

**Guidelines for the systematic
impact significance assessment
– The ARVI approach**

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**Improving environmental assessment
by adopting good practices and tools
of multi-criteria decision analysis**

1. Principles of impact significance assessment with the ARVI approach

1.1. Assessment framework

One deliverable of the IMPERIA project is a systematic approach called ARVI for assessing the significance of the expected impacts of a proposed development project. The fundamental principle of the ARVI approach is that for each impact (for instance noise, landscape or water quality) one first assesses the sensitivity of the target receptor in its baseline state, and then the magnitude of the change, which would probably affect the target receptor as a result of the proposed project. An overall estimate of the significance of an impact is derived from these judgments. Both the sensitivity of the target receptor and the magnitude of the change are evaluated systematically based on more detailed sub-criteria (Figure 1). These criteria are described in more detail on the following pages.

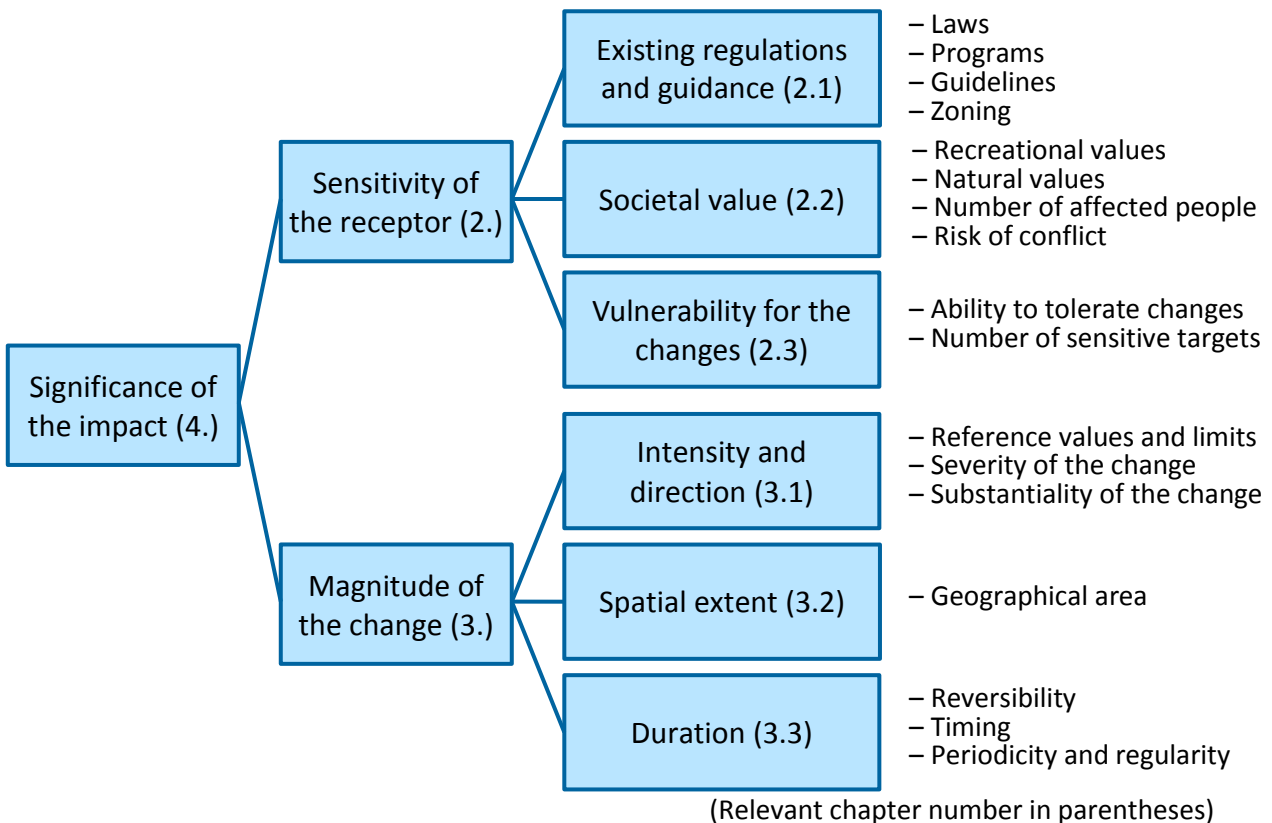


Figure 1. The structure of the ARVI approach.

The objective of this approach is to improve the transparency and consistency of impact assessment. In addition, the approach aims to promote dialog among EIA experts, between experts and stakeholders, and to improve the stakeholders’ and citizens’ understanding of impact characteristics.

1.2. Assessment process

The assessment process is described in Figure 2. For each alternative and impact combination under evaluation, an assessment form is filled including all the factors in the figure. Typically, each impact is assessed by an expert of the particular field, who evaluates all the alternatives with respect to this impact. Besides evaluation, it is important to also document the basis and rationale for reaching the conclusion in the evaluation form.



Figure 2. The assessment process with the ARVI approach.

First, one has to consider whether assessment of the following aspects can be integrated or should be addressed separately:

- Phases of the project, including construction, operation and decommissioning phase
- Separate actions comprising the alternatives
- Near and far impact zones
- Time periods of the impacts

If the impacts do not essentially differ from each other in terms of these dimensions, it is sufficient to fill in a single ARVI form. In other cases, one has to consider filling separate evaluation form for each dimension.

For instance, typically one makes one overall assessment for the entire target area. However, this approach may be inappropriate in cases where the target area contains targets with distinctively different sensitivity or where the experienced effects are clearly of different magnitude. An example of this is an area which hosts one target sensitive to noise further away (experiencing a low magnitude), and another target insensitive to noise nearby (experiencing a large magnitude). In a case like this, it may be necessary to treat the near and far impact zones separately. On the evaluation form, fields are provided for specifying impact zones. Another instance which may require separate evaluation forms is the assessment of short and long-term impacts.

2. Assessment of the sensitivity of the receptor

Sensitivity of the receptor is a description of the **characteristics of the target of an impact**. It is a measure of 1) existing regulations and guidance, 2) societal value and 3) vulnerability for the change. The sensitivity of a receptor is estimated in its current state prior to any change implied by the project.

2.1. Existing regulations and guidance

Existing regulations and guidance describes whether there are any such objects in the impact area, which have some level of protection by law or other regulations (e.g. prohibition against polluting groundwater and Natura areas), or whose conservation value is increased by programs or recommendations (e.g. landscapes designated as nationally valuable).

The following issues could be considered in the evaluation of this factor:

- Are there any regulations in the legislation for the receptor?
- Are there any targets in the area with preservation orders or classified as valuable?
- Are there any species in the area classified as endangered or threatened?
- Does the receptor belong to any national or international protection program?

Very high * * * *	The impact area includes an object that is protected by national law or an EU directive (e.g. Natura 2000 areas) or international contracts which may prevent the proposed development.
High * * *	The impact area includes an object that is protected by national law or an EU directive (e.g. Natura 2000 areas) or international contracts which may have direct impact on the feasibility of the proposed development.
Moderate * *	Regulation sets recommendations or reference values for an object in the impact area, or the project may impact an area conserved by a national or an international program.
Low *	Few or no recommendations which add to the conservation value of the impact area, and no regulations restricting use of the area (e.g. zoning plans).

2.2. Societal value

Societal value describes the value of the receptor to the society and depending on the type of impact may be related to economic values (e.g. water supply), social values (e.g. landscape or recreation) or environmental values (e.g. natural habitat). Societal value measures general appreciation from the point of view of the society, but should not consider that much the point of view of individuals exposed to negative impacts. When relevant, the number of people impacted is taken into account. Generally the anxiety of interest groups is not included in societal value because anxiety is taken into account in social impact assessment.

The following issues could be considered in the evaluation of this factor:

- How valuable or important is the receptor in general?
- Does the receptor have any cultural or historical values?
- How extensive is the recreational or other use of the area?
- Are there any valuable natural targets?
- What is the number of affected people?
- How original or unique is the state of the receptor?
- Does the project raise any concerns or conflicts (only on social impacts)?

Very high * * * *	The receptor is highly unique, very valuable to society and possibly irreplaceable. It may be deemed internationally significant and valuable. The number of people affected is very large.
High * * *	The receptor is unique and valuable to society. It may be deemed nationally significant and valuable. The number of people impacted is large.
Moderate * *	The receptor is valuable and locally significant but not very unique. The number of people impacted is moderate.

Low *	The receptor is of small value or uniqueness. The number of people impacted is small.
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2.3. Vulnerability for the change

Vulnerability for the change describes how liable the receptor is to be influenced or harmed by pollution or other changes to its environment. For instance, an area which is quiet is more vulnerable to increasing noise than an area with industrial background noise.

The following issues could be considered in the evaluation of this factor:

- How vulnerable or susceptible is the state of the receptor for the external changes in the environment?
- What is the ability of the receptor to tolerate changes?
- Are there any sensitive targets in the area (hospitals, schools, kindergartens, etc.)?

Very high * * * *	Even a very small external change could substantially change the status of the receptor. There are very many sensitive targets in the area.
High * * *	Even a small external change could substantially change the status of the receptor. There are many sensitive targets in the area.
Moderate * *	At least moderate changes are needed to substantially change the status of the receptor. There are some sensitive targets in the area.
Low *	Even a large external change would not have substantial impact on the status of the receptor. There are only few or none sensitive targets in the area.

2.4. Deriving the overall sensitivity of a receptor from components of sensitivity

The overall sensitivity of a receptor is assessed by an expert on the basis on his/her assessment of the components of sensitivity. A general rule for deriving the overall sensitivity is to pick the maximum of existing regulations and guidance and societal value and then adjust that value depending on the level of vulnerability. However, the expert evaluating the impact should also use his/her judgment when necessary. The following are a few examples:

- If the receptor is strictly conserved by regulation, its sensitivity is high even though if societal value is low. However, if the receptor is not vulnerable for changes, its sensitivity could be adjusted to moderate because it's not liable to be harmed by external changes.
- If there's no regulation concerning the receptor, but it has moderate societal value (e.g. recreational value), sensitivity is assessed as moderate. For a receptor which is highly vulnerable that estimate could be adjusted even to high.

In the table below, there are example descriptions of different categories for the sensitivity of the receptor.

Very high * * * *	Legislation strictly conserves the receptor, or it is irreplaceable to society, or extremely liable to be harmed by the development. Even minor influence by the proposed development is likely to make the development unfeasible.
High * * *	Legislation strictly conserves the receptor, or it is very valuable to society, or very liable to be harmed by the development.
Moderate * *	The receptor has moderate value to society, its vulnerability for the change is moderate, regulation may set reference values or recommendations, and it may be in a conservation program. Even a receptor which has major social value may have moderate sensitivity if it has low vulnerability, and vice versa.
Low *	The receptor has minor social value, low vulnerability for the change and no existing regulations and guidance. Even a receptor which has major or moderate social value may have low sensitivity if it's not liable to be influenced by the development.

3. Assessing the magnitude of the change

Magnitude of the change describes the **characteristics of changes the planned project is likely to cause**. The direction of change is either **positive** (green) or **negative** (red). Magnitude is a combination of 1) intensity and direction, 2) spatial extent, and 3) duration. On duration, the timing of the impact should also be considered for impacts which aren't observable all the time such as periodic impacts. Assessment of magnitude should evaluate the probable changes affecting the receptor without taking into account the receptors sensitivity to those changes.

3.1. Intensity and direction

Intensity describes the physical dimension of a development and direction specifies whether the impact is negative ("–"/red) or positive ("+"/green). Depending on the type of impact, intensity can often be measured with various physical units and compared to reference values, such as the decibel (dB) for sound. Some impacts, such as landscape, have no natural unit of measurement, so then an expert evaluates the impact relative to available frameworks.

The objective is to make an assessment which describes the overall intensity across the impact area. However, it is common that intensity decreases over distance. Then a possible course of action is to assess intensity at the closest sensitive or at the most sensitive target at the impact area. In any case, the objective is to make an assessment which captures the overall characteristics of the impact.

The following issues could be considered in the evaluation of this factor:

- Is the change positive or negative?
- Are there any reference values for the change?
- Does the change cause exceeding regulatory limits?
- How much is the increase in the load or emissions?
- How severe are the changes caused by the project?
- How essential is the change?
- How much the project affects the characteristics of the area?
- How much the project affects the living conditions of people and nature?

Very high ++++	The proposal has an extremely beneficial effect on nature or environmental load. A social change benefits substantially people's daily lives.
High +++	The proposal has a large beneficial effect on nature or environmental load. A social change clearly benefits people's daily lives.
Moderate ++	The proposal has a clearly observable positive effect on nature or environmental load. A social change has an observable effect on people's daily lives.
Low +	An effect is positive and observable, but the change to environmental conditions or on people is small.
No impact	An effect so small that it has no practical implication. Any benefit or harm is negligible.
Low –	An effect is negative and observable, but the change to environmental conditions or on people is small.
Moderate --	The proposal has a clearly observable negative effect on nature or environmental load. A social change has an observable effect on people's daily lives and may impact daily routines.
High ---	The proposal has a large detrimental effect on nature or environmental load. A social change clearly hinders people's daily lives.
Very high ----	The proposal has an extremely harmful effect on nature or environmental load. A social change substantially hinders people's daily lives.

3.2. Spatial extent

Spatial extent describes the geographical reach of an impact area, or the range within which an effect is observable. In principle, spatial extent can be expressed as distance from the source, but the extent of an impact area may vary by direction due to topography, vegetation or other factors.

The following issues could be considered in the evaluation of this factor:

- In how large area can the change be observed?
- What share of the overall living territory of the target is covered by the project?

Very high * * * *	Impact extends over several regions and may cross national borders. Typical range is > 100 km.
High * * *	Impact extends over one region. Typical range is 10-100 km.
Moderate * *	Impact extends over one municipality. Typical range is 1-10 km.
Low *	Impact extends only to the immediate vicinity of a source. Typical range is < 1 km.

3.3. Duration

Duration describes the length of time during which an impact is observable and it also takes other related issues such as timing and periodicity into account. These are relevant for impacts which aren't observable all the time such as periodic impacts. A long-term impact, for example, can be comparable to a periodic moderate-term impact which occurs at such periods that it causes the least possible disturbance.

The following issues could be considered in the evaluation of this factor:

- How long can the change be observed?
- Is the change irreversible?
- How periodic and regular is the change?
- What is the timing of the change?

Very high * * * *	An impact is permanent. The impact area won't recover even after the project is decommissioned.
High * * *	An impact lasts several years. The impact area will recover after the project is decommissioned.
Moderate * *	An impact lasts from one to a number of years. A long-term impact may fall into this category if it's not constant and occurs only at periods causing the least possible disturbance
Low *	An impact whose duration is at most one year, for instance during construction and not operation. A moderate-term impact may fall into this category if it's not constant and occurs only at periods causing the least possible disturbance.

3.4. Deriving the overall magnitude of the change from components of magnitude

Magnitude of the change is a comprehensive synthesis of its component factors. In a case, where intensity, spatial case and duration all get the same value, the magnitude would also be given this value. In other cases, intensity should be taken as a starting point, and the assessment should be adjusted based on spatial extent and duration to obtain an overall estimate. Also here, the expert evaluating the impact should also use his/her judgment when necessary. The aim is that the overall assessment should capture the characteristics of an effect.

The table below describes some example descriptions of different categories for the magnitude of the change.

Very high + + + +	The proposal has beneficial effects of very high intensity and the extent and the duration of the effects are at least high.
High + + +	The proposal has beneficial effects of high intensity and the extent and the duration of the effects are high.
Moderate + +	The proposal has clearly observable positive effects on nature or people's daily lives, and the extent and the duration of the effects are moderate.
Low +	An effect is positive and observable, but the change to environmental conditions or on people is small.
No impact	No change is noticeable in practice. Any benefit or harm is negligible.
Low	An effect is negative and observable, but the change to environmental conditions

–	or on people is small.
Moderate --	The proposal has clearly observable negative effects on nature or people's daily lives, and the extent and the duration of the effects are moderate.
High ---	The proposal has harmful effects of high intensity and the extent and the duration of the effects are high.
Very high ----	The proposal has harmful effects of very high intensity and the extent and the duration of the effects are at least high.

4. Assessing the significance of an impact

The **assessment of significance** is based on the **magnitude of the change** affecting a receptor and on the **sensitivity of the receptor** to those changes. In the assessment of the overall significance, one can utilize a table show below, where positive impacts are in green and negative in red. The values obtained from the table are indicative because the most relevant dimensions for characterizing an impact are dependent on the type of impact. Thus, some discretion from the expert is required, in particular in cases, where the one component is low and the other one high or very high. **In any case, it is essential that experts retain informed judgment and record their reasoning on the assessment form.**

Impact significance		Magnitude of change								
		Very high	High	Moderate	Low	No change	Low	Moderate	High	Very high
Sensitivity of the receptor	Low	High*	Moderate*	Low	Low	No impact	Low	Low	Moderate*	High*
	Moderate	High	High	Moderate	Low	No impact	Low	Moderate	High	High
	High	Very high	High	High	Moderate*	No impact	Moderate*	High	High	Very high
	Very high	Very high	Very high	High	High*	No impact	High*	High	Very high	Very high

* Especially in these cases, significance might get a lower estimate, if sensitivity or magnitude is near the lower bound of the classification

5. Evaluation of uncertainty and risks

The assessment of the future impacts of the project might involve various uncertainties inherited from different kinds of sources. In the ARVI form one can address three drivers of uncertainty:

1. **Uncertainty about the realization of the impact.** Assessment of how probable it is that the impact will be realized at the level anticipated. Typically, this issue is related to the uncertainty about the future conditions and external influences.
2. **Imprecision in the assessment.** Assessment of imprecision related to the evaluation, for example, due to lack of baseline information and imprecise models.
3. **Risks arising from the possible disruptions of the process.** Assessment of the risks related to fault situations or disruptions of the process, which may be improbable but may result potentially major consequences if not properly managed. Assessment of risk involves estimation of probability and the level of consequence for a number of fault scenarios.

The evaluator assesses each type of uncertainty on a scale (not at all / low / moderate / high).

6. Evaluation of mitigation measures

Mitigation measures are evaluated on the basis of how effective they are in reducing potentially significant environmental impacts. For each impact, the evaluator assesses to what extent it can be mitigated on a scale (not at all / low / moderate / high), and specifies what measures are included in the assessment. The evaluator is also asked to estimate residual significance, namely the significance after the specified measures are implemented. Typically, mitigation measures influence the intensity of an effect, so residual significance can be estimated by plugging in new values to the familiar framework. It is a good practice to document what components of magnitude are reduced by a given measure.

7. Assessment of cumulative impacts

Cumulative impacts can arise from an interaction between the various impacts of a single development, or from the interaction between distinct developments in the same region. The coexistence of impacts may, for example, increase or decrease their combined impact. Similarly, other developments in the region may, for example, contribute to a build-up of environmental load on shared resources. The expert is asked to

identify and assess cumulative impacts. Reasoning should include a documentation of the origin of cumulative effects.