Confidence, Uncertainty, and Risk in Environmental Assessment

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In recent years, there has been growing concern among regulators and EA process administrators (at least in some jurisdictions in Canada) about the adequacy of consideration of risk not only in EA, but in government decision-making generally.

This concern is likely being driven by several factors, including high employment turnover in government, resulting in EA process administrators with less experience in and familiarity with EA methods, growing stakeholder engagement and activism in relation to proposed development projects, increasing risk aversion on the part of regulators and technical reviewers in government departments (itself driven by increasing litigation, among other factors), and increasing pressure from statutory decision-makers to be able to demonstrate explicit risk management to their constituents.

Risk – how do we consider it?

- Integrated consideration of risk in EA
- When is additional risk analysis required?
- What issues should be considered?

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This presentation describes how risk is considered in standard EA methods, suggests criteria to determine when additional risk analysis may be warranted, and outlines key issues to consider when undertaking additional risk analysis in the context of an EA.

EA = Risk Management

Risk Assessment	Environmental Assessment
Establish Context	Describe the Project
	Describe the Existing Conditions
Identify Risks (Causes, Events, Impacts)	Identify Project- VC Interactions
	Identify Potential Effects
Consider Existing Mitigation	Develop Suite of Mitigation
Analyze Risk	Residual Effect Characterization
Evaluate Risk	Significance Determination
Treat Risk (Additional Mitigation)	(*Done in an iterative manner prior to residual effect characterization and significance determination.*)
Monitor and Review	Follow-up and Monitoring

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The EA process is inherently a risk management process. The typical steps involved in identifying and assessing the potential effects of a project in an EA (right column in the slide) are similar to the steps used in standard risk assessment practice (left column).

A key difference between these two processes is that a risk assessment evaluates a range of possible outcomes, and evaluates the level of risk of those outcomes based on likelihood and consequence.

An EA, in contrast, focuses primarily on *likely* outcomes – the practitioner's best prediction of what *will* occur if a specific project is developed in a specific place in a specific way – and evaluates those outcomes (referred to as residual effects) in terms of significance.

Risk Management Paradigm

5	LOW	MEDIUM	HIGH	EXTREME	EXTREME
4	LOW	MEDIUM	HIGH	HIGH	EXTREME
3	LOW	MEDIUM	MEDIUM	HIGH	HIGH
2	LOW	LOW	MEDIUM	MEDIUM	MEDIUM
1	LOW	LOW	LOW	LOW	LOW
LIKELIHOOD	1	2	3	5	6
	CONSEQUENCE				

EA (Values Management) Paradigm

Likely			
LIKELIHOOD	Not Significant	Justifiable	Not Justifiable
		Significant	
	CONSEQUENCE		

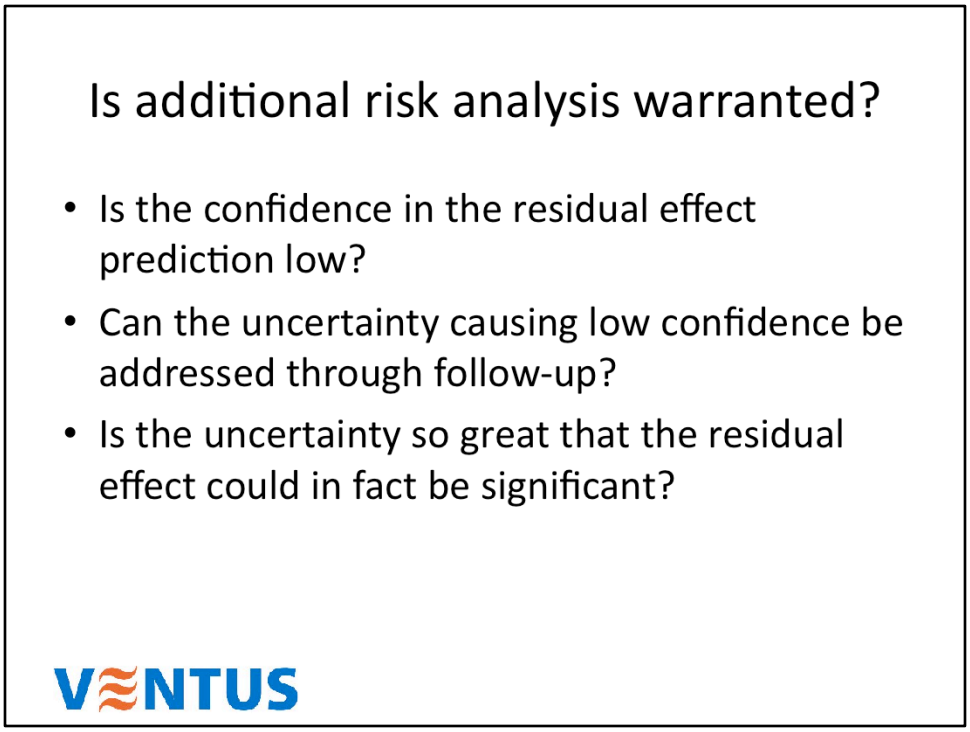
Let's compare how the outcomes of these assessments might be represented.

The top chart here illustrates a typical 'heat map' used in risk assessment to determine the level of risk associated with outcomes of varying levels of likelihood and consequence (ranging from 1 for lowest to 5 or 6 for highest). Of course, the greater the consequence and likelihood, the higher the real or perceived risk.

The bottom chart illustrates how the typical conclusions of an EA might appear using a similar 'heat map' model. In this case, the outcome – the residual effect – is usually what is considered *likely* to occur, and the consequence is described as "not significant" or "significant". The determination of significance is typically made initially by the practitioner, and reviewed and accepted (or modified) by the regulator or administrator of the EA process. The determination of whether or not a predicted significant residual effect is justified (or "acceptable" in some jurisdictions) is typically made by the statutory decision-maker.

Thus, the conduct of an EA effectively constitutes the assessment and management of risk.

The residual effect predictions documented in an EA by and large describe the 'risk' associated with the project (albeit with fewer gradients of risk), articulated in terms of the likelihood of significant adverse residual effects occurring. For most interactions between the project and the environment, the analysis conducted for the EA will suffice to understand the potential risk associated with the proposed project or activity and to facilitate the effective management of risk.



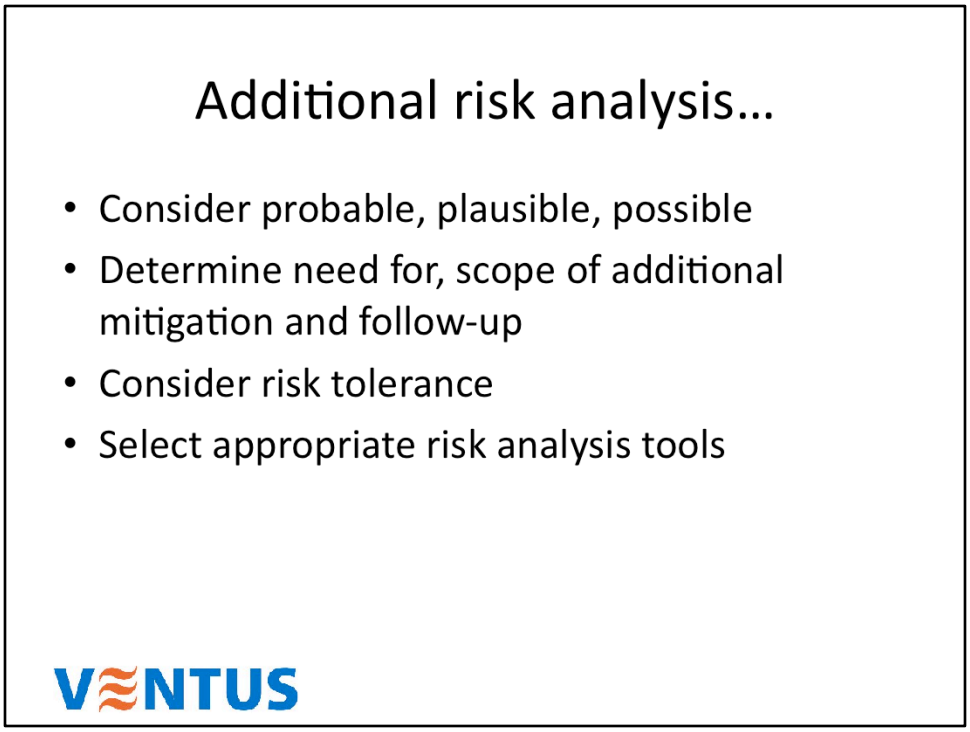
When is additional risk analysis warranted? In good EA practice, the practitioner will articulate the level of confidence he or she has in the residual effect prediction. This statement of confidence depends on the degree of uncertainty associated with the residual effect prediction.

The practitioner should always make their best possible residual effect prediction based on the available information. Sometimes, limitations in the available information may make it difficult to characterize residual effects and determine significance.

For example, information about the conditions or sensitivity of an environmental component or about the nature of the interaction between the project and the environment may be incomplete. Also, the project may involve new technology, the effects of which are not fully understood, or mitigation measures that have not yet been proven to be effective. Where such data gaps exist, the residual effect prediction may be *less certain*. That is, there is a greater possibility that the outcome – the residual effect – may be different from what is predicted. This difference might manifest as a change in the characteristics of the residual effect (*i.e.*, magnitude, extent, reversibility, duration, or frequency) but not change the likelihood or significance of the residual effect, or this difference might be sufficient to change the practitioner's determination of likelihood and/or significance (*e.g.*, from 'not significant' to 'significant' or vice versa). Generally speaking, as the uncertainty associated with the residual effect prediction increases, the level of confidence in the prediction becomes lower.

In most cases, uncertainty (particularly low to moderate uncertainty) can be adequately addressed through monitoring or other follow-up programs that confirm actual residual effects are as predicted and mitigation measures are effective, and through adaptive management programs that facilitate action when unforeseen effects occur or when ongoing monitoring identifies a need for new or modified mitigation.

However, if the uncertainty associated with a residual effect prediction is of sufficient degree that the significance of the residual effect could change if the prediction is wrong, additional analysis may be needed to ensure the likelihood of a significant adverse residual effect is understood. Similarly, if the consequence of an unintentional project-related event, such as an accident or malfunction (including failure of mitigation), could be a significant adverse effect, more detailed consideration of the range of possible outcomes in terms of likelihood and significance may be warranted.



If more detailed risk analysis is deemed to be necessary in relation to uncertain residual effect predictions, the practitioner should describe the range of probable, plausible, and possible outcomes in terms of likelihood and potential significance. This information will assist the decision-maker to understand both the likely outcome – that is, the predicted residual effect – and the risk, particularly of more serious outcomes.

The additional analysis should also inform the need for and scope of additional mitigation and/or monitoring and follow-up programs to better manage risk by reducing the likelihood and/or significance of any potential adverse residual effect.

The need for additional mitigation and/or follow-up programs in relation to uncertain residual effect predictions will depend in part on the likelihood of significant adverse residual effects if the residual effect prediction turns out to be incorrect, and in part on the level of **risk tolerance** of the decision-maker. Consultation between the practitioner/proponent and the regulator or EA process administrator may be helpful to characterize risk tolerance.

When selecting and applying risk assessment tools, care must be taken to ensure the selected tools provide results that are compatible with a values-based EA paradigm and enable the decision-maker to make the decision required by the prevailing EA legislation.

In particular, risk analysis tools may require modification to avoid duplicating relevant analysis already completed in the context of the EA, and creating confusion for the reader, such as may arise from inconsistent terminology. In addition, risk assessment tools and methods vary by discipline, and the practitioner must select an approach that is appropriate to the Valued Component being assessed.

Conclusion

- In most cases, EA sufficiently assesses risk
- Where there is high uncertainty (low confidence), additional risk analysis may be warranted
- Additional risk analysis should describe expected significance of likely outcome, ***and*** risk of more serious outcomes

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In most cases, the analysis and findings in an EA, presented in terms of the likelihood and significance of potential residual adverse effects, will suffice to characterize the potential risk associated with a proposed project or activity. Where a high degree of uncertainty associated with a residual effect prediction warrants additional analysis of potential risk, the practitioner should apply appropriate tools and methods to enable the decision-maker and other users to understand the expected significance of the likely outcome – that is, the predicted residual effect – and the risk particularly of more serious outcomes.

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