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# Critical Factors for Green Public Procurement: The Case of Greece

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**Abstract:** *Background*: Green Public Procurement (GPP) is a sector that has been growing in recent years through policies encouraged by the European Union. In the Greek public sector, the respective National Action Plan (NAP), which sets specific targets for GPP, has very recently come into force. However, although the influencing factors that contribute to the success of the implementation of green procurement are a crucial element of this policy, they have not yet been explored for the Greek public sector. *Methods*: This study applied data collection and a combined qualitative and quantitative data analysis. The research was divided into two phases: (i) the identification of critical factors (CFs) based on the literature, and (ii) an analysis of fourteen experts' insights into those factors employing the Grey DEMATEL approach. *Results*: Based on the surveyed literature, fourteen CFs that contribute to the successful implementation of GPP were identified. From the analysis of the experts' views, the factors were classified into two groups. Each group contains seven CFs. The CFs in the first group (causes) affect the CFs in the second group (effects). *Conclusions*: This study of the success factors in implementing green procurement in Greek public organizations can be further improved by incorporating new factors, as well as by utilizing the presented results in the follow-up of the NAP.

**Keywords:** green public procurement; Grey DEMATEL; green procurement decision factors



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## 1. Introduction

The emergence of Green Public Procurement (GPP) in the EU is directly linked to the growing need to protect the environment. GPP has appeared in EU priorities and objectives, particularly in the last two decades. EU legislators designed the green shift in public procurement, which led to the adoption of several GPP framework policies, some of which are indeed binding [1]. Member states are implementing these policies as a way of promoting innovation in the areas of public administration, with their application gradually moving from voluntary to mandatory [2]. Within the context of the implementation of green policies stemming from the Green Deal, environmental national targets and sustainability outputs and various methodologies and tools have been developed to assess the achieved performance. These assessment tools are crucial for measuring progress, identifying areas for improvement, and ensuring that the policies are effectively contributing to sustainability goals [3–5].

Moreover, public organizations need to follow regional and national laws and regulations regarding their environmental standards [6]. On this basis, contracting authorities and entities, as the largest purchasers of goods, services, and works, are a powerful tool for implementing environmental, social, and economic policies. By using their power to procure with a reduced environmental impact, they can contribute to achieving national and international sustainability and environmental policy objectives. Since organizations

are increasingly being pressed by stakeholders, shareholders, customers, employees, and society to assess their socioeconomic impact and manage their actions sustainably and resiliently [7], GPP can be an important driver in promoting innovation by providing incentives for the development of green products and services. In addition, it can contribute to savings for the public sector, particularly when the life-cycle costs of the goods, services or projects are considered, as well as the purchase price.

Greece has been a laggard in the adoption of a National Action Plan (NAP) for GPP, as it was only in 2021 that the Greek government presented such a plan. The official recording of relevant data through the Central Electronic Register of Public Procurement started in early 2024; therefore, there are no aggregated data for Greek public contracts established using green criteria prior to this date [8]. This delay can be attributed to a number of factors, such as political priorities, regulatory complexity, lack of resources, and capacity development. Changing political priorities and the economic crisis that Greece has faced in recent years drew attention away from GPP initiatives, so they were not a priority. Moreover, the complex legal and regulatory landscape in Greece has not contributed to the creation of a coherent action plan. A lack of adequate funding and human resources has also hindered the development and implementation of green public procurement strategies. Finally, the insufficient training and knowledge of civil servants regarding sustainable procurement practices pose an additional barrier.

Despite this delay, Greece's adoption of GPP policies in 2021 is noteworthy, as it marks a significant commitment by the country to sustainability, in line with the broader EU environmental objectives. Public awareness of environmental issues is also stimulated. Moreover, this alignment with the corresponding EU policies places Greece as an active participant in the collective efforts of the Union to reduce carbon dioxide emissions.

The importance of GPP as a critical strategy for sustainable policymaking is widely recognized [9], but there is a significant research gap in terms of identifying the CFs influencing the implementation of GPP and its outcomes—especially in Greece. Studies usually refer either to the general European landscape or to a specific sector, dismissing the specificity of the Greek context in terms of socio-economic and regulatory factors. Apart from this geographical specificity, the very recent implementation of the NAP in Greece and the lack of data are additional reasons for further research.

As the application of green criteria in Greek public procurement is on the rise, it is important to identify the CFs in this process, even if these factors are directly influenced by human behavior [10]. The scope of this paper is to investigate the CFs influencing GPP and to understand their interrelationships through the application of the Grey Decision-Making Trial and Evaluation Laboratory (DEMATEL) method. By conducting a comprehensive literature review, key factors pertinent to GPP were identified. These factors were then subjected to expert evaluation within the Greek context for assessment. The use of Grey DEMATEL allows the researchers to elucidate the cause–effect relationships between the identified factors, thereby providing insights into how they interact and impact the effectiveness of GPP initiatives. This methodological approach not only contributes to the theoretical understanding of GPP but also has practical implications for policymakers and practitioners aiming to enhance sustainable procurement practices.

The paper is structured as follows: in Section 2, a literature review is presented, identifying the CFs in green supply chain management and green procurement. Section 3 analyses the methodology used for both the identification of the CFs and the Grey DEMATEL. In Section 4, the results of the applied methodology are presented, while a discussion of the results is presented in Section 5. Finally, the conclusions, the managerial implications, the limitations, and the scope for future research are presented in Section 6.

## 2. Literature Review

Green procurement is an increasingly interesting research topic. The growth in the green procurement literature spans from the early 1990s with the advent of corporate environmental management, environmentally conscious production strategies, and supply

chain management [10]. On the other hand, the European Commission is the driving force behind the implementation of green policies in public procurement in the Member States through its definition of the criteria per product category and the guidelines it issues to this end.

OECD countries have developed strategies/policies that support the incorporation of environmental objectives in the public procurement process [11]. The most recent report presenting the results of the OECD's 2022 GPP survey, to which 38 countries (OECD members and candidate countries) responded, shows that countries are increasingly recognizing GPP as a key driver of innovation [12]. In 2022, almost every OECD country had developed a policy framework or strategy for GPP (Mexico and Hungary were the only exceptions) and governments clearly referred to GPP in their national environmental commitments. The survey also highlighted several examples of public sector efforts to engage more actively with the market to increase the uptake of GPP. Despite widespread recognition of the importance of GPP (92% of the surveyed countries have set mandatory requirements and targets for public procurement), compliance is not always monitored. Moreover, while governments tend to report the use of GPP as part of their procurement activities, they rarely assess its impact on environmental factors such as $CO_2$ emissions. Finally, although GPP initiatives usually have positive results [13,14], the issues that need to be addressed in their implementation, such as sustainability (economic, environmental, and social) [15], restrictive product specifications, and the applied criteria [16], create a climate of uncertainty regarding the selection of green procurement by public bodies. The managerial approach to the implementation of GPP includes organizational change management, the circular economy, and sustainability reporting.

According to Santos et al. [17], most studies focused on exploring the drivers and barriers to organizational change in a single context—for example, a single country or a single organization. The factors that are critical for the implementation of green supply chain management (GSCM) practices in the Taiwanese electrical and electronics industries in relation to the European Union directives are examined in Hu & Hsu [18]. They extract 20 such CFs along four dimensions (supplier management, product recycling, organization involvement, and life cycle management). The empirical findings of this study show that the dimensions of supplier management and organizational involvement were identified as important, regardless of the difference between environmental legislation and industrial property.

Walker et al. [19] reviewed the literature and identified the factors that drive or hinder organizations when implementing GSCM initiatives, revealing that the majority of studies identify more drivers than barriers, possibly due to the need to focus on the positive aspects of GSCM research, and that the focus is more on internal than external barriers. Based on interviews conducted in seven different private and public sector organizations, they identified internal barriers such as cost and a lack of legitimacy, as well as external barriers such as regulation, poor supplier engagement, and industry-specific barriers. This study noted that suppliers are not a significant driver of GSCM projects. However, it is possible that large organizations are more likely to gain power in supplier relationships and influence suppliers to respond to the environmental agenda.

Soo Wee & Quazi [20] identified seven CFs in their research regarding environmental management, namely top management's commitment, the total involvement of employees, training, green products/process design, supplier management, measurements, and information management. The aim of this study was to develop and validate a set of critical environmental factors that could be used by managers to evaluate and improve their own practices. Malviya & Kant [6] grouped the influencing factors in the implementation of a green supply chain and the initiatives implemented by organizations to achieve this end. Five critical success factors were highlighted from a total of twelve influencing factors, i.e., top management's commitment and support, strategic planning, environmental policy, willingness to invest, and empowering and motivating employees. This study was carried

out by exploiting the fuzzy DEMATEL method, dividing the set of factors into a cause group and an effect group, and thus yielding a visible causal diagram.

The accurate identification and thorough analysis of the CFs that impact GPP that were conducted in this paper are crucial for multiple reasons. First and foremost, understanding the CFs enables the resolution of problems that hinder the successful execution of GPP, such as insufficient information and awareness, which pose formidable challenges in governments' green procurement endeavors. By precisely identifying the CFs, policymakers and practitioners can apply focused approaches to surmount these obstacles. Furthermore, the analysis enables the enhancement of GPP procedures, assuring the successful integration of environmental goals into public procurement operations. Procurement decisions have the potential to greatly impact supply chain practices and stimulate demand for ecologically suitable products and services [21]. Moreover, a meticulous examination of the CFs offers a valuable understanding of the dynamics of GPP and can facilitate the synchronization of public procurement with wider sustainability objectives, therefore helping to attain both national and international environmental targets.

## 3. Methodology

The objective of the paper is to investigate the CFs influencing GPP and to understand their interrelationships using the Grey DEMATEL method. By identifying the CFs through a comprehensive literature review and evaluating them within the Greek context, the study aims to elucidate their cause–effect relationships, providing insights into their interactions and impact on the effectiveness of GPP initiatives. The research questions addressed in this study relate firstly to the investigation of the CFs affecting GPP, and secondly, to how these factors interact with each other and influence the effectiveness of GPP initiatives in the Greek context.

Figure 1 presents the methodological approach of the research.

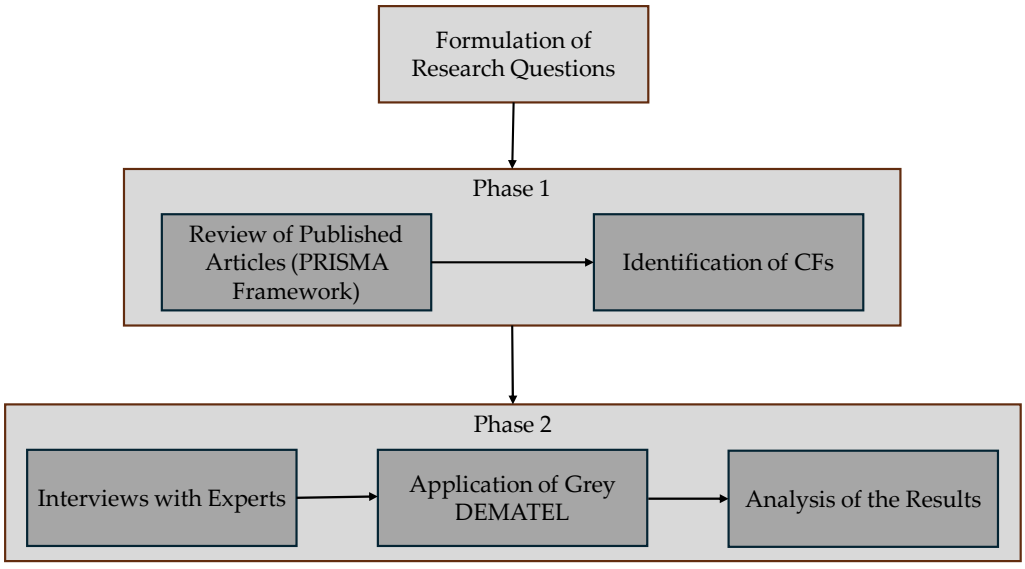


**Figure 1.** Methodology framework.

The research was conducted in two phases. In the first phase, a systematic literature review, using a network analysis to document publications on the original topic and identify the CFs for GPP, was carried out based on the PRISMA framework [22,23].

For evidence-based reporting standards, PRISMA is an effective tool for critical appraisal. In this context, a systematic review relates to a comprehensive and coherent search followed by a reasonable and predefined approach to selecting and analyzing pertinent contributions, which are then synthesized critically [23]. For the purpose of this study, a comprehensive literature search was undertaken in December 2023 to identify papers on

topics related to GPP CFs. The database used in this research is Scopus. The search terms used in the title, abstract, and keywords of the articles on the significance of CFs on GPP were ("green public procurement" OR "sustainable public procurement") AND ("critical factors" OR "success factors"). Furthermore, inclusion and exclusion criteria, like language and literature type, were considered, as shown in Table 1. Articles published in technical press magazines were considered to be less rigorous from an academic point of view; this was the reason they were excluded from the study [24]. Only English language articles were reviewed based on the inclusion criteria. However, government reports, conference proceedings, and book chapters were also considered since they can provide up-to-date data that may not be available in peer-reviewed journals.

**Table 1.** Inclusion and exclusion criteria.

| | Inclusion | Exclusion |
|---|---|---|
| Literature type | Indexed journals, book chapters, government reports, conference proceedings | Technical press magazine articles, non-indexed journals |
| Language | English | Non-English |

The selection of articles for consideration was made using the process shown in Figure 2, where the tool offered in an open-source package and a web-based app developed by [25] were used. According to the aforementioned search terms, the initial number of results from the Scopus database was 363, of which 101 were removed due to duplication. Subsequently, out of the 262 results, 25 were excluded due to the use of a non-English language. Of the 237 articles retrieved for review, 212 did not directly contribute to the paper's research questions and were therefore excluded. Finally, 25 articles were included in the research process.

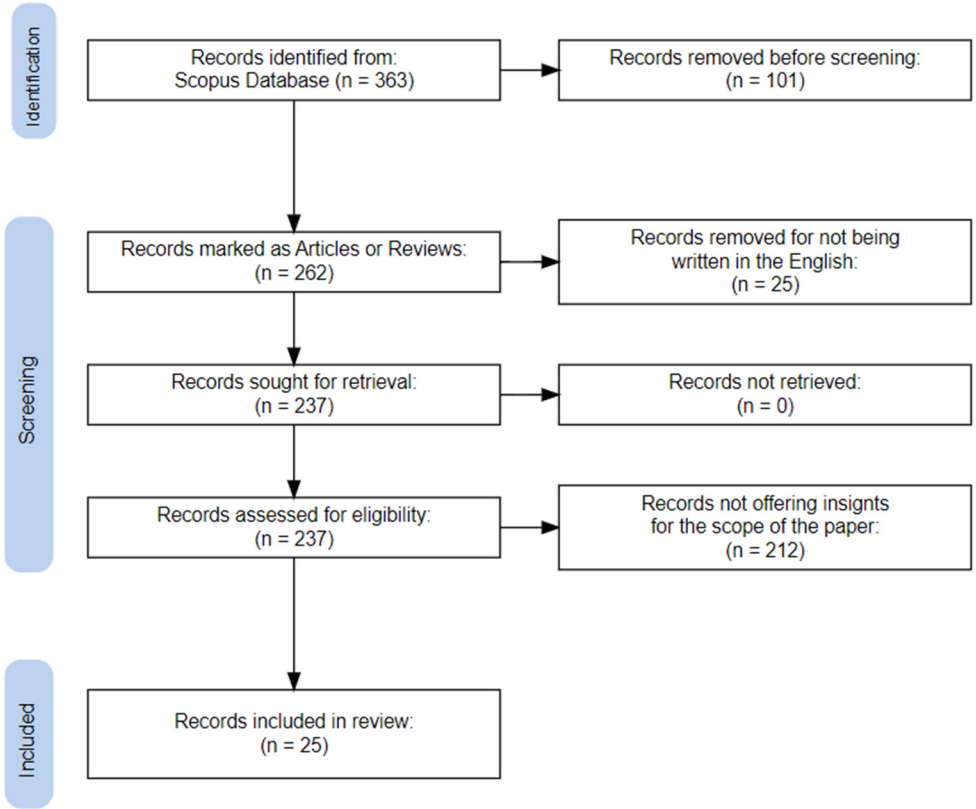


**Figure 2.** PRISMA methodology for identifying articles in the Scopus database.

Regarding the evaluation criteria and variables, different studies used different numbers when applying DEMATEL. The criteria were generally between four and ten and the factors (or variables) between 10 and 30. In terms of the sample size requirements for DEMATEL, the number of experts surveyed was between three and ten [26], with at least five years of relevant experience. Regarding educational requirements, in most of the relevant studies, the main criterion for the participation of experts was that they held a degree in the relevant field.

During the second phase, the DEMATEL method was used in cooperation with experts (procurement executives in the Greek public sector) in order to exploit their experience and knowledge in this field. The initial selection comprised public sector employees who had participated in training activities in the field of GPP since 2021. They were subsequently assessed on the basis of their experience ($\geq$ 5 years) in public procurement. An invitation to participate was initially sent to 19 executives, of which 16 decided to participate. Two of the participants were excluded as they did not actually have the required experience in public procurement, and eventually fourteen executives participated (thirteen females). Twelve held a bachelor's university degree and one held a Ph.D. degree. Their overall working experience, as well as their experience in the field of public procurement, are presented in Figure 3.

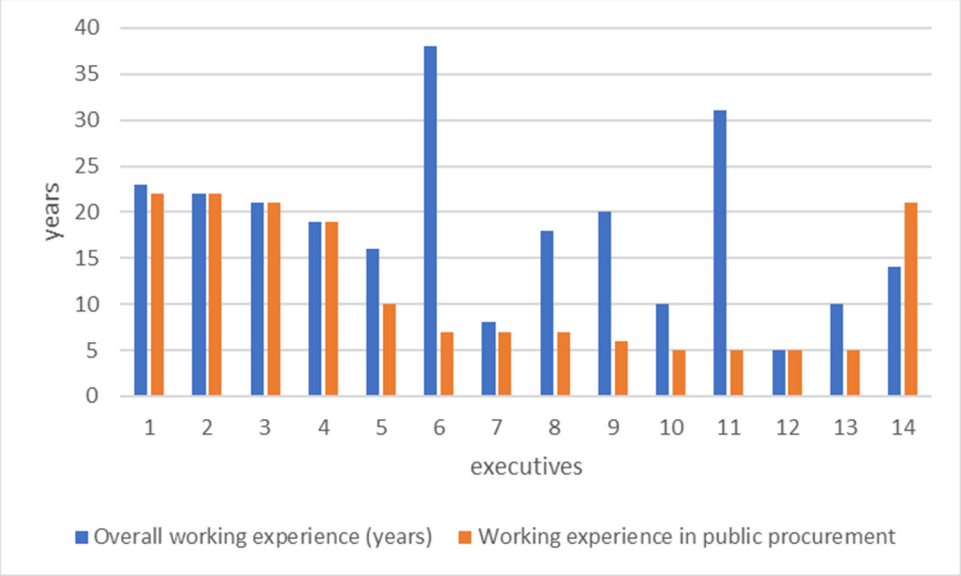


**Figure 3.** Executives' overall working experience and working experience specifically in public procurement.

A semi-structured interview was first conducted with each participant in order to analyze the context and purpose of the research and to resolve any questions. In addition, they were reassured regarding the protection of their personal data, confidentiality, and the protection of information coming from their organizations. Each one of them provided their consent to participate and was free to end the survey at any time if the questions or the format were deemed uncomfortable.

The identified CFs were assessed through experts' responses to the questionnaires and were analyzed using the grey DEMATEL method. The questionnaire was structured in three sections. The first section sought the demographic information of the participants regarding the details of the government agency by which they were employed, their years of experience, and their educational level. In the second section, participants were asked to rank the CFs according to the degree of their importance. In the third section, the degree of influence of each factor on the others was captured according to the linguistic scale shown in Table 2 and as reflected in the experts' responses.

**Table 2.** Linguistic scale and the corresponding grey numbers.

| Linguistics Term | Notation | Grey Number |
|---|---|---|
| No influence | 0 | [0, 0] |
| Very low influence | 1 | [0, 1] |
| Low influence | 2 | [1, 2] |
| High influence | 3 | [2, 3] |
| Very high influence | 4 | [3, 4] |

The DEMATEL method [27] was developed by the Battelle Memorial Institute of Geneva between 1972 and 1976 to address complex problems by identifying the crucial elements that must be considered and their causal connections. The advantage of this method in relation to other approaches is its ability to find the interdependencies among factors regarding their impact from the decision-makers' perspectives [28]. In recent years, DEMATEL has proven to be a popular multi-criteria decision-making tool to help address practical evaluation problems compared to other methods. For instance, a wider breakdown is possible with DEMATEL compared to Interpretive Structural Modeling (ISM). In DEMATEL, the intensity of the correlations between the components can vary widely in range, whereas in ISM the levels range from 0 to 1. While the Analytic Hierarchy Process (AHP) only permits unidirectional relationships and yields several independent matrices that require integration, in contrast, DEMATEL stands out as it permits the possibility of multiple directional relationships [29]. Moreover, the Analytic Network Process (ANP) is capable of handling criteria reliance and feedback but the assumption of equal weight for each cluster, which is required to obtain a weighted supermatrix in the ANP, is not reasonable in practical situations [30].

One disadvantage of DEMATEL is the difficulty of evaluating ambiguous scenarios when there is disagreement among experts, mainly due to a lack of tacit knowledge [31]. Nevertheless, it is very practical for situations with small sample sizes or uncertain data, and it is simple to integrate with other decision-making techniques to assess the accuracy of the inferences [32]. Grey theory is a mathematical theory proposed to cope with systems that lack information. Grey numbers, characterized by their representation of values within a range defined by upper and lower limits, allow for a more flexible and nuanced analysis compared to traditional crisp values. This capability is particularly advantageous in situations where data is incomplete or ambiguous, as it enables the incorporation of expert judgments and subjective assessments in a structured manner. By integrating grey numbers into the DEMATEL framework, decision-makers can better capture the inherent uncertainties in evaluating the interdependencies and causal relationships among factors, leading to more robust and reliable outcomes. Finally, compared to the Fuzzy Set Theory (FST), the main benefit of the grey theory lies in the possibility of flexible pattern detection and the relaxed sample data requirements [33]. FST is a mathematical theory designed to model the vagueness or imprecision of human cognitive processes. The Grey DEMATEL method enhances the decision-making process by providing a clearer understanding of the influence and interaction of various factors, ultimately supporting more informed and strategic decisions [34–36].

The steps of the grey DEMATEL method are as follows [37].

Step 1: Develop a fuzzy direct relationship matrix defining a linguistic scale, as depicted in Table 2.

The initial direct relationship matrix was developed using the evaluation of criteria $c = \{c_i \mid i = 1, 2, \ldots, n\}$ by $k$ experts regarding pair-wise relations using the linguistic scale. The corresponding grey numbers are the matrix elements. Hence, the $k$-th number of $Z^1$, $Z^2$, …, $Z^k$ direct-relation grey matrix was obtained from the $k$-th expert. The element of the direct relation grey matrix is represented as "$\otimes z_{ij}^k$" (i.e., criterion "$i$", influence "$j$", by expert $k$). The overall grey relation matrix was developed by combining all the grey direct relation matrices using Equation (1):

$$Z = \sum_{i=0}^{k} (Z^k)/k \quad (1)$$

Step 2: The overall grey relation matrix was converted to the normalized grey direct relation matrix $N$ using Equations (2)–(4):

$$\otimes s = [\underline{s}, \overline{s}] = \frac{1}{\max\limits_{0 \le i \le n} \sum_{j=0}^{n} \otimes Z_{ij}} i, j = 1, 2, 3 \ldots n \quad (2)$$

$$N = \otimes s \cdot Z \quad (3)$$

$$\otimes n_{ij} = [\underline{s} \cdot \otimes z_{ij}, \overline{s} \cdot \otimes z_{ij}] \quad (4)$$

Step 3: The total relation matrix '$T$' was determined by using Equation (5):

$$T = N \cdot (I - N)^{-1} \quad (5)$$

where $I$ is the identity matrix.

Step 4: The causal parameters were determined using Equations (6) and (7):

$$\otimes R_i = \sum_{j=1}^{n} T_{ij} \quad \forall i \quad (6)$$

$$\otimes C_j = \sum_{i=1}^{n} T_{ij} \quad \forall j \quad (7)$$

where $\otimes R_i$ represents the direct and indirect influence of criterion $i$ over the other criteria and $\otimes C_j$ represents the influence imposed on criterion $j$ by the other factors.

Step 5: The prominence ($P_i$) and net effect ($E_i$) of the criteria were determined using Equations (8) and (9):

$$\otimes P_i = \otimes R_i + \otimes C_j \,|\, i = j \quad (8)$$

$$\otimes E_i = \otimes R_i - \otimes C_j \,|\, i = j \quad (9)$$

$\otimes P_i$ values show the index representing the total cause and effect. The values of $\otimes E_i$ show the net effect or cause of $CF_i$. If $\otimes E_i > 0$, then $CF_i$ is a net cause. If $\otimes E_i < 0$, then $CF_i$ is the net effect of ot her CFs.

## 4. Results

### *4.1. Identification of Critical Factors*

Through the review of 25 papers using the process described in Figure 2, 14 CFs for the implementation of GPP were identified and are presented in Table 3.

**Table 3.** CFs for implementing GPP.

| Factor | Description | References |
|---|---|---|
| K1 | Legislation | [38,39] |
| K2 | Government incentives on green policy | [39,40] |
| K3 | Degree of centralization of procurement | [41,42] |
| K4 | Organizational culture | [41–43] |
| K5 | Senior management's support, commitment, and involvement | [6,13,39,41,44,45] |
| K6 | Clear strategies and goals | [32,42,44,46] |
| K7 | Organizational size | [9,13,46–48] |
| K8 | Employee empowerment and Motivation | [6,9,10,43] |
| K9 | Knowledge of the environmental impact of products | [39,49,50] |
| K10 | Knowledge and training on GPP | [6,9,39,41,43,46,47,51] |
| K11 | Specialized professionals | [38,52] |
| K12 | Cost structure | [39,45,46,53] |
| K13 | Energy consumption | [38] |
| K14 | Certification requirements | [6,43,47,49,50] |

1. Legislation

Legislation serves as a means to establish regulatory frameworks that guide organizations toward sustainable purchasing practices. It plays a crucial role in establishing standards and guidelines that promote sustainable practices in public purchasing, demonstrating its significant impact on the implementation of green procurement. Compliance with environmental laws and regulations ensures that procurement processes align with national and international standards for sustainability, promoting responsible sourcing and a reduced environmental impact [38]. The legislation often mandates specific criteria for energy efficiency, waste management, and the use of eco-friendly materials, driving organizations to adopt greener practices. Additionally, government incentives and support programs can further encourage the adoption of green procurement, fostering a culture of accountability. Transparent legislative and regulatory support from the government for green purchases is considered a motivation for GPP in many countries, and the changes in purchasing policy (through legislation) obtained through enforcing certain green practices can stimulate the market in the production of green products [39].

2. Government incentives on green policy

A government should provide incentives for the procurement of green goods or ensuring green contracts, which could be in the form of tax benefits or price subsidies for public services or organizations that purchase green goods, thus establishing green/environmental governance [39]. State funding provides the financial resources necessary to support and scale sustainable procurement initiatives, enabling public organizations to invest in environmentally friendly technologies, products, and services that might otherwise be cost-prohibitive. This financial support helps to bridge the gap between the higher upfront costs of green alternatives and their long-term economic and environmental benefits. Additionally, state funding can facilitate training programs, capacity building, and the development of robust monitoring and evaluation systems to ensure the effective implementation of GPP practices. However, there are also studies that show that although the government's financial availability makes green purchases more attractive, the effect remains marginal [40].

3. Degree of centralization of procurement

Centralized procurement in GPP streamlines purchasing processes, enhances bargaining power, and ensures the uniform implementation of sustainable practices across an organization or governmental body. Consolidated procurement allows for the consistent application of environmental criteria, making it easier to enforce green standards and select eco-friendly products and suppliers [41]. It also enables economies of scale, reducing costs associated with sustainable goods and services that might be more expensive if procured individually. Moreover, centralized procurement facilitates data collection and monitoring, helping organizations to track their environmental impact and continuously improve their GPP strategies. However, while centralization could bring cost savings, process efficiency, and demand rationalization, decentralization may enable innovation and improve service quality [42].

4. Organizational culture

Organizational culture shapes the values, attitudes, and behaviors that drive sustainable procurement practices. It may be referred to as a set of basic assumptions created, developed, or discovered by a group during the learning process in order to deal with problems of either external fit or internal integration. A culture that prioritizes environmental responsibility encourages employees to integrate green principles into their daily operations and decision-making processes [43]. Organizational culture's importance is proven by the fact that organizations with rigid, top-heavy, and bureaucratic structures face more difficulties while implementing changes than companies with a lean and flexible organizational structure. Therefore, the motivation behind efforts to support environmental improvement may be supported or undermined by the organizational culture. When

sustainability is embedded in the organizational ethos, it fosters proactive engagement with eco-friendly initiatives, such as selecting sustainable suppliers, reducing waste, and minimizing carbon footprints. An organizational culture that encourages employee participation and establishes mutual trust and respect between employees and management is certain to increase their responsiveness to innovation and risk-taking [41,42].

5. Senior management's support, commitment, and involvement

The support, commitment, and involvement of senior management set the tone for organizational priorities and drive sustainable initiatives. When senior leaders actively champion green procurement, they allocate the necessary resources, establish clear sustainability goals, and integrate environmental considerations into the company's strategic objectives. This top-down commitment not only empowers employees to embrace sustainable practices but also fosters a culture of accountability and innovation [39]. By visibly supporting green procurement, senior management reinforces its importance, motivating the entire organization to adopt eco-friendly practices and engage with suppliers who share similar values [6,41]. Ultimately, strong leadership in green procurement enhances corporate reputation, ensures regulatory compliance, and contributes to long-term environmental and economic benefits [39]. Several challenges in implementing green procurement have been illustrated in the literature, and the support of top management is a crucial one. Studies suggest that support from senior management not only promotes GPP but also aids mid-level managers in mobilizing organizational resources to develop and implement green procurement strategies [6,13,44,45].

6. Clear strategies and goals

By establishing specific, measurable, achievable, relevant, and time-bound (SMART) goals, organizations can effectively integrate environmental considerations into their procurement processes. Additionally, having a structured approach encourages stakeholder buy-ins and reinforces the organization's commitment to sustainability, ultimately enhancing environmental performance and compliance with regulatory requirements [42]. The managers who are responsible for implementing GPP must be sufficiently informed about the objectives of green procurement [46]. Without a clear strategic direction, it would be hard to implement green procurement. There is evidence suggesting that organizations with no clear goals failed to reap the benefits of implementing green procurement. The choice of strategy influences how public procurement is used, for example, how the requirements are set and how increased costs are perceived [32,44].

7. Organizational size

The literature provides mixed evidence for the organization size being a factor in the implementation of GPP. As reported in the literature [48], the potential of GPP is higher when the public sector is a large, coordinated purchaser of products. Further research showed that green procurement was significantly better established in large municipalities than in small ones. However, a similar study [47] found that the size of the municipalities did not influence the adoption of GPP practices. Instead, differences among small and large municipalities were narrowed through the provision of training initiatives and guidelines on GPP. Although the previous evidence is mixed, it is safer to estimate that larger municipalities score better than smaller ones and that the size of a municipality is also correlated with several other aspects, such as the existence of a purchasing department and a purchasing strategy. In addition, population size is an important correlation factor with GPP [46], since, in this case, a larger percentage of the financial resources is available for public procurement, and this will facilitate a focus on sustainable products and services [9,13].

8. Employee empowerment and motivation

Empowerment and motivation enable staff to actively contribute to sustainability initiatives. Environmental empowerment is defined as a process through which an organization's authority shares its power with employees to address environmental issues [6,10,43].

By fostering a culture where employees are encouraged to suggest eco-friendly solutions and participate in decision-making, organizations tap into their creativity and commitment to environmental goals. Providing training, resources, and recognition of sustainable efforts further motivates employees, making them integral to the success of green procurement practices. Empowered employees are more likely to champion green initiatives, promote sustainable supplier choices, and implement innovative practices that reduce environmental impact. Ultimately, a motivated workforce drives the organization's sustainability objectives, enhancing overall performance and contributing to a positive environmental footprint [43]. Employee empowerment needs a flatter, more horizontal organizational structure instead of a traditional top-down one, which tends to inhibit employee empowerment. Employee empowerment can lead to several potential benefits for the organization such as increased employee commitment, better decisions, and increased job satisfaction [43], and these benefits will likely have a greater impact on environmental improvements. Another CF in effective GPP implementation is employee involvement. Several studies point out that a higher rate of employee involvement in environmental improvement programs is observed when employees enjoy autonomy and decision-making power [9].

9. Knowledge of the environmental impact of products

Knowledge of products' environmental impact enables organizations to make informed purchasing decisions that align with sustainability goals. Understanding the life cycle impact of products—from resource extraction to disposal—helps procurement teams select eco-friendly alternatives that minimize negative environmental effects. This knowledge allows organizations to assess factors such as carbon footprint, energy consumption, and recyclability, ensuring that their procurement choices support broader environmental objectives. Additionally, educating employees about the product impacts fosters a culture of sustainability, empowering them to advocate for greener options. Therefore, a lack of knowledge regarding the environmental benefits of purchasing products limits the application of green procurement preferences in an organization [39,49,50].

10. Knowledge and training on GPP

The role of knowledge and information is seen as an important factor affecting the outcome of GPP. The European Commission points to a lack of knowledge when it comes to the life cycle costs and benefits of environmental products, as well as uncertainties regarding the legal rights when applying environmental criteria to procurement. In the literature review, this factor was mentioned in multiple studies, confirming its importance [6,9,39,43,46,47,51]. Providing comprehensive training ensures that employees understand the principles, benefits, and implementation strategies of GPP, empowering them to make sustainable purchasing decisions. This conclusion is supported by [41], who also find that the lack of knowledge and training seems more important than the availability of economic resources and budget flexibility.

11. Specialized professionals

Specialized professionals are a crucial element due to their expertise in sustainable sourcing and supply chain management. Their knowledge of environmental standards and eco-friendly practices enables organizations to effectively implement green procurement strategies. A lack of knowledge, skills, or experience usually results in poorly prepared tender specifications and the selection of the cheapest solutions [38]. By assessing suppliers' sustainability credentials and identifying environmentally responsible products, these professionals ensure that the procurement decisions align with the organization's sustainability goals [38]. Additionally, their ability to negotiate and foster relationships with sustainable suppliers enhances overall procurement effectiveness. Ultimately, having skilled professionals dedicated to green procurement drives organizational success, reduces environmental impact, and promotes a culture of sustainability. Research shows the important role that procurement and environmental professionals can play in promoting

GPP and that they are effective guides in the application of the GPP. Thus, in order to positively enforce GPP in practice, procurement professionals need to recognize, identify, and source green alternatives and adopt sustainable standards in procurement [52]. It is worth mentioning that the profession of public procurement specialist has existed for several years, and its introduction occurred in the 1990s in The World Bank [38].

12. Cost structure

Cost structure directly influences the feasibility and adoption of sustainable practices. Previous researchers have identified a common perception among public procurers that it costs more and takes longer to carry out purchasing when environmental requirements are considered [46,53]. While initial investments in green products or technologies may be higher compared to those in non-green products, organizations often benefit from long-term savings through improved energy efficiency, reduced waste, and reduced disposal costs. Additionally, cost-effective green procurement can enhance competitiveness by meeting stakeholder expectations and regulatory requirements [46]. There is still a lack of empirical studies on to what extent GPP increases costs or whether the design of environmental requirements can have differing effects on socio-economic cost-effectiveness. The European Commission has discussed GPP as a way to save money if the costs are looked at from a life cycle perspective, for example, by saving materials and energy and reducing waste and pollution [39]. Ultimately, managing costs effectively ensures that GPP initiatives are sustainable, both environmentally and economically, driving their broader adoption across sectors [45].

13. Energy consumption

Energy consumption underscores the need for sustainable energy solutions and efficient resource use. Key factors in the use of energy-efficient public procurement are human capital, industry, and the energy crisis. As energy costs rise and resources become scarcer, organizations are driven to prioritize procurement practices that reduce energy consumption and promote renewable energy sources. GPP encourages the selection of energy-efficient products and technologies, which not only mitigate the impact of the energy crisis but also lead to long-term cost savings and reduced carbon footprints. By addressing energy challenges through green procurement, organizations can enhance resilience, support sustainability goals, and contribute to broader environmental benefits. This approach positions them as leaders in the transition to a more sustainable energy landscape [38].

14. Certification requirements

Certification requirements provide a structured framework for organizations to manage their environmental responsibilities effectively [6,43,47,50]. In recent years, it has been observed that an increasing number of EU public bodies and authorities are certified with standards such as ISO 14001 [54] as an effective way to stimulate the adoption of GPP and to provide a very strong methodological basis on which to build a GPP-oriented strategy [43]. In addition, ISO 14001 certification is usually included in the evaluation criteria for environmental suppliers [47]. By complying with ISO 14001, organizations can systematically identify and control their environmental impacts, ensuring that procurement practices align with sustainability objectives. This certification demonstrates a commitment to continuous improvement in environmental performance, enhancing credibility and stakeholder trust. In the context of GPP, ISO 14001 helps organizations establish clear environmental criteria for suppliers, promote the adoption of sustainable products, and ensure compliance with environmental regulations [49].

### *4.2. Application of Grey DEMATEL Method*

Following the steps outlined in Section 3, Table 4 shows the total relationship matrix ($T$) as derived from the responses of the 14 experts using Equation (5). The values in this

table that exceed the threshold value, which is the average of the matrix are highlighted with bold text and grey cell coloring.

**Table 4.** Total relation matrix.

| | K1 | K2 | K3 | K4 | K5 | K6 | K7 | K8 | K9 | K10 | K11 | K12 | K13 | K14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K1 | 0.28 | 0.40 | 0.34 | 0.33 | 0.39 | 0.45 | 0.24 | 0.36 | 0.42 | 0.46 | 0.45 | 0.39 | 0.38 | 0.36 |
| K2 | 0.36 | 0.34 | 0.36 | 0.35 | 0.43 | **0.48** | 0.26 | 0.41 | 0.44 | **0.47** | **0.47** | 0.42 | 0.40 | 0.37 |
| K3 | 0.29 | 0.33 | 0.25 | 0.31 | 0.35 | 0.39 | 0.24 | 0.33 | 0.36 | 0.40 | 0.40 | 0.34 | 0.32 | 0.30 |
| K4 | 0.32 | 0.38 | 0.33 | 0.31 | 0.43 | **0.47** | 0.27 | 0.42 | 0.44 | **0.48** | **0.46** | 0.39 | 0.39 | 0.37 |
| K5 | 0.34 | 0.41 | 0.37 | 0.39 | 0.37 | **0.50** | 0.27 | 0.44 | **0.46** | **0.50** | **0.48** | 0.41 | 0.40 | 0.38 |
| K6 | 0.40 | **0.46** | 0.41 | 0.43 | **0.50** | **0.46** | 0.30 | **0.47** | **0.52** | **0.56** | **0.55** | **0.47** | **0.46** | 0.44 |
| K7 | 0.27 | 0.34 | 0.32 | 0.33 | 0.36 | 0.39 | 0.19 | 0.34 | 0.37 | 0.40 | 0.40 | 0.34 | 0.33 | 0.31 |
| K8 | 0.34 | 0.41 | 0.35 | 0.39 | 0.43 | **0.47** | 0.27 | 0.35 | 0.45 | **0.48** | **0.48** | 0.40 | 0.40 | 0.37 |
| K9 | 0.36 | 0.42 | 0.36 | 0.39 | 0.45 | **0.50** | 0.28 | 0.44 | 0.41 | **0.52** | **0.51** | 0.44 | 0.43 | 0.40 |
| K10 | 0.38 | 0.43 | 0.37 | 0.40 | **0.46** | **0.51** | 0.28 | 0.45 | **0.49** | 0.44 | **0.52** | 0.44 | 0.43 | 0.41 |
| K11 | 0.36 | 0.43 | 0.38 | 0.39 | 0.45 | **0.50** | 0.28 | 0.44 | **0.49** | **0.52** | 0.42 | 0.41 | 0.40 | 0.39 |
| K12 | 0.32 | 0.37 | 0.31 | 0.31 | 0.37 | 0.41 | 0.24 | 0.35 | 0.40 | 0.41 | 0.41 | 0.30 | 0.37 | 0.33 |
| K13 | 0.35 | 0.40 | 0.35 | 0.36 | 0.42 | **0.46** | 0.26 | 0.40 | 0.45 | **0.47** | 0.46 | 0.41 | 0.33 | 0.37 |
| K14 | 0.30 | 0.34 | 0.29 | 0.31 | 0.34 | 0.40 | 0.22 | 0.32 | 0.38 | 0.40 | 0.40 | 0.35 | 0.34 | 0.27 |

The degree of prominence and the net cause/effect of the CFs are presented in Table 5 and are calculated using Equations (8) and (9). The cause and effect depend on the sign (positive/negative) of $E_i$. If the value of $E_i$ is positive, the corresponding factor is a net cause, and if negative, then the factor is a net effect. The values of influence/prominence (R + C) and effect (R − C) of each factor are plotted on the graph in Figure 4.

**Table 5.** Degree of influence/prominence and net cause/effect.

| Factors | R | C | R + C | R − C | Classification |
|---|---|---|---|---|---|
| K1 | 5.22 | 4.66 | 9.88 | 0.56 | Cause |
| K2 | 5.57 | 5.46 | 11.02 | 0.11 | Cause |
| K3 | 4.60 | 4.79 | 9.39 | −0.19 | Effect |
| K4 | 5.46 | 5.01 | 10.47 | 0.45 | Cause |
| K5 | 5.72 | 5.74 | 11.46 | −0.02 | Effect |
| K6 | 6.42 | 6.36 | 12.78 | 0.06 | Cause |
| K7 | 4.70 | 3.60 | 8.30 | 1.10 | Cause |
| K8 | 5.58 | 5.54 | 11.12 | 0.04 | Cause |
| K9 | 5.92 | 6.09 | 12.01 | −0.17 | Effect |
| K10 | 6.03 | 6.50 | 12.52 | −0.47 | Effect |
| K11 | 5.85 | 6.41 | 12.26 | −0.56 | Effect |
| K12 | 4.89 | 5.51 | 10.40 | −0.62 | Effect |
| K13 | 5.51 | 5.39 | 10.90 | 0.12 | Cause |
| K14 | 4.66 | 5.07 | 9.74 | −0.41 | Effect |

Based on the results, the non-increasing ranking of CFs based on influence level (R + C) is K6 > K10 > K11 > K9 > K5 > K8 > K2 > K13 > K4 > K12 > K1 > K14 > K3 > K7. There are seven CFs that are classified as causes (with R − C > 0): K7 > K1 > K4 > K13 > K2 > K6 > K8. 'Organizational size' (K7), 'Legislation' (K1), and 'Organizational culture' (K4) are the most influential factors, affecting the implementation of GPP in a significant way, according to the experts' opinion.

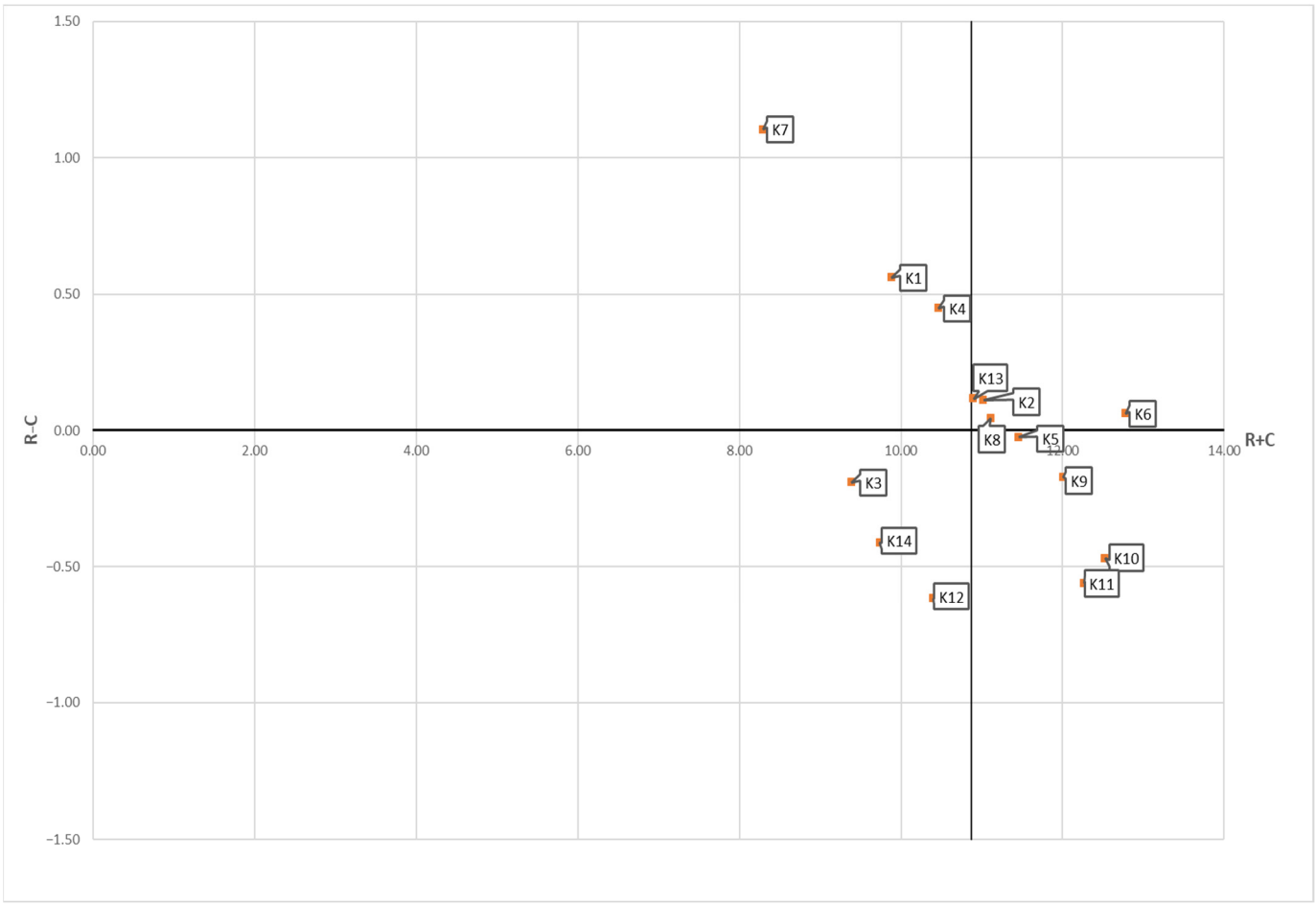


**Figure 4.** Overall DEMATEL prominence–causal graph.

There are seven CFs that are classified as effects (with R − C < 0): K5 > K9 > K3 > K14 > K10 > K11 > K12. 'Cost structure' (K12), and 'Specialized professionals' (K11) are the factors that are most influenced by other factors and by the results of the decision-making.

The overall prominence–causal graph is presented in Figure 4, which includes all the CFs that were examined in this research. It was developed in a Cartesian Coordinate System with R − C along the *Y*-axis and R + C along the *X*-axis. By calculating the mean of the (R + C) values, four quadrants were created:

The factors in the upper right quadrant (K2, K6, K8, K13) are core factors with a high influence, which lie in the cause group and are considered significant in the implementation of GPP.

The factors in the upper left quadrant (K1, K4, K7) are driving factors with a low influence that lie in the cause group.

The factors in the bottom left quadrant (K3, K12, K14) are impact factors with a low influence that lie in the effect group.

The factors in the bottom right quadrant (K5, K9, K10, K11) are impact factors with a high influence that lie in the effect group.

## 5. Discussion

The Grey DEMATEL analysis provided the importance order of each factor and classified them into "cause" and "effect" groups. Significant research implications can be derived from the cluster of the cause factors as they have a high impact on the implementation of GPP. If the cause group factors are the first to be improved by the decisionmakers, they can improve the effect group factors.

The survey revealed that there are four main factors that influence the implementation of green contracts in Greek public organizations: K2 "Government incentives on green policy", K6 "Clear strategies and goals", K8 "Employee empowerment and motivation", and K13 "Energy consumption". These factors are termed Key Success Factors and it is possible for top management to solve the prevailing problems in GPP by concentrating on them.

Government policy regarding GPP is one of the most important factors in facilitating green procurement. When a government incentivizes the procurement of green goods or services, it can ensure the satisfactory implementation of green policies in public procurement. Government funding to support initiatives for sustainable public procurement, to invest in environmentally friendly products, and to develop training programs for public sector personnel are initiatives that will contribute to this direction.

Along with government initiatives, the setting of clear goals and strategies for green procurement is a key factor. Setting specific targets, which are measurable and have time limits, makes a decisive contribution to the implementation of green policies. In the Greek public sector, during the implementation of the NAP for GPP, there was a trial period during which the application of green criteria was not mandatory. In this case, the results were not very encouraging.

The empowerment and motivation of employees was also highlighted as an important success factor. Employees are the driving force for organizations to achieve the goals set by management. Therefore, empowered employees, who should also be well trained, will be able to implement GPP practices, promote sustainable choices, and carry out intensive market research to identify suppliers of green products.

Directly related to these factors, energy consumption is a major driver in an organization's adoption of green procurement. The increase in energy costs and the reduction in available resources, combined with the need for public organizations to reduce their operating costs, can lead to a search for sustainable solutions.

The results also show that legislation (K1), organizational culture (K4), and organizational size (K7) can be considered cause factors, with a lower interaction rate than the aforementioned ones. Organizational culture had the lowest interaction rate. CF's "Senior management" (K5), "Knowledge of environmental impact of products" (K9), and "Degree of centralization of procurement" (K3) are relatively less influenced but are also vital, as they lie close to the cause group, as reflected in Figure 4. The factor "Employee empowerment and Motivation" (K8) often affects the risk associated with "Senior management support, commitment and involvement" (K5), as they are on the borderline of the cause-and-effect groups, respectively.

Finally, the present study's results concerning the Greek public sector have to be interpreted with caution and should not be hastily generalized. Each country's framework provides information on how procurement bodies and other stakeholders operate [55]. For example, there are different ways of creating a legal basis for GPP depending on a country's legal system and traditions [56].

## 6. Conclusions

### *6.1. Overview*

The main objective of this research was to identify the CFs for the implementation of green procurement in the Greek public sector. Furthermore, the cause–effect relationships and the interactions between these factors were highlighted. The research was conducted with the contribution of fourteen experts from Greece with active roles in purchasing departments in various public organizations. The experts were selected because of their experience in public procurement and green procurement issues.

Subsequently, fourteen CFs that affect the implementation of GPP were identified based on the literature review, and the relationships between them were highlighted. In order to mitigate the errors associated with human judgment, the DEMATEL method was

combined with Grey theory. The fourteen factors were classified into two groups: the first group included the "causal" factors and the second group the "effects".

Greek public procurement is facing a significant challenge in terms of implementing green policies following the adoption of the NAP for GPP. The evaluation of the results of the present research and the exploitation of the CFs for the implementation of GPP will contribute significantly to enabling the Greek public sector to move forward in energy transformation. By improving one factor, e.g., legislation, other factors, such as knowledge and training about GPP, qualified professionals, and certification requirements, can be directly influenced. Traditional procurement strategies focus on a "buy–make–dispose" approach, aligned with the current linear economy agenda. However, the principles of the circular economy are becoming more important every day, affecting the well-established way of working in procurement. The major challenges in implementing more sustainable practices within the corporate environments are still in the foreground of research, and perhaps even in higher demand due to the intense environmental degradation, the strict deadlines related to decarbonization, and the shift towards greener production systems [57]. In order to meet these challenges, partnering with designers and developers is essential to obtain materials that can be reused, repaired, and remade [58], which will involve the use of strategic suppliers who can deliver over time. Thus, a new mindset will be needed for procurement activity, as well as new performance measurement systems and new skills and competencies.

### 6.2. Managerial Implications

Governments could boost sustainability and green procurement by formulating policies establishing and enforcing laws, managing natural resources and other state-owned properties, providing a vision and strategy to incorporate sustainability into public policy, allocating funds for conservation and development, redistributing resources between groups in society, providing examples such as improving the environmental performance of public acquisitions, facilitating sustainable development (e.g., taxing waste and pollution), acting as a green fiscal authority, and advancing innovation. With the growing recognition of the environmental consequences of procurement decisions by governments and organizations globally, GPP has become a crucial tool for incorporating environmental factors into buying procedures. Knowledge of KSFs is critical to introducing novel processes in an organization, the role of employees, and the design of governmental green policies. The findings of this study could also help managers to identify the important factors that are conducive to adopting circular initiatives for their organization and to strategically use their resources through promoting a culture of sustainability throughout the procurement process. Furthermore, by motivating suppliers to embrace greener practices, well-informed procurement decision-making may foster innovation in supply chains. Overall, the thoughtful integration of green procurement considerations promotes long-term performance in addition to achieving the environmental objectives.

### 6.3. Limitations and Future Research

Based on the literature review, the first limitation stems from the fact that only the SCOPUS database was used to select the articles, with no factors from different sources being captured. The second limitation is related to the experts, as the sample involved in this study was drawn exclusively from a GPP training group of the Greek public sector, excluding professionals from different backgrounds and with different forms of experience.

Future research should consider expanding the database from which the articles are drawn as well as the expert panel. Furthermore, additional factors emerging from the literature should be incorporated and this approach should be applied to specific public organizations to identify sector-specific nuances. Additionally, longitudinal studies could track the evolution of these factors as the NAP progresses.

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