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Materials and Clean Processes for Sustainable Energy and Environmental Applications

Evaluation of the effectiveness and performance of environmental impact assessment studies in Greece

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Abstract. As environmental management is becoming increasingly complex, adequate assessment techniques must be utilized to forecast environmental impact trends. The current study aims to investigate the effectiveness of the evaluation system in Greece regarding environmental impact assessment (EIA) concerning projects. Data were extracted from literature and a questionnaire, which was distributed electronically on a Pan-Hellenic scale. Results indicated that the EIA system in Greece has solid foundations with a weak point regarding implementation. Strengths, weaknesses, and threats of EIA institution were analyzed through SWOT-AHP (Strength, Weaknesses, Opportunities, Threats and Analytical Hierarchy Process) analysis. A dominant criterion in the analysis due to the dynamic of the deep economic recession was found to be the economic crisis.

Keywords. AHP-SWOT analysis, Effectiveness, EIA, Environmental impact assessment, Performance.

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1. Introduction

Environmental protection constitutes a non-negotiable substantial need for today's society. Policy makers, governments and relevant stakeholders need to ensure that the lives of citizens are not at risk due to inadequate environmental protection on an urban, enterprise, national, European and global level [1,2]. Still, according to Statista [3], it is estimated that by 2050, carbon dioxide (CO_2) emissions will reach 43 billion metric tons due to the disregard of humanity for the environment.

Over these rising levels of CO_2, the European Union (EU) has acknowledged the need for a transition towards a greener society and migration from fossil fuels and has introduced several strategies, directives and schemes for combating environmental, social and economic implications in the framework of sustainable development [4–6]. Through the European Green Deal (EGD), the EU strives towards carbon neutrality by 2050, with a goal of decreasing greenhouse gasses (GHG) emissions at least by 50% by 2030, compared to 1990. Furthermore, through the Sustainable Development Goals (SDGs) of the United Nations (UN), world leaders are urged to accomplish 17 main goals concerning social (i.e. SDG 1—no poverty; SDG 2—Zero Hunger etc.), economic (i.e. SDG 8—Decent work and economic growth etc.) and environmental (i.e. SDG 12—responsible production and consumption; SDG 13—climate action etc.) themes [6–8]. Furthermore, a key player in the smooth transition towards a green and sustainable future with a viable economy which leaves no one behind is the Circular Economy (CE) concept [9–11]. It is mainly an economy system aiming at eliminating landfilling and waste, while optimizing the use of natural resources and closing the loop of linear production [12,13]. According to many researchers [14–19], CE has captured the attention of policy makers and scholars, as the concept extends its focus from waste reduction to economic prosperity. Main technologies used in the concept of CE include the "R" strategies of waste management (i.e. refuse, reuse, recycle, remanufacture, refurbish etc.) while the Circular Economy Action Plan of the EU lays out measures to push the transition towards circularity in a just manner [20–22]. This plan alters the way products are promoted, designed and processed, while encouraging sustainable consumption and the reduction of waste production and landfilling.

Still, assessing long-term impacts of CE can be difficult as challenges may arise through its implementation, that were not considered [23]. Similarly, there are still debates concerning the existence of adequate policies and tools for the correct implementation of strategies for achieving SDGs [8,24–26]. This is because environmental management is becoming more and more complex as nations are gearing up to shift towards sustainability. This transition requires authority figures, policy makers, scientists, researchers, and other parties to have the necessary information and data to develop plausible and actionable solutions and data [8,27,28]. Therefore, assessment methods and monitoring tools must be used in order to predict future trends regarding environmental impact as well as account for existing effects of human activities on all three sustainability pillars (environmental, social, economy) [23,29,30].

In this regard, Environmental Impact Assessment (EIA) is an integral part of decision making procedures of proposed projects, plans and actions [31,32] and is one the most influential tools of environmental policy [33,34], environmental management [35–37] and protection worldwide [38,39]. In 1985, the first EIA directive was adopted by the EU which ensured that the effects of specific public projects were assessed. The directive was amended three times until 2009, so that international commitment was considered in environmental legal areas. Finally, in 2014, the amending Directive 2014/52/EU was adopted and entered into force in 2017 [40]. EIA could be characterized as an *ex ante* decision-support tool serving as a preventive measure for practicing environmental policy and management [41]; informing stakeholders about the potential impacts of certain proposed projects [42] and their alternatives [43], while it identifies likely consequences at an early stage, before final planning decisions are made [44, 45], so that irreversible damages are avoided [46,47].

EIA, being a relatively transparent and accountable process, has the capability to provide wider information to a majority of stakeholders like decision makers, city planners, developers, researchers, scientists, engineers and any party, which deems the estimation of environmental impact necessary [41, 42,48]. At the same time, EIA collaboration between consultants, academics and interested parties

(i.e. policy makers) to assess relevant project outputs and deliverables may have a significant policy and implementation impact and long-term learning opportunities for all parties involved [49]. EIA has gained legal and institutional validity all over the world, even in developing countries where economic growth is a major priority [50,51]. According to Morgan [52], EIA is a statutory process in about 180 countries of the world. However, EIA varies in implementation, capabilities, and quality in each country. EIA's scope and quality differ from country to country and great plurality in used methodologies and in statutory context [43,53] is seen. Even among EU countries, despite common regulations, there is diversity of processes and practices [54–57].

At the same time, the system's effectiveness depends on the implementation context. For example, at project level, the effectiveness depends largely on involved actors and their interests, as well as on the way that environmental values are incorporated in the decision making process. On the other hand, regulatory statutory context plays a significant role in the performance of an EIA system [58]. Accordingly, any assessment of the effectiveness of EIA is meaningful only when it includes socioeconomic, political and cultural elements (i.e. country, region, business etc.) [52,59–61].

Other tools for assessing the implementation of key concepts like CE, include key performance indicators (KPIs) which constitute computational sets for providing a quantitative approach to data (i.e. waste production rate) [4,62–64]. KPIs are commonly used for monitoring the environmental performance of a system (i.e. business, industrial process, city, country etc.) and can help to quantify environmental performance for tackling the goals set by the EU (i.e. EGD) [65–68]. Furthermore, in order to address the strengths, weaknesses, opportunities and threats faced by a system in the immediate or near future, Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis is used [4,69–71]. The SWOT analysis components that are seen in the internal environment and the external environment, respectively, are classified according to whether they are favorable or unfavorable [72–74]. When using it without combining it with other tools, SWOT analysis simply records the views or beliefs without relying on any analytical or hierarchical approach. This results in a great deal of subjectivity when ranking external (opportunities and threats) and internal (strengths and weaknesses) factors [72,75]; thus its results are highly dependent on the skills and expertise of those involved in the EIA design process [69,76].

Having the above in mind, this research focuses on the effectiveness and performance of EIA in Greece, in the context of its current implementation status; i.e., through reformed statutory regulations, in a negative socioeconomic and political environment due to the deep economic crisis that hit the country. The effectiveness of the current Greek system has been studied [77,78], though using different methods and approaches than the one proposed here. The studies under investigation are those which are being conducted for projects and activities with major or significant effects to environment and consequently are categorized as subcategory A1 and A2 according to Greek legislation [79].

The aim of the current research was to study the effectiveness and to detect the strengths and deficiencies of the current EIA system in Greece. It focuses mainly on the outcomes of the EIA system from a substantive perspective rather than from a procedural one. In other words, it seeks to answer two main questions: (a) whether the system fulfills the objectives it is meant to fulfill and (b) which are the strengths and the deficiencies of the current EIA system?

2. Methodology

Before an approach or method was chosen and steps to be followed were organized, an initial inquiry was made into international literature as to the types of available EIA studies that could be examined and evaluated.

The main objective of the current research was to track down the weaknesses of EIA procedure in Greece and to detect the points where the process is languishing and needs to be improved, modified or revised. An effort was made in order to evaluate the institution of Environmental Impact Studies (EIS) being conducted for projects and activities in Greece. The next objective was to show what the added value of the above-mentioned institution is. In order to give a quantitative picture of the evaluated data, a combined SWOT analysis and Analytical Hierarchy Process (AHP) model was used.

AHP, as well as SWOT analysis are both basic methods that are widely used and relatively easy to understand [16,69,80,81]. Analysis took place in three stages. The first step involved the process of the survey's results. Next step included the structure of the SWOT matrix and the last step, following appropriate restructuring and grouping the criteria initially selected was to prioritize them according to their importance [69].

After an extensive literature review, an initial selection of criteria and sub-criteria was made and compiled into a list as presented in Table 1, grouping them according to their influence on the effectiveness of the process. Among other things, the objectives that the institutional framework seeks to meet and the broader goals of both Greek and European policy were used to classify these criteria. Many of those criteria were based on those already recognized by other researchers and international literature.

A combination of criteria from different models was used rather than following a specific model of EIA effectiveness criteria. Models developed by Theophilou *et al.* [82] and Chanchiptpricha and Bond [83] were used as a foundation after being modified, mostly by adding sub-criteria coming from literature sources [42,84–86]. Furthermore, researchers included sub-criteria based on the experience and knowledge of the particular field. On the other hand, criteria that were considered inappropriate for this particular case were subtracted (i.e. criteria referred to Strategic Environmental Assessment were not used).

Most of the selected criteria were classified in the substantive dimension of effectiveness and a smaller proportion of them concerned transactive effectiveness and normative efficacy even though the last two dimensions are not clear concepts and, consequently, are harder to be defined. The initially selected criteria, shown in Table 1 formed the basis for the construction of the questionnaire.

Since there are a lot of variables heavily influencing EIA process, such as institutional, legal, social and political factors [42,87], it was considered that in order to evaluate the performance of the process, the most appropriate approach of data collection was a combined one.

Primary data, regarding stakeholders and interested parties' perception of EIA institution's performance, were collected through a Pan-Hellenic survey with a questionnaire, which was distributed electronically while secondary data were collected from international literature and the results from the research of Pediaditi *et al.* [77]. Concerning primary data collection, answers collected play an important role; they contributed to final selection of criteria and helped in structuring SWOT analysis and were used to prioritize the evaluated criteria. Evaluation data were also extracted from the review of Environmental Terms Approval Decisions of all Category A projects and activities issued from 2015 until the end of 2017.

In order to construct the questionnaire, the objective of EIA, as defined in literature, expectations and goals of statutory texts of European Union and Greece were taken into account. Furthermore, the use of a questionnaire aimed at providing answers regarding substantive effectiveness as well as the conception of the respondents related with elements of transactive and normative effectiveness.

The questions were categorized into five (5) groups:

- Demographics.
- Statutory/legislation background of EIA Studies (What was the perception of respondents about legislation related to the environmental licensing and conducting EIA).
- Actual Implementation (What the respondents believed about the way that the statutory process is implemented).
- Contribution of the EIA institution (Questions about the perception of EIA's contribution).
- Factors that enhance or decrease the degree of institution performance (Questions about factors, which are inhibitory and which ones could contribute to enhancement of performance).

The questionnaire was structured using an online tool (https://docs.google.com/forms), and the relevant link was sent via e-mail to the respondents. The respondents consisted of actors involved in the EIA process (i.e. project implementation or operation, conductors of EIA studies, environmental licensing authorities, actors participating in statutory consultation, environmental inspectors, political actors and environmental science community). Respondents could fill out the form between 15/11/2018 and

Table 1. Initially selected criteria per effectiveness dimension

Type of effectiveness	A/A	Description of criteria	Source
Substantial effectiveness = Performance	**A1**	**Contribution to final decision making and planning**	[36,75]
	A1.1	Incorporation of proposed changes (to what extent the proposals that resulted from EIA study and emerged from consultation process were taken into account in the final version of the project)	[71]
	A1.2	Main determinants of the final planning decision	[36]
	A2	**Informed decision making**	[71]
	A2.1	Quality of the research underlying EIA (i.e. validity and comprehensiveness)	[74]
	A2.1.1	Scientific and reasonable outcomes of EIA	[75]
	A2.1.2	Completeness of the EIA study in order to lead to the enforcement of conditions and restrictions that are: (a) congruent with current environmental or other related legislation, (b) compatible with spatial planning and urban design, (c) adequate to ensure environmental protection, (d) directly correlated with the specific project or activity and its impacts, (e) fair and proportionate to the size and type of project or activity accurate, (f) feasible, binding and controllable (paragraph 7 Article 2).	[68]
	A3	**Enhancement of environmental protection**	[75]
	A3.1	To what extent are project stakeholders including the competent authorities receptive to environmental issues?	[36]
	A4	**Close collaboration**	[71]
	A4.1	Contribution of project stakeholders to EIA process	[36]
	A4.2	Contribution of EIA study conductors in project planning	[36]
	A5	**Early start** (Was EIA process initiated at the very first stages of project planning?)	[71]
	A5.1	Extent to which there was already an agreement on the proposal before the EIA was conducted	[74]
	A6	Successful statutory consultation (Did statutory consultation bodies have a fair opportunity to contribute and were their views and comments taken into account?)	[71]
	A7	Successful public consultation (Did the public consultation bodies have a fair opportunity to contribute and were their views and comments taken into account?)	[71,76]
	A8	**Contribution to sustainability**	

(continued on next page)

30/11/2018 and during that period, 220 questionnaires were filled out.

The method of analyzing the results involved three distinct steps. One involved editing the poll results, which contributed significantly to the next two steps. These steps relate to the construction of the SWOT matrix, after restructuring and appropriately grouping the criteria initially selected and prioritizing them according to their importance.

2.1. *Step 1: editing the survey results*

At the first stage, the results of the pan-Hellenic survey were grouped and organized. Although

Table 1. (continued)

Type of effectiveness	A/A	Description of criteria	Source
Transactive effectiveness $\tau\alpha$ = Proficiency	**B1**	**Time (Was EIA process carried out within a reasonable time frame without undue delay or within a very short time period?)**	[71]
	B2	**Financial resources (carrying out the EIA study did not entail excessive spending)**	[71]
	B2.1	EIA study costs with respect to the overall cost of the project	[36]
	B3	**Skills—proficiency (the acquiring of skills and personnel required for the SEA did not constitute a big burden and these were easily accessible) or**	[71]
		The immediate availability of competent authorities' staff with sufficient skills	[73]
	B3.1	Skills and capabilities of the responsible authority	[36]
	B3.1.1	Does the competent authority have the appropriate logistical infrastructure and properly trained staff in order to evaluate the EIA in the shortest possible time and at the least cost?	
	B3.2	Skills and capabilities of EIA studies conductors	
	B3.2.1	Do EIA studies conductors have the appropriate training or knowledge in order to conduct EIA studies?	[77]
	B3.2.2	Are the required data easily accessible in order to conduct an EIA study?	
Normative efficacy = Objective − aim	**C1**	**Learning process, perception and lessons learned in the process**	[78]
	C2	**Development or changes in policy choices**	[72]
	C3	**Improvement of health and quality of life**	[72]

questionnaire replies were organized, analyzed and visualized into graphs automatically and in real time, by the application "Forms", it was considered necessary to further process the results and create more appropriate graphs to meet the needs of the research. After the survey was completed and the questionnaire platform was deactivated, the results were exported to a spreadsheet for further processing. Respondents' answers were grouped, based on the types of questions and the group of respondents. Then the required calculations were made and the graphs that were judged to be the most appropriate were created.

2.2. *Step 2: Restructuring and appropriately grouping the criteria initially selected—SWOT analysis*

The number of criteria and sub-criteria initially selected was too large and was therefore condensed or merged to reduce and further group them based on how they affect effectiveness (positively or negatively). The responses to the questionnaire contributed significantly to the construction of the final list of criteria, as criteria or sub-criteria were added or removed depending on the elements identified by interested parties invited to respond. Furthermore, external factors that could affect the EIA system and its effectiveness were identified.

After the answers were selected, SWOT analysis was used, which categorized the criteria according to the way they influence the effectiveness (positively or negatively) and the area in which they do (internal or external).

A major limitation of the method is that the importance of each factor in decision making cannot be quantified [88]. For instance, factors such as the availability and uncertainty of information, and due to the ambiguity of human perception and recognition as well as the subjectivity of the qualitative

judgment, accurate evaluations are not easy to obtain [86].

2.3. *Step 3: Prioritization of criteria according to their importance (AHP)*

In order to give a quantitative dimension to the results and overcome some of the limitations mentioned in Section 2.2, the next step was to combine SWOT analysis with AHP [89,90]. AHP is globally accepted by the scientific community as a powerful and flexible multi-criteria decision-making tool [91–93]. It is a mathematical method for the analysis of complex multi-criteria decision problems developed by Saaty [94] and a general theory of measurement based on mathematical and psychological bases; it can handle both qualitative and quantitative characteristics [69,92].

The analysis is based on three fundamental principles: problem splitting, pairwise comparisons of different criteria, and composition of preferences [91]. In short, AHP is a method for deriving analogue scales from pairwise comparisons [95].

According to Saaty [94], the main steps followed in the AHP procedure in order to decompose the problem are the following:

- Define the problem and determine what knowledge we seek to gain by using it.
- Structure the decision hierarchy, where the goal pursued is at the top, followed by the individual objectives, the criteria on which they depend, and finally the alternative scenarios that are usually the lowest level.
- Construct a number of benchmark matrices by which the required comparisons are made and the preferences between the criteria are extracted.
- Calculate the weights of each item and their overall priority.

After identifying the key factors that will influence the evaluation, criteria (SWOT groups) and sub-criteria (SWOT elements) were prioritized. This structure is schematically shown in Figure 1.

A pairwise comparison of the factors identified within each SWOT group was then performed in order to identify which factors are most important and to what extent [69,88], so that a priority value and a weight for each factor was calculated [88]. In this way, quantified values that reflect the priorities of the factors included in the SWOT analysis were obtained [69].

Even though, most commonly, AHP-SWOT analysis is used to compare alternatives, this was not the goal of the current study [89,90,96,97]. The criteria were prioritized in order to quantify the weaknesses and strengths of the EIA, the threats to its effectiveness and opportunities to improve it. These quantitative data will contribute in a more comprehensive and clear way to the final conclusions on the institution's performance within the environment it is called to operate.

AHP and the required calculations were made using the free limited version of the online software "TransparentChoice's AHP software" (https://app.transparentchoice.com). TransparentChoice helps organizations measure and understand how existing or future projects can support their strategic goals by leading to better decisions about projects and their resources.

3. Results and discussion

3.1. *Questionnaire results*

Survey results indicated both positive and negative aspects of the EIA studies procedure. First, regarding the contribution of the institution to the final decision, the results from the processing of respondents' answers are shown in Figure 2. The vast majority of the respondents considered that the institution's contribution to the final decision on a project or activity is not that important; it is obvious that very few respondents (just 2%) believe that by implementing EIA, extensive changes are made in a project's planning, while 8% of them consider that the outcome of the procedure is the most environmentally friendly alternative to be chosen.

Furthermore, 142 out of 220 respondents consider that the results of public consultation are not taken into consideration as much as they should (barely or even not at all (Figure 3a)) while 125 of them believe that results of statutory consultation are accountable (Figure 3b).

In accordance with the above results, EIA studies have very little contribution to final decision making; even if objections are raised or criticism and doubts are expressed during statutory consultation, the only

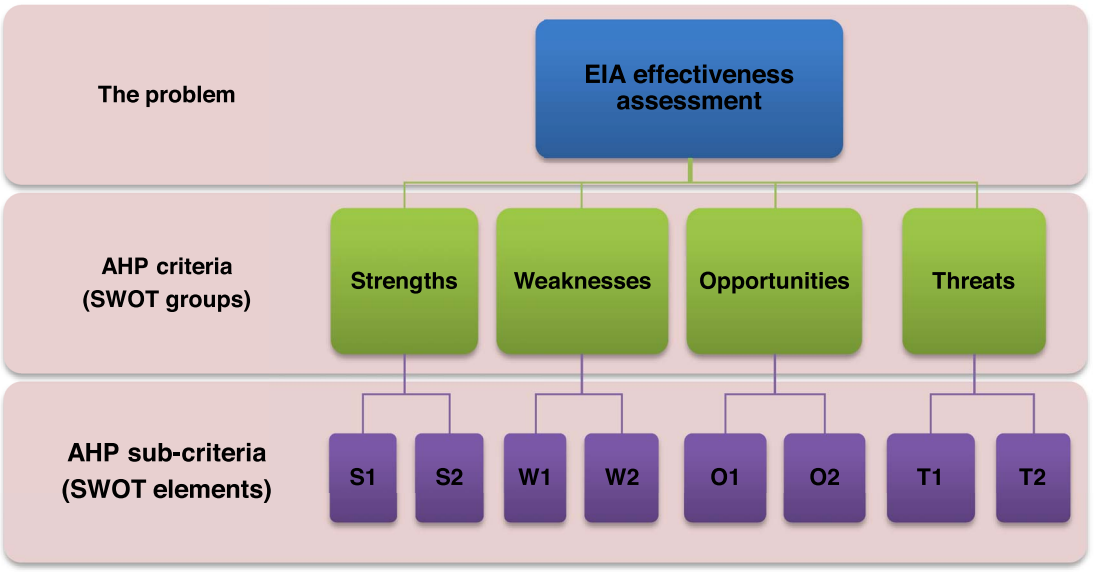


Figure 1. Hierarchy of SWOT groups and elements according to AHP.

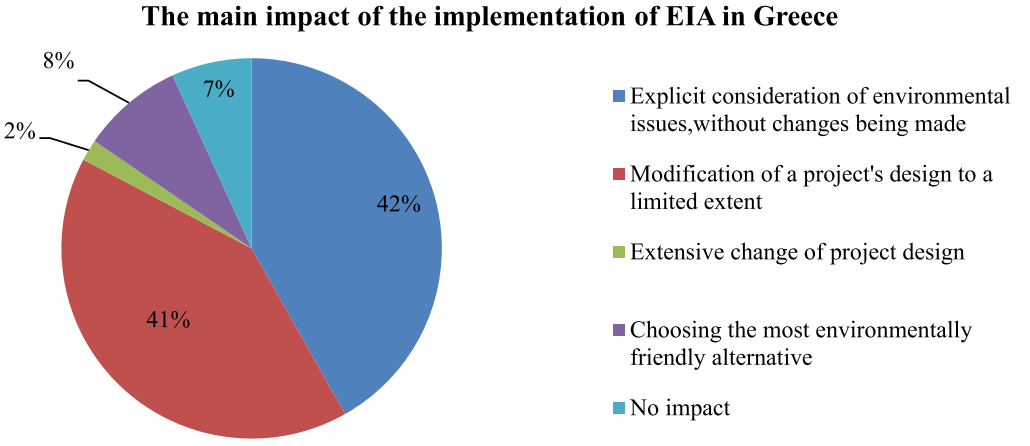


Figure 2. Respondents answers concerning the main consequence of EIA studies institution in Greece.

changes made to the final decision are merely the imposition of relevant conditions or in exceptional cases, particularly when there is a question of compatibility with the legislation, very slight modifications are made.

A significant 26% of respondents disagree with the statement that EIA studies are made in such an early stage so that they contribute to the final choice, while 11.8% of them disagree completely with the above statement (Figure 4). In a similar question, most of the respondents agree that EIA studies are carried out after the key decisions related to a project or activity (location, size, applied technology, etc.) had already been made.

Most negative elements refer to the way EIA procedure is implemented. The way EIA institutional context is implemented, according to the majority of respondents, is not satisfactory in many aspects.

The majority of respondents evaluate the EIA institutional context positively, in accordance with

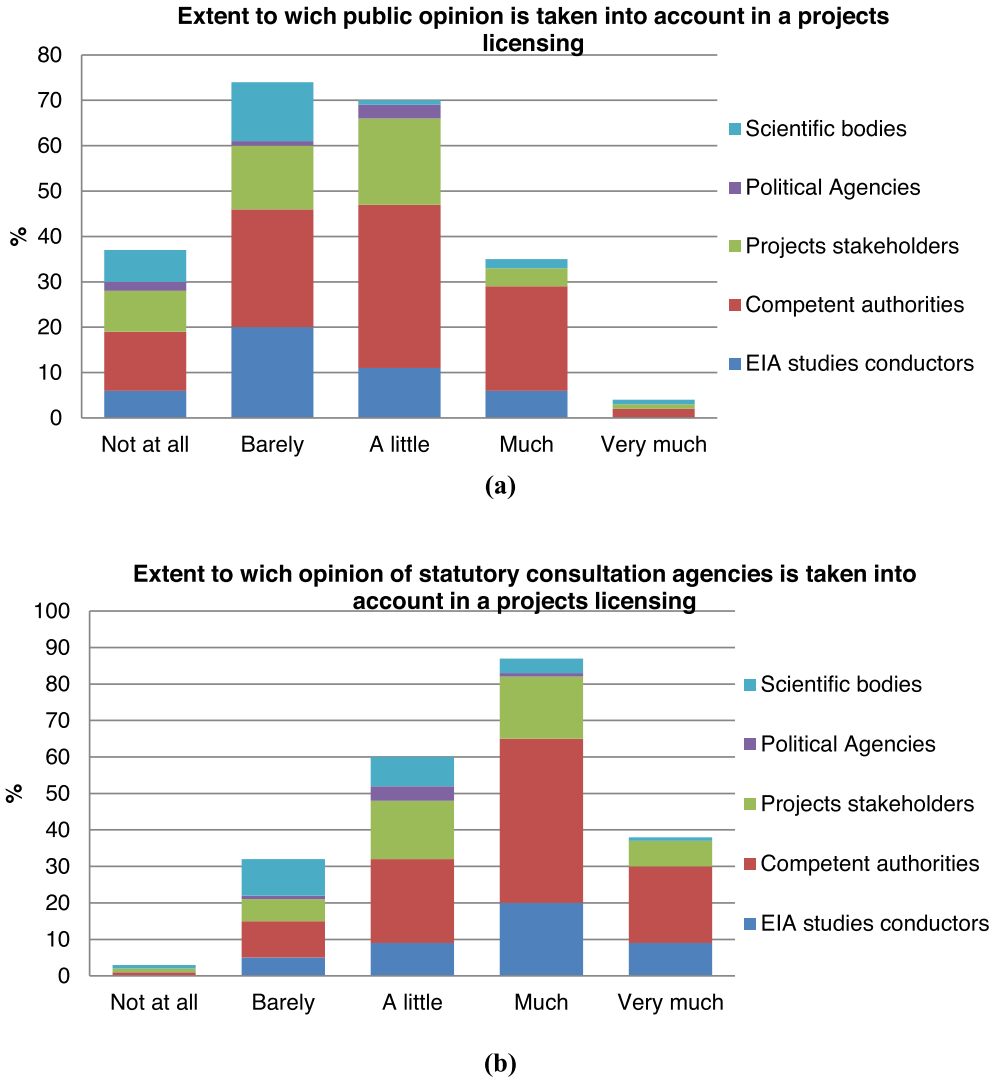


Figure 3. (a) Perception of the respondents (per representative party), about consultations contribution of public opinion in environmental licensing of a project. (b) Perception of the respondents (per representative party), about consultations contribution of statutory consultation agencies in environmental licensing of a project.

the answers that they gave in relevant questions as shown in Figure 5. Namely, the questions concerned if: (a) the legislation regarding the preparation of EIAs is clear and understandable, (b) the legislation requirements were excessive, (c) the statutory context ensures that all stakeholders are equitably involved in the decision making process or if it (d) ensures fair public participation in the decision making process (public consultation), (e) if the statutory context is transparent, (f) the standardization of procedures and forms contributes to better quality of EIA studies or if it (g) facilitates the evaluation of EIA studies and (h) if the list of projects and activities for which EIA is mandatory includes more projects than it should.

On the contrary, regarding the way in which this institutional framework is implemented, it is judged to have a negative image. In general, it is believed that it is improperly applied by the involved actors and that noncompliance with the EIA study content specifications exists. The prevailing view was that studies are tailored according to the requirements of

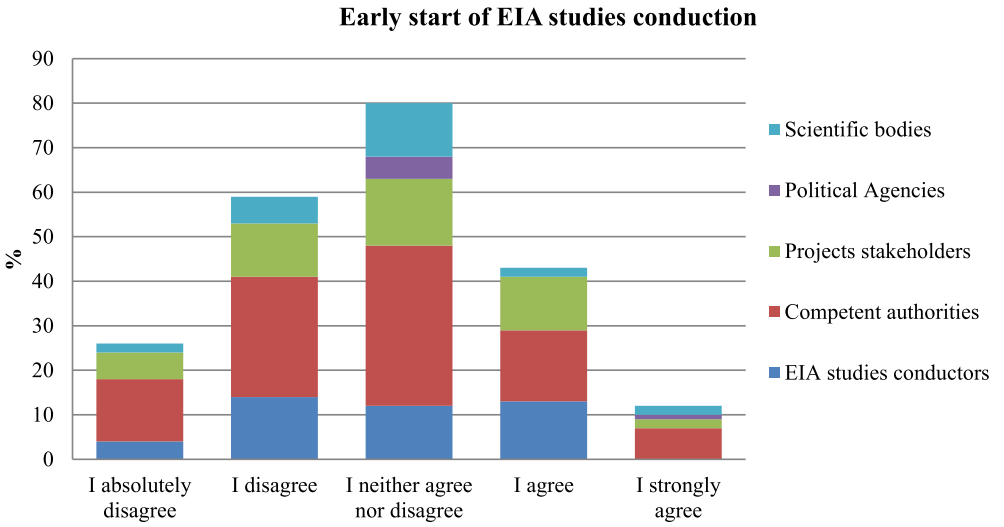


Figure 4. Opinions about the time of decision making and the start-up time.

project stakeholders, that the most important criterion for project planning is the financial one, and that the design and evaluation of EIA studies is highly subjective (Figure 6a–d). In addition, the control of documentation by the authorities is considered by many of the respondents to be flexible (Figure 6a). It is noteworthy that out of the 81 representatives of licensing authorities that responded to the questionnaire, only 5 disagreed with the statement while 26 believe this much to be the case and 6 very much.

As far as the question about the quality of EIA studies is concerned, it is notable that neither the conductors of studies nor the representatives of authorities had a clear view, as shown in Figure 7(a–c). But when the answers are more specific, it appears that the methods in which EIA studies are conducted have deficiencies.

Questions about quality and content of documents (EIA studies) were posed in order to investigate whether they contribute in informed decision making (Figure 8a–d). Unfortunately, questionnaire results indicated that EIA studies do not lead to informed decision making. Very characteristic is that results refer to the conduction of additional technical studies in next stages, indicating the lack of key data and predictions. It is clear that EIA studies do not contribute to problems that are compatible with the requirements of the legislation.

The skills and proficiency of the whole Greek system (i.e. human and material resources, data availability, subjectivity, etc.) in many aspects were considered to be factors which contribute substantially to negative performance, although the answers varied depending on the question. It is mostly considered that EIA conductors are not qualified, while an important deficiency of the system is the lack of personnel in the competent authorities (Figure 9a–e).

Referring to the cost and time, although most of the respondents did not believe that the cost is high, they believed that the required time for the completion of environmental licensing is unjustifiably long. Even if the institution implemented EIA poorly, respondents considered that it contributes to environmental protection, to some extent as shown in Figure 10(a,b).

It should be noted that a large proportion (73.6%) of the respondents stated that they believe that the EIA was institutionalized in Greece because it was demanded by European Union, while a large proportion (66.4%) also believe that the EIA studies are conducted only because it is mandatory. Finally, many of them believe that there is no environmental consciousness and that stakeholders are not willing to take into account environmental values.

Finally, in open-ended questions, there were responses that raised the issue of corruption, clientelism and political involvement as being deterrents to the effectiveness of the EIA institution, as well as the intensification of environmental inspections as a measure to improve it.

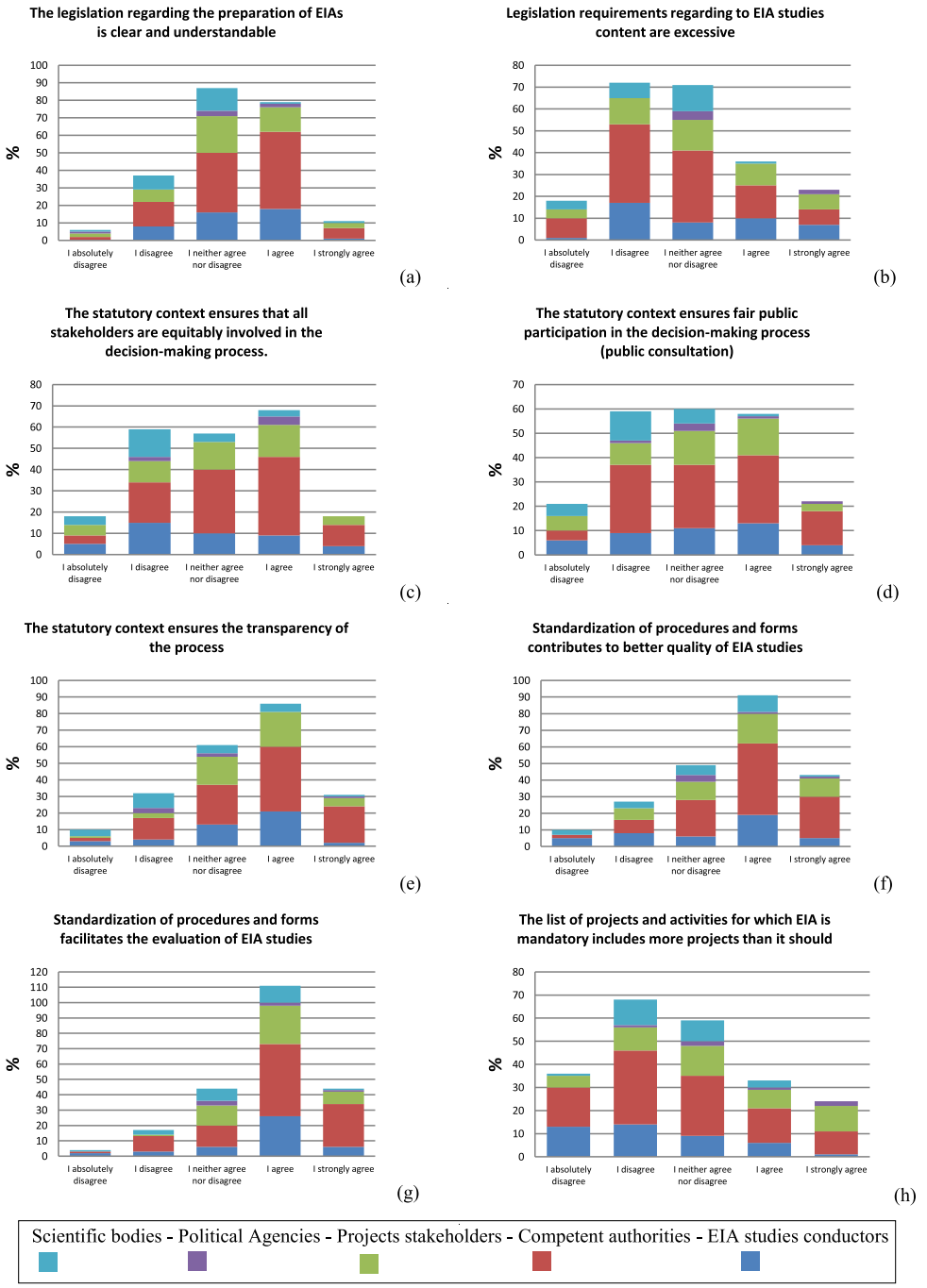


Figure 5. Answers to questions (a–h) regarding the provisions of statutory context.

3.2. *SWOT analysis results*

After reducing and grouping the initially chosen criteria, described in Section 2, the following SWOT analysis matrix (Figure 11) was constructed.

3.2.1. *Strengths*

Based on the replies to the questionnaires, the institutional framework was incorporated into the strengths, as the response to the individual elements

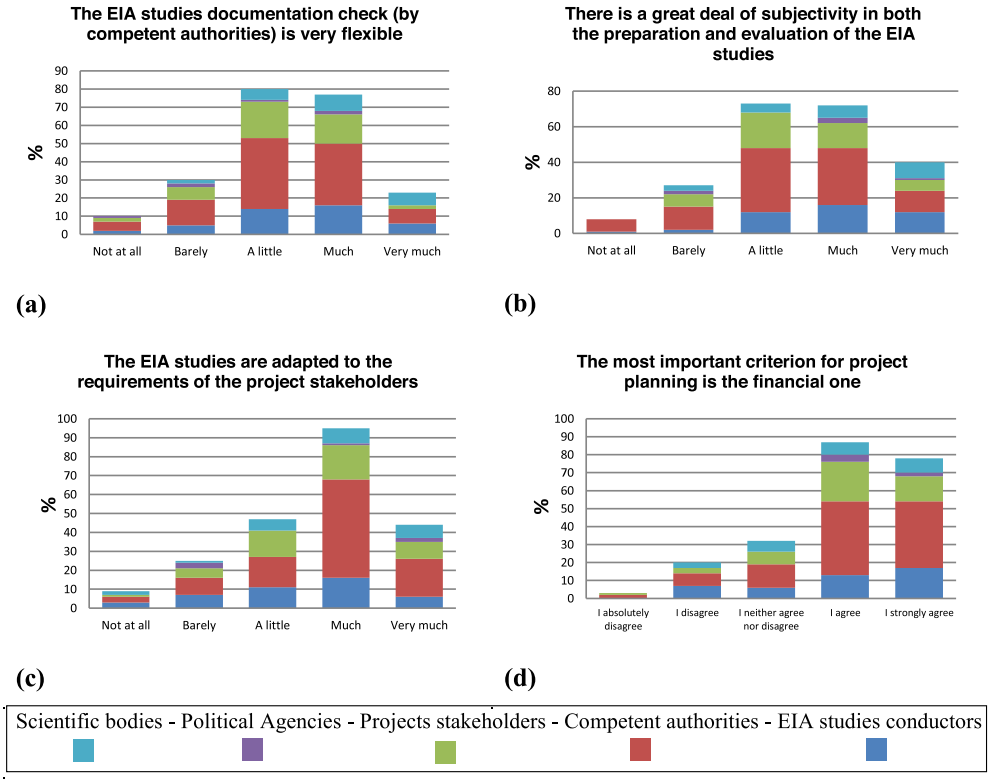


Figure 6. Answers about the respondents' opinion on statements concerning the way EIA studies institution are implemented (a–d).

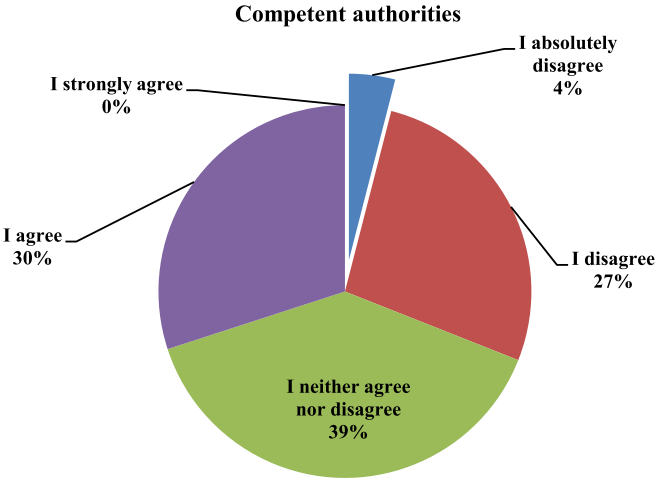
of the questionnaire examined was positive. These elements include the provisions of current institutional framework, examining whether all the necessary decisions have been taken in order for it to work fully. It was considered that it ensures public participation and transparency. Standardization of procedures contributes significantly to the process. Finally, there was a positive response to the right scope of the EIA procedure.

Although environmental protection did not have the same positive response rate, respondents felt that the institution contributes to some extent to effective environmental protection and environmental performance of projects and activities. Other strengths that emerged from the survey process were the criterion of close cooperation and the criterion of the EIA cost over the total cost, but these were not included in the SWOT.

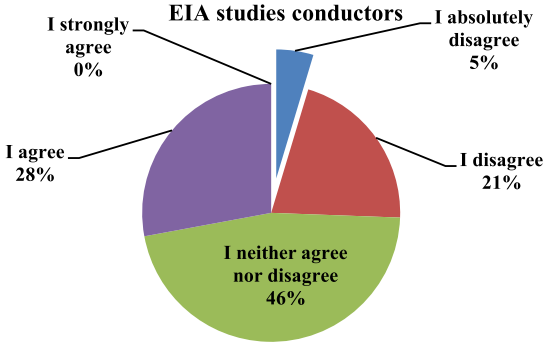
3.2.2. *Weaknesses*

The criteria that were classified as weaknesses due to the responses and the AERO review are clearly exceed the strengths. Good institutional background does not imply proper implementation; this is evidenced by the findings of the research. For this reason, it is also a criterion that has been classified as a weakness. Further evidence, beyond the answers of the respondents, who advocate this classification, is the fact that Law 4014/2011 has not yet been fully implemented [79]. The information provided by EIA studies, considering that it has effect on the actual effectiveness, have to enable informed decision making. The serious shortcomings of the EIA studies, identified from the research, showed a small contribution to informed decision making, and consequently the lack of informed decision making was classified as weakness.

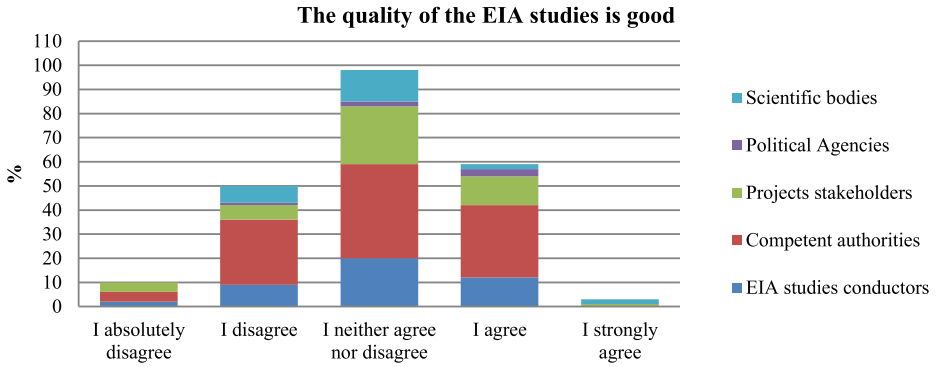
On the other hand, although none of the proficiencies of the investigated system had a negative sign, they were classified as weaknesses as a whole, due to the lack of staff, inadequate training of EIA study conductors, unavailability of data that would make the development of EIAs more efficient.



(a)



(b)



(c)

Figure 7. Statements about EIA studies quality: (a) competence of authorities (b) competence of conductors (c) quality of EIA study.

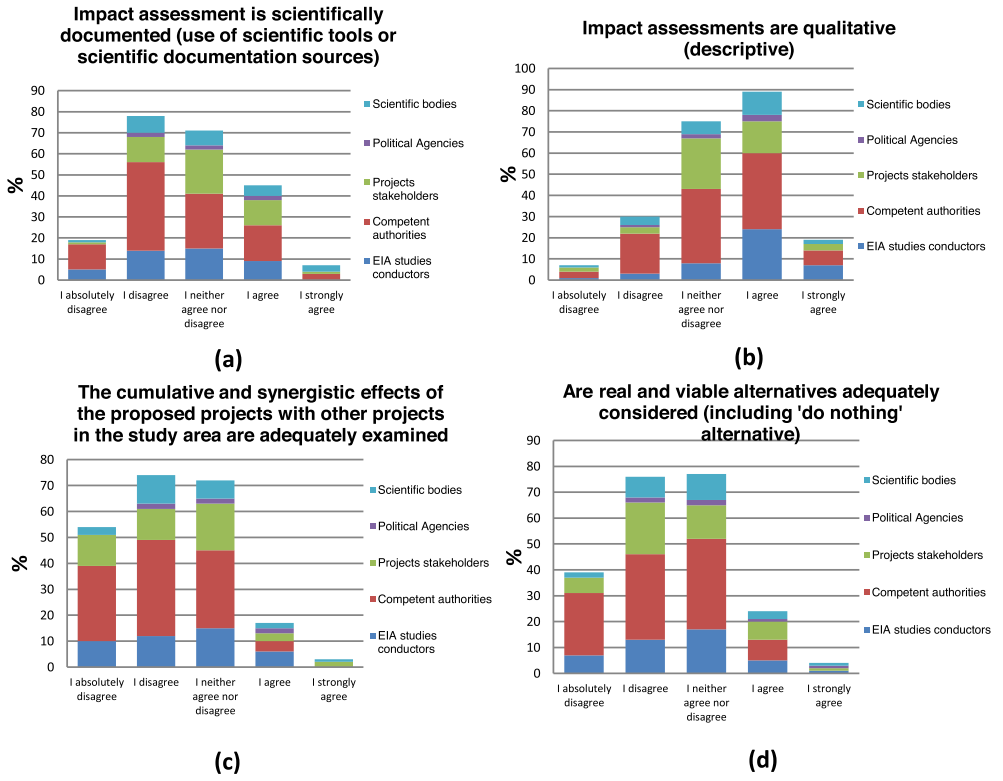


Figure 8. Answers referring to the content of EIA studies.

3.2.3. *Opportunities*

E-governance and open data, though not fully implemented, were considered as opportunities to improve the efficiency of the system as they can contribute to all dimensions of efficiency in a variety of ways. Learning, a criterion of normative efficacy, can also be an opportunity as a factor of enhancing effectiveness when acquired through the EIA process; it fuels the skills and improves performance.

Finally, the benefits that can be gained, in terms of system performance, by technological development and great development of science, especially environmental science, are also numbered among the opportunities.

3.2.4. *Threats*

The first and most obvious threat identified is the Financial Crisis, as it is so profound that it has affected all aspects of public life in Greece. Consequently, it affects the implementation of the EIA institution in a variety of ways. The fact that the economic crisis and recession is a major threat is also recognized in international literature. Bond and Pope [98], for example, make it a major threat to all forms of impact assessment, which undermines environmental and social goals. Another threat identified by the respondents' proposals, in a question where a free answer could be given, is the issue of corruption, mainly in terms of the involvement of political interests but also of members of specific sectors involved in the EIA process.

3.3. *AHP results*

As mentioned before, pair-wise comparisons of SWOT groups and elements (AHP criteria and subcriteria, respectively), based on the results of the survey and on the researchers experience upon the subject was performed. Literature review contributed significantly to the rating. Table 2 presents in detail the comparisons between SWOT elements and groups and the ratings of each item compared to

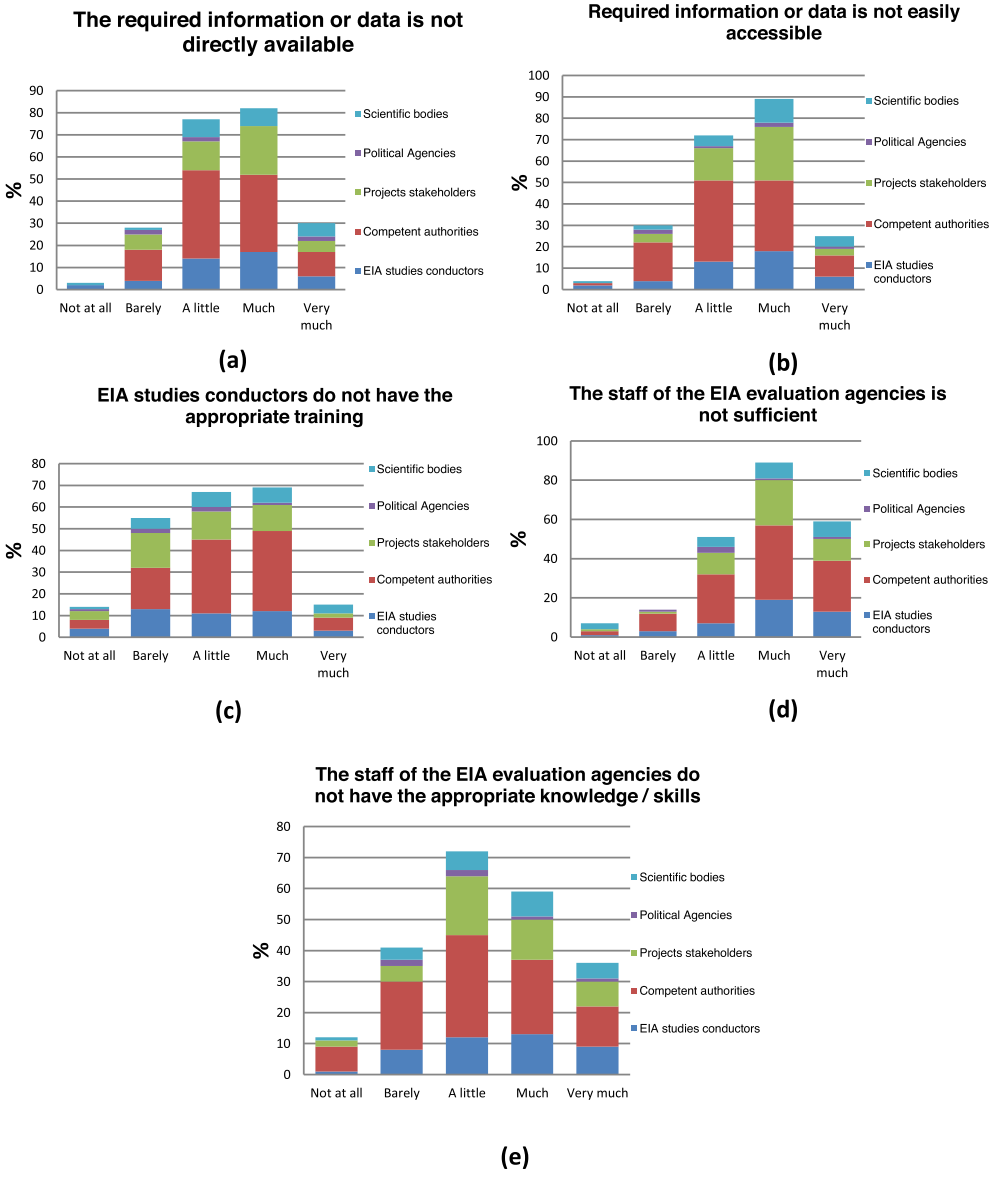


Figure 9. (a–e) Answers concerning the proficiency and skills.

each other, according to the Saaty scale used by the software [94].

When pairwise comparisons were completed, the software automatically extracted the results regarding the relative weights of the individual elements of SWOT and its groups as well as their total weights, as shown in Table 3.

As the rating of one criterion over the other is subjective and a matter of personal perception of each evaluator, more comparisons were made with slight variations in order to compare the results with those already extracted. With the differentiated comparisons, the results did not change substantially. The accepted results of the process, illustrated in Table 3, were those that were the most consistent. It is clear from the results that the threats had the greatest weight at 53%, and economic crisis that constitutes an element of threats was classified as the one with the highest local weight (43%). Although local weight of institutional context was also high, due to

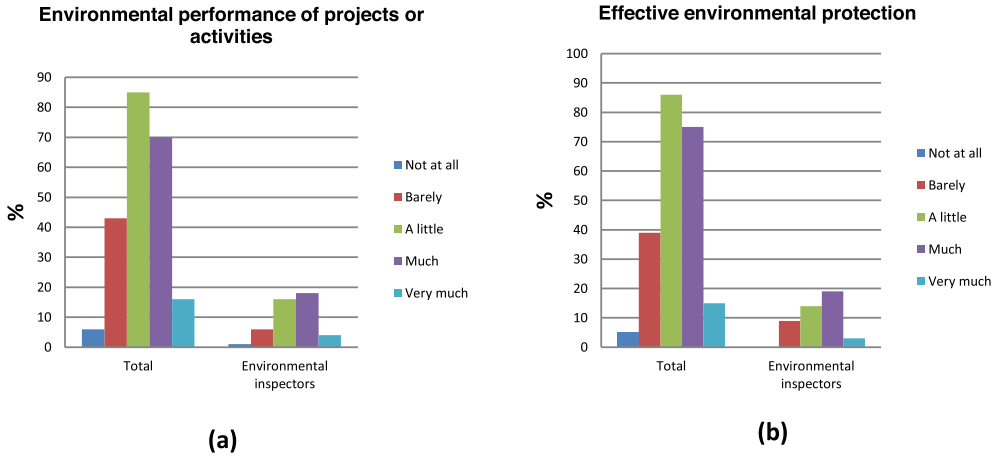


Figure 10. Perceptions about contribution to environmental protection.

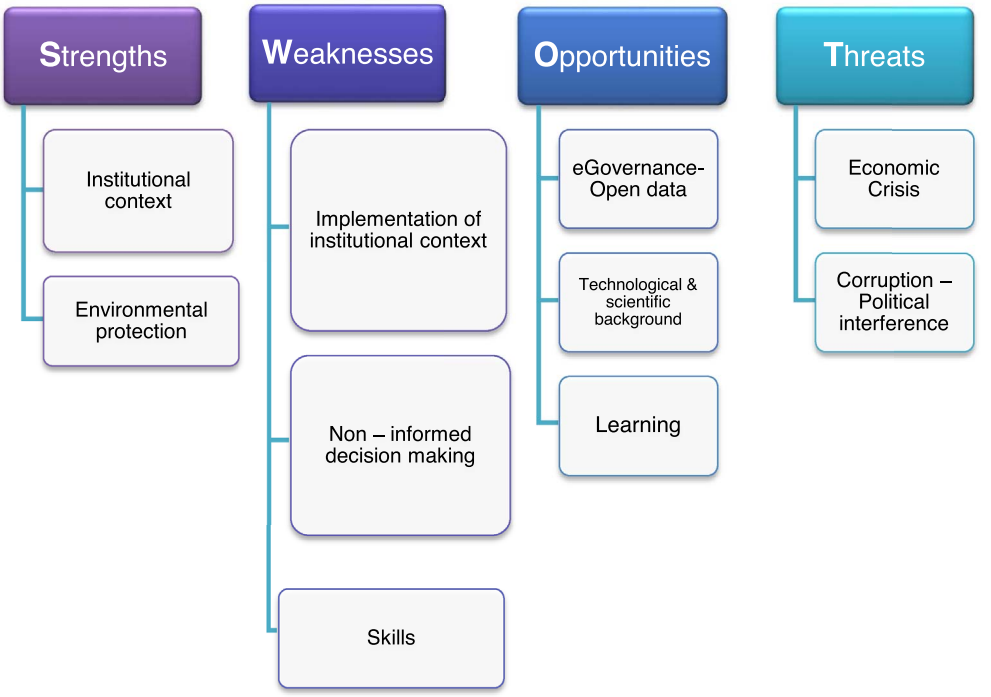


Figure 11. SWOT analysis.

its groups rating it, it was overall ranked relatively low having a global weight of 7%.

Among the elements of weaknesses, the most dominant with the same rating are non-informed decision making and the implementation of institutional context. On the other hand, the highest-rated opportunities were technological and scientific background. The most important elements of both weaknesses and strengths are criteria measuring the substantive effectiveness of the system, namely its performance.

In contrast to the argument of Zvijáková *et al.* [99], referring to the impact of institutional framework on the system under consideration, in this case the

Table 2. Pair wise comparisons between the items of each SWOT group and those groups

	Strengths			Weaknesses					Opportunities				Threats		
	1	**S1**	**S2**	**1/3**					**1**				**1/5**		
Strengths	**S1**	1	3												
	S2	1/3	1												
	3			**1**	**W1**	**W2**	**W3**	**W4**	**3**				**1/2**		
Weaknesses				**W1**	1	1	3	2							
				W2	1	1	3	2							
				W3	1/3	1/3	1	1/2							
				W4	1/2	1/2	2	1							
	1			**1/3**					**1**	**O1**	**O2**	**O3**	**1/6**		
Opportunities									**O1**	1	1/4	1			
									O2	4	1	4			
									O3	1	1/4	1			
	5			**2**					**6**				**1**	**T1**	**T2**
Threats													**T1**	1	4
													T2	1/4	1

The elements in red demonstrate the contribution of each criterion in the final results of the SWOT-AHP analysis.

Table 3. AHP results

Criteria		Relative (local) weights (%)	Overall (global) weights (%)
1.	Weaknesses	28	28
1.1.	Proficiency (skills)	11	3
1.2.	Non-informed decision making	35	10
1.3.	Implementation of statutory context	35	10
1.4.	Contribution in decision making	19	5
2.	Threats	53	53
2.1.	Corruption–Political interference	20	11
2.2.	Economic Crisis	80	43
3.	Strengths	10	10
3.1.	Institutional (statutory) context	75	7
3.2.	Environmental Protection	25	2
4.	Opportunities	9	9
4.1.	E-governance–Open data	17	2
4.2.	Learning	17	2
4.3.	Technological and scientific background	67	6

institutional framework was considered adequate, having comprehensible regulations. This conclusion is in line with that of the recent research of Pediaditi *et al.* [77] which presented a significant discrepancy between institutional framework regulations and their practical application.

The institution was recognized by interested parties, who participated in the survey, as contributing to environmental protection and to the environmental performance of the projects. Even if EIA studies are conducted because it is mandatory due to institutional framework, the fact that proposed projects or activities are evaluated before being approved may discourage project developers from proposing an environmentally damaging project, as pointed out by Ortolano and Shepherd [43]. Thus, the institution

contributes to the protection of the environment. However, this is not sufficient as the institution needs to be able to meet objectives set by the national as well as by European legislative framework which aim at a high level of environmental protection.

Greece is one of the last countries of the EU to adopt EIA legislations. The approval and implementation of the EIAs by the authorities are very complicated decisions, thus making the application of EIA in Greece difficult. This is because, to simplify these procedures, crucial elements that should have been evaluated are excluded, and therefore the analysis is a far-off estimation of the reality [100]. The system also fails to achieve one of the key objectives of the EIA process: to identify, and to propose, optimal alternatives. Such weaknesses are observed in many countries. For example, Anifowose *et al.* [101], identified problems related to EIA preparation and lack of available data as were highlighted in this paper, too. Rathi [50] found similar problems, such as the fact that study approvals set conditions for compliance with the provisions of the law, rather than specific conditions arising from the EIA procedure.

The most common weaknesses, identified in the literature were also identified in the present system. Such weaknesses are associated with public participation in the process [42,58,102,103], considering alternatives [42,104], and cumulative impact assessment [101,103], as well as monitoring [35, 104]. According to Elvan [103], EIA studies in Turkey revealed that public participation in environmental decision making are not binding while decisions should include members from nongovernmental organizations.

It is rather discouraging that, even though Greece has a strong institutional framework, as required by European Union directives, and has had a well-established EIA system for many years, the EIA institution in Greece shows weaknesses similar with the ones that are found in EIA systems of less developed or poorer countries, such as the weaknesses identified by Anifowose *et al.* [101] in Nigeria or Gałaś *et al.* [104] and Rathi [50] in the Visegrad Group countries (Czech Republic, Hungary, Poland and Slovakia) and India respectively. Specifically, in Visegrad Group countries, technological and economical development along with changes in legislations led to the obligatory modification of the EIA systems to simplify the EIA processes. There are still differences in the conduction of the studies during screening, scoping and preparation of the reports, yet Visegrad group countries still work in similar ways regarding EIA [104].

The results of the survey also show that the corruption and political involvement that were identified by Williams and Dupuy [105] in the Albanian system are also a threat to the Greek system and its performance.

Of course, research has shown that the most important element of all is the economic crisis, as an external factor that significantly undermines the functioning of the system; an external factor that is overrated, in terms of its weight against all the opportunities recognized [106]. Specifically, the economic crisis can affect all dimensions of efficiency, while the technological and scientific background that has emerged as the most important opportunity can have a positive impact on both the substantive and the transactional dimension, but much less on the basis of its total weight in relation to the economic crisis. The impact of an economic recession or crisis on EIA systems has also been pointed out by other researchers in the international literature such as Jha-Thakur and Fischer [107], who presented that austerity and economic recession inevitably cause more challenges, or Bond and Pope [98] which include it as a threat, as important and capable of undermining environmental and social goals.

In relation to previous surveys conducted in Greece, the institution, despite its significant improvements and modifications, still has weaknesses that had also been identified in the past and shows low effectiveness [54,108]. However, the fact that it has a strong institutional framework, as well as acknowledging its contribution, albeit small, to the protection of the environment and the environmental performance of projects gives it a limited yet added value.

It is encouraging though, that significant and fundamental advantages have been identified which can contribute in improving the efficiency of the system, along with the beginning of the Electronic Environmental Registry operation and the preparation of planned annual inspections by the competent authorities. Finally, it is very important to consider the opportunities highlighted in this study to strengthen the EIA system and increase the skills of both the

management system and all stakeholders. Increasing the skills of management and stakeholders will bring the country a little closer to adequately monitoring and assessing the environmental impact of its projects, systems and urban settings as well as fulfilling its EU legislative obligations.

A big step towards the fulfillment of such obligations, is the connection of EIA studies with SDGs and circular economy. According to Ravn Boess *et al.* [109], EIA in both academia and policy making is expected to act as a vehicle for achieving the SDGs. To encompass all 17 goals of the UN, the goals must be translated into a project level and thus create an objective assessment. At the same time, SDGs could be used a reference point for EIA in both strategic and project level development [109]. The necessity of the adoption of the SDGs along with adequate monitoring and translation of the goals into quantifiable data will initiate a responsive alteration of EIA procedures in Greece and throughout the EU. Furthermore, as supply chain management has become an essential business management tool, EIA could aid with estimating the environmental impact of a production line along with optimization and monitoring. As these points of optimization could be pointed out during an EIA, circular economy principles concerning waste management, end of life practices along with optimization points throughout the production line (of an industry) or system (of a given city) could be analyzed to provide adequate circularity opportunities. Technologies used in the concept of circular economy (i.e. remanufacture, refurbish, reuse, recycle etc.) could be assessed for their environmental benefits and impacts along with Life Cycle Assessment (LCA) and EIA to design and promote processes with long-term positive impact to the environment and circularity [110].

4. Conclusions

As a result of this research, a number of issues have emerged, mainly from the use of questionnaires, concerning the performance of the institution of environmental studies in Greece. Such issues are in line with the findings of other researchers. The overall picture, according to the conclusions, is that the evaluation system's performance, mainly in terms of its substantive dimension of effectiveness, is low; although strengths and opportunities for improvement are recognized, the dominant threat, namely economic crisis is an important factor undermining it. Whilst the institutional framework has emerged as a strength of the EIA system in Greece, it has also concluded that it is not implemented as intended, rendering the institution ineffective in many aspects. Furthermore, considering the weaknesses arising from the research, environmental education and social training is necessary to encourage participation and involvement in considering alternatives and monitoring of environmental assessment. Decision-making processes cannot be one-sided, as social behavior is a key component for the development of a successful strategy regarding environmental assessment practices. As systems and conditions within which institutions operate change, it is clearly necessary that all dimensions of these systems are constantly evaluated. The effort made in this study only examined part of this aspect, and certainly further research is needed in order to determine more accurately and clearly the performance of the EIA institution in Greece.

Conflicts of interest

The authors declare no conflict of interest.

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