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Development and Validation of a Measurement Instrument for Sustainability in Food Supply Chains

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Abstract: The purpose of this paper is to develop a measurement instrument for sustainable supply chain management (SSCM) critical factors, practices and performance and validate it in the food industry. A literature review was conducted in order to identify pertinent variables and propose relevant measuring items. An email survey was carried out in 423 Greek companies in the food and beverage sector. The questionnaire was sent by e-mail in the Google Forms format and it was requested to be answered by a representative of the company. The collected data was processed using exploratory factor analysis in order to extract the latent constructs of the SSCM critical factors, practices and performance measures. The validity of the proposed instrument was confirmed through confirmatory factor analysis. The extracted SSCM critical factors are "firm-level sustainability critical factors" and "supply chain sustainability critical factors". The extracted SSCM practices are "supply chain collaboration" and "supply chain strategic orientation". The extracted SSCM performance factors are "economic performance", "social performance" and "environmental performance". The three developed constructs constitute a measurement instrument that can be used both by practitioners who desire to implement SSCM and by researchers who can apply the proposed scales in other research projects or use them as assessment tools.

Keywords: sustainable supply chain management; measurement instrument; critical factors; practices; performance; Greece

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1. Introduction

Sustainable supply chain management (SSCM) is one of the key sustainability concepts receiving significant attention during the last two decades [1,2]. SSCM involves the management of material, information and capital flows as well as the cooperation among all companies in the supply chain, considering all three dimensions of sustainable development, i.e., economic, environmental and social [2]. SSCM involves practices (SSCM-PRA) related to environmental, social and economic activities which often have a positive influence on SSCM performance (SSCM-PER) [3]. These practices might be enabled or inhibited by various contingent factors that are critical for the successful implementation of SSCM. Different industries address these SSCM critical factors (SSCM-CF) from several perspectives based on their size, organizational culture, geographical location and their stakeholders. SSCM has been investigated in several sectors, such as oil and gas [4], the automotive industry [5], energy [6] and the food industry [7]. The food industry, in particular, is one of the sectors facing significant sustainability challenges due to the special biological processes employed, the perishability and bulkiness of food products and environmental and social concerns such as climate change and food safety, respectively [7–10]. At the same time, factors such as globalization, advanced technology and transportation affect food supply chain sustainability [11,12], since changes or re-configurations in one stage of the supply chain are expected to affect other stages of the supply chain as well. In addition, during the last two years, food supply chains have been heavily influenced by the COVID-19 pandemic and as a result, SSCM has become even more important in the face of increasing demand and disruptive events that boost uncertainty [13].

Numerous studies have highlighted the importance of SSCM critical success factors, SSCM practices and SSCM performance. While previous research, especially in the food industry, has offered valuable results [14–16], the literature is still limited regarding the common conceptualization of SSCM critical success factors, SSCM practices and SSCM performance across food supply chains [1,7,17]. Regarding the SSCM critical factors, ref. [18] has identified a set of key enablers and inhibitors for implementing SSCM in small Greek enterprises. In [13], which explored SSCM critical factors during the COVID-19 pandemic, it was found that information sharing, food safety and innovation are only some of the driving forces that companies need to take into account in order to develop sustainable food supply chains during uncertainty. In [7], a conceptual set of SSCM practices were proposed, highlighting the need to evaluate the practices in more depth. Furthermore, SSCM performance has been investigated in the literature in relationship to SSCM practices [3,19,20]. What is common in the abovementioned studies is that different factors are used to describe each construct, indicating a lack of agreement on how these factors should be used in the field of SSCM. In addition to the above, the validation of SSCM critical factors, SSCM practices and SSCM performance needs to be investigated in more depth [1,7,17].

Based on the above arguments, the aim of this study is to empirically validate the theoretical scales of three key SSCM concepts i.e., SSCM critical factors, SSCM practices and SSCM performance in the Greek food industry. The discussion concerning the measurement instrument of the three key SSCM concepts is important because it provides an enhanced understanding of the complexity of the SSCM implementation in the food sector. Identifying these scales, and their related critical factors and measurement items, is crucial both for practitioners and researchers. Their identification will help practitioners in the food industry; first, to secure, provide and promote the necessary resources for effective SSCM, both within their companies and along their supply chains; second, to recognize and apply the necessary practices for the implementation of SSCM; and third, to use the appropriate measures for SSCM performance appraisal and improvement. In addition, the identification of these scales will help researchers to advance theory in SSCM and to test various research hypotheses regarding their relationships within the food industry in particular. The proposed measurement instrument contributes to the development of knowledge on the operationalization of the three key SSCM concepts. Exploratory and confirmatory factor analyses are deployed for the purpose of this study. With this approach, this study addresses the identified challenge that highlights the application of quantitative research methods (surveys) in order to test the reliability and validity of the developed SSCM theory [1]. Another gap that is addressed in this work is the limited work that has been conducted on the investigation of industry- and location-specific factors [21,22]. It is proposed that future research should identify industry-specific and geographically significant factors of SSCM [21]. Hence, this study will do so by exploring these factors in the Greek food industry. It is expected that the developed measurement instrument will offer useful guidance for SSCM critical factors, practices and performance measurement and provide a stepping-stone for future research in the field.

The rest of the paper is organized as follows. The Section 2 presents an overview of the related literature for the development of the three constructs. The research methodology is described in Section 3, while the results are presented in Section 4. Finally, in Section 5, the results are discussed in conjunction with previous research and conclusions are drawn, including the study limitations as well as future research paths.

2. Literature Review

2.1. SSCM Critical Factors

In the extensive literature on SSCM, it is supported that several factors are responsible for the success or failure of the implementation of SSCM [1]. Indeed, many researchers have described a number of factors (enablers, inhibitors, drivers, firm level strengths, barriers, etc.) that may impact the implementation of SSCM practices [18,23–27]. In this research work, these factors are named critical factors (CFs). In order to detect the SSCM critical factors, one should identify the enablers, drivers, success factors, motives, as well as barriers and inhibiting factors, that may influence the adoption and implementation of SSCM practices. The investigation of CFs is mainly analysed in two dimensions: the firm level and the external level, which includes the supply chain dimension as well. Among the most common firm level CFs are top management commitment [23,24,26], customer demands [15,24,25], and knowledge and expertise about sustainability [15,25]. Government policy [21,24,25,28,29], international/national regulatory frameworks [15,23,25], pressure and interaction with stakeholders, competitors and investors [15,24], and food incidents [15] are identified as some of the most common external CFs. On the external level, factors with a supply chain focus are also identified as critical. Information sharing [13,21,23,26,30] and building trustful relationships are two of the most critical supply chain factors for implementing SSCM in the food industry [16,30].

As already noted, several researchers have studied the critical factors for implementing SSCM. However, there is a scarcity of research related to the operationalisation and validation of the SSCM-CF construct. Hence, in line with these arguments, the following research hypothesis is generated:

Hypothesis 1 (H1). *SSCM critical factors (SSCM-CF) in the food industry can be reflected by firm level critical sustainability factors and external critical sustainability factors.*

2.2. SSCM Practices

Based on the SSCM definition given in the introduction and on [31]'s definition on supply chain management practices, SSCM practices are characterized "as a set of sustainability (i.e., economic, environmental and social) activities undertaken in an organization in cooperation with each stakeholders, to promote effective sustainability management of its supply chain". SSCM practices span from green supply chain management practices, such as environmental management and eco-design [5,20,32], to logistics social responsibility practices, such as socially responsible purchasing, sustainable transportation, reverse logistics, sustainable packaging and sustainable warehousing [33]. SSCM practices may also include land management and recycling activities [19] as well as codes of conduct and social audits [34]. Among the most common SSCM practices, especially in the food industry, are strategic orientation, supply chain continuity, collaboration, risk management, and proactivity [7]. Despite the fact that these practices are tested in the context of Chinese manufacturing firms from several sectors [35], the validation of these practices exclusively in the food industry is still limited. Hence, in order to address the need to further evaluate these practices [7], this study adopts them and posits the following hypothesis:

Hypothesis 2 (H2). *SSCM practices (SSCM-PRA) in the food industry can be reflected by strategic orientation, supply chain continuity, collaboration, risk management, and proactivity.*

2.3. SSCM Performance

SSCM performance refers to how well a supply chain achieves its environmental, economic and social goals. The literature mainly focuses on the economic and environmental facet of performance. The social dimension and the integration of the three sustainability dimensions are still lagging behind [2]. In [36], a rising interest in the aforementioned gap was revealed but more research is still needed in the field. SSCM performance is usually analysed as a three-dimensional concept including environmental, economic and social aspects. The ultimate goal of the implementation of SSCM practices is to improve overall SSCM performance. Among the most frequently used environmental performance measures are the reduction or avoidance of hazardous/harmful/toxic materials, water and energy consumption, recycled materials, Life Cycle Analysis (LCA), and environmental penalties [17,36]. Energy efficiency, air emissions, and greenhouse gas emissions are also highly cited indicators in the extant body of literature [36]. Regarding economic performance, the most frequent measures are quality, including quality of products provided by suppliers [17] or quality of the production process [37]. Sales, market share, and profits, as well as delivery time and customer satisfaction, are frequently used as financial performance indicators. The social dimension of SSCM performance is the hardest to measure due to the qualitative nature of the social issues. For example, the supply chain impact on customer experience or social welfare is difficult to be quantified; hence, the development of quantitative metrics is of crucial importance. Several researchers have identified a few measures that are frequently used in the SSCM literature. Among the most common measures are recordable accidents, training and education, and labour practices. So far, researchers have investigated SSCM performance measurement and more than 2500 unique metrics have been identified, indicating a lack of agreement and demonstrating that it is not yet clear how SSCM performance should be measured [17]. In addition to that, several studies have investigated sustainability performance as a multi-dimensional concept. For example, [3] investigated sustainability performance as a four-dimensional concept including operational, economic, environmental, and social outcomes, while [17] found 13 key characteristics for measuring performance of SSCM, including economic, environmental, social, volunteer, resilience, long-term, stakeholder, flow, coordination, relationship, value, efficiency, and performance indicators. In the food industry, researchers have investigated sustainability performance in terms of efficiency, flexibility, responsiveness, and product quality [8,14]. In [19], the performance of social and environmental sustainability practices in the food industry was found to be reflected by quality, cost, and environmental outcomes. Despite the fact that the definition of SSCM clearly states that the dimensions of sustainability are the economic, environmental, and social, empirical studies show that sustainability performance is a multidimensional concept. So far, as noticed in the literature, most papers concentrate on the performance measurement of one or two sustainability dimensions, mainly the environmental and economic [36]. Based on the above, it is obvious that there is a need to develop a valid and reliable construct to measure the performance of SSCM, especially in the food industry. In line with these arguments and SSCM theory, the following research hypothesis is generated:

Hypothesis 3 (H3). *The three dimensions of SSCM performance (SSCM-PER) (environmental, economic, and social) in the food industry reflect the measured indicators identified in the literature.*

3. Research Methodology

3.1. Research Instrument

The data of this study were collected through a structured survey questionnaire based on the literature review on SSCM [7,15,17,25,26,29,30,35,38]. Similar studies in the field have also conducted surveys demonstrating the relevance of this method in SSCM research [32]. The survey questionnaire was structured in four sections. The first section included questions regarding the critical factors for effective SSCM implementation. The second section included questions regarding the implementation of various SSCM practices. The third section included questions regarding the SSCM performance and the fourth section included questions regarding the profile of the companies and the respondents. The content validity of the questionnaire was ensured through extensive literature review that resulted in an initial list of 80 items. In order to further validate the questionnaire's content, a pilot study was conducted with 10 experts from the food industry. The experts' comments and suggestions were incorporated during the questionnaire pretesting phase [39,40], in order to improve the questions regarding the clarity of expression, the explanation of terms and items, the research scope, and the expected results. The draft version of the questionnaire was also reviewed and revised by four academics/researchers [41], resulting in a final list of 68 items. A seven-point Likert scale (with 1 "strongly disagree" and 7 "strongly agree") was used in order to allow respondents to report the extent to which they agree or disagree with each of the 68 items of the questionnaire. The statistical packages SPSS 24 and AMOS 21 were used for data processing.

3.2. Research Sample

The population of the survey consisted of firms in the food and beverage sector included in Greek sustainability databases, such as "CSR HELLAS NET", "Sustainable Greece 2020", "CSR Index GR", etc. Apart from the sustainability databases, the population included firms from other business databases, such as the "Federation of Hellenic Food Industries" and ICAP (the largest business information and consulting firm in Greece), among others, totaling an initial sample of 904 companies. Due to the COVID-19 pandemic restrictions, all companies were contacted via e-mail. The questionnaire was addressed to the personnel responsible for the supply chain and administered via e-mail by the authors and university students, who participated in a training session related to the research scope and content. The e-mail included a cover letter that assured the confidentiality of the submitted answers. The respondents were also advised to provide their contact details in case they were interested in the research results. Responses were collected from May 2020 to August 2021. By the end of the survey, 423 completed questionnaires were collected, yielding a response rate of 46.8%. This response rate was considered acceptable, as compared to other similar studies [35].

3.3. Non-Response Bias and Common Method Bias

In order to examine the dataset for non-response bias, the sample was divided into early and late respondents, where late respondents represent the theoretical non-respondents [42]. Comparisons between the two groups were made with use of the Mann–Whitney U test and no statistically significant differences were found, indicating that non-response bias is not an issue in this study.

Furthermore, the common method bias, which is another critical validity risk in behavioral research [43], is tested. To avoid this phenomenon, the Harman's single factor test was applied to test whether a single factor explained more than 50 percent of the variance in the data. All items were loaded in one single factor and the total variance explained was 35.198 percent, way below 50 percent, assuring the absence of common method bias in this study.

4. Results

4.1. Company Profiles

The sample included companies that belong to several food industry sub-sectors, covering the entire food supply chain network and ensuring that the findings do not relate only to specific supply chain members. Of the companies involved, 39.5% of the firms participate in more than one supply chain activities and 21.7% operate in the food services sub-sector; 16.1% operate in the retail sector and 10.9% in food manufacturing. The rest of the companies operate in other sub-sectors such as wholesale (4.5%), crop and animal production (2.6%), beverage industry (2.6%), and transportation and storage (2.1%) (Figure 1). Regarding the size, based on the number of employees, the responding companies were grouped as follows: 51.5% were very small enterprises (1–10 employees), 22.5% small enterprises (11–50 employees), 13.2% medium enterprises (51–250 employees), and 12.8%were large enterprises (>250 employees) (Figure 2).

4.2. Exploratory and Confirmatory Factor Analysis

Before performing the EFA and CFA, the items were examined individually in order to identify unique or extreme observations. The SPSS's boxplot is applied in order to define the extreme observations that are greater than 1.5 quartiles away from the end of the box [44]. Defined as outliers, 37 observations were deleted from the analysis as they were very likely to influence the outcome of any multivariate analysis [44]. The SSCM critical factors, SSCM practices, and SSCM performance items identified in the literature were used as measured variables in the following analysis. EFA was applied in order to extract the latent constructs of SSCM Critical Factors. Two latent factors (constructs) were extracted with the following values: KMO: 0.855, Bartlett's test of Sphericity: 985.769, df: 28, *p*: 0.000, eigen-value > 1, 0.907 = MSA $\geq$ 0.814, 0.800 = factor loadings $\geq$ 0.603, explaining 60.604% of the total variance. The factors were named after the items that were loaded on them, as follows: "firm-level critical sustainability factors" and "supply chain critical sustainability factors". EFA was also applied to extract the latent constructs of the SSCM Practices. Two latent factors were extracted (KMO: 0.872, Bartlett's test of Sphericity: 1181.660, df: 28, *p*: 0.000, eigen-value > 1, 0.909 = MSA $\geq$ 0.815, 0.863 = factor loadings $\geq$ 0.672), explaining 63.547% of the total variance, and were named as follows: "supply chain collaboration" and "supply chain strategic orientation". Eleven items related to supply chain continuity, risk management, and proactivity demonstrated cross-loadings greater than 0.4 on more than one latent construct; hence, they were dropped, since they do not provide clear measures of a specific factor [44]. One item from these practices was also dropped, since it demonstrated a factor loading below 0.5, which is not considered practically significant [44]. Finally, EFA was applied on SSCM performance, extracting three latent factors (KMO: 0.865, Bartlett's test of Sphericity: 3028.048, *p*: 0.000, eigen-value > 1, 0.937 = MSA $\geq$ 0.792, 0.937 = factor loadings $\geq$ 0.652), namely "economic performance", "social performance", and "environmental performance", explaining 70.780% of the total variance. The reliability of the extracted factors was confirmed by using Cronbach's alpha coefficient, recognized as a good direct measure of internal consistency. In each latent construct, the alpha value exceeds 0.7 [42,43], indicating that all factors are measured by reasonably reliable items.

In order to estimate the level of SSCM critical factors' adoption, the SSCM implementation practices, as well as the SSCM performance, perceived by the respondents, the mean scores of the three constructs were computed and analyzed. From the following three tables (Tables 1–3), it is evident that the companies have a high level of SSCM-CF adoption and SSCM-PRA implementation. Furthermore, the mean value of the social performance reached 6.24 with a standard deviation of 0.99, indicating the positive level of social performance of the participating companies. In general, it can be argued that the same level of importance has been given to all aspects of SSCM.

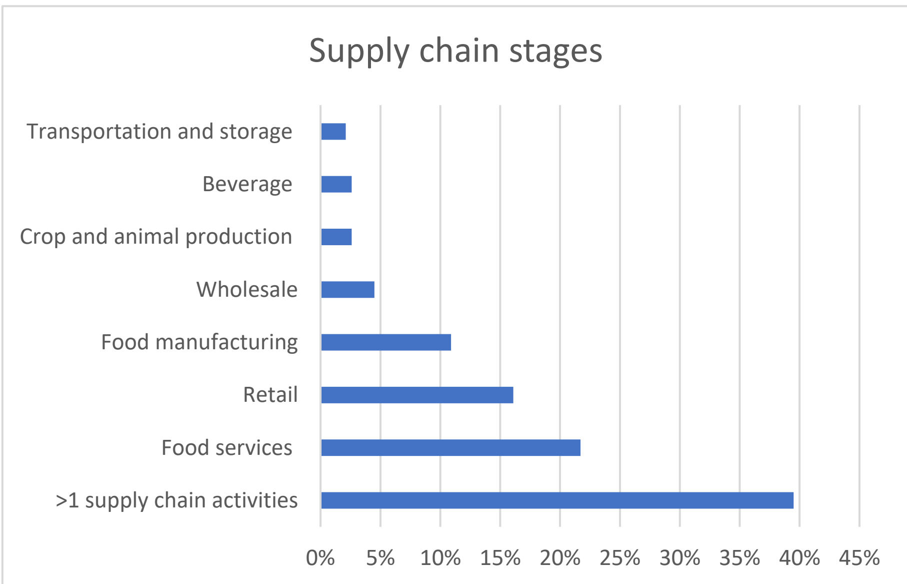

Figure 1. Supply chain stages.

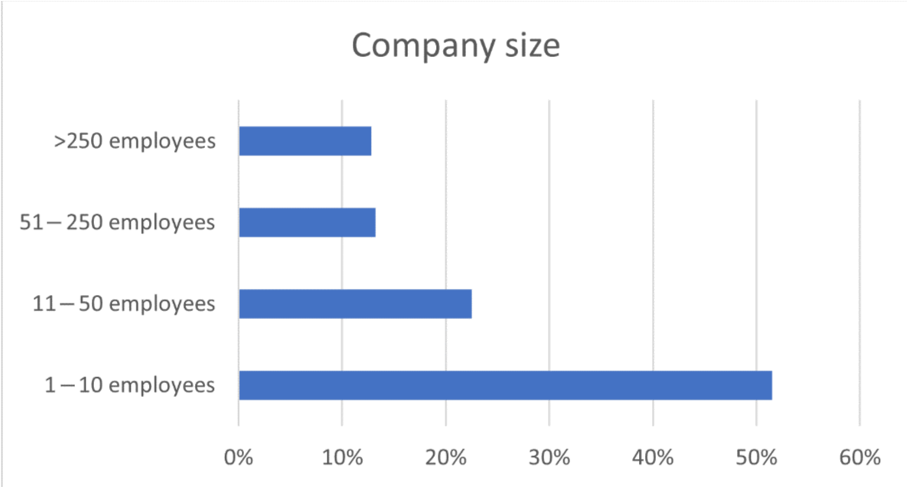

Figure 2. Company size.

Table 1. Descriptive analysis of SSCM-CF construct.

Factors	Items	Mean	SD
Firm-Level Critical Sustainability Factors	Sustainability knowledge and expertise	6.11	1.09
	Sustainability training	5.93	1.10
	Top management commitment to sustainability	5.28	1.47
	Customer needs and requirements for sustainability	6.14	0.96
	Mean value	5.87	1.15
Supply Chain Critical Sustainability Factors	Trust and commitment between supply chain partners	6.25	0.91
	Information sharing between supply chain partners	5.63	1.31
	Preventive measures regarding food scares, incidents and scandals of supply chain partners	6.51	0.85
	Mean value	6.13	1.02

In order to determine whether the empirical data fit the extracted latent factors of the EFA, CFA (maximum likelihood estimation technique) was performed for each of the three constructs (SSCM critical factors, SSCM practices and SSCM performance). The extracted latent factors of the three constructs show acceptable fit to the empirical data. The goodness of fit of the three constructs to the measured data is presented in Table 4. It is evident that the findings of this study consistently support the structure of the latent factors of the three developed constructs.

Table 2. Descriptive analysis of SSCM-PRA construct.

Factors	Items	Mean	SD
Supply chain collaboration	Technical integration of supply chain partners	5.15	1.35
	Monitoring supply chain partners	5.32	1.34
	Knowledge, information and resources sharing (upstream and downstream)	5.32	1.36
	Training and discussing sustainability issues with suppliers	4.67	1.60
	Mean value	5.12	1.41
Supply chain strategic orientation	Sustainability strategic goal setting	5.97	1.03
	Equal importance on environmental, social and economic issues	5.88	1.14
	Understanding sustainable development issues	5.45	1.23
	Mean value	5.77	1.13

Table 3. Descriptive analysis of SSCM-PER construct.

Factors	Items	Mean	SD
Economic performance	Profit growth rate	5.04	1.49
	Profit margin	5.01	1.52
	Cash flow	5.03	1.46
	Return on investment (ROI)	5.13	1.44
	Mean value	5.05	1.48
Environmental performance	Water consumption	5.12	1.52
	Waste reduction	5.60	1.38
	Energy efficiency	5.63	1.24
	Mean value	5.45	1.38
Social performance	Accidents per employee	6.26	1.02
	Accidents related to environment	6.36	0.96
	Environmental penalties	6.27	1.06
	Health and safety	6.27	0.91
	Product safety	6.20	0.97
	Hazardous/harmful/toxic materials	6.06	1.05
	Mean value	6.24	0.99

Table 4. The goodness of fit of the three constructs of the measurement instrument.

Fit Indices	SSCM Critical Factors	SSCM Practices	SSCM Performance	Acceptable Fit Indices
Absolute fit indices				
Chi-square (CMIN or χ^2)	37.516	29.980	144.476	$0 \leq \chi^2 \leq 2df$
Degrees of freedom (df)	13.000	13.000	60.000	
Probability level	0.000 *	0.000 *	0.000 *	$p > 0.05$
Root mean square residual (RMR)	0.042	0.054	0.060	<0.08
Root mean square of approximation (RMSEA)	0.070	0.058	0.060	<0.08
Incremental fit indices				
Incremental fit index (IFI)	0.972	0.983	0.972	>0.90
Tucker–Lewis coefficient (TLI)	0.954	0.973	0.963	>0.90
Comparative fit index (CFI)	0.972	0.983	0.972	>0.90
Parsimonious fit indices				
Chi-square/degrees of freedom (χ^2/df)	2.886	2.306	2.408	Between 1 and 3
Normed fit index (NFI)	0.958	0.971	0.953	>0.50
Goodness of fit index (GFI)	0.975	0.979	0.948	>0.50
Adjusted goodness of fit index (AGFI)	0.945	0.955	0.921	>0.50

Note: * acceptable when n > 250, the number of the measured variables range between 12 and 30, RMR < 0.08, RMSEA < 0.07, and CFI > 0.92 ([44]).

The construct validity of the latent factors is confirmed by calculating the convergent validity (AVE > 0.5), the discriminant validity (AVE > Corr^2) [45,46], the face-content validity (questionnaire feedback from food industry experts), and the nomological validity (significant correlations among the extracted latent factors) [47]. The convergent validity of the latent factors is confirmed by assessing the factor loadings (>0.606), the average variance extracted (AVE) (>0.431), and the construct reliability (CR) (>0.694) in all constructs [44]. It has to be mentioned that AVE value for Supply Chain Critical Sustainability Factors is found less than 0.50. If AVE is between 0.4 and 0.5, but composite reliability (CR) is higher than 0.6, the convergent validity of the construct is still adequate [48,49]. In order to assess discriminant validity, the AVE is compared with the highest squared correlation between the factor of interest and the remaining latent factors [47]. As shown in Table 5, the AVE is greater than the Corr^2, confirming the discriminant validity [44]. The items reflecting the three SSCM constructs, along with their standardised regression weights, are represented in Tables 6–8. The results of CFA confirmed the three constructs revealed by EFA and demonstrate that the extracted latent factors show acceptable fit to the empirical data.

Table 5. Constructs validity and reliability.

Latent Factors	CR	AVE	Cronbach's Alpha	Corr^2
SSCM Critical Factors				
Firm-level Critical Sustainability Factors (FLCSF)	0.829	0.549	0.817	0.244
Supply Chain Critical Sustainability Factors (SCCSF)	0.694	0.431	0.706	0.251
SSCM Practices				
Supply Chain Collaboration (SCC)	0.835	0.561	0.824	0.087
Supply Chain Strategic Orientation (SC)	0.753	0.504	0.776	0.251
SSCM Performance				
Economic Performance (FIN)	0.929	0.765	0.932	0.030
Social Performance (SOC)	0.873	0.536	0.877	0.234
Environmental Performance (ENV)	0.774	0.535	0.770	0.110

Table 6. CFA and standardised regression weights for SSCM Critical Factors.

Factors	Items	Components	
		1	2
Firm-level Critical Sustainability Factors	Sustainability knowledge and expertise	0.747	
	Sustainability training	0.714	
	Top management commitment to sustainability	0.743	
	Customer needs and requirements for sustainability	0.759	
Supply Chain Critical Sustainability Factors	Trust and commitment between supply chain partners		0.679
	Information sharing between supply chain partners		0.629
	Preventive measures regarding food scares, incidents and scandals of supply chain partners		0.659

Table 7. CFA and standardised regression weights for SSCM Practices.

Factors	Items	Components	
		1	**2**
Supply chain collaboration	Technical integration of supply chain partners	0.830	
	Monitoring supply chain partners	0.788	
	Knowledge, information and resources sharing (upstream and downstream)	0.754	
	Training and discussing sustainability issues with suppliers	0.606	
Supply chain strategic orientation	Sustainability strategic goal setting		0.689
	Equal importance on environmental, social and economic issues		0.718
	Understanding sustainable development issues		0.723

Table 8. CFA and standardised regression weights for SSCM Performance.

Factors	Items	Components		
		1	**2**	**3**
Economic performance	Profit growth rate	0.956		
	Profit margin	0.898		
	Cash flow	0.840		
	Return on investment (ROI)	0.824		
Environmental performance	Water consumption		0.729	
	Waste reduction		0.805	
	Energy efficiency		0.653	
Social performance	Accidents per employee			0.777
	Accidents related to environment			0.768
	Environmental penalties			0.669
	Health and safety			0.758
	Product safety			0.749
	Hazardous/harmful/toxic materials			0.661

5. Discussion, Implications and Concluding Remarks

This study developed and validated a measurement instrument comprised of three key SSCM constructs: one for SSCM critical factors, one for SSCM practices, and one for SSCM performance. The confirmation and validation of the three constructs supports the theory that firm-level and supply chain critical sustainability factors may be responsible for the success or failure of the implementation of SSCM practices that influence sustainability performance. The exploratory and confirmatory factor analysis revealed two latent constructs that reflect SSCM critical factors, two factors that represent SSCM practices, and three factors that measure SSCM performance. The extracted SSCM critical factors reflect the internal and external environment of an organization and indicate the focus that should be given to factors that are under the control of the company, such as providing sustainability knowledge and expertise or ensuring top management commitment, and on factors that are not 100% under the control of a company, such as the preventive measures regarding food scares, incidents, and scandals that are related to the supply chain as a whole. These factors have been labeled: "firm-level critical sustainability factors" and "supply chain critical sustainability factors". This distinction is in line with prior research that has acknowledged that there are critical factors for the implementation of SSCM [1] that can be categorized into firm-level and external, including also the supply chain level [15,50].

Regarding the SSCM practices, two factors have been extracted reflecting the practices that companies adopt to manage and control their supply chains. The first latent factor is named "supply chain collaboration", reflecting the importance of technical integration of supply chain partners and the sharing of information, knowledge, and resources upstream and downstream of the supply chain. This is not a surprise, since supply chain collaboration is one of the most commonly applied practices, especially in the food sector [7,51]. The second latent factor is named "supply chain strategic orientation". This is a more intangible factor since it involves measures such as sustainability strategic goal setting and placing equal importance on environmental, social, and economic issues. The results are in line with previous studies, which show that a strategic SSCM focus on all business decisions, even the ones that are directly related to the company's operations, is critical for the successful management of supply chains [2,52]. It is worth mentioning that the respondents did not explicitly consider supply chain continuity (establishing long-term relationships), risk management (adoption of standards and certifications) or proactivity practices (innovation capability or stakeholder management) [7] to be significant. This is an interesting finding, since it would have been expected that responses given during the pandemic, which caused severe disruptions to the food supply chains, would have considered risk management, supply chain continuity, and proactive practices as highly significant. This can be justified by the fact that Greek companies are usually reluctant to adopt and endorse SSCM practices and appear to be less proactive [53]. However, the recent study of Kafetzopoulos et al. [54] found that an agri-food company's knowledge orientation, collaboration, and quality orientation are factors that drive innovation. Hence, the two identified practices of supply chain collaboration and strategic orientation are expected to act as significant enablers for innovation in the future.

Regarding SSCM performance, three factors have been extracted and validated, addressing the three dimensions of sustainability i.e., environmental, social, and economic performance. The first factor is named "economic performance", since it involves key economic measures. Profit seems to prevail in this construct and this is not a surprise since this is one of the key measures that companies try to improve both in the short and long term. In line with this, ref. [14] also identified gross profit margin as one of the key sustainability performance indicators in the food industry (dairy sector). The second factor of the SSCM-PER construct is named "environmental performance". This construct involves key environmental measures such as water consumption, waste reduction, and energy efficiency, which are also supported by prior literature [55]. The third factor identified through the EFA and CFA is "social performance". This factor involves items that measure accidents per employee, health and safety, and product safety, which are commonly used in the description of the social dimension of sustainability [56]. Interestingly, some indicators in the social dimension cover environmental issues as well. For example, the management of hazardous materials, environmental accidents, and penalties are indicators that can be found in the environmental performance dimension. The hazardous materials are included in the social dimension because companies are responsible for treating these materials safely in order to avoid health and safety incidents that would hurt their social image. The social image of a company can also be affected by environmental accidents and penalties. In addition to the above, the majority of Greek firms have limited awareness of sustainability performance, especially in their supply chains, and they operate based on a low-cost/cost-cutting strategy [53]; hence, accidents and penalties related to environmental issues are expected to increase costs.

The results of the present work fully support the first and third research hypotheses. Regarding the second research hypothesis, there is evidence that the level of adoption of SSCM practices such as supply chain continuity, risk management, and proactivity should be further increased. Based on the above and on the evaluation process of the food firms' sample against the SSCM practices construct, the second research hypothesis is partially accepted.

5.1. Research and Practical Implications

The present work contributes to the existing research by providing a measurement instrument comprised of three key SSCM concepts, i.e., SSCM critical factors, SSCM practices, and SSCM performance. The first construct identifies the factors that are critical for companies that desire to successfully implement SSCM. The second identifies the factors related to SSCM practices and the third identifies the factors that need to be taken into account in order to improve SSCM performance. The three constructs of the measurement instrument offer insights into the nature of SSCM critical factors, practices, and performance in the food industry in the Greek business context. This paper answers the question of what factors to measure in order to implement SSCM practices and improve SSCM performance. The developed measurement instrument can be used both by practitioners and researchers. Supply chain practitioners can apply the three scales individually or together both in the firm level and the supply chain level. Furthermore, these constructs may be exploited by managers who desire to implement SSCM and allocate resources in order to improve supply chain sustainability performance. The proposed measurement instrument offers the opportunity to supply chain professionals to appropriately align their supply chain strategy towards positive environmental and social outcomes. The environmental and social performance items are the key aspects that should be taken into consideration for improving SSCM. Both practitioners and researchers may take advantage of the proposed scales and use them as assessment frameworks, benchmarking tools, or guidelines for the design of future strategies or research projects. Last but not least, the proposed measurement instrument was developed during the pandemic; hence, it may be beneficial for managers that wish to develop SSCM during uncertain times.

5.2. Limitations and Future Steps

It is recognized that there are several limitations to this work that can be used as future research propositions. First, in this study, the three constructs were tested separately. Based on the research findings, it is proposed that future studies should emphasise investigation of the relationships among the three constructs in order to provide a deeper understanding of how SSCM critical factors, SSCM practices, and SSCM performance relate to each other. The second limitation is related to the characteristics of the food firms' sample. The suggested measurement instrument is valid in the food industry and especially in the Greek business context. Future studies may examine the way the instrument's validity replicates in other sectors and countries. Another future opportunity would be to develop a SEM-PLS model, especially if the sample is smaller than this study. The analysis with SEM-PLS could be compared with the SPSS analysis to test if the developed measurement instrument is confirmed or not. Finally, this study was designed before the outbreak of the pandemic and was conducted during the pandemic. An interesting future research opportunity would be to repeat this survey in the post- COVID 19 era and compare the findings.

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