



Strategic environmental assessment performance factors and their interaction: An empirical study in China



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ABSTRACT

Strategic Environmental Assessment (SEA) has been seen as a preventive and participatory environmental management tool designed to integrate environmental protection into the decision-making process. However, the debate about SEA performance and effectiveness has increased in recent decades. Two main challenges exist in relation to this issue. The first is identifying the key influencing factors that affect SEA effectiveness, and the second is analyzing the relationship between SEA and these influencing factors. In this study, influencing factors were investigated through questionnaire surveys in the Chinese context, and then a Structural Equation Model (SEM) was developed and tested to identify potential links and causal relationships among factors. The associations between the independent factors were divided into direct and indirect causal associations. The results indicate that the decision-making process and policy context directly affect SEA implementation, while information and data sharing, public participation, expertise and SEA institutions are indirectly related with SEA. The results also suggest that a lack of cooperation between different sectors is an obstacle to the implementation of SEA. These findings could potentially contribute to the future management and implementation of SEA or enhance existing knowledge of SEA. The results show that the proposed model has a degree of feasibility and applicability.

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1. Introduction

Strategic Environmental Assessment (SEA) is being promoted through laws in many parts of the world with the aim of integrating environmental considerations into the decision-making process and improving sustainable development. However, after several decades of international implementation, SEA currently faces increasing pressure from planners and decision makers regarding its value (Fischer, 1999; Stoeglehner et al., 2009; Partidario and Clark, 2000; Bina et al., 2011), and its effectiveness is being questioned (Sadler and Verheem, 1996; Retief, 2007; Fischer and Gazzola, 2006; Cashmore et al., 2008). Over the past decade, the study of SEA effectiveness has made remarkable progress because of the growing breadth and depth of studies and empirical cases. The effectiveness debate in relation to SEA has focused primarily on procedural issues, essentially good practice, as well as criteria or indicators. Evaluation of effectiveness is generally divided into two broad categories: outcome evaluation and process evaluation. Outcome evaluation assesses performance using a series of indicators such as

objectives and targets. Process evaluation evaluates processes relative to indices of best practice. Both outcome and process evaluation are important components of assessing SEA effectiveness. In 2002, the International Association for Impact Assessment (IAIA) formally adopted a set of performance criteria for the assessment of SEA (IAIA, 2002) to establish the characteristics of a “good quality SEA”. The performance criteria were described according to six categories: integrated; sustainability-led; focused; accountable; participative; and iterative. These six criteria mainly focused on SEA procedures, the achievement of SEA, and SEA cost–time effectiveness. After evaluating transport and spatial/land use policies, plans and programs (PPPs) based on the IAIA’s Performance Criteria, Fischer (2002a, 2002b) found that the Performance Criteria are not equally valid for every SEA. Additionally, Fischer and Gazzola (2006) argued that context criteria (institutional framework, cooperation and public participation) and methodological criteria should be distinguished when evaluating SEA effectiveness. Theophilou et al. (2010) applied substantive and transactive indicators to evaluate the SEA in EU operational programs. Bina et al. (2011) identified the need for a broader set of effectiveness criteria going beyond the substantive and procedural dimensions to also include the incremental dimension.

As for China, Planning Environmental Impact Assessment (PEIA, the most common form of SEA in China) has become a legal requirement

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and has been strongly promoted since the Law of the People's Republic of China on Environmental Impact Assessment (the EIA Law) became effective in 2003. After more than a decade of work, remarkable progress has been made on SEA implementation in terms of both theoretical study and practical application; however, as in many other countries, the system of SEA in China has begun to take shape with the emergence of practical and institutional constraints. Researchers and practitioners have devoted much attention to problems and challenges in the implementation of SEA in China. Most criticism revolves around such issues as the inadequacy of third-party participation, a lack of transparency in decision-making, inadequate consideration of alternative analyses, and a lack of high-quality baseline data in the SEA process, all of which have considerably affected the effectiveness of SEA implementation in China and have become the main concern related to China's SEA development in the international EIA literature (Zhu et al., 2005; Bao et al., 2004; Bina et al., 2011; Zhu and Ru, 2008; Wang et al., 2010; Tang et al., 2007).

To fully understand and ensure the implementation of SEA in China, improving effectiveness is crucial. This study investigates two concerns: (i) key issues and how they affect SEA implementation in China; (ii) the extent of influence and relevance of the issues associated with SEA effectiveness. This paper, based on a questionnaire survey, identifies seven potential key issues associated with SEA effectiveness. The Structure Equation Model (SEM) has been applied to identify the relevance and degree of influence of the factors associated with SEA effectiveness and the nature of these relationships. By analyzing the relevance of the factors in the SEM, this study attempts to create a better understanding of the influencing factors involved in SEA implementation. The aim is to identify important issues by identifying entry points for improving the implementation performance and effectiveness of SEA in China.

This paper is organized as follows: first, the research design and methods are explained, after which the influencing factors that affect SEA effectiveness are presented. Then, a SEM for SEA effectiveness index is proposed, and the SEA implementation factors and their relationship with SEA effectiveness are discussed. Finally, the limitations of this research are discussed, together with directions for future work on SEA.

2. Methodology

2.1. Questionnaire survey

To determine the potential influences on SEA implementation in China, this study conducted a questionnaire survey. The survey was organized and conducted by researchers from the Center for Strategic Environmental Assessment of Nankai University and the Center for Strategic Environmental Assessment in China of the Chinese University of Hong Kong. Factors were identified in the recent findings of the SEA effectiveness project (The project, entitled "The institutional hurdles of effective strategic environmental assessment practice in China", involved partners from China and Europe) and confirmed by literature review and consultation with experts. The questionnaire went through several reviews by SEA experts, who also piloted a draft questionnaire to ensure the questions were clear and unambiguous. A questionnaire comprising questions with pre-selected answers was used as the main research tool (Li, 2010). To ensure the scientific validity and accuracy of the survey results, semi-structured interviews with respondents were integrated with the questionnaire survey (Wang et al., 2012).

The survey was conducted in July 2013 among SEA researchers, planners, consultants, and government officials. The questionnaire was distributed via e-mail to 160 individuals who had experience with SEA, and 110 individuals completed the questionnaire for a response rate of 69% (comprising 13 individuals from government agencies, namely central and local authorities and environmental protection bureaus; 39 from environmental consultancies; 20 from

environmental research institutions; and 38 from universities, including a few who reflected on their role as consultants), as shown in Table 1.

Table 2 shows the questionnaire structure along with a detailed description of each issue. A list of influencing factors was developed that comprised seven indicators (SEA process and method, public participation, information and data, SEA consulting agency and department, decision-making institute, legislation and political context, and international experience) and 37 sub-indicators. The influencing factors were designed and integrated into a single comprehensive list drawing on numerous established international studies on SEA (Fischer, 2010; Wu et al., 2011; Therivel et al., 2009; Heinma and Pöder, 2010; Salvador et al., 2000). Respondents were asked about the importance of the indicators using a six-point scale (levels 1 to 6, from strongly disagree to strongly agree). The questionnaire attempted to balance comprehensiveness and feasibility, and the factors were simplified to reduce the possibility of misinterpretation.

2.2. Analytical methods

Two types of analytical methods were used to examine influencing factors and their associations. First, descriptive statistical analysis was used to provide a preliminary description of the SEA influencing factors. Then, SEM was applied to highlight the interactions and relevance between the factors associated with SEA effectiveness. Notably, SEM is subject to potential limitations. This study encompasses important factors that influence SEA implementation, and measurement of other factors could yield different results.

3. Results and discussion

3.1. Influencing factors that affect SEA

Table 3 presents the importance of various influencing factors and their classifications. The results show that generally, three indicators—information and data (5.39), decision-making process (5.32), and legislative and political context (5.28)—are most important to SEA implementation. Expertise and SEA institutions (5.08) and public participation (5.05) are of moderate and similar importance to SEA, followed closely by process and methods (5.01). The indicator considered of least importance is international experience (4.52). The standard deviations for the indicators indicate the dispersion of results in the samples.

Table 2 represents a more detailed breakdown of the figures. The main explanations are summarized as follows:

3.1.1. SEA process and methods

According to the indicator of process and methods, more than 76% of respondents argued that three aspects would result in an ineffective SEA process: "SEA is too late to take part in the decision-making process" (4.76), "lack of certain mechanisms in facing uncertainties" (4.59), and

Table 1
The basic circumstance of the samples.

		N (number)	(Percent) %
Sex	Male	58	52.7
	Female	52	47.3
Age	20–30	54	49.1
	30–40	31	28.2
	40–50	19	18.2
	Above 50	7	5.5
Education	Bachelor's degree	18	16.4
	Master's degree and above	92	83.6
Affiliation	Government authority	13	11.9
	EIA unit/private consultancy	39	35.5
	Environmental research organizations	20	18.2
	Colleges and universities	38	34.4
Total		110	100

Table 2
Measurement of potential problems and barriers and descriptive statistics.

Topics	Possible reasons for these problems	Mean	Min.	Max.	Std. dev.
Process and methods	The assessment process and procedures are over flexible	2.73	1	5	1.219
	Too much dependency on the procedures	3.71	1	6	1.379
	Lack of effective management and monitoring	4.44	1	6	1.169
	SEA takes place too late in the decision-making process	4.76	1	6	1.141
	Lack of assessment experience and assessment methods, i.e., cumulative impact assessment	4.56	1	6	.990
	Inadequate considerations on alternatives	4.11	2	6	1.209
Information and data	Lack of adequate mechanisms in facing with uncertainties	4.59	1	6	1.506
	Lack of efficient information sharing between departments	5.34	4	6	.618
	Inconsistency of the information between departments	5.03	2	6	.960
	Low quality data	4.58	2	6	1.033
	Lack of examples of good practices	4.29	2	6	1.088
	The information can't be publicized due to its confidential attribute in the early stage of decision making	4.29	2	6	1.094
Public participation	There is no initiative to public participation, it is still at a stage of "being suggested by the government"	4.56	1	6	1.118
	There is no independent law system for public participation	4.77	2	6	1.132
	Venerable groups are usually ignored	4.35	1	6	1.177
	Lack of environmental awareness of the public	4.05	1	6	1.270
	Public have limited chance to learn about the planning	4.78	2	6	.887
	The profit relationship and barriers between public and planners will affect the enthusiasm of the public	4.68	1	6	1.007
SEA agency and department	The effectiveness of public suggestions is very limited	4.71	1	6	1.070
	Lack of experienced technical staff in the SEA institutions	4.17	2	6	1.110
	Lack of adequate power of assessment institutions	3.99	1	6	1.214
Decision-making process	Other departments are more powerful than SEA responsible department	4.42	1	6	1.353
	Decision making in China is characterized by a 'top-to-bottom management system'	4.51	2	6	.890
	Inconsistencies among government departments' interests and limited cooperation adversely affected the efficiency of the assessment process	4.84	3	6	.724
	Lack of a systematic framework for decision making	4.71	2	6	.803
	Lack of transparency	4.66	2	6	.918
	Lack of effective law stipulations on management and monitoring	4.78	2	6	.929
Legislative and political context	There is no clear responsibility division in EIA law	4.41	2	6	1.092
	Lack of legislative support in the implementation of SEA	4.41	1	6	1.204
	Lack of political will and economic development is till prioritized	4.61	1	6	1.018
	Lack of funding	3.97	1	6	1.309
	Lack of implementing ability of the government	4.10	1	6	1.226
	Limited control over local governments from the central government	3.81	1	6	1.156
International experience	Difficult for Chinese experts to find foreign SEA literature	3.47	1	6	1.412
	International literature focuses mainly on theoretical studies which is not very helpful to enhance capacity building among Chinese experts	4.17	2	6	1.211
	Lack of studies on the differences between SEA methods in different countries due to various countries' political systems	4.69	2	6	1.048
	Language and cultural differences	3.55	1	6	1.273

"lack of assessment experience and assessment methods, i.e., cumulative impact assessment" (4.56). Moreover, 85% of respondents believed that early integration of SEA into the planning process would ensure that environmental considerations and suggestions could help shape a more scientific and rigorous plan. However, as many planning authorities lack environmental awareness and are unaware of the need to conduct SEA, they consider SEA to be an intrusion; typically, SEA is conducted when the plan is 'almost final' even though it has often already been approved.

3.1.2. Information and data

The results presented in Table 2 suggest that "information sharing between departments" (5.34) and "inconsistency of information between departments" (5.03) contribute more than other indicators to the problem of "Information and data". In China, inadequate information sharing has always been one of the most criticized points for

administrative departments and scientific research based on "inconsistency of department interests and insufficient cooperation between departments". The decision-making process leaves limited space for transparency and discussion, especially between development authorities and environmental authorities. Different departments collect data and deal with statistics separately, and they usually retain data based on the potential to profit from it. This limits the flow of information and the scope for openness within the SEA process.

3.1.3. Public participation

For public participation, the issues "Lack of an independent legal system for public participation" (4.78), "The public have limited opportunities to learn about planning" (4.77), and "The effectiveness of public suggestions is limited" (4.71) are the foci for participants. Respondents argued that little effort appeared to be directed at ensuring the 'general public' had a real opportunity to engage in SEA. Public participation in China has drawn increasing attention in recent years. For PEIA in China, the main type of public participation is consultation meetings with experts and representatives from related departments, with the general public rarely invited to participate. In this situation, with the plan and related information not being divulged to the general public, the comments and viewpoints of the general public cannot be incorporated effectively.

Interviewees from scientific research institutions argued that public involvement in the SEA process was legally mandated, yet there exists a lack of concrete requirements to maximize transparency and

Table 3
Descriptive statistics of the variable.

Category of problems	Mean	Min.	Max.	Std. dev.
Process and methods	5.01	2	6	1.109
Information and data	5.39	3	6	.687
Public participation	5.05	3	6	.815
Expertise and SEA institutions	5.08	1	6	.859
Decision-making process	5.32	1	6	.777
Legislative and political context	5.28	3	6	.767
International experience	4.52	2	6	.814

Table 4
Measure for the Structural Equation Model.

Fit statistic	Recommended level	Value
χ^2/df	1–2	2.31
GFI	0–1	0.829
CFI	0–1	0.949
RMSEN	<0.10	0.088
NFI	0–1	0.918

involvement. Plan formulation, approval and implementation are mainly conducted by government agencies and they lack transparency.

3.1.4. SEA agency and department

Respondents from environmental authorities and consulting agencies argued that the Ministry of Environmental Protection, the main department responsible for SEA implementation, continued to have a severely limited influence on other ministries. They felt that the environmental departments have difficulty influencing decision-making compared with the sectors responsible for decision-making, and that the immediate interests of ministers and local officials prevented cross-sectoral collaboration to facilitate effective SEA. Therefore, more detailed and comprehensive discussions are needed on the institution system surrounding SEA in China. This issue links to the next issue, involving the decision-making process, since respondents believed decision-making in China to be characterized by a ‘top-to-bottom management system’, where ‘inconsistencies between sectoral department interests and limited cooperation’ adversely affected SEA process efficiency.

3.1.1. Legislative and political context

About 80% of respondents agreed that “lack of effective legal stipulations on management and monitoring” (4.78) and “lack of political will and economic development” (4.61) would hinder SEA implementation. The EIA Law remains weak because it lacks operable detailed rules and regulations on implementation and relevant provisions on accountability, especially in terms of information disclosure, public participation, and penalties.

3.2. Relational links between factors

3.2.1. Research hypothesis and proposed SEM

In this study, a Structural Equation Model (SEM) was proposed to combine factor-effect considerations with questionnaire data. By model calculation, we try to find the relevance of different factors. SEM is a causal relationship model and can identify influencing factors and paths (Jöreskog, 1973; Arhonditsis et al., 2006).

Based on the above analysis, as summarized in Table 3, the Analysis of Moment Structure (AMOS 17.0) model was applied to estimate the formation of relevancy among different issues and factors that comprised the hypothetical model, and to calculate the degrees of influence of these relationships. In this paper, the causal relationships represented the four hypotheses in the path model. The research hypotheses based on the factors are shown as follows:

H1. Each factor (SEA process and methods, Information and data, Public participation, SEA agency and department, Decision-making process, Legislative and political context, International experience) is positively related with SEA implementation.

H2. The Decision-making process is positively related with Information and data, Public participation, SEA agency and department, and Legislative and political context.

H3. Information and data are positively related with Public participation and SEA agency and department.

H4. A relationship exists between SEA process and methods and SEA agency and department.

3.2.2. Analysis of the proposed SEM

The goodness-of-fit statistic for SEM given in Table 4 indicates that the calculated result fits the data well. Besides the model's goodness of fit, the associated standard error, critical ratios and P levels are estimated.

An SEM was constructed based on these hypotheses, and the results are shown in Table 5. According to Table 5, all path coefficients appear significant at the 5% or 10% levels. Therefore, all factors have a positive relationship with SEA effectiveness. The estimates and their associated significance levels are shown in Fig. 1.

According to the SEM findings, the decision-making process, with a coefficient of 0.491, is highly correlated with SEA implementation, followed by legislative and political context (0.152), public participation (0.084), information sharing (0.081), and process and methods (0.06). The results show that SEA is influenced by more contextual factors, such as planning process and political context. In some previous similar surveys, the improvement of methodology and technique has been more important than other issues for effective SEA (Fischer, 2002a, b; Bina, 2008). After about ten years of theoretical study and practical application, work on SEA procedures and methodology became increasingly robust. In China, the decision-making process is highly political and involves different authorities. Institutional and organizational hurdles thus prevent SEA fully participating in the decision-making process (Zhou and Sheate, 2011; Wu et al., 2014). Under these circumstances, the need to understand the SEA context and adapt SEA effectiveness to different institutional contexts has recently been highlighted by

Table 5
Estimates of the relationship between influencing factors and SEA effectiveness.

Parameters	Parameters	Standard Error	Path coefficient	P
Decision-making process	→ SEA effectiveness	0.059	0.491	0.000
Legislative and political context	→ SEA effectiveness	0.147	0.152	0.031
SEA process and methods	→ SEA effectiveness	0.091	0.061	0.027
International experience	→ SEA effectiveness	0.118	0.026	0.041
Information and data sharing	→ SEA effectiveness	0.148	0.081	0.569
Public participation	→ SEA effectiveness	0.121	0.084	0.609
Expertise and SEA institutions	→ SEA effectiveness	0.114	0.029	0.934
Information and data sharing	→ Decision-making process	0.113	0.213	0.037
Public participation	→ Decision-making process	0.093	0.226	0.024
Expertise and SEA institutions	→ Decision-making process	0.087	0.242	0.013
Legislative and political context	→ Decision-making process	0.093	0.365	0.000
Public participation	→ Information and data sharing	0.091	0.313	0.005
Expertise and SEA institutions	→ Information and data sharing	0.086	0.286	0.009
Expertise and SEA institutions	→ SEA process and methods	0.132	0.204	0.071

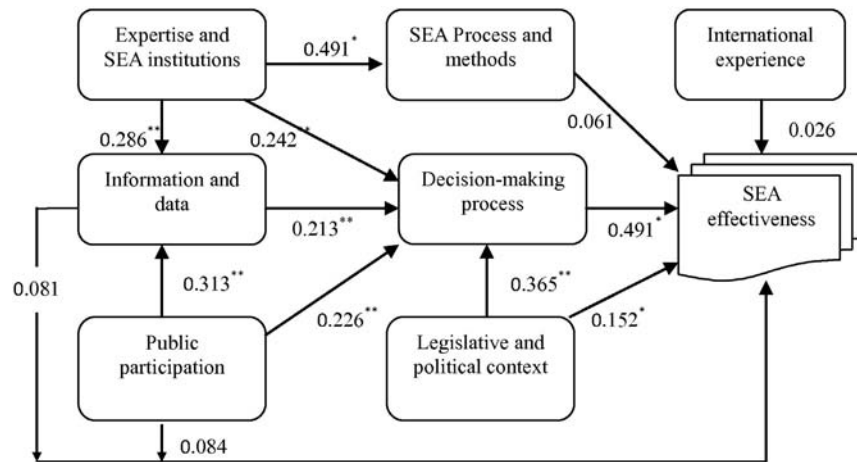


Fig. 1. Structural Equation Model for SEA effectiveness.

some academics (Marssden, 1998; Fischer, 2002a, b; Fischer, 2007; Hilding-Rydevik and Bjarnadottir, 2007; Noble, 2009; Wang et al., 2012).

The second hypothesis is supported by the results of this study. The decision-making process in regard to structural factors positively influences the following parametric variables: information and data (0.213), public participation (0.226), expertise and SEA institutions (0.242), and legislative and political context (0.365). This finding is also supported by other researchers who suggested these external factors are becoming increasingly important for effective SEA implementation (Fischer, 2002a, 2002b; Chaker et al., 2006; Stoeglehner et al., 2009; Elling, 2009).

The third hypothesis is supported by the results of this study. The SEM suggests that information and data has a positive relationship with public participation (0.286), as well as with expertise and SEA institutions (0.313). In China, information and data sharing has been a critical issue for EIA agencies and researchers. Data sharing is difficult to achieve because sectors do not cooperate with one another, and they collect data and deal with statistics separately, which affects the fairness of decision-making procedures.

The SEM indicates that processes and methods are positively related to expertise and SEA institutions (0.204), suggesting techniques can be improved by expertise and SEA institutions. This finding is logical because the ability of SEA practitioners to directly affect SEA techniques.

To improve the effectiveness of SEA and accumulate practical experience and lessons, the Chinese SEA system is still evolving via fine-tuning, adjustment and improvement in the following ways:

(1) Besides sound legislative support, PEIA systems require a number of key factors to be in place before they can operate effectively, including the political will and sectoral co-operation necessary for success, and institutional structures to enforce and control their operations. Strengthening the skills of SEA professionals and the resources necessary for SEA preparation, appraisal and enforcement offers significant benefits and can bolster the effectiveness of the SEA legislative framework.

(2) Encourage the general public to participate in the management of SEA to exercise their “Right to know,” “Right to participate,” and “Right to supervise,” as ensured and guaranteed by law, and to play an active role in all public participation activities, such as demonstration meetings, public hearings, seminars and other forums. Non-governmental organizations, such as business associations and academic associations, should also encourage the public to play an active role in SEA supervision and management.

(3) Build an SEA information platform through the integration of data and information from all relevant institutions. To promote the effectiveness of SEA, the disclosed information should be broad and detailed. Inter-departmental communications and coordinating agencies

should be established to build and strengthen cooperation mechanisms among departments, and to establish a sound basic database.

4. Conclusion

This study analyzes the factors influencing SEA implementation in China, and the relationships and levels of influence among the factors associated with SEA. To analyze the extent and relevance of different influencing factors, descriptive statistical analysis and a Structural Equation Model (SEM) were applied in this paper.

The descriptive statistical analysis shows that the main influencing factors that affect SEA implementation are contextual factors, such as laws and regulations, SEA management, and decision-making procedures. The SEM developed in this study shows that SEA is directly and positively related to the decision-making process, as well as legislative and political context. The results also suggest that, although the direct relationship between information sharing and SEA is weak, the former nevertheless has a strong indirect effect on the latter, which means collaboration among different sectors is crucial. These factors can all be recognized as institutional problems. Therefore, we find that SEA improvement relies more on the decision-making process, SEA political context, and sector collaboration.

In this study, SEM has been applied to calculate the relevance of the different factors associated with SEA effectiveness. Although the model and approach have been applied in a specific study, the research results show the proposed method is reliable and suitable for use, with slight modifications, in other contexts.

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