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Search Engine Results Optimization for Supply Chain SMEs Through Digital Content Management and Fuzzy Cognitive Models

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Abstract: Throughout crises and financial prosperity, the role and influence of small and medium supply chain enterprises (SMEs) have been solid and key factors for the economic growth of global markets. Hence, a great need arises for digital promotion to keep up with recent technological advancements. Such an aim could be achieved by SMEs in the supply chain by optimizing the results of their websites in search engines and utilizing the digital content (DC) of their web pages. This research is focused on the optimization of supply chain SMEs' search engine results from the efficient management of their DC. The authors collected big data from the DC of five supply chain SMEs' websites and performed statistical analysis (correlation and linear regression analysis), followed by six fuzzy cognitive mapping simulation scenarios. Supply chain SMEs' customers enter their website and are found capable of producing DC metrics, originating from their interaction with the webpage, which is valuable for supply chain SMEs since they impact the performance of their search engine results. The outcomes of this study indicate that specific DC metrics, related to website customers' activity, can accurately simulate and predict the course of supply chain SMEs' digital marketing performance KPIs (global rank, organic, and paid traffic). It has been discerned that supply chain SMEs could enhance their search engine results, by increasing traffic originating from social sources, organic keywords, and the costs required for paid advertising campaigns. Accordingly, the increased number of pages opened by website visitors also indicates enhanced search engine results.

Keywords: supply chain, digital content management (DCM), fuzzy cognitive mapping (FCM), small–medium enterprises (SMEs), digital marketing strategy, search engine optimization (SEO), search engine marketing (SEM), decision support systems (DSS)

1. Introduction

Small–medium enterprises (SMEs) have been adversely affected by acute financial constraints, but they have demonstrated endurance and adaptability, which speaks favorably for their potential to make an impact on innovation and adaptation [1]. The SCM innovation method can assist SMEs in balancing budget and timeframe restrictions [2]. As a result, this might imply that SME profitability and characteristics are directly tied to and integrated with different categories of significant ICT implications in the marketplace.

The present study's motivations lie in the examination of the benefits that might arise for supply chain SMEs' digital marketing performance, from the implementation of digital content management (DCM) methods. Since there is little knowledge of the impact of digital content (DC) originating from webpages on firms' search engine results, the authors intended to highlight the effect that each website DC factor has on their digital marketing performance KPIs (global rank, organic, and paid traffic metrics).

Throughout the paper's outcomes, important insights arise that concern the search engine results' performance for supply chain SMEs. The authors utilized website DC data and metrics to study their impact on specific search engine optimization (SEO)/search engine marketing (SEM) KPIs (global rank, organic, and paid traffic) for supply chain SMEs. Thus, the following website DC metrics have been discerned as determinants for the enhancement of SMEs' search engine results: (a) social sources' traffic, (b) organic keywords, (c) paid campaign costs, and (d) number of pages opened by their website visitors. The preferred outcomes emerged from the fuzzy cognitive mapping (FCM) analysis and scenarios, where each DC metric's impact was individually examined.

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From this point of view, the research work is organized as follows: through the first part of the paper, the Introduction to the study's interest and main definitions is made, while in the Literature Background part, the current analysis and research in the field of SMEs and their digital promotion takes place. Later, in the Research Methodology part, the authors seek to elaborate on the factors that could enhance SMEs' search engine results and formulate the research hypotheses, and then, the deployment of the required methods of statistical analysis and FCM is presented. Finally, in the Discussion and Conclusion section, proper insights regarding the produced outcomes from the research are provided with parallel reference to their potential benefits and exploitation.

2. Literature Review

2.1. Supply chain SMEs

According to available research, SMEs drive socio-economic prosperity. Small- and medium-sized businesses provide an equal element at both the micro and macroeconomic levels. SMEs, which reflect society's middle group, also substitute for cartels and oligopolies diminishing major corporations' capacity to regulate markets [3], particularly those working in the supply chain industry.

Consumers are becoming more demanding, expecting superior and less expensive items, a greater quality of service, a wider range of product options, and quicker shipping [4]. In addition, shifts in company structures like decreased manufacturing expenditures, the shipment of growing value to customers, adaptability with improved services, and the widespread effect of technological innovations offer progressively difficult hurdles for corporate sustainability [5].

Establishing tight ties with suppliers allows them to be particularly willing to assist whenever demand increases to satisfy client demands [6]. As stated by Consoli [7], SMEs confront a variety of hurdles to ICT implementation, owing partially to the reality that SMEs often have scarce funds, technological advances, and expertise, despite the reality that a less complicated architecture provides smaller businesses greater ability to adapt.

2.2. Big data and digital web content

Big data originate from a range of origins and are classified into three categories: data that are structured, semi-structured, and unstructured. Organized information presents a previously categorized and organized warehouse of information, whereas unorganized information is unpredictable and harder to evaluate. Semi-structured information lacks predefined categories and instead includes identifiers for specific information pieces [8]. Data volumes and sizes increasingly transcend terabytes and petabytes. Information on a massive scale is outperforming conventional preservation and processing approaches [9].

Quick processing is crucial not merely for big data but also for every operation overall. Big data should be employed for limited-time activities since it allows the company to optimize its worth [9]. Based on these findings, the adoption of DC on company web pages may culminate in an enhancement of search engine ranking and outcomes [10].

2.3. Digital marketing and search engine results

SEM is a collection of tasks that encompasses SEO, social networking promotion, as well as other search engine-related operations [11]. Search engine marketing management is a business administration technique that enhances the ranking of a webpage's goods or offerings toward the highest position of search engine results pages, hence increasing company performance [12].

SEO may be accomplished via both organic and paid methods. The operator of the webpage chooses to use organic SEO to attain the greatest rating of the web page in search outcomes without utilizing extra commercial tactics. The designer of the website should be familiar with numerous SEO approaches that will progressively position the appropriate content-rich webpage on the leading search engine outcome sites [11].

The preceding explanations demonstrate the significance of merchandise online marketing in search engines. That type of result could be essential for supply chain SMEs with a substantial part of the world's market that want to capitalize on the possibility of expanding their customer reach and promoting their line of goods and services. The utilization of their webpages' DC falls under this category.

2.4. DC of websites utilization need for supply chain SMEs

Researchers have increasingly used analytical tools to investigate enormous media text collections, particularly social networking content flows, at the interface of information studies and social research [13]. In the domains of computer science and promotion, DCM in e-commerce is a lucrative study field. With the existence of social assistance, the collaborative nature of social shopping allows users of branded retail webpages to contribute to higher worth in enterprises [14].

Results from Tajvidi et al. [15] give important information for firms to better their DCM by inspiring consumers to participate in brand collaboration. They additionally give suggestions and guidelines for additional social enterprise research. The influence of ICT on SME efficiency aspects (profitability, development, valuation, sustainability, social and effectiveness, performance, and contentment) may be a significant determinant of company sustainability [16]. Implementing sophisticated search engine outcomes optimization techniques and supplying every day, every week, or every month accomplishments assist in enhancing traffic to the website and general revenue of the good or service, consequently increasing the success rate of SMEs' profitability [11].

2.5. Related research and fuzzy cognitive methods

In the field of fuzzy cognitive applications in digital marketing and DC, multiple studies have been conducted. Various research concerning FCM has been developed, and many digital marketing factors, such as paid advertising, website traffic, and SEO initiatives, enhance SMEs' performance [17]. Kaltenrieder et al. [18] used fuzzy analytical network processes to analyze website customers' DC data, while Kumar and Dash [19] used fuzzy structural models to simulate decision-making for firms' digital marketing strategies. Moreover, the utilization of fuzzy methods (like SWARA-COPRAS) showed the need for customers' behavior analysis, as a determining factor for supply chain SMEs' digital marketing performance [20].

Furthermore, Xie and Makki [21] applied FCM concepts to study the digital marketing transformation of firms' business models, where big data, web analytics, and DCM play a crucial role [22]. Such fuzzy analytics tend to exploit digital and consumer marketing to enhance firms' performance [22]. With application to the tourism industry, Esmaelnezhad et al. [23]

indicated that the analysis of digital marketing strategies through multiple fuzzy hybrid approaches results in improved business performance.

In the field of FCM, Sharaf [24] stated that these methods are a necessary tool for business decision-making and problem-solving. Furthermore, fuzzy models and graphs promote the sustainable economic development of businesses [25]. The combination of quantitative data and fuzzy methods influences numerous factors of companies' performance, such as strategic decisions and managerial and promotional activities [26]. FCM's contribution to decision-making for businesses has also been highlighted by Seiti and Hafezalkotob [27]. Paik and Mondal [28] point out the benefits of fuzzy mapping applications in multicriteria decision-making for firms, by harvesting intuitionistic fuzzy parameterized models.

A research gap arises in the analysis of supply chain SMEs' search engine results' optimization, based on their website customers' DC, through the application of FCM models. The main motivations for this research lie in the fact that DC metrics reflect website customers/users changing behavior and thus provide a better adaptation for supply chain SMEs' digital marketing strategies. Moreover, DCM offers a cost-effective option for SEO/SEM optimization, while enhancing supply chain SMEs' online presence, a much-needed for SMEs' sustainability. SMEs must exploit their website customers' DC metrics in favor of their enhanced online presence through search engine results. The capitalization of FCM models to examine the effects of DC variables on supply chain SMEs' digital marketing KPIs (related to search engine results) could provide valuable insights for transforming their digital marketing strategy. Thus, a throughout examination of each DC metric should be performed to obtain a clear image of their impact on supply chain SMEs' search engine results.

3. Research Methodology

Following the review of the relevant literature, the authors adopted the following methodological framework, seeking to analyze the effect of supply chain SMEs' website DC on their potential customers' search engine results. To do so, the following research methodology was applied. The authors extracted DC metrics from the website visitors of supply chain SMEs, using a decision support system (DSS) platform, that reflect the digital behavior of their website visitors. Then, by using suitable statistical metrics, the needed coefficients (Pearson's correlation and linear regression) were extracted to verify or not the research hypotheses and be inserted into the FCM simulation model as inputs. At the last stage of the methodology, the authors utilized the FCM method for deploying the total interrelationships of supply chain SMEs' DC and digital marketing metrics. In this way, the static representation of DC metrics variation's impact could be easily examined through a wide range of variables and environments.

The methodology's novelty lies in the fact that the utilization of DC metrics offers a clear picture of firms' website users' digital behavior. This provides significant insights for optimizing SEO/SEM strategies. FCM's novelty can be discerned through its produced outcomes in various sectors of application. The impact of FCM on the SEO of companies has been analyzed through the scope of various metrics' utilization [29–31]. More specifically, Giakomidou et al. [32] studied the benefits of FCM's application to energy SMEs' digital performance. Our methodology capitalizes on the referred FCM procedure but focuses on the analysis of supply chain SMEs' website DC data. Furthermore, Nasiopoulos et al. [33] utilized FCM to aid the planning of digital marketing and decision-making efforts for IT products. FCM's application to other service industries has been highlighted by Maftei et al. [34]. Regarding the agricultural products sector, FCM can be used to find ways to promote the brand name of these firms [35]. FCM offers the possibility for firms to analyze the direct impact of any adjustment of their DC metrics to their SEO results (static variations), thus enabling the examination of each DC metric's effect individually.

This work is oriented to examine and find possible ways to improve the search engine results of supply chain SMEs, through the exploitation of their website DC. To leverage DC, businesses can use big data generated and collected from their website traffic activity, known as web analytics [36].

Since FCM incorporates the statistical processing of a firm's data, it can comprehensively study an industry. Doing so can create improvement opportunities for many firms in the same industry [37]. Such an element is extremely beneficial for SMEs because the implementation of such a strategy can provide important information for gaining a competitive advantage [38].

Thus, the authors opted to use FCM models that are based on the observed, through 6 months, digital performance (DC metrics) of supply chain SMEs' website visitors, rather than selecting other fuzzy methods. Such data do not represent any problems of agents' hesitation or imprecise data [39]. Due to big data's (DC) nature, they tend to provide high levels of data accuracy and precision [40]. So, the intuitionistic fuzzy c-means algorithm and methods, based on machine learning, do not appeal to a competitive alternative.

3.1. Data sampling

The SMEs selected for the research are some of the most innovative in the supply chain sector. Thus, five SMEs were selected from the supply chain sector, which offer innovative services that contribute to the satisfaction of their customers [41]. The sample of five SMEs consists of Flexport, Zipline, Convoy, Controland, and Berkshire Grey. Regarding the way of collecting the DC data of the websites, the services of the online platform Semrush [42] were used, to which a corresponding fee was paid. About 2,300,000 behavioral web data [43] were collected through this platform, which refers to a measurement period from July 01, 2021, to May 31, 2022.

3.2. Research hypotheses

Most of the SMEs in the supply chain need additional tools in their arsenal to be able to achieve a more effective promotion of their services. This could result in an increase in their income, enhanced sustainability, and corporate growth. By improving their digital marketing results, SMEs can attract more visitors and potential customers to their websites. Through proper DCM, supply chain SMEs have the opportunity to improve their organic and paid traffic results (SEO, SEM), as well as manage to climb higher in user online searches. In this effort, SMEs can use tools to collect and analyze big data from the content of their websites. Considering the stated pursuits of supply chain SMEs, this research raises the following research hypotheses for investigation.

Hypothesis 1. (H1): "*Digital Content (DC) metrics can aid in the enhancement of the Global Ranking of Supply Chain SMEs.*"
Hypothesis 2. (H2): "*Website Organic Traffic of Supply Chain SMEs is affected by their Digital Content (DC) metrics.*"

Hypothesis 3. (H3): "*Supply Chain SMEs' Digital Content (DC) metrics impact their website's Paid Traffic.*"

3.3. Statistical and regression analysis

Moving on to the statistical analysis part, we will examine the data obtained from the selected sample mentioned in Section 3.2. This data analysis will help gain a deeper understanding of their structure and descriptive elements so that a more detailed statistical method can be deployed, to identify significant relationships and connections between variables.

In Table 1, we observe the correlations among the sample variables. Correlations of variables with statistical significance are presented in bolder letters, i.e., combinations of variables that are strongly related to each other. Therefore, since the (dependent) variables of the study are website global ranking, organic traffic, and paid traffic, the application of linear regression analysis with the independent variables takes place in Table 4. Thus, the authors included the statistically significant variables per dependent variable (e.g., for the website's global ranking the independent variable's search sources).

At this stage, and after examining the descriptive statistics and identifying the statistically significant correlations of the dependent and independent variables, three linear regression models were produced. To proceed to the linear regressions' creation, the authors made sure that the dependent and independent variables followed the normal distribution. Moreover, the produced regression models were selected based on their Akaike criterion [44], which implies that these models were the best-adapted ones to the dependent variables' variation.

In the first linear regression model, the websites' global ranking is used as a dependent variable, and as can be observed in Table 2, the regression is confirmed overall, with $R^2 = 1.000$, and p-value $= 0.000 < a = 0.01$ level of significance. From the independent variables, the following were selected as statistically significant: organic keywords, paid traffic, paid traffic cost, pages per user, new visitors, and old visitors. All independent variables were statistically significant (p-values $< a = 0.01$).

For the second linear regression model, with organic traffic as the dependent variable (Table 3), the regression is confirmed overall, with $R^2 = 1.000$, and p-value $= 0.000 < a = 0.01$ level of significance. The statistically significant independent variables of this regression, which had p-values $< a = 0.01$, were organic keywords, social network sources, search sources, bounce rate, time on site, and past visitors.

Finally, the last regression with paid traffic as the dependent variable (Table 4) is also confirmed overall, with $R^2 = 1.000$, and p-value $= 0.000 < a = 0.01$ level of significance. The statistically significant independent variables of this regression, which had p-values $< a = 0.01$, were organic keywords, social sources, search sources, time spent on the website, and new and old visitors.

3.4. Fuzzy cognitive model

The authors executed and evaluated six scenarios to improve the digital marketing performance of supply chain SMEs across several important indicators by modifying the content of their websites. From the previous stage of linear regression analysis and variables' correlations, the metrics that influence the SEO variables for supply chain SMEs (global ranking, organic traffic, and paid traffic) were discerned. FCM is a theoretical interpretation and a parametric approach to mind mapping, in which static structures depicting cognition can be modeled by specifying various criteria, both negative and positive connections between elements, and the extent to which each element is connected to others. To this end, the authors used the web-based software MentalModeler [45], which includes the FCM simulation interface. These principles can be used to model a structure with components and to identify the connections between the components and the network [46]. The FCM model developed for this study is presented in Figure 1.

3.4.1. FCM scenario 1: Increase in website traffic from all sources

To perform the FCM scenarios, the sigmoid transfer function [47] was used, due to its effectiveness and the dynamics it offers for the analysis and simulation of various processes, but also for the measurement of the similarity of the variables of a sample [48]. For the deployment of the FCM calculations, the following steps were made:

(a) Definition of the Variables:

Identification and definition of the variables that represent different elements of the website DC metrics' impact on supply chain SMEs' search engine results (global ranking, organic traffic, and paid traffic).

(b) Establishment of the Relationships:

Here, the deployed relationships among dependent and independent variables take place. In FCM, relationships are typically represented by directed links or edges connecting pairs of variables.

(c) Specification of the Fuzzy Values:

Fuzzy values were assigned to each category of DC metrics, which were grouped into three classes (traffic sources, behavioral data, and traffic costs and keywords), with each variable's value representing the degree of membership in different categories.

(d) Setting of the Initial State:

The initial state of the supply chain SMEs' search engine results was set after specifying the initial values or conditions for each variable, before applying the fuzzy values.

(e) Iterative Adjustment:

Iterative adjustments of the fuzzy values of the variables included in the developed classes were made based on the defined relationships, with a simple variation of +/−10%.

(f) Analysis of the Results:

Examination of the simulation's results follows, aiming to understand the dynamic behavior of the DC metrics to supply chain SMEs' search engine results. MentalModeler [45] often provides visualizations and metrics to help interpret the model output.

To estimate the direct and static impact of DC metrics of supply chain SMEs on the search engine performance (SEO, SEM) of their websites, we created six scenarios. Based on the MentalModeler [45] DSS platform, the authors entered the desired level of the selected variables' variation (+10% and −10%), on the propriate spot, based on the platform's layout. In the first scenario, all traffic sources were increased by 10% to see the variation caused in key SEO/SEM metrics such as site global ranking, and organic and paid traffic. Thus, in Table 5 and Figure 2, we can see that the overall trend of these metrics is upward and improving, except for the website's global ranking which improves when it decreases. Website global ranking increases slightly by 4%, which is a negative result in terms of digital marketing performance, organic traffic increases by 29%, and paid traffic increases by 16%, which is also a good sign of digital marketing effectiveness.

Table 1
Correlations

Variables	Global ranking	Organic traffic	Organic keywords	Organic costs	Paid traffic	Paid keywords	Paid costs	Direct sources	Referral sources	Paid sources	Social sources	Search sources	Bounce rate	Pages per visit	Time on site	New visitors	Old visitors
Global ranking	1	−0.373	−0.638	−0.313	0.588	−0.104	0.355	−0.040	0.102	0.061	0.059	**−0.807***	0.483	−0.376	−0.316	−0.496	−0.204
Organic traffic	−0.373	1	**0.727***	0.684	0.141	**0.919****	0.075	**−0.869****	**−0.737***	**−0.857****	0.493	−0.062	−0.576	0.539	0.577	−0.524	**−0.792***
Organic keywords	−0.638	**0.727***	1	**0.800***	−0.357	0.625	0.034	−0.514	−0.313	−0.477	**0.793**	0.139	−0.588	0.252	0.614	−0.303	−0.385
Organic costs	−0.313	0.684	**0.800***	1	−0.069	**0.743**	0.500	−0.572	−0.395	−0.498	**0.950**	0.045	−0.630	0.189	0.573	−0.357	−0.459
Paid traffic	0.588	0.141	−0.357	−0.069	1	0.299	0.463	−0.329	**−0.895****	−0.320	0.046	0.180	−0.130	0.038	−0.179	0.050	−0.356
Paid keywords	−0.104	**0.919****	0.625	**0.743***	0.299	1	0.254	**−0.851****	−0.609	**−0.842***	0.580	−0.008	−0.637	0.566	0.692	−0.533	**−0.741***
Paid costs	0.355	0.075	0.034	0.500	0.463	0.254	1	−0.145	−0.305	−0.045	**0.831***	0.113	−0.577	−0.117	0.145	0.170	−0.097
Direct sources	−0.040	**−0.869****	−0.514	−0.572	−0.329	**−0.851****	−0.145	1	0.556	**0.989****	−0.325	0.476	0.526	**−0.717***	−0.650	**0.782***	**0.971****
Referral sources	0.102	**−0.737***	−0.313	−0.395	**−0.895****	−0.609	−0.305	0.556	1	0.500	−0.285	0.133	0.196	−0.048	0.092	0.222	0.614
Paid sources	0.061	**−0.857****	−0.477	−0.498	−0.320	**−0.842***	−0.045	**0.989****	0.500	1	−0.231	0.419	0.539	**−0.800***	−0.698	**0.756***	**0.944****
Social sources	0.059	0.493	**0.793***	**0.950****	0.046	0.580	**0.831***	−0.325	−0.285	−0.231	1	0.129	−0.577	−0.037	0.402	−0.126	−0.225
Search sources	**−0.807***	−0.062	0.139	0.045	0.180	−0.008	0.113	0.476	0.133	0.419	0.129	1	−0.219	−0.149	0.039	**0.725***	0.636
Bounce rate	0.483	−0.576	−0.588	−0.630	−0.130	−0.637	−0.577	0.526	0.196	0.539	−0.577	−0.219	1	−0.671	**−0.779***	−0.004	0.364
Pages per visit	−0.376	0.539	0.252	0.189	0.038	0.566	−0.117	**−0.717***	−0.048	**−0.800***	−0.037	−0.149	−0.671	1	**0.838***	−0.419	−0.606
Time on site	−0.316	0.577	0.614	0.573	−0.179	0.692	0.145	−0.650	0.092	−0.698	0.402	0.039	**−0.779***	**0.838***	1	−0.422	−0.468
New visitors	−0.496	−0.524	−0.303	−0.357	0.050	−0.533	0.170	**0.782***	0.222	**0.756***	−0.126	**0.725***	−0.004	−0.419	−0.422	1	**0.816***
Old visitors	−0.204	**−0.792***	−0.385	−0.459	−0.356	**−0.741***	−0.097	**0.971****	0.614	**0.944****	−0.225	0.636	0.364	−0.606	−0.468	**0.816***	1

Note: * and ** indicate statistical significance at the 95% and the 99% level accordingly.

Table 2
Global ranking linear regression

Variables	Std. coefficient	R^2	*F*	*p-value*
Constant	–	1.000	–	0.000**
Organic keywords	−0.324			0.000**
Paid traffic	−0.821			0.000**
Paid costs	0.046			0.000**
Pages per visit	−1.005			0.000**
New visitors	0.054			0.000**
Old visitors	−1.270			0.000**

Note: ** indicates statistical significance at the 99% level.

Table 3
Organic traffic linear regression

Variables	Std. coefficient	R^2	*F*	*p-value*
Constant	–	1.000	–	0.000**
Organic keywords	0.236			0.000**
Social sources	0.041			0.000**
Search sources	0.715			0.000**
Bounce rate	0.113			0.000**
Time on site	−0.102			0.000**
Old visitors	−1.236			0.000**

Note: ** indicates statistical significance at the 99% level.

Table 4
Paid traffic linear regression

Variables	Std. coefficient	R^2	*F*	*p-value*
Constant	–	1.000	–	0.000**
Paid costs	0.387			0.000**
Social sources	−0.459			0.000**
Search sources	1.324			0.000**
Bounce rate	−0.894			0.000**
New visitors	−0.113			0.000**
Old visitors	−1.591			0.000**

Note: ** indicates statistical significance at the 99% level.

Table 5
FCM scenario 1 impacts

Variables	Direct sources +10%	Referral sources +10%	Paid sources +10%	Search sources +10%	Social sources +10%
Global ranking			**+4%**		
Organic traffic			**+29%**		
Organic keywords			**+4%**		
Organic costs			**+6%**		
Paid traffic			**+16%**		
Paid keywords			**+7%**		
Paid costs			**+1%**		
New visitors			**−23%**		
Old visitors			**−28%**		

3.4.2. FCM scenario 2: Decline in website traffic from all sources

On the other hand, in scenario 2 we chose to reduce by 10% all sources of traffic attraction and we observe that according to Table 6 and Figure 3, the overall course of these metrics has improved for organic and paid traffic, but it was less favorable for the website global ranking, compared to scenario 1. More specifically, the website's global ranking increased more than before, by 7%, which continues to be a negative development in terms of digital marketing performance; organic traffic is growing 14% more than before (43% overall), as is paid traffic, which is growing 9% more (25% overall).

3.4.3. FCM scenario 3: Increase in visitor behavioral data

The third scenario of the paper examines the influence of a 10% improvement in visitor behavioral data, with its effects on the remaining variables of the analysis shown in Table 7 and Figure 4. An increase was observed in most of the variables, with all sources of traffic remaining unchanged. More specifically, the website's global ranking increased by 7% (negative development regarding digital marketing performance), organic traffic increased by 16%, organic keywords, and organic traffic costs increased by

Figure 1
Fuzzy cognitive mapping model

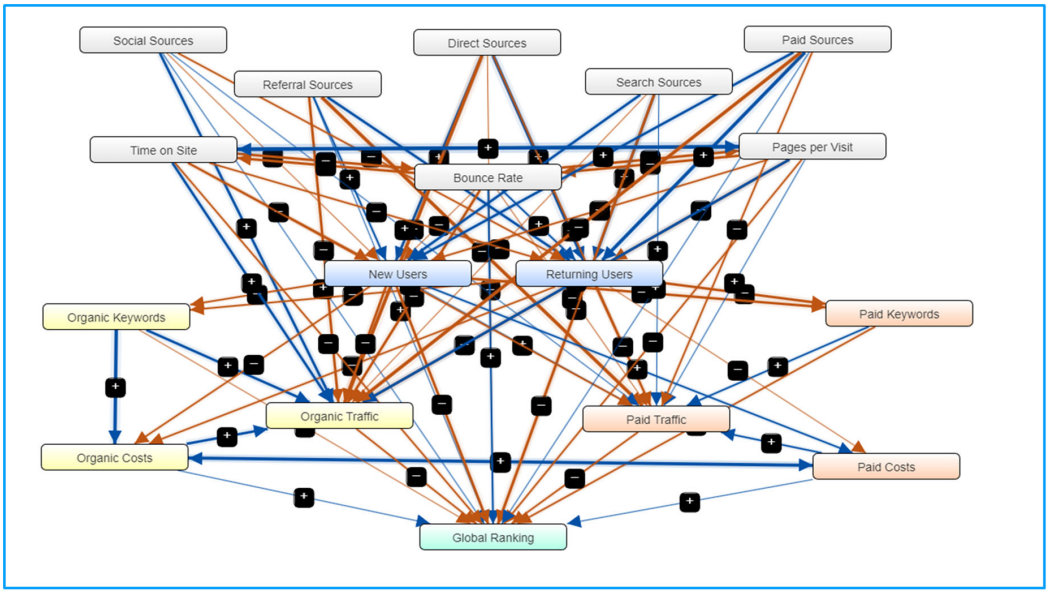


Figure 2
FCM scenario 1

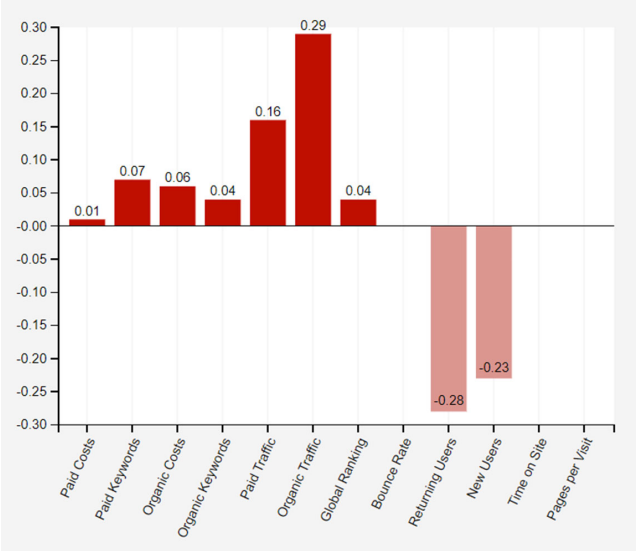


Table 6
FCM scenario 2 impacts

Variables	Direct sources −10%	Referral sources −10%	Paid sources −10%	Search sources −10%	Social sources −10%
Global ranking			**+7%**		
Organic traffic			**+43%**		
Organic keywords			**+6%**		
Organic costs			**+9%**		
Paid traffic			**+25%**		
Paid keywords			**+11%**		
Paid costs			**+1%**		
New visitors			**−34%**		
Old visitors			**−41%**		

Figure 3
FCM scenario 2

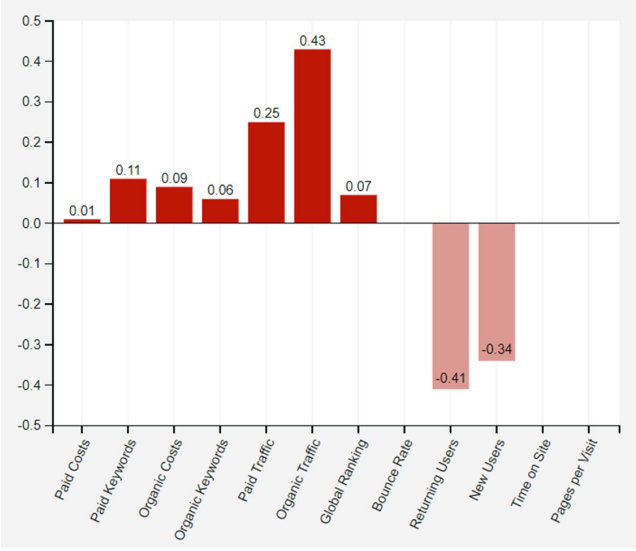


Table 7
FCM scenario 3 impacts

Variables	Bounce rate −10%	Pages per visit +10%	Time on site +10%	New visitors +10%	Old visitors +10%
Global ranking			**+7%**		
Organic traffic			**+16%**		
Organic keywords			**+10%**		
Organic costs			**+14%**		
Paid traffic			**+9%**		
Paid keywords			**+18%**		
Paid costs			**+2%**		

Figure 4
FCM scenario 3

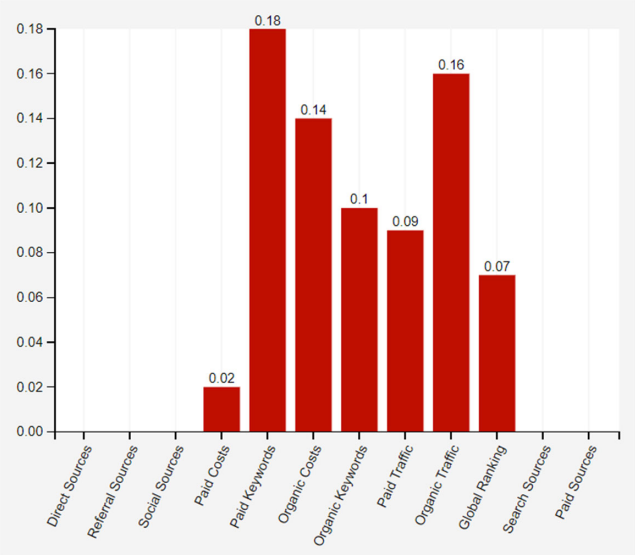


Table 8
FCM scenario 4 impacts

Variables	Bounce rate +10%	Pages per visit −10%	Time on site −10%	New visitors −10%	Old visitors −10%
Global ranking			**+15%**		
Organic traffic			**+15%**		
Organic keywords			**+14%**		
Organic costs			**+18%**		
Paid traffic			**+11%**		
Paid keywords			**+24%**		
Paid costs			**+2%**		

10 and 14%, as well as there was also an increase in paid traffic and paid keywords and cost of traffic by 9, 18, and 2%, respectively.

3.4.4. FCM scenario 4: Decline in visitor behavioral data

Concerning the fourth scenario and the examination of the impact of the deterioration of the behavioral data of the visitors of the websites of the newly established supply chain companies by 10%, the following conclusions are drawn (Table 8 and Figure 5). Most metrics showed an

Figure 5
FCM scenario 4

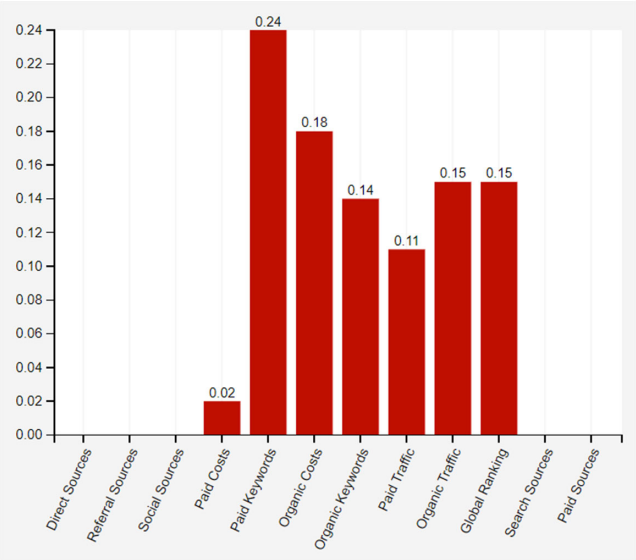


Figure 6
FCM scenario 5

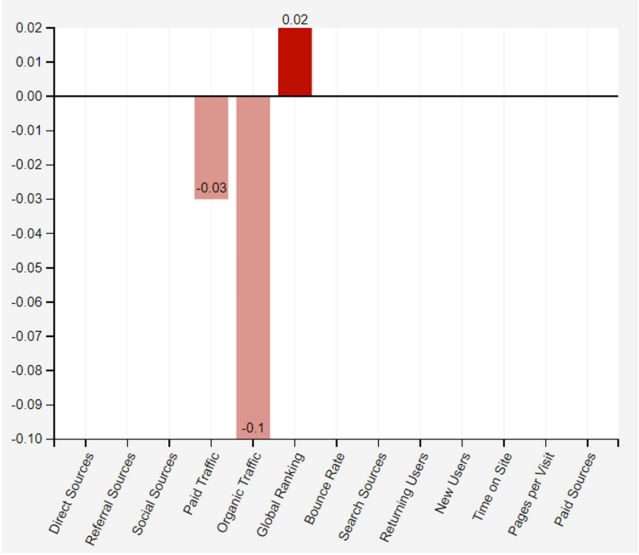


Table 9
FCM scenario 5 impacts

Variables	Organic keywords +10%	Organic costs +10%	Paid keywords +10%	Paid costs +10%
Global ranking		**+2%**		
Organic traffic		**−10%**		
Paid traffic		**−3%**		

Table 10
FCM scenario 6 impacts

Variables	Organic keywords −10%	Organic costs −10%	Paid keywords −10%	Paid costs −10%
Global ranking		**+3%**		
Organic traffic		**−14%**		
Paid traffic		**−6%**		

increase, while again traffic sources did not show any change. More specifically, an increase of 15% in website's global ranking (which indicates a negative development in firms' digital marketing performance), leads to an increase of 15% in organic traffic, 14% and 18% increasing in organic keywords, and organic traffic costs, as well as an increase of 11%, 24%, and 2% in paid traffic, paid keywords and traffic costs respectively.

3.4.5. FCM scenario 5: Increase in SEO/SEM costs and keywords

Analyzing the fifth scenario, the interest of the paper focuses on the influence of the individual variables of SEO and SEM digital marketing strategies, through the variation of their keywords and costs. First, we examine the impact caused to the remaining digital marketing metrics of supply chain SMEs by a 10% increase in cost and keywords of organic and paid traffic (Table 9 and Figure 6). As a whole, the digital marketing variables show no change from the imposed increase, except for the website's global ranking which increased by 2% (negative development regarding the performance of digital marketing), organic traffic, which decreased by 10% (also negative development), and paid traffic, which also decreased by 3% (negative development).

3.4.6. FCM scenario 6: Decline in SEO/SEM costs and keywords

In the last scenario of the FCM analysis, the influence of the cost and keyword variables of the organic and paid traffic strategy on the rest of the digital marketing variables appears, following a negative change. A reduction of 10% in organic and paid traffic costs and keywords leads to the following effects, an increase of 3% in website's global ranking (indicating a decrease in firms' digital marketing performance), a decrease of 14% in organic traffic, and a decrease of 6% in paid traffic. As in Scenario 5 (Table 10 and Figure 7), the rest of the reported variables showed no change.

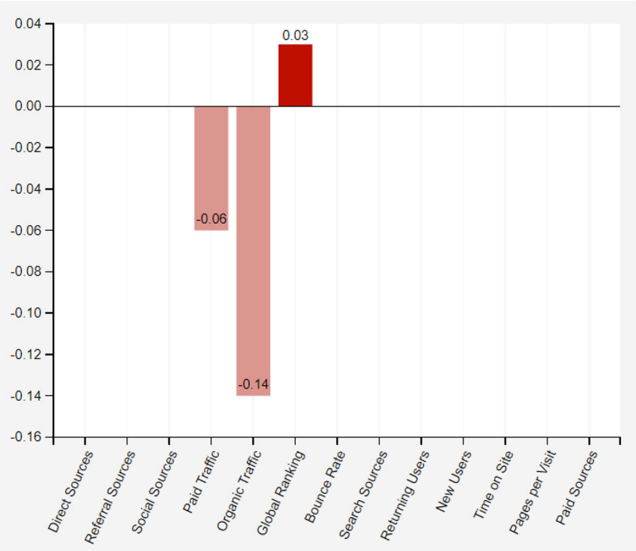
4. Discussion

The interest of the study turned to the strategic importance of the utilization of specific website DC metrics, in terms of how they affect selected KPIs of search engine results. For this purpose, the method of linear regression and static modeling of FCM was used [49].

Regarding the results of the FCM simulation, it is observed that from the six static scenarios carried out, scenarios 1, 3, and 5 appear to be the most prevalent. More specifically, website global rank and organic and paid traffic of supply chain SMEs were increased by higher website traffic from any source (social, search, etc.,), improved visitor behavioral data, and increased costs and keywords of SEO/SEM campaigns.

Finally, regarding the research hypotheses raised in Section 3.2, we should mention that hypotheses H1, H2, and H3 are verified. This is because the linear regressions of supply chain SMEs' global rank, organic, and paid traffic are statistically significant. The p-value levels of the DC variables were lower than the $a = 0.01$ level of significance [50]. Hence, these outcomes highlight the role that specific DC metrics have on the determination of supply chain

Figure 7
FCM scenario 6



SMEs' search engine factors. The lower the independent variables' *p*-values, the stronger their relationship and impact on the dependent variables of global rank, organic, and paid traffic [50]. For the referred reasons, the research hypotheses (H1, H2, H3) are considered to be verified.

Additionally, from the FCM analysis performed in Section 3.4, global ranking, organic, and paid traffic metrics were affected by the variation of DC management metrics. Therefore, we conclude that:

- The website ranking result of supply chain SMEs is closely connected to DC management metrics.
- The traffic that supply chain SMEs drive from organic and paid advertising campaigns is influenced by DC performance metrics.

5. Conclusions

5.1. Theoretical implications

Throughout this paper, special emphasis was placed on the influence of DC metrics in improving the digital marketing performance of supply chain SMEs. Strategies based on DCM can explain satisfactorily the performance of the digital brand name of these companies. It is suggested that by increasing the average number of pages opened by website visitors, traffic from social sources, organic keywords, and the costs of paid traffic, supply chain SMEs' digital marketing performance could be enhanced [51]. A successful development of digital marketing strategies that succeed in increasing the above website DC metrics will lead to better results supply chain SMEs' search engine results.

Through it all, computational tools have been deployed to augment the work of human coders, allowing businesses to deal with a larger dataset [52]. Big data analysis has been extensively studied as a way for organizations to gain market insights and remain competitive [53]. Hence, supply chain SMEs should seek to harvest the DC data collected from their website customers' activity to rank higher in their potential customers' search engine results.

The results of the present work are similar to the results of the research concerning affiliate [54], video, and SM [54] marketing strategies that promote firms' digital marketing performance. Regarding the study results' comparison with similar research, it can be highlighted that it comes in terms of DCM's capability for promoting SEO performance, according to Gjorgjevska and Mirceva [55]. Moreover, our study is aligned with the findings of Terho et al. [56], regarding the positive impact of DC metrics of website customers on a firm's business performance. Therefore, this paper concludes that the utilization of the DC data of supply chain SMEs' websites can improve the performance of their digital marketing strategies, resulting in higher ranking in their potential customers' search engine results.

5.2. Significance of methodology

The applied methodological context offers multiple benefits for the examination of website DC data for supply chain SMEs' search engine results enhancement. Such data represent the digital behavior of website visitors and customers, and their connection with firms' search engine results provides valuable insights for developing SEO/SEM strategies [51]. Apart from the origin and representation of the DC data, the FCM model includes all the potential relationships of SEO/SEM metrics and the independent variables of DC metrics. More specifically, some of the most important benefits of the proposed methodology are the following:

(a) Data-Driven Decision-Making.

Statistical analysis allows supply chain SMEs to make decisions based on data rather than intuition [57].

(b) Identifying Key Factors.

FCM can help identify key factors influencing search engine results through website DC metrics [32].

(c) Statistical analysis can reveal which types of content perform well and resonate with the target audience.

(d) Enhancing SEO Strategies.

By understanding the factors that contribute to search engine rankings, firms can tailor their SEO strategies [58].

(e) Adaptation to Algorithm Changes.

Search engine algorithms are continually evolving. Statistical analysis enables firms to adapt to algorithm changes by monitoring performance metrics and adjusting their DC strategies accordingly. FCM can assist in understanding the dynamic relationships within the evolving digital landscape.

(f) Risk Assessment and Mitigation.

FCM can be used to model and assess risks associated with certain content strategies.

(g) Competitive Analysis.

Statistical analysis allows firms to compare their DC performance with that of competitors.

(h) Continuous Improvement.

Both statistical analysis and FCM support a cycle of continuous improvement [33].

(i) Resource Allocation Optimization.

Understanding the effectiveness of different aspects of DC allows firms to allocate resources more effectively. Hence, FCM can present the static variation of supply chain SMEs' DC metrics on their search engine results. For this purpose, the preferred methodology is considered mandatory.

5.3. Future work

The application of monitoring DCM metrics to improve supply chain SMEs' appearance in their customers' search engine results paves the way for utilization in other sectors and purposes. For example, DCM strategies could be leveraged to aid user experience (UX) website designs and optimization processes of mobile applications. Moreover, DCM could engineer the digital transformation procedures of firms [59], by offering a plethora of customer-generated metrics. This extension can be applied to areas related to business-to-business and customer-to-business communications. It can also be utilized in favor of assessing sustainability initiatives for firms' digital marketing strategies and investigating SM DC in firms' online presence.

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Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Author Contribution Statement

Damianos P. Sakas: Conceptualization, Methodology, Software, Formal analysis, Supervision, Project administration. **Nikolaos T. Giannakopoulos:** Conceptualization, Methodology, Software, Formal analysis, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision. **Alexandros G. Panagiotou:** Software, Validation, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Funding acquisition. **Nikos Kanellos:** Software, Validation, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration, Funding acquisition. **Christos Christopoulos:** Validation, Investigation, Resources, Data curation, Writing – review & editing, Visualization, Project administration, Funding acquisition.

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