a sensitivity matrix that reflects the environmental sensitivity of each power line alternative according to the recognized environmental attributes (Table 3)

We limited the first step of the study to the environmental components, available from the public databases. For each environmental component, we accounted for their attributes and estimated the potential impacts that considered technology could represent for these attributes (Table 1). According to the impact classification (Table 2), we then evaluated the environmental risks and incorporated them in a sensitivity model (Figure 1). This step was done at the earliest phase of the project planning, prior to the formal environmental assessment procedure.

During the first step, we also accounted for the effects of the existing power lines and the plans for the transmission infrastructure to be adopted in the near future.

ATTRIBUTES	COMPONENTS	POTENTIAL IMPACTS
SOCIAL ATTRIBUTES	Settlement	inhabitation potential, impact on existing inhabitation
	Economic activities	economic development, loss of income, the number of employees
	Social values	tourism, recreation and free time
	Cultural heritage	culture
NATURAL ATTRIBUTES	Natural resources and natural areas	adverse effects on sensitive natural areas and ecosystems
SPATIAL ATTRIBUTES	Geomorphology	terrain stability
	Spatial potentials of the area	temporary or long term loss of land, floor area and spatial use
	Landscape	visual impact on landscape and environment
ENVIRONMENTAL ATTRIBUTES	Soil quality	soil contamination, soil modification
	Water quality	running water and underground water quality
	Air quality and climate conditions	air quality
HEALTH PROTECTION	Noise	human health impact
	Electromagnetic radiation	
	Light pollution	
	Drinking water	

Table 1: Environmental attributes and impact on environmental quality indicators [3]

In the next phase, we considered the requirements, demands and future plans and identified the potential conflict points on the field. This information was obtained with consideration of different stakeholders' requirements and social values of local area. We upgraded the sensitivity model with the acquired information and estimated the environmental sensitivity of each power line route alternative, based on criteria shown in Table 2. Finally, we identified the most significant environmental impacts of each route alternative in a sensitivity matrix (Table 3).

Impact classification	Sensitivity level	Definition of impact classification
I. (level 1-2)	Not sensitive areas	The potential impact on value is negligible.
II. (level 3-5)	Sensitive areas	The potential impact of value is small.
III. (level 6-8)	More sensitive areas	The potential impact of value is moderate.
IV. (level 9-10)	The most sensitive areas	The potential impact of value is devastating.

Table 2: The scale of the sensitivity of the environment and impact on the environment [4]

Main findings of the study

During the first phase, we identified the most sensitive areas in the environment with model calculations. Those were the areas with the highest risk for a successful transmission line project realization (Figure 1, in red). The most important risks to consider in the study area were the risks arising from cultural protection regimes and the risks associated with the living environment.
On the other hand, the model suggests the least conflict areas with the lowest risk for the transmission line implementation (Figure 1, in green).

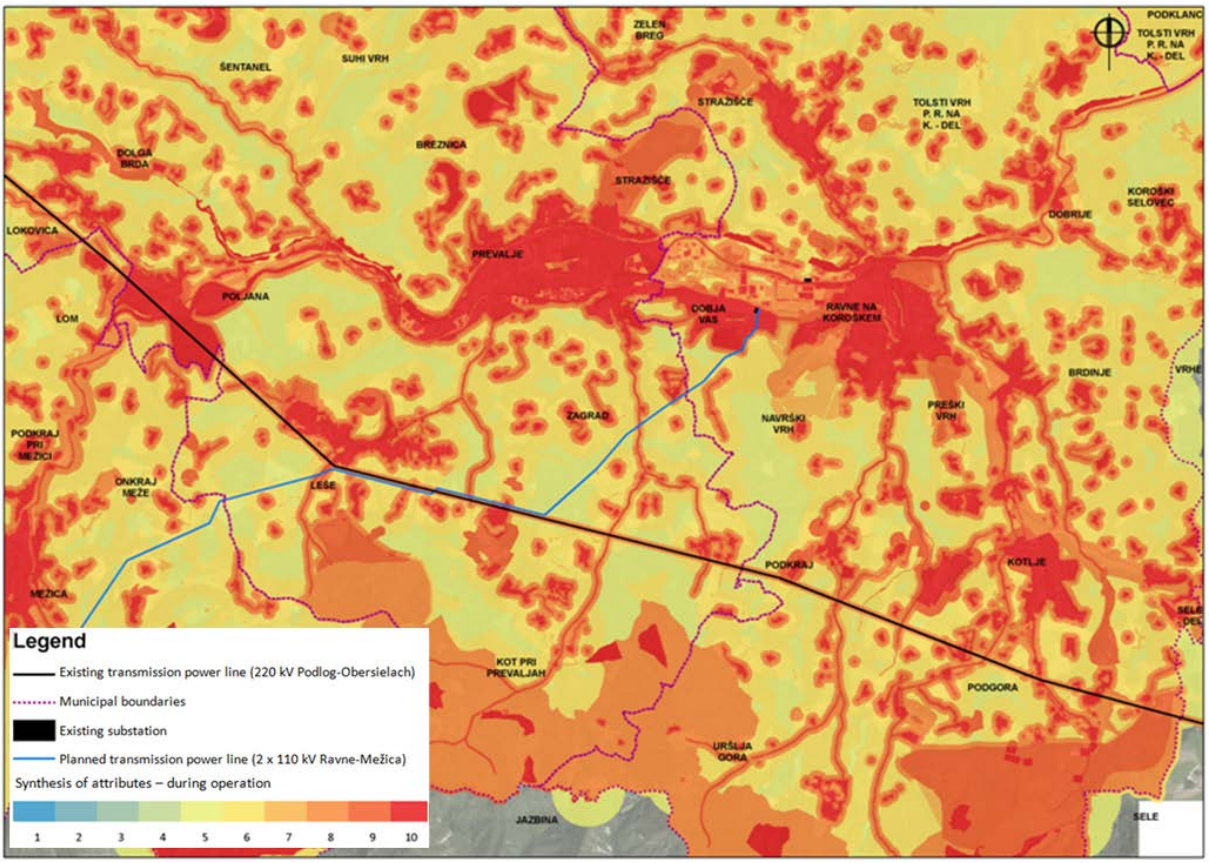

Figure 1: Sensitivity model of all the components with a potential environmental impact (during the operative phase of a transmission line) [3] The most sensitive areas are colored in red.

The areas with the greatest risk (Figure 1) were then analyzed in more detail and critically evaluated though stakeholder consultation. The sensitivity matrix produced afterwards (Table 3) shows that the most sensitive environmental components for the project are social values and cultural heritage of the area. Additionally, some spatial attributes (landscape and spatial development potentials) and forestry are important factors to consider.

As the sensitivity matrix examines the sensitivity of the environmental components for each power line alternative, we can also suggest the alternatives with the least environmental risks. As the most environmentally acceptable were recognized alternatives 1 and 2.

		Variant							
		1	2	3	4	5	6	7	8
SOCIAL ATTRIBUTES	Social values								
	Cultural heritage								
	Forestry								
	Agricultural land								
	Industry and trade								
	Public infrastructure								
	Settlement								
NATURAL ATTRIBUTES	Natural resources and natural areas								
SPATIAL ATTRIBUTES	Landscape								
	Geomorphology								
	Spatial potentials of the area								
ENVIRONMENTAL ATTRIBUTES	Soil quality								
	Water quality								
	Air quality								

Legend:

	Not sensitive areas
	Sensitive areas
	More sesitive areas
	The most sensitive areas

Table 3: Sensitivity of the individual environmental components (during the operating phase of the transmission line) [3]

Discussion

During the risk assessment, it is necessary to identify the implications of the regulation or the changes in regulation for the considered infrastructure plan. Moreover, it is important to optimize the siting of spatial arrangment in order to distance it from the individual sensitive areas.
However, due to the changed relationship between operators, individuals and various public and civil society stakeholders, the legally required environmental assessment and the related activities are no longer sufficient. Prescribed procedures could be accompanied by a new paradigm (examples and models of operation), because public opinion is changing faster than regulations.

Public opinion is most commonly expressed as opposition to a specific project; first locally, then on the wider scope.

Therefore it is necessary to improve the communication with stakeholders and local communities. If we ignore the people and other stakeholders we risk opposition and eliminate the possibility of argumentative dialogue, which is essential in the planning process.
With the presented approach, we can improve the estimation of the potential consequences of the recognized risks and evaluation of the probability of an impact. Identifying the risks at the beginning of the environmental impact assessment could clearly define the potential harm for the environment that a proposed plan could cause.

The approach suggested has so far been well accepted amongst different stakeholders and we suggest such an approach to spatial planning could be treated as a valuable addition to the existing procedure.

Investors should update the methods of monitoring and reporting, and not percept those as an obligation, but as part of a stable business process that requires continuous adaptation.

We recommend regular and continuous monitoring of at least four areas:

- Legal environmental protection regimes (nature protection, cultural heritage protection, water protection areas, forests) and the requirements of other sectors
- Spatial Development of local areas where infrastructure projects are planned
- Human well-being, quality living environment and property value
- Active public involvement alternatively to the compulsory informing of the public

Currently extremely important aspect in risk assessment is careful consideration of perceptions of nature, cultural heritage and living environment with an affinity, expressed by nature protection services and local residents. Aiming towards a balanced consideration of counteracting interests during the planning process, balancing the interests of strictly opposing parties remains greatly challenging.

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