

# Measurement indicators and an evaluation approach for assessing Strategic Environmental Assessment effectiveness

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## ABSTRACT

Carrying Strategic Environmental Assessment (SEA) is being promoted through law in many parts of the world with the aim of integrating environmental consideration into decision-making process and improving sustainable development. Although it is generally agreed that SEA plays an important role in the decisions affecting the environment, SEA is currently experiencing increased pressure from decision makers and politicians to argue and prove its effectiveness. Recently, studies concerning this area have been accelerating. When considering evaluating SEA effectiveness, two main challenges need to be addressed. Firstly, the identification and formulation of evaluating indicators, and secondly, finding ways and methods to quantify and measure conformance to the indicators. In this study, we first review critically the indicators and criteria on the effectiveness of the impact assessment, four dimensions evaluating indicators, including substantive indicator, procedural indicator, contextual indicator, and incremental indicator, and 13 sub-indicators have been identified. An evaluating model is developed and a fuzzy analytic hierarchy process (fuzzy AHP) approach for designing and evaluating SEA is established and applied to a regional planning in China.

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## 1. Introduction

Whilst Strategic Environmental Assessment (SEA) has been practiced since the 1970s, it was not widely institutionalized until the 1990s in the European Union (EU) (Theophilou et al., 2010) and some other countries, since then its application has been growing rapidly with its benefits and challenges (Sheate et al., 2001). Although it is generally agreed that SEA plays an important role in the decisions affecting the environment and improving sustainability, the questions are still raised by decision makers and politicians to argue and prove the effectiveness of SEA. Since the early days of environmental assessment, performance evaluation has been regarded as one of the most important components of any well functioning environmental assessment system (Sadler, 1996; Wood, 2003; Fischer, 1999.), yet the area has also been one of the most difficult to conceptualize and least explored empirically. When considering evaluating SEA effectiveness, two main challenges need to be addressed. Firstly, the identification and formulation of indicators, and secondly, finding ways and methods to quantify and measure conformance to the indicators. Recent years various sets of SEA performance indicators have been developed

and used in different contexts, and different methods for evaluating SEA effectiveness have been introduced (Thérivel and Minas, 2002; Theophilou et al., 2010; Fischer and Gazzola, 2006; Bina, 2008; Runhaar, 2009; Hendriks et al., 2011). Qualitative and semi quantitative methods are usually applied in evaluating SEA performance.

Three main kinds of systematic approaches for evaluating SEA performance and effectiveness have been developed: prescriptive approach, policy and programme evaluation methodologies, and 'a life-cycle approach'. The first one is used for comparing what should be done with what is done, which is widely followed (Retief, 2007; Nykvist and Nilsson, 2009; Fischer, 2010). The second one is widely applied in government for examining the larger context of decision-making. The third one is an evaluation cycle including the three interconnected stages from pre-to-post decision making. However, with the chain of cause and effect unclear or attenuated, and complexity of SEA, neither science nor practitioners have provided major support by developing reliable as well as practical and operative methods for indicator assessment, which has been one of the key factors limiting empirical and systematic SEA research.

Indicators for SEA effectiveness have non-physical structures in most cases, in particular, there are some inconsistencies in measuring the indicators. For example, it is almost impossible to measure the indicators with qualitatively structures, it is difficult to evaluate how environmental-related change before and after

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SEA, and how plan changes due to SEA. For this reason, measuring SEA effectiveness inquires a holistic approach. Indicators affecting SEA performance should be measured not separately but in a multi-dimensional approach that considers indicators simultaneously.

Based on this fact, in this study, after critical review of the state-of-the-art in assessing the performance of SEA indicators, indicators and sub-indicators of SEA performance are explored, an evaluating model and fuzzy analytic hierarchy process (fuzzy AHP) method are developed to examine SEA effectiveness. Using this method, all the indicators are integrally evaluated and also the indicators which cannot be measured by crisp numbers exactly are evaluated effectively using fuzzy numbers. The fuzzy AHP has the advantage of mathematically representing uncertainty and vagueness and provides formalized tools of dealing with the imprecision intrinsic to many problems (Chang and Yeh, 2002). This model was elaborated to help visualize which indicators are prioritized and formulate strategies for SEA implementation, and a detailed evaluation of the SEA performance for urban planning is presented. Using such an approach, decision-makers can evaluate both the potential and the actual performance of SEA.

## 2. Indicator identification—literature review

Recent years witnessed an increased interest in the effectiveness of SEA, as a concept and in the evaluation of the practice (Bina et al., 2011). Progress has been made in measuring the effectiveness or performance of environmental assessment through evaluations. 'The International Study of the Effectiveness of Environmental Assessment' (Sadler, 1996) could be considered a milestone, of sorts, for defining and measuring effectiveness (Theophilou et al., 2010). Since then, there have been increasing researches focusing on the effectiveness of SEA through criteria-based assessment (Fischer and Gazzola, 2006; Noble, 2009; Retief, 2007; Bina et al., 2011; Stoeglehner et al., 2009; Aschemann, 2004; Fischer, 2003, 2010; Hildén et al., 2004; Partidário, 2000; Runhaar and Driessen,

2007; Sheate et al., 2003). Evaluation of effectiveness is generally divided into two broad categories: outcome evaluation and process evaluation. Outcome evaluation assesses performance by using a series of indicators such as objectives and targets. For example, Thérivel and Minas (2002) analyzed and evaluated SEA effectiveness whether the strategic action was changed as a result of the SEA. Process evaluation evaluates process relative to best practices indicator. As noted by Sadler (1996, 18), the concern with evaluating effectiveness is with 'how well SEA actually works, which components and activities contribute to or detract from success, and what realistically could be done to improve process(es) under review'. Both outcome and process evaluation are important components of assessing SEA. However, these two cannot offer a complete picture of how SEA's effectiveness is discussed amongst scholars. We argue that the effectiveness categories ought to move beyond these two dimensions when exploring indicators of SEA evaluation. An exhaustive list of critical indicators integrated from literature review on SEA effectiveness and performance is shown in Fig. 1. The evaluation framework considers the political context, the institutional arrangements, the SEA processes, and the SEA methods that contribute to the effectiveness of a SEA system for comprehensive plans.

### 2.1. Procedural indicator

The procedures and methodologies adopted through the whole SEA process and the decision-making process are key factors for determining the technical quality of the documents produced by the SEA actors and decision-makers (Sadler, 1996). Sadler defines procedural effectiveness as whether the SEA conforms to the 'accepted provisions and principles' (Sadler, 1996, 39). For example, how an SEA implementation policy works from a procedural aspect is the extent to which it meets accepted principles such as clearly defined objectives, provision of support and guidance, application to socio-economic effects and provision for monitoring. A multitude of indicators, associated with the

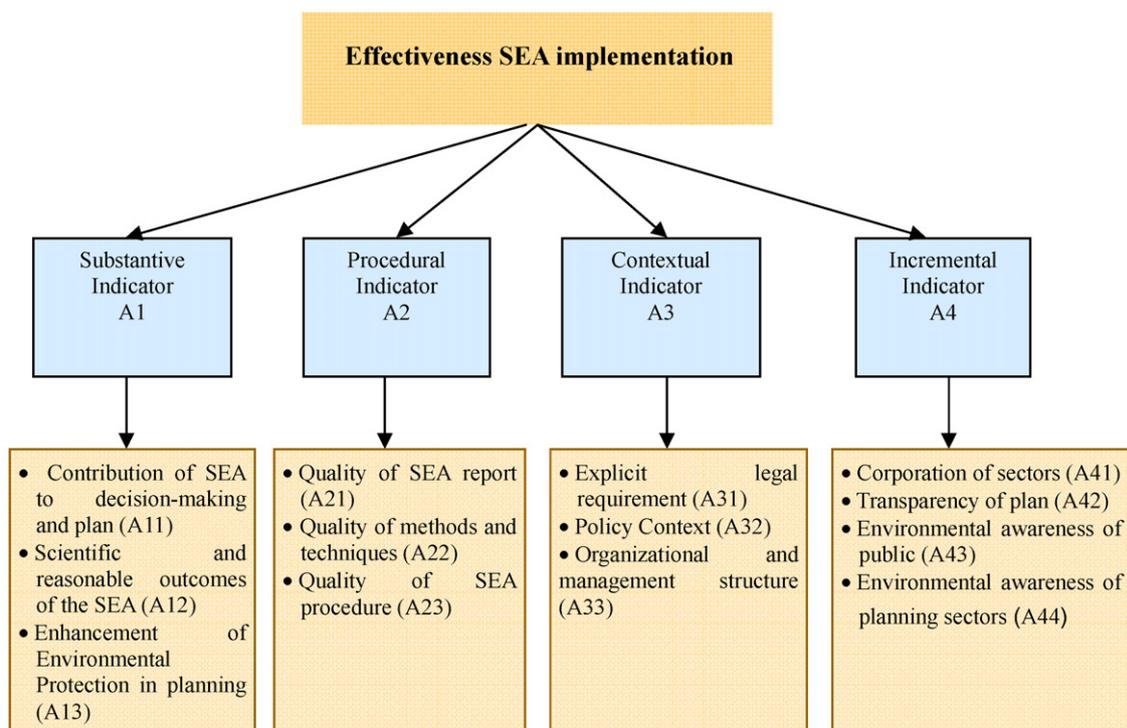


Fig. 1. Structure for SEA effectiveness indicators.

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