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Strategic environmental assessment in Swedish municipal planning. Trends and challenges

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ABSTRACT

More than a decade after the implementation of the EU Directive on Strategic Environmental Assessment (SEA) into Swedish legislation, a comprehensive study has been conducted to analyze the development of SEA practice in municipal planning. The analysis was based on a nationwide mapping of SEA in Swedish municipal comprehensive plans and municipal sector plans, such as energy plans and waste plans, which were adopted in the period 2004–2014. The mapping was used for obtaining evidence of, and explanations for, the extent to which SEAs have been carried out and to enable an identification of the presence of alternatives and specified purposes of the plan. In this paper, the result of the analysis of the development of SEA practice is presented, which shows that municipal comprehensive plans had an SEA to an increasingly greater extent, up to on average 90% for the period 2010–2014. For waste plans and energy plans, corresponding figures for the same period were significantly lower. In addition, the result shows a decreasing trend between 2006 and 2014 regarding the proportion of SEAs that included more than one plan alternative. The use of a zero alternative, however, increased from 2006 to 2014. A regression analysis was conducted to identify determinants that explain the variation in the degree to which screening and SEAs were conducted. The findings of the study show that a systematic mapping of SEA practice provides empirical basis for the development of policy measures to enhance the use of SEAs in municipal planning. Furthermore, it is argued that strengthening the link between alternatives and the purposes of the plan may foster a more strategic thinking when identifying reasonable alternatives on how to promote sustainable development within the planning. Moreover, it is argued that mandatory SEA should be considered in municipal comprehensive and sector planning.

1. Introduction

The Strategic Environmental Assessment (SEA) Directive (European Commission, 2001) was introduced to enhance the effective consideration of environmental targets and environmental effects by planners and decision-makers, in particular through the assessment of alternatives (Commission of the European Communities, 1996). According to European Commission (2009, 2017), SEA practice has progressively led to a higher quality of plans and a greater environmental emphasis. However, problems exist with the selection of reasonable and relevant alternatives to a plan or program (European Commission, 2009) which depends on the lack of a common approach for defining the type and number of alternatives to be included (European Commission, 2017). As a consequence, alternatives cannot fully play its role as the intended means for addressing environmental impacts in

planning and decision-making. To fulfill the potential of SEA, all Member States should pursue their implementation efforts to ensure compliance with the SEA Directive (European Commission, 2017).

The EU reports provide a broad overview of SEA practice in the 28 Member States, but they need to be complemented with empirical analyses of SEA in different national contexts in order to gain a deeper understanding of how SEA practice is developing. Numerous national studies and research projects have been conducted in which SEA performance in different countries was analyzed (e.g. Fischer, 2010; Stoeglehner, 2010; Weiland, 2010). These studies provide insights into SEA practice from individual countries and contribute to the accumulated transnational knowledge on the role of SEAs in planning. Other studies have reported on elements in the SEA process such as alternatives (e.g. Geneletti, 2014) and screening (e.g. Bidstrup, 2017), meaning the process of determining whether plans and programs are

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likely to have significant environmental effects and thus require an SEA (Glasson et al., 2005). Pope et al. (2013) and González et al. (2015) state that alternatives are often not properly handled, while others discuss poor routines for screening due to, for example, the lack of understanding of legal requirements (Faith-Ell et al., 2015) or because the SEA is one step behind the planning process (Stoeglehner, 2010). Empirical studies like these nourish a learning process that gradually improves the application of SEA in planning and decision making. Hence, a systematic analysis of SEA practice to identify trends and challenges will help Member States to meet the Commission's call for additional efforts to ensure compliance with the SEA Directive.

In Sweden, the need for a further consolidation of environmental assessment as a tool for catalyzing sustainable development was discussed in the latest evaluation of the Swedish environmental quality objectives (Swedish Environmental Protection Agency, 2015a:6662). The evaluation report highlighted the important role of spatial planning in meeting environmental quality objectives and stated that environmental assessment could be an effective tool for targeting these objectives (Swedish Environmental Protection Agency, 2015a:6662). However, due to a lack of compliance with national legislation, e.g. concerning the inclusion of alternatives, SEA is not able to fully fulfill its purpose (Swedish Environmental Protection Agency, 2015b:6664).

In addition, the National Board of Housing, Building and Planning (2013:16) stated that SEAs in municipal comprehensive plans are not being used as the strategic process tool they are meant to be. Several reasons have been mentioned for the limited application of SEAs in planning practice, e.g. the uneven distribution of knowledge among practitioners on SEA processes and SEA regulations (Faith-Ell et al., 2015). Moreover, a lack of municipal resources might restrict the application of SEAs, especially in smaller municipalities (Swedish Environmental Protection Agency, 2015c:6666; Emmelin and Lerman, 2005). Furthermore, the Swedish Environmental Protection Agency (2015b:6664) concludes that several authorities in Sweden have difficulties in determining whether the impacts on the environment are considered to be significant, which results in an uncertainty about when to carry out an SEA.

In order to generate knowledge on how to strengthen spatial planning as a tool to meet environmental objectives, the Swedish Environmental Protection Agency and the Swedish Agency for Marine and Water Management set up a research program (Swedish Environmental Protection Agency, 2012a,b). Within this program, a three-year research project, Sustainable Planning and Environmental Assessment Knowledge (SPEAK) was initiated in 2014 which included a comprehensive scientific study of SEA practice in municipal planning. This study encompassed a combination of qualitative and quantitative methods with the purpose to analyze trends and challenges in Swedish SEA practice and identify possible determinants that strengthen or weaken SEA as a tool to enhance sustainable development through municipal planning. More specifically, the study addressed three research questions:

1. How has the application of SEA for municipal comprehensive and sector planning developed from their introduction in 2004?
2. To what extent does Swedish SEA practice comply with legal requirements concerning the identification and assessment of alternatives to fulfill the purpose of the plan?
3. Which determinants affect the likelihood that an SEA is conducted?

This paper addresses the development of SEA practice in Swedish municipal planning since the implementation of EUs SEA Directive in 2004. On basis of empirical analysis, trends regarding the use of SEA in municipal planning are explored and challenges related to the inclusion of key components such as screening, plan alternatives and the purpose of the plan are discussed. In addition, possible determinants for using or not using screening and SEA in municipal planning are examined to identify potential impediments for the application of SEA and

consideration of environmental targets in municipal planning. To remedy deficiencies in SEA practice, measures are discussed to ensure the environmental assessment of municipal plans and counteract possible underlying causes for the possible lack of compliance with regulations such as the EU SEA Directive and the Swedish Environmental Code. While these measures are based on a study of Swedish experiences, they address issues regarding e.g. the use of screening and alternatives that apply to SEA practice beyond the Swedish context.

2. Description of the Swedish context

2.1. Planning in Sweden

The Swedish planning system can be described as strongly decentralized in an international perspective (Hedström and Lundström, 2013). Unlike many other countries, the relation between different governmental levels is not hierarchical. Instead, Swedish planning can be described as an interaction between municipal land use planning and sector planning on a local, regional, and national level. The so-called municipal planning monopoly means that the State can only act against municipal decisions that contravene certain national interests (Blücher, 2013). Hence, municipal land use planning becomes the focal point for action towards sustainable development in Sweden, where national and regional policies are integrated and implemented in the local spatial context.

Municipal land use planning is carried out through the various planning instruments provided for by the Planning and Building Act (2010:900), among others the municipal comprehensive plan (MCP). Each municipality is required to prepare an MCP, which is the central planning instrument of the Swedish planning system (Fredriksson, 2013). Even though the MCP is not legally binding, it provides guidance for other municipal decisions that affect land and water use and how the built environment is used, developed, and preserved (Hedström and Lundström, 2013), e.g. through the detailed development plan that is used to regulate land use in line with the goals of the MCP. The MCP must be considered by the municipal council at least once during each term of office (4 years) in order to assess the up-to-dateness of the plan (Plan and Building Act, 2010). Besides MCPs, municipalities can develop a detailed comprehensive plan (DCP) in order to achieve more in-depth planning in relation to a limited development area. Moreover, the municipalities can decide to draw up a supplement to the MCP, a so-called thematic comprehensive plan (TCP) in which questions that are not (fully) addressed in the MCP are elaborated. Framing a TCP is a way of keeping the current MCP updated pending a revision. The DCP and TCP are optional plans, in contrast to the MCP. The TCPs have in recent years frequently been used for the assessment of the location of wind parks within the municipalities.

In addition to the land use plans, municipalities are also responsible for a number of sector plans e.g. municipal energy plans (EPs) (Act on Municipal Energy Planning, 1977:439) and municipal waste plans (WPs) (Environmental Code, 1998: Chapter 15 Section 41 and the Ordinance on Waste, 2011:927). Both municipal EPs and WPs are important strategic instruments and provide a basis for the municipality's efforts to contribute to achieving national energy and waste-related environmental quality objectives. It is up to each municipality to design the work on the WP and the EP. However, collaboration between municipalities is encouraged in order to strengthen the work on sustainability issues (Swedish Environmental protection Agency, 2012a: 6525). According to the Waste Ordinance (2011: 927), the data in the WP must be reviewed at least every four years, and according to the Act on Municipal Energy Planning (1977: 439), each municipality must have an up-to-date plan for the supply, distribution, and use of energy.

2.2. Application of SEAs in Swedish planning

The Swedish SEA legislation is based on the EU Directive 2001/42/

EC (European Commission, 2001) that was transposed into the Environmental Code that regulates the application of SEAs in Sweden. In addition, supplementary provisions for environmental reports are included in the Ordinance on Environmental Impact Assessment (1998:905). An SEA provides a legally based requirement in Sweden to promote sustainable development and “to identify and describe the direct and indirect effects of the planned activity or action” as well as “to enable an overall assessment to be made of this impact on human health and the environment” (Environmental Code, 1998: Chapter 6 section 11).

Like in most European countries, the zero alternative, meaning the likely evolution of the current state of the environment without the implementation of any action (European Commission, 2003), is often included in Swedish SEAs (European Commission, 2016). However, as in several other countries, there is an ongoing discussion about what is meant by, and how to interpret, reasonable alternatives (González et al., 2015; COM, 2016). According to Swedish legislation, the reasoning behind the proposed plan shall be defined and assessed and the SEA shall include a description of reasonable alternatives to fulfill the purpose of the plan. In line with the EU guidelines (EU Commission, 2003), the alternatives shall be environmentally assessed and described in a comparable way. Regarding the number of alternatives, the Swedish Environmental Protection Agency stated in the handbook “SEA for Plans and Programs” (Swedish Environmental Protection Agency, 2010 p. 92) that it is usually appropriate to present at least two plan alternatives.

3. Material and methods

3.1. Mapping of SEA practice

As the first step in the data collection, a nationwide database was created containing various types of municipal comprehensive plans and sector plans, as well as their SEA reports that were adopted since the implementation of the SEA Directive in Swedish legislation in 2004. For this purpose all available plans and environmental reports for all 290 municipalities in Sweden were downloaded from the municipalities' websites. In the next step, a sample of 80 municipalities was drawn (see Fig. 1), for which missing documentation was requested through telephone contact. These municipalities were sampled based on stratification according to the municipality categories defined by the Swedish Association of Local Authorities and Regions' classification (SALAR, 2011). In the SALAR classification, the municipalities are divided into 10 categories based on structural parameters such as population, commuting patterns, tourism and travel industry, and economic structure. The 80 municipalities were sampled from each of the categories in order to have a nationally representative sample (Wallström, 2015).

All documents were imported into the software NVivo 10 (QSR International, 2015) that was used for data analysis. The plans were coded, and classified, giving information about a number of variables (Table 1). Initially, five variables were selected, but during the coding and classification it became evident that neighboring municipalities were cooperating in the development of certain plans. Thus a sixth variable was added, i.e. inter-municipal cooperation. The coding of variables 5 and 6 was carried out based on assessments of the plan and the SEA. The interpretation of Yes or No was done in an inclusive way, which meant that the coding was interpreted as Yes if the municipality claimed to have included screening and an SEA. Thus the coding only considered that a screening had been performed and that an SEA had been carried out. The SEA reports were assessed and coded according to whether or not they included alternatives and/or included the purpose of the plan (variables 5.1–5.3 in Table 1). These variables represent key components that provide an indication of the quality of the SEA, but as part of the mapping no quality review was made of the alternatives or of the purpose of the plan.

In order to validate the coding process and to ensure that the

material was coded in the same way regardless of the person coding the material, a pilot study was conducted and a coding manual was developed. In the pilot study, 10 plans and SEAs were coded by all encoders individually. The different codes were compared, and the coding manual was updated, which ensured that all coding was carried out in the same way.

3.2. Method for analyzing the variation in conducting an SEA

A qualitative and a quantitative approach was combined and applied to find determinants of the extent to which SEAs were conducted or not for the plans that were sampled. Potential determinants were first explored qualitatively in focus group discussions involving key actors and experts. Two focus group discussions were organized. In the first one (23 October 2015) a multidisciplinary group of 10 researchers participated, whereas in the second one (5 November 2015) representatives of Swedish agencies and the international research community participated, 19 in total. Participants worked in pairs during the first focus group discussion and in groups during the second focus group discussion, and they reported the results both in oral and written formats.

The results of the focus groups discussions was followed up by a quantitative assessment, in order to find out whether patterns found in the dataset of municipal plans were statistically significant or not. For the quantitative assessment regression analysis was chosen because it is a widely accepted tool to estimate the statistical relationship among variables. The suggestions of potential determinants brought up in the focus groups discussions, including patterns suggested by the dataset, were used as a basis for defining potential explanatory variables in the regression analysis. The availability of data determined which variables were possible to include.

For the regression analysis, a model was considered where the binary dependent variable (whether an SEA was conducted or not) is a function of a row vector x of explanatory variables in the following way (cf., e.g., Greene, 2011):

$$\text{Prob}\{\text{SEA conducted} = 1\} = F(\beta x')$$

$$\text{Prob}\{\text{SEA conducted} = 0\} = 1 - F(\beta x'),$$

where $\text{Prob}\{\text{SEA conducted} = 1\}$ denotes the probability that an SEA is conducted, $\text{Prob}\{\text{SEA conducted} = 0\}$ is the probability that an SEA is not conducted, and β is a row vector of coefficients to be estimated. $F(\cdot)$ was specified by using the commonly used logistic regression model, and the analysis was performed using the statistical software R 2.15.2 (R Core Team, 2011) and forward stepwise selections (function in R: step) for finding empirical models including only variables that contributed significantly to explaining the variability in the dependent variable. Explanatory variables were added sequentially, and each variable was evaluated on the basis of its significance level. When it comes to categorical explanatory variables, the different categories were dummy (0–1) coded. A similar analysis with screening as a dependent variable was also applied because of the potentially unclear practice with respect to screening.

4. Results

4.1. Key descriptive statistics

The proportion of municipalities in the sample that adopted different types of plans is shown in Table 2. The result shows that 79% of the municipalities adopted at least one MCP between 2004 and 2014, while in 19% of the municipalities an MCP was adopted outside the time interval which involves that more than 95% of all municipalities have a MCP. All municipalities in the sample adopted a WP, but 8% of the municipalities adopted the plan outside the selected time interval. EPs were carried out to a lesser extent than other municipal plans.

The sample was also compared to all Swedish municipalities in order to assess the validity of the sample. Table 2 indicates no major

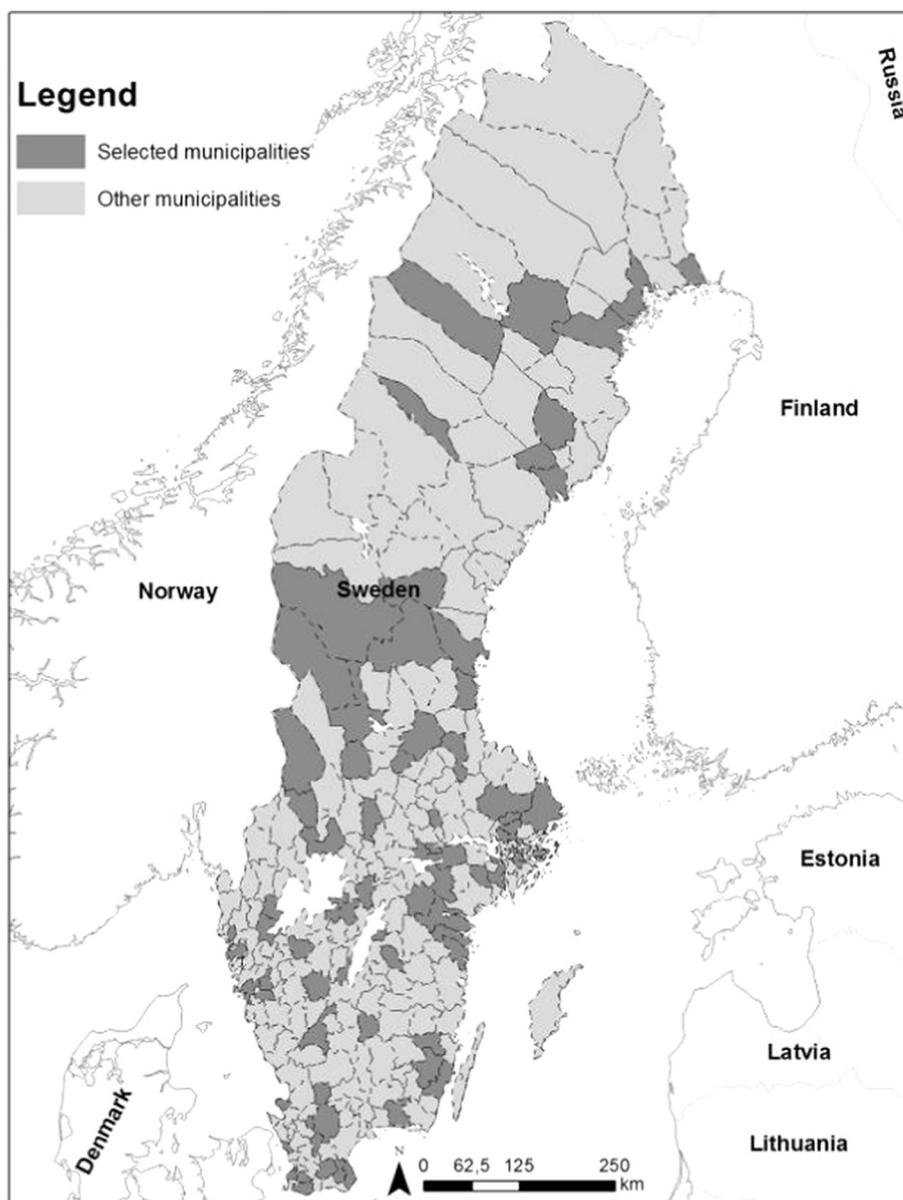


Fig. 1. All 290 municipalities in Sweden with the 80 sampled municipalities in dark color.

Table 1

Variables used for the coding and classification of the plans and SEA reports included in the dataset.

- 1) Year when the plan was adopted (time interval 2004–2014)
- 2) Type of plan (MCP, TCP, DCP, EP, WP)
- 3) Classification of municipality according to SALAR (2011)
- 4) Conducted screening (Yes/No/NA)
- 5) Conducted a Strategic Environmental Assessment (SEA) (Yes/No/NA)
 - 5.1) Zero alternative is included (Yes/No)
 - 5.2) More than one plan alternative is included (Yes/No)
 - 5.3) Purpose of the plan is included (Yes/No)
- 6) Inter-municipal cooperation (Yes/No)

differences in the proportions between the municipality sample and all municipalities. This suggests that the sample data can be regarded as being representative of the whole population, i.e. all Swedish municipalities.

Some of the municipalities adopted more than one plan of each type within the selected time interval 2004–2014 and a few municipalities adopted joint plans. The total number of unique plans in the sample is

303, but the total number of plans counted by municipality (including joint plans) is 316.

The proportion of plans for which an SEA exists varies (Fig. 2) between the types of plans, ranging from 19% for EPs to 85% for TCPs for the entire period of 2004–2014. Fig. 2 also shows how the proportion of plans for which an SEA exists changed over time. The specification of the numbers of each type of plan shows that the proportion of MCPs, DCPs, and TCPs that came with an SEA increased from 30 to 45% in the period between 2004 and 2009 to close to 90% or more for the period 2010–2014. For the WPs and EPs, the increase in the proportion of plans for which an SEA exists was less substantial. For WPs the proportion was about 55% for the entire period while for EPs there was a little increase from 16% for the period 2004–2009 to 21% for 2010–2014.

Table 3 presents the number and proportion of plans for which a screening was conducted in order to determine whether the plan was expected to cause significant environmental impacts in accordance with Annex 4 of the EIA-ordinance (1998:905). On average, 61% of all plans underwent a screening, varying between 34% for EPs and 82% for TCPs. From the total number of 171 SEAs that were conducted, 86%

Table 2
Proportion of municipalities adopting at least one plan in 2004–2014.

	Sample municipalities		All Swedish municipalities	
Total number of municipalities	80	100%	290	100%
Municipal Comprehensive Plan (MCP)	63	79%	229	79%
MCP adopted outside the selected time interval	15	19%	48	17%
MCP does not exist	2	3%	2	1%
Unknown whether MCP exists or not	0	0%	11	4%
Waste Plan (WP)	74	93%	256	88%
WP adopted outside the selected time interval	6	8%	22	8%
Unknown whether WP exists or not	0	0%	12	4%
Energy Plan (EP)	57	71%	202	70%
EP adopted outside the selected time interval	11	14%	33	11%
EP does not exist	12	15%	38	13%
Unknown whether EP exists or not	0	0%	17	6%

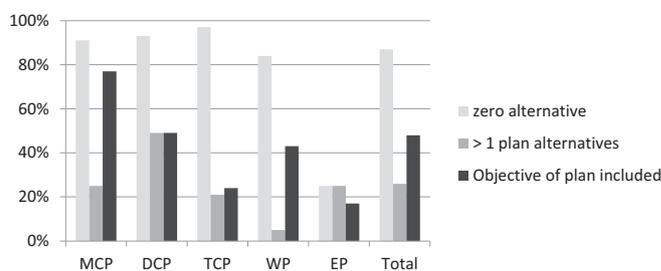


Fig. 3. Proportion of SEAs with a zero alternative and more than one plan alternative for different types of plans. MCP = Municipal Comprehensive Plan, DCP = Detailed Comprehensive Plan, TCP = Thematic Comprehensive Plan, WP = Waste Plan, EP = Energy Plan.

screening in municipal planning. For 118 plans no screening was conducted and although that for 25 of these a SEA was prepared, the remaining 93 plans (ca 30% of the total number of municipal plan) were approved without screening nor SEA, among these 17 MCPs and 21 DCPs. However, Fig. 2 shows that the proportion of plans that was adopted without an SEA, was particularly high between 2004 and 2009, which includes 21 MCPs and 24 DCPs. Thus not only the proportion of comprehensive plans that include an SEA has increased since 2010, but also the proportion for which screening has been conducted increased. For WPs and EPs the increase was less even though the impact of screening on the probability that an SEA was conducted was high for WPs (89%) compared to EPs (68%).

As mentioned in 3.1, SEA reports were assessed and coded according to whether or not they included alternatives and/or included the purpose of the plan. The results that are presented in Fig. 3 show that most of the SEAs, except SEAs for EPs, included a zero alternative and that the share of such SEAs increased from 2006 to 2014 (see Fig. 4). Fig. 3 also shows the share of SEAs that included more than one plan alternative. For DCPs this was most common (49%), and for all other plans the share was 20% or less. Fig. 4 indicates a decreasing trend regarding the inclusion of an additional alternative in SEA besides the main plan alternative. WPs had on average the lowest proportion of SEAs that included more than one plan alternative. Regarding the inclusion of the objective of the plan in the SEA, the mapping shows a mixed result. The figures differ widely, from 77% for MCPs to 24% for TCPs and 17% for EPs (see Fig. 3).

4.2. Explaining the variation in conducting SEAs: Qualitative and quantitative analyses

The two focus group discussion mentioned in section 3.2 resulted in a set of potentially important determinants for the extent to which SEAs are carried out. Several of them focus on resource availability and

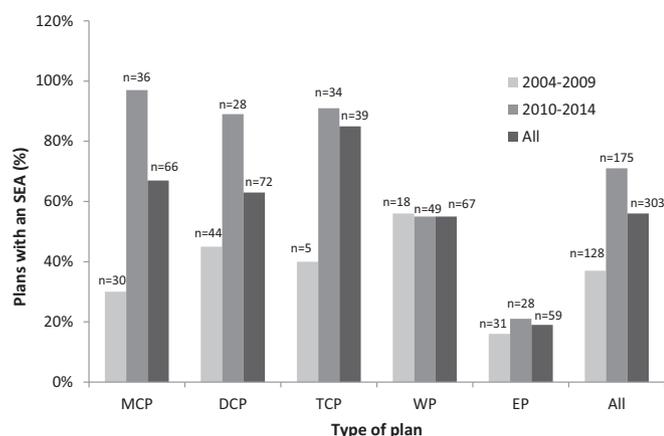


Fig. 2. Proportion of plans adopted in 2004–2014 and specified for the periods 2004–2009 and 2010–2014 for which an SEA exists. n = the total number of plans for each type of plan and time period, MCP = Municipal Comprehensive Plan, DCP = Detailed Comprehensive Plan, TCP = Thematic Comprehensive Plan, WP = Waste Plan, EP = Energy Plan.

were preceded by a screening. This means that for 14% of the SEAs, no screening of the plan was applied, and this was mostly related to DCPs and EPs.

The figures in Table 3 indicate ambiguity regarding the use of

Table 3
Number and proportion of plans and SEAs for which a screening was conducted, specified for different types of plans.

	Municipal Compre-hensive Plan	Detailed Compre-hensive Plan	Thematic Compre-hensive Plan	Waste Plan	Energy Plan	Total
Number of adopted plans	66	73	39	67	59	303
Screening conducted			32	48	20	185
Number	43	42	82%	72%	34%	61%
Percentage of total no. of plans	65%	58%				
No screening conducted	23	30	7	19	39	118
Number	35%	42%	18%	28%	66%	39%
Percentage of total no. of plans						
Total number of SEAs	44	45	33	37	12	171
Screening conducted						
Number	38	36	31	33	8	146
Percentage of total no of SEAs	86%	80%	94%	89%	68%	86%
No screening conducted	6	9	2	4	4	25
Number	14%	20%	6%	11%	33%	14%
Percentage of total no. of SEAs						

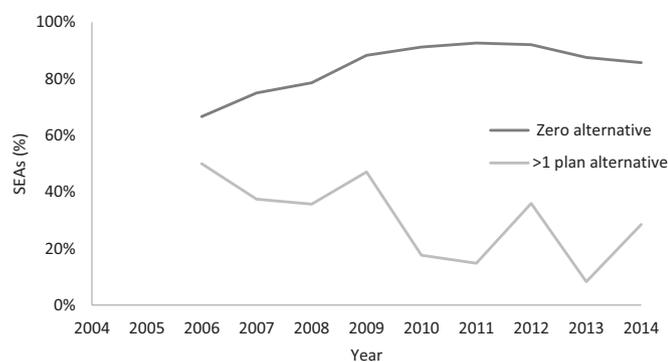


Fig. 4. Proportion of SEAs (in all MCPs, DCPs, TCPs, WPs, and EPs) with a zero alternative and more than one plan alternative, respectively. Data are not shown for year 2004–2005 due to too few observations.

organizational aspects, but the participants in the focus group discussions also suggested other types of determinants, such as the local political situation and the degree of environmental impact. In Table 4, these suggestions are divided into eight groups of determinants and are described briefly.

To enable a quantitative analysis, a number of potentially quantifiable variables were identified for each of the eight suggested determinants (see Table 4). The availability of data in the dataset and in complementary public statistics determined which variables to include in the row vector x in the regression analysis. Those variables are marked in bold in Table 4 and statistically described in the Appendix A.

This implies that all eight potentially important determinants in Table 4 were represented in the regression analysis. Logistic regressions were applied, with two binary dependent variables: whether an SEA was conducted or not and whether a screening was conducted or not, respectively. The 12 explanatory variables used in the full model are listed in Table 5. Through forward stepwise selections, final models were obtained including only variables that contributed significantly (at the 0.05 level) to explaining the variability in the dependent variables. Table 5 indicates whether or not the tested explanatory variables were included in the final models. If so, the direction of the impact is shown as positive (+) or negative (−). Regarding categorical predictor variables, the largest category in terms of number of observations and/or the median category in terms of mean values was chosen as the reference category. The detailed estimation results for the final models are found in Table 6.

The regression results confirm several indications from section 4.1, i.e. carrying out a screening had a significantly positive impact on the probability of whether an SEA is conducted or not. There were also significant differences between the types of plans, where EPs has the lowest probability of being accompanied by a screening process or an SEA, cf. Fig. 1. Moreover, the regression shows that the share of SEAs increased significantly during the study period, confirming the tendency indicated by Fig. 2. The results are presented for all types of plans taken together, but when looking at specific types of plans no significant increase in the share of SEAs over time was seen for WPs or EPs (Wallström, 2015).

The regression results also support the importance of some of the other potential determinants suggested by the participants of the focus group discussions. Inter-municipal cooperation increases the probability that a screening is carried out and thus indirectly also the probability that an SEA is conducted. Also, local tax rate shows a significantly negative relationship with the probability that an SEA is conducted, which suggests that the availability of resources such as the financial capacity of the municipalities plays an important role.

5. Discussion

5.1. Assessment of the research methodology

The research methodology facilitated a systematic analysis of SEA practice based on empirical data from a representative sample of 80 municipalities in Sweden. The methodological strength of this study is the integrative effort of combining, collecting and organizing data and applying both qualitative and quantitative analysis. The comprehensive database with municipal plans and SEAs enabled a statistical mapping of SEA practice, but also allowed a qualitative analysis by coding variables in the dataset supported by NVivo 10 software, which was validated through a pilot study. To identify determinants that affect the probability for conducting a screening or SEA, a combination of focus group discussions involving key actors and experts, and regression analysis was used. Although each part may not be considered innovative per se, the assemblage of research methodologies facilitated an incremental process of knowledge generation that can be refined for future research. The outcome provided a comprehensive understanding of the development of SEA practice in Sweden and revealed challenges where measures are needed to strengthen the role of SEA in municipal planning. In addition, the explorative character of the research methodology provided a basis for complementary research, e.g. on the quality of alternatives in substance or the integration of environmental objectives within the defined purpose of the plan.

A weakness of the research methodology was that lack of data limited the quantification of possible determinants. For the majority of the suggested determinants in Table 4 no data was available in public statistics. Future research should therefore foster data collection efforts that enable the quantification of additional determinants. Also the analysis of possible determinants should be subject to further research, e.g. through a scientific synthesis of research results to justify the accuracy of each of the determinants, and identify interdependencies and verify causalities among determinants. Innovative research tools for computational analysis can be used to deepen the understanding of explanatory variables for the use of SEA in municipal planning.

The software-supported analysis that was used in this study introduces a remedy and key enabler of SEA research, which facilitated swift search through all documents (e.g. plans and SEAs) simultaneously, and it also includes a method of coding and classification that is suitable for both quantitative and qualitative studies. To enhance future SEA research, the national database needs to be maintained to provide an updated repository of Swedish SEA practice that is comparable with the database developed by the Scottish government (Fischer et al., 2015).

5.2. Trends in Swedish SEA practice

The result of the mapping of the municipal plans showed that the application of SEAs in comprehensive planning has increased during recent years. For Municipal Comprehensive Plans, Detailed Comprehensive Plans and Thematic Comprehensive Plans, the increase was significant, and more than 90% of all plans that were adopted in the period between 2010 and 2014 included an SEA (see Fig. 2). The low proportion of plans that came with an SEA in the first 5-year period 2004–2009 can possibly be explained by start-up problems. This could either depend on the lack of guidance or difficulties among municipalities in interpreting the new legislation, but the mapping provides no evidence for either of these explanations.

For the municipal sector plans, i.e. Waste Plans and Energy Plans, the increase of the proportion of plans for which an SEA exists was modest (Fig. 2). For Waste Plans, 55% of the plans included an SEA for both the first and second 5-year period of study. For Energy Plans, the number was 16% for 2004–2009 and 21% for 2010–2014, which indicates a minor increase. Yet, the figures show that an SEA was conducted for only 1 out of 5 plans.

Table 4
Potentially important determinants and potentially quantifiable variables for the extent to which SEAs are carried out. The selected variables that are included in the regression analysis are marked in bold.

Resources and organizational aspects at the municipality level		Resources and organizational aspects at other governmental levels		Other suggested types of determinants	
<p>1. Human resources</p> <p>Having a municipality staff with sufficient size, time, and competence to handle SEA issues, which might in turn be dependent on the socio-economic characteristics of the municipality such as residents' income and associated local income tax payments.</p>	<ul style="list-style-type: none"> Budget for staff handling SEA issues (SEK) Staff size (no. of persons) Educational level of this staff (number of persons having a particular level) Experience among this staff (years/person) Gross regional product/day population (SEK/inhabitant) Population size (number of inhabitants) Type of municipality (SALAR typology) Total local tax rate (%) Separate unit for environmental issues (yes/no) Presence of coordination measures (number of joint meetings across units) Inter-municipal cooperation (presence of joint plans) Presence of joint projects with academia (yes/no) University in the vicinity of the municipality (yes/no) County in which the municipality is situated SEA carried out by consultancies (yes/no) 	<p>4. SEA review and support at the regional level</p> <p>For example, the availability of resources from County Administrative Boards. High capacity might contribute to thorough reviews and support activities.</p>	<ul style="list-style-type: none"> Presence of relevant staff on County Administrative Boards (yes/no) Use of guidance material on County Administrative Boards (yes/no) County in which the municipality is situated Region of the country in which the municipality is situated Timing of regional guidance initiatives (year when the plan was adopted) 	<p>6. Formal components in the planning process</p> <p>7. Political situation in the municipality</p> <p>Political parties with a distinctively green agenda in the political majority, these parties' influence on planning issues, stability of the majority.</p> <p>Ambitious environmental policies and membership in, e.g. the National Association of Swedish Eco-municipalities.</p>	<ul style="list-style-type: none"> Type of plan Screening has been carried out (yes/no) Result in municipal elections for Green Party (%) Green Party holds the chairmanship for the committee handling planning decisions (yes/no) More ambitious local environmental objectives (yes/no, i.e. reduction of CO₂ emissions and becoming a "fossil fuel-free" municipality) Membership in the National Association of Swedish Eco-municipalities (yes/no) Share protected area of in municipality (%) Presence of emission-intensive industry (no. of firms, level of emissions) Gross regional product (SEK/inhabitant) Population (no. of inhabitants) Type of municipality (SALAR typology) Total local tax rate (%)
<p>2. Organization</p> <p>Municipal internal organization and collaboration between units. Cooperation with other municipalities.</p>	<ul style="list-style-type: none"> Use of national guidance material (yes/no) Timing of national guidance initiatives (year when the plan was adopted) Participation of municipal representatives at seminars (no. of participants/seminar) 	<p>5. SEA guidance at the national level</p> <p>Use of national SEA handbooks, participation in seminars, etc., by the Swedish EPA, National Board of Housing, Building & Planning, Swedish Association of Local Authorities and Regions.</p>	<ul style="list-style-type: none"> Use of national guidance material (yes/no) Timing of national guidance initiatives (year when the plan was adopted) Participation of municipal representatives at seminars (no. of participants/seminar) 	<p>8. Apparent impacts and protected areas</p> <p>Depend on socio-economic conditions, e.g. type/size of economic activities, demography. Share of protected areas need to be taken into account.</p>	<ul style="list-style-type: none"> Apparent impacts and protected areas Depend on socio-economic conditions, e.g. type/size of economic activities, demography. Share of protected areas need to be taken into account.
<p>3. Co-operation with academia and consultancies</p> <p>Co-operation with experts to foster SEAs.</p>	<ul style="list-style-type: none"> Cooperation with academia and consultancies Co-operation with experts to foster SEAs. 				

Table 5

Results from logistic regression analyses of determinants for whether a screening or an SEA was conducted or not, respectively, where “+” indicates a positive impact and “-” indicates a negative impact. (Detailed results are found in Table 6 as indicated below.) *n* = 316.

Explanatory variables tested	Included in the final model with a significant impact on the probability that a:	
	Screening was conducted (Table 7)	SEA was conducted (Table 8)
Region of the country in which the municipality is situated	No	No
County in which the municipality is situated	No	No
Gross regional product/day population for the municipality (mean value 2004–2012 (SCB, 2017))	No	No
Inter-municipal cooperation	Yes (+)	No
Membership in the National Association of Swedish Eco-municipalities (SEKOM, 2017)	No	No
Population of the municipality (2014) (SCB, 2017)	No	No
Screening has been carried out	-	Yes (+)
Share protected area of total municipality area (2014) (SCB, 2017)	No	No
Total local tax rate (mean value 2004–2015) (SCB, 2017)	No	Yes (-)
Type of municipality (SALAR, 2011)	No	No
Type of plan	Yes ^a	Yes ^b
Year when plan was adopted (time interval 2004–2014)	Yes (+)	Yes (+)

^a EP has a significantly negative impact on the probability that a screening is conducted for all types of plans, given the use of WP as a reference category.

^b WP and EP have a significantly negative impact on the probability that an SEA is conducted for all types of plans, given the use of MCP as the reference category.

Table 6

Results of the final logistic regression model evaluating A: whether screening was conducted. Dependent variable: Screening – Yes (1) or No (0) and B: whether an SEA was conducted. Dependent variable: SEA – Yes (1) or No (0).

Explanatory variables	A: whether screening was conducted. Dependent variable: Screening – Yes (1) or No (0).		B: whether an SEA was conducted. Dependent variable: SEA – Yes (1) or No (0).	
	Coefficient	s.e.	Coefficient	s.e.
Inter-municipal cooperation	1.527 ***	0.592		
Screening			2.291 ***	0.325
Year plan was adopted	0.287 ***	0.050	0.258 ***	0.061
Total local tax rate			-0.403 *	0.169
Type of plan [WP]	reference category		-1.264 **	0.456
Type of plan [EP]	-1.097 **	0.419	-2.050 ***	0.507
Type of plan [MCP]	0.332	0.428	reference category	
Type of plan [DCP/TCP]	0.331	0.384	0.271	0.431
Intercept	-576.946		-506.612	
McFadden R-squared	0.174		0.358	
Log-likelihood	-172.478		-138.863	
Akaike information criterion	356.956		291.726	
Observations	316		316	

Standard errors in the third and fifth column.

*** significant at 0.1%.

** significant at 1%.

* significant at 5%.

Regarding the number of screenings, the score for Energy Plans was the lowest, while for Waste Plans the number of screenings was equivalent to the numbers for the comprehensive plans. The highest proportion of plans for which a screening was conducted was found for Thematic Comprehensive Plans (82%), while for Municipal Comprehensive Plans and Detailed Comprehensive Plans the figures were 65% and 58%, respectively. Moreover, Table 3 shows that a large number of SEAs were preceded by a screening (86%). This indicates that municipalities to a great extent decided to carry out an SEA when a screening was conducted. This observation is also found in the regression analysis, which shows a positive correlation between screening and whether an SEA is conducted or not. In addition, the proportion of plans for which screening has been conducted increased since 2010, as

presented in section 4.1. This involves that grey assessment practice, which aims at adjusting proposals to a state where they will not display a concern for significant environmental impacts (Bidstrup, 2017), is not an issue in Swedish municipal planning, at least not for spatial plans (i.e. MCP, DCP and TCP). Instead, most municipal authorities identify a need of SEA for these types of plans. This raises, however, the question on the role of screening in municipal planning, which was already addressed in the Bill which stated that MCP is a type of plan that should normally require an SEA (Governmental Bill, 2003/2004:116), but yet the Environmental Code stipulates a general screening requirement to determine whether the plan is expected to generate significant impacts (Governmental Bill, 2003/2004:116).

5.3. Compliance with legal requirements

As mentioned in section 2.2, the lack of understanding of the legal requirements for when to perform a screening and an SEA (Swedish Environmental Protection Agency, 2015b:6664) might be an explanation for the poor use of SEAs in Waste Plans and Energy Plans. Furthermore, the legal frameworks that apply to Waste Plans (Environmental Code, 1998, Chapter 15 Section 41) and Energy Plans (Act on municipal energy planning, 1977:439) might need to become more precise. In Wretling et al. (2018), it is emphasized that the Act on Municipal Energy Planning (1977:439) is outdated and needs to be revised in order to better reflect contemporary municipal planning. To clarify when to perform an SEA or to make SEA mandatory for municipal plans, including sector plans like energy plans and waste plans, might be a way to avoid uncertainties when deciding whether the impacts on the environment are significant or not. Making SEAs mandatory for municipal comprehensive plans as well as for municipal sector plans implies that the screening process can be left out, which can save resources for the municipalities. As stated by StoeGLEHNER (2010) there is no need for screening if an SEA is perceived not as an administrative procedure but as a meaningful planning instrument for the structured integration of environmental issues in the planning process.

According to the European Commission (2017), some countries have adopted national guidelines to clarify how to identify and select reasonable alternatives in the SEA procedure, but there is no common approach to define the types and the numbers of alternatives to be identified, described, and assessed. This is a difficulty that was observed already in 2009 and still remains (European Commission, 2017). The Swedish legal requirements indicate that an SEA should clarify the reasoning behind the proposed plan and should present reasonable alternatives to fulfill the purpose of the plan. However, the results of the statistical analysis show that the plan's purpose is not frequently

described in the SEA or expressed in the plan and hence the rationale for the identification of alternatives is lacking. The mapping and the analysis presented in section 4.1 show that only 26% of all SEAs for all municipal plans in Sweden included more than one plan alternative, and Fig. 4 also indicates a decreasing trend over time, from 50% in 2006 to 29% in 2014. This means that SEA practice regarding Swedish municipal planning is slowly changing. The highest proportion of having more than one plan alternative was seen in the Detailed Comprehensive Plans. Regarding the inclusion of a zero alternative, the share increased from 67% in 2006 to 92% in 2012. The question of the number of alternatives within the SEA has been the subject of court decisions at the Land and Environmental Court of Appeal. According to Hörnberg (2016), the Court of Appeal has been quite clear considering the need for alternatives within the SEA. In one case, the Court of Appeal expressed that realistic alternatives must be specified and made understandable for both the authorities and the public, and that there must be an explanation for why different alternatives were neglected. However, it is too early to draw any firm conclusions from the cases from the Court of Appeal considering the interpretations of the requirements of alternatives in SEAs for comprehensive plans (Hörnberg, 2016).

In Sweden, the two laws – The Planning and Building Act and the Environmental Code – are based on different legislative platforms, and the different platforms by their nature bring different cultures (Hörnberg, 2016). It cannot be ignored that the legislative differences and cultures could be an explanation for the difficulties in fully integrating SEAs in municipal planning. This also means that even if the SEA procedure is intimately connected to the planning process, the assessments within the SEA and the strategic issues that the SEA includes might not contribute effectively to the comprehensive planning process. It has been noted that even with SEAs, the purpose of the comprehensive plan and reasonable alternatives are often lacking. Because the comprehensive plan should express the direction of how to promote sustainability and how to coordinate national environmental goals, this noted lack of compliance and indication of absent plan purpose needs to be studied further.

5.4. Determinants affecting the probability for conducting SEA

The regression analysis identified various variables that might have had an impact on the number of SEAs that was carried out. While caution should always be exercised when interpreting the relationships found by a regression analysis as causal, we find the following results to be reasonable. The first variable is the year the plan was adopted, which means that the share of plans including an SEA increased over time. This is true for the comprehensive plans but not equally evident for Waste Plans and Energy Plans. As mentioned above, there was a minor increase, but this does not explain the low figures in comparison with the different types of comprehensive plans. A second variable is screening, which had a positive impact on the number of SEAs. Hence, the higher proportion of screenings for Waste Plans can explain why the proportion of Waste Plans with an SEA was higher than for Energy Plans. Inter-municipal co-operation is a third variable that according to the quantitative analysis had a positive impact on the probability of carrying out screenings, which in turn tended to increase the probability of an SEA being conducted. Among Waste Plans, inter-municipal cooperation was most common (17 plans), which might have contributed to a larger proportion of screening compared to Energy Plans. Inter-municipal co-operation is already encouraged by the Swedish Environmental Protection Agency (2012a,b), which emphasizes improved collaboration in planning as being an important factor for achieving environmental quality objectives, and additional ways to stimulate such cooperation might thus be warranted. A fourth variable is local tax rate, which was negatively correlated with the probability that an SEA was carried out. This suggests that the availability of resources plays an important role, which is in line with international

studies, e.g. Baker and McLelland, 2003; Glasson et al., 2005. Swedish municipalities with a relatively high local tax rate are typically relatively small and are characterized by a weak income situation among residents. However, resource availability is not only about budget size. The results of the focus group discussions indicate that it could also be about a well-functioning municipal organization, including preventing a strong “silo culture” in order to facilitate the sharing of information and collaboration (e.g. Slunge and Trang, 2014), or the availability of impact assessment professionals (Chanchitpricha and Bond, 2013). Stimulating inter-municipal cooperation might thus also be a way to support financially weak municipalities. Regarding variables that did not show a statistically significant impact in the regression analysis, geographical location and several other municipality characteristics (gross regional product, population size, and type of municipality) were not of importance for the probability that SEAs is conducted. While these insignificancies contradict some of the suggestions from the participants of the focus group discussions, the results from the qualitative and quantitative analyses should be viewed together, not separately. Thus, the lack of significance of some variables in the regression analysis should not necessarily be interpreted as a lack of importance of those determinants. It rather suggests the need for further research that involves data collection that allows the quantification of other variables. For example, many municipalities with a high local tax are situated in sparsely populated regions. The fact that the geographical variables and the SALAR municipality classification variable were not significant in the regression analysis might suggest that they were not defined in a way that fully captures the resource issue.

6. Conclusions

The study presented in this paper demonstrates the importance of time series of empirical data for evaluative research on SEA practice. The methodological approach that combined quantitative and qualitative tools, including descriptive statistics, focus group discussions and software supported tools for qualitative analysis (NVivo 10), facilitated an explorative analysis of the dataset. Similar methodological approach can be usefully employed within and outside EU in order to contribute to knowledge transfer between countries and thus further improve SEA practice.

Through the explorative approach we addressed three research questions and identified needs for further evaluative research, including in-depth qualitative studies on the link between alternatives and the purposes of the plan. The first research question concerned the development of the application of SEA in municipal comprehensive and sector planning since 2004. The result of the study shows that the application of SEAs in municipal comprehensive planning (MCP, TCP and DCP) has gradually increased since the implementation of the SEA Directive in Sweden in 2004. During the period 2010–2014 ca 90% of the municipal comprehensive plans included an SEA. For the same period corresponding figures for waste plans and energy plans were significantly lower. The more limited application of SEA in sectoral plans is in line with SEA practice in other European countries where spatial plans make up the significant majority of SEAs (European Commission, 2016). Like in other countries, the interpretation of the legal requirements can be a possible explanation. The Swedish Environmental Protection Agency (2015a,b,c) concluded that several authorities have difficulties in determining whether the environmental impacts are significant, there is a need for policy measures, e.g. better national guidelines for the application of SEAs in different sector plans and an update of legislation for municipal energy plans.

The second question addressed the compliance of Swedish SEA practice with legal requirements concerning the identification and assessment of alternatives to fulfill the purpose of the plan. The analysis shows a decreasing trend between 2006 and 2014 as regards the proportion of SEAs that included more than one plan alternative. The use of a zero alternative, nevertheless increased during the same period.

The link to the purpose of the plan has shown to be overall vague during the whole period. The ongoing discussion on reasonable alternatives reflects support for considering alternatives in SEAs, but ambiguity in the legal requirements creates uncertainty regarding the need to present alternatives. The decreasing trend indicates, however, a growing acceptance to include only one alternative. To reverse this trend, the rationale for including more than one alternative might need to be explained. As we discussed and as argued by [González et al. \(2015\)](#), alternatives should be considered as different ways to fulfill the purpose of the plan. Thus, if the need to link alternatives with the purpose of the plan is better understood, more SEAs might present reasonable alternatives. It is argued that strengthening the link between alternatives and the purposes of the plan foster strategic thinking when identifying reasonable alternatives.

The third question focused on determinants that affect the likelihood that an SEA is conducted. The results of the regression analysis of determinants for carrying out an SEA or not reveals that a lack of resources could also be an explanation for why only one alternative is presented in an SEA. Although the analysis examines explanatory variables for conducting an SEA, the available resources might also affect the scope of the SEA, e.g. the alternatives that are considered. In

addition, the regression analysis shows that inter-municipal collaboration had a positive impact on screening and that screening in its turn had a significantly positive impact on the probability of whether an SEA was performed or not. This indicates a need to develop incentives to encourage screening and collaboration between municipalities through guidance or legal requirements. On the other hand, it can be argued that the role of screening is obsolete because screening in a vast majority of cases resulted in an SEA, in particular for municipal comprehensive plans. Thus screening becomes a needless step towards the preparation of the SEA, and a requirement for mandatory SEAs for certain municipal plans might be more beneficial to further strengthen the use of SEAs in municipal comprehensive and sector planning.

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Appendix A. Appendix

Table 7
Statistical description of explanatory variables in the regression analysis. n = 316.

	Mean	Median	Min	Max	Standard deviation
Region of the country in which the municipality is situated					
Göteborg	0.48	0	0	1	0.50
Norrland	0.13	0	0	1	0.33
Svealand	0.39	0	0	1	0.49
County in which the municipality is situated					
Blekinge	0.02	0	0	1	0.12
Dalarna	0.07	0	0	1	0.25
Gotland	0.00	0	0	1	0.00
Gävleborg	0.04	0	0	1	0.19
Halland	0.00	0	0	1	0.00
Jämtland	0.03	0	0	1	0.16
Jönköping	0.06	0	0	1	0.24
Kalmar	0.03	0	0	1	0.18
Kronoberg	0.01	0	0	1	0.10
Norrbottn	0.04	0	0	1	0.20
Skåne	0.12	0	0	1	0.33
Stockholm	0.13	0	0	1	0.33
Södermanland	0.03	0	0	1	0.18
Uppsala	0.03	0	0	1	0.16
Värmland	0.07	0	0	1	0.25
Västerbotten	0.04	0	0	1	0.21
Västernorrland	0.02	0	0	1	0.12
Västmanland	0.02	0	0	1	0.15
Västra Götaland	0.16	0	0	1	0.36
Örebro	0.01	0	0	1	0.11
Östergötland	0.09	0	0	1	0.28
Gross regional product/day population for the municipality in SEK (mean value 2004–2012 (SCB, 2017))	660 898	626 467	482 233	1 291 091	148 507
Inter-municipal cooperation (presence of joint plans)	0.12	0	0	1	0.33
Membership in the National Association of Swedish Eco-municipalities (SEKOM, 2017)	0.18	0	0	1	0.39
Population of the municipality (2014) (SCB, 2017)	60 567	23 244	2 451	911 989	124 407
Screening has been carried out	0.63	1	0	1	0.48
Share protected area of total municipality area in percent (2014) (SCB, 2017)	5.14	3.65	0.10	51.60	5.89
Total local tax rate in per cent (mean value 2004–2015) (SCB, 2017)	32.19	32.27	29.41	33.81	0.93
Type of municipality (SALAR, 2011)					

(continued on next page)

Table 7 (continued)

	Mean	Median	Min	Max	Standard deviation
Commuter municipalities	0.11	0	0	1	0.31
Large cities	0.17	0	0	1	0.37
Manufacturing municipalities	0.13	0	0	1	0.33
Metropolitan municipalities	0.05	0	0	1	0.21
Municipalities in densely populated regions	0.09	0	0	1	0.29
Municipalities in sparsely populated regions	0.08	0	0	1	0.28
Sparsely populated municipalities	0.07	0	0	1	0.25
Suburban municipalities	0.13	0	0	1	0.33
Suburban municipalities to large cities	0.08	0	0	1	0.28
Tourism and travel industry municipalities	0.09	0	0	1	0.29
Type of plan					
MCP	0.21	0	0	1	0.41
DCP/TCP	0.36	0	0	1	0.48
WP	0.24	0	0	1	0.43
EP	0.19	0	0	1	0.39
Year when plan was adopted (time interval 2004–2014)	2010	2010	2004	2014	2.79

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