Environmental Impact Assessment Review 31 (2011) 538–548

Contents lists available at ScienceDirect

Environmental Impact Assessment Review

journal homepage: www.elsevier.com/locate/eiar

An inquiry into the potential of scenario analysis for dealing with uncertainty in strategic environmental assessment in China

Zhixi Zhu, Hongtao Bai, He Xu *, Tan Zhu

Research Centre for Strategic Environmental Assessment, College of Environmental Science and Engineering, Nankai University, No.94 Weijin Road, Tianjin, PR China

ARTICLE INFO

Article history:
Received 5 August 2009
Received in revised form 17 November 2009
Accepted 3 February 2010
Available online 5 March 2010

Keywords:
Scenario analysis
Strategic environmental assessment
Uncertainty
China

ABSTRACT

Strategic environmental assessment (SEA) inherently needs to address greater levels of uncertainty in the formulation and implementation processes of strategic decisions, compared with project environmental impact assessment. The range of uncertainties includes internal and external factors of the complex system that is concerned in the strategy. Scenario analysis is increasingly being used to cope with uncertainty in SEA. Following a brief introduction of scenarios and scenario analysis, this paper examines the rationale for scenario analysis in SEA in the context of China. The state of the art associated with scenario analysis applied to SEA in China was reviewed through four SEA case analyses. Lessons learned from these cases indicated the word "scenario" appears to be abused and the scenario-based methods appear to be misused due to the lack of understanding of an uncertain future and scenario analysis. However, good experiences were also drawn on, regarding how to integrate scenario analysis into the SEA process in China, how to cope with driving forces including uncertainties, how to combine qualitative scenario storylines with quantitative impact predictions, and how to conduct assessments and propose recommendations based on scenarios. Additionally, the ways to improve the application of this tool in SEA were suggested. We concluded by calling for further methodological research on this issue and more practices.

1. Introduction

Strategic environmental assessment (SEA) is an approach that aims to integrate environmental concerns into upstream decision-makings. The main tasks of SEA are to identify, to predict and to evaluate likely environmental consequences of the strategies, i.e. policy, plan and programme, as well as to provide with prevention and mitigation measures. Thus, SEA definitely is "an exercise in futuring" (Duinker and Greig, 2007).

Since the future is inherently uncertain, all exercises about the future are facing and should cope with great uncertainty. The same situation happens to SEA. Given our limited understanding, ecosystem dynamics and human's actions can never be fully anticipated (Carpenter et al., 2005). SEA researchers and practitioners, in China and worldwide, have had consensus on this substantial issue (for example, Fischer, 2007; Liu, 2007; OECD DAC, 2006; Partidário, 2007; UNECE and REC CEE, 2006; Wang et al., 2004; Zhao and Lin, 2008). Additionally, compared to environmental impact assessment (EIA) for projects, the objects of SEA, high-level decision-making, are more comprehensive, since (1) they are strategies of medium or long time horizons (beyond 5 years); (2) practitioners need to assess their impacts at large spacial scales; and (3) they all relate to complex systems, e.g. urban system, energy system, and transport system, etc.

Thus, we need to deal with greater complexity and uncertainty in SEA than in EIA. No matter what type of strategy is assessed in an SEA, the uncertainty originates from internal components and external circumstances of the complex system in question (see Fig. 1).

1.1. Internal uncertainty

(a) Strategic decision-making directs human actions (i.e. societal and economic activities) so as to change the complex system that it is associated with. Because these future activities are arranged at large temporal and spatial scales, future development of the complex system is uncertain.
(b) Natural environment within the spacial scope of the strategy is uncertain because of, on the one hand, complexity of the environment subsystem itself and our limited knowledge of it; and on the other hand, intricate interconnections among human activities and natural environment.

* Corresponding author. Postal address: Room 407, Mengminwei Bldg., College of Environmental Science and Engineering, Nankai University, No.94 Weijin Road, Tianjin, PR China. Tel./fax: +86 22 23508348.
E-mail addresses: zhuzhixi@gmail.com (Z. Zhu), bahonta@gmail.com (H. Bai), seacenter@nankai.edu.cn (H. Xu), zhutan@nankai.edu.cn (T. Zhu).

0195-9255/$ – see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.eiar.2010.02.001

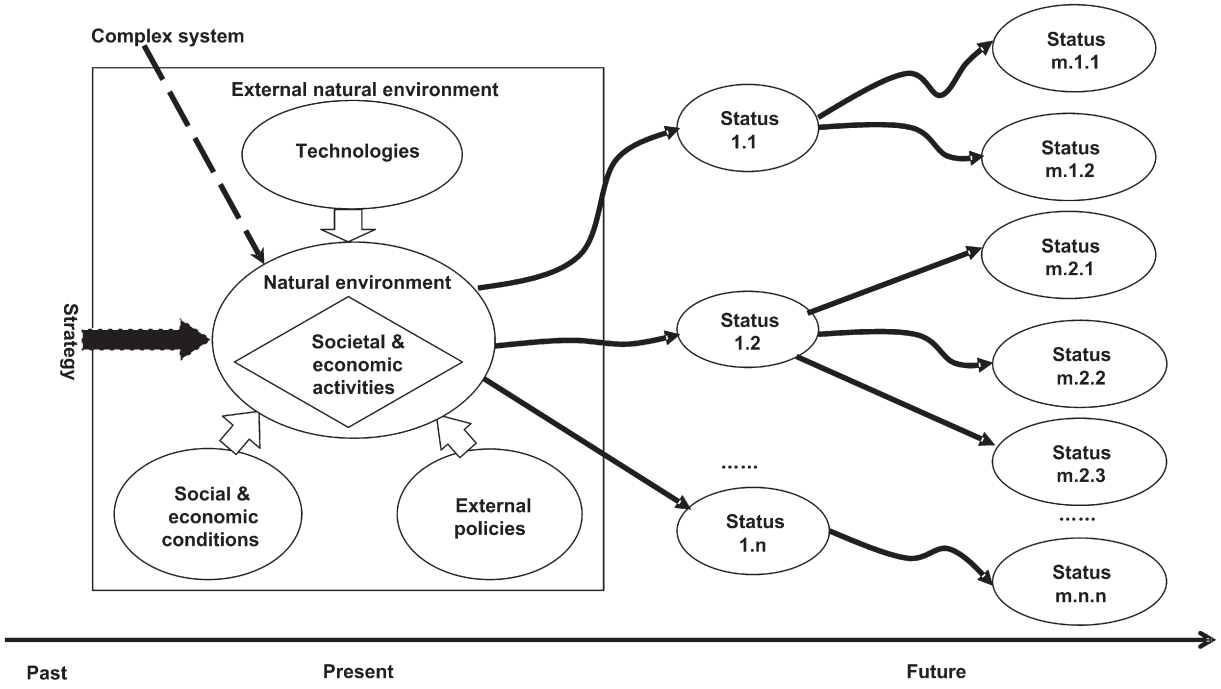

Fig. 1. Sources of uncertainty in SEA.

1.2. External uncertainty

External uncertainty could have impacts on the complex system in the formulation process or implementation process of the strategy. In the context of China, it includes:

(a) Uncertain changes of external natural environment, e.g. global environmental change, regional environmental problems and transboundary environmental issues, etc.
(b) Uncertain social and economic conditions: (1) the changing global circumstances; (2) China's special context of economic growth and social transition; and (3) regional differences in the country.
(c) Uncertain external policy. Existing policies would influence the formulation and the implementation of the strategy. Some future policies would also have effects on the implementation and consequently affect the complex system.
(d) Uncertainty of future technologies.

Fig. 1 shows how the complex system, influenced by both internal and external uncertainties, might develop into different possible status in the future via different pathways at different time points.

In this context, there is therefore an emerging need for specific methods that are able to identify and cope with the internal and external uncertainties analyzed above. Scenario-based methods offer a way to deal with this issue. Many SEA text and manuals (OECD DAC, 2006; SEPA, 2003; Therivel, 2004; UNECE and REC CEE, 2006) have made reference to scenario tools, but scenarios have rarely been investigated in detail (Bartlett and Brunstad, 2006; Höjer et al., 2008). This paper first briefly introduces what scenario and scenario analysis are and their typologies. Then it elaborates why scenario analysis is needed in SEA in China. Subsequently, typical SEA cases with so-called "scenarios" in the country are reviewed and analyzed. Both good experiences and lessons learned are discussed. We also recommended the ways to improve its application in order to meet SEA's specific requirements regarding uncertainty.

2. Scenarios and scenario analysis

The word "Scenario" was borrowed from theatre where it refers to "an outline for a screenplay" (Editors of The American Heritage Dictionaries, 2000). Numerous definitions of "scenario" exist since strategic planners took over it to business. The widely cited definition is "Scenarios are hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision points" (Kahn and Wiener, 1967 cited in ICIS, 2000).

In the mid-1960s, scenario building was pioneered by Herman Kahn of RAND Corporation for military strategy research. Scenario methods entered the field of strategic planning in 1970s, which is called scenario planning. Several approaches to scenario planning have been developed by both academics (e.g. Godet and Roubelat, 1996; Ringland, 1998; Schwartz, 1991; Van der Heijden and Schlange, 1997; Wack, 1985) and practitioners like consultant groups (e.g. Battelle, Sema, Stanford Research Institute, and Hudson Institute) (Godet and Roubelat, 2000). In the mid 1980s, scenario planning became more popular after the Royal Dutch/Shell story in scenario planning was published. This has been the most well-known success case in this field (Godet and Roubelat, 2000), in which the corporation benefited from the application of scenario planning in the lead up the 1973 oil crisis.

As an aid to strategic planning, scenarios or scenario planning are defined as, for example:

"…an internally consistent view of what the future might turn out to be- not a forecast, but one possible future outcome" (Porter, 1985);

"… a tool for ordering one's perceptions about alternative future environments in which one's decisions might be played out" (Schwartz, 1991);

"… a disciplined methodology for imagining possible futures in which organizational decisions may be played out" (Schoemaker, 1995).