

# **A SYSTEMATIC REVIEW OF SUSTAINABLE SUPPLIER MANAGEMENT FOR ANALYTICAL AND BEHAVIORAL DECISION MAKING**



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*The purpose of this paper is to examine the literature on sustainable supplier management, behavioral decision theory, and analytical decision support models. We conducted a systematic literature review. It was found current research that analyses sustainability-related SRM and decision models has employed theoretical lenses on risk management, stakeholders and corporate social responsibility. Moreover, studies combine more than one method for decision making, such as fuzzy and data envelopment analysis*

*(DEA); quality function design and analytical network process; fuzzy and Stackelberg scenario analysis. This paper brings discussions on theoretical lenses in the current literature in the supplier sustainable risk management and decision support analytical models. This contribution can be considered one of the first efforts on systematizing the literature on sustainability-related SRM through the theoretical lenses of behavioral decision theory and decision support analytical models.*

*Palavras-chave: decision making, behavioral theory, sustainable supplier, risk management, analytical model*

## 1 Introduction

A key challenge for companies is powerful long-term supply chain, which are interdependent units that can influence each other's attention and performance, meaning that as sustainability companies have more members of the chain of supply, which can be held accountable for the environmental and social performance of their suppliers (SEURING; MULLER, 2008; KYLE; RUGGIE, 2005).

Currently, with increasing outsourcing activities for suppliers, it is common for supply chains to generate an aggregate value of over 80% of the final product (HARTLEY; CHOI, 1996). As a consequence, the relationship between buyers and suppliers has become increasingly critical to the success of companies (HANDFIELD et al., 2002).

Decision makers may develop models with quantitative and qualitative criteria. De Boer et al. (2001) revised the literature review on supplier selection and found a several normative rational models, such as AHP, ANP, MCDA and MILP. Wu and Barnes (2011), in the posterior review, observed a trend for combing models with quantitative and qualitative criteria, in which there were fuzzy set approach and analytic hierarchy/network process. These authors evidence decision makers have required by qualitative strategies that could be combine with optimization strategies.

Alexander et al. (2014) reviewed 160 papers and classified models as belonging to either un-structured contexts (behavioural/contingent) or structured contexts (rational/universal), which can be called behavioural empirical and rational normative approaches respectively.

Despite research on formal decision support models in supplier selection, supplier monitoring and supplier development increasing in recent years (Seuring, 2013, Brandenburg et al., 2014, Zimmer et al., 2016), it is necessary to systematize the main contributions and lessons from the field through a systematic and comprehensive review. Therefore, the following research question is considered: What kinds of methods have been used in decision

support models for sustainable supplier chain management, and how have they developed over time? By answering this question, our objective is to conduct a systematic review of on behavioral decision theory and analytical decision support models in sustainable supplier chain management

## 2 Methodology and procedures

Following the systematic approach of Tranfield et al. (2003), first, a primary search was conducting using Scopus using the words "behavioral", "decision making" and "supply chain". For the other researches carried out in the web pages of each specific journal, we used: decision making AND supply chain AND sustainability OR ethical OR reputation OR and behavi \*.

This primary research contributed to establishing our research questions, the basic terminology and key words for this article. Our primary references were: March and Shapira (1987); Seuring (2013); Brandenburg et al. (2014); Hajmohammad and Vachon (2016), Foerstl et al. (2010) and Zsidisin (2003). In the second stage, we identified the knowledge fields, keywords and the criterion of inclusion and exclusion articles. Then, we summarised the data on analyses categories. Finally, in the third stage, report and dissemination, we put forward the results and a discussion by analyzing the findings of the literature review.

We determined five exclusion criteria, two of them were based on Alexander et al. (2014): (a) semantic relevance and (b) relevance to the research problem. For example, these include articles that focus on sustainable supply chain management and decision making. And the three others criteria on Brandenburg and Rebs (2015); (c) empirical manuscripts using statistical approaches for evaluating causal relationships were excluded from the analysis; (d) purely economic publications were not considered; (e) purely education/learning publications were not considered.

In the data collection, we investigated 36 articles present in Seuring (2013) in detail. Then, we selected the Scopus database and found scientific journals that contained a majority of published model-based sustainable supply chain management papers (Seuring, 2013,

Brandenburg et al., 2014): Decision Support Systems (DSS), European Journal of Operational Research (EJOR), International Journal of Production Economics (IJPE), International Journal of Production Research (IJPR), Journal of Cleaner Production (JCLP), Transportation Research Part E. Additionally, complementary searches were executed in scientific journals on supply chain management. Initially, 1,148 hits in total were found, as shown in Table 1, indicating the number of articles found after the search and the number of articles selected.

Table 1: Collection Method

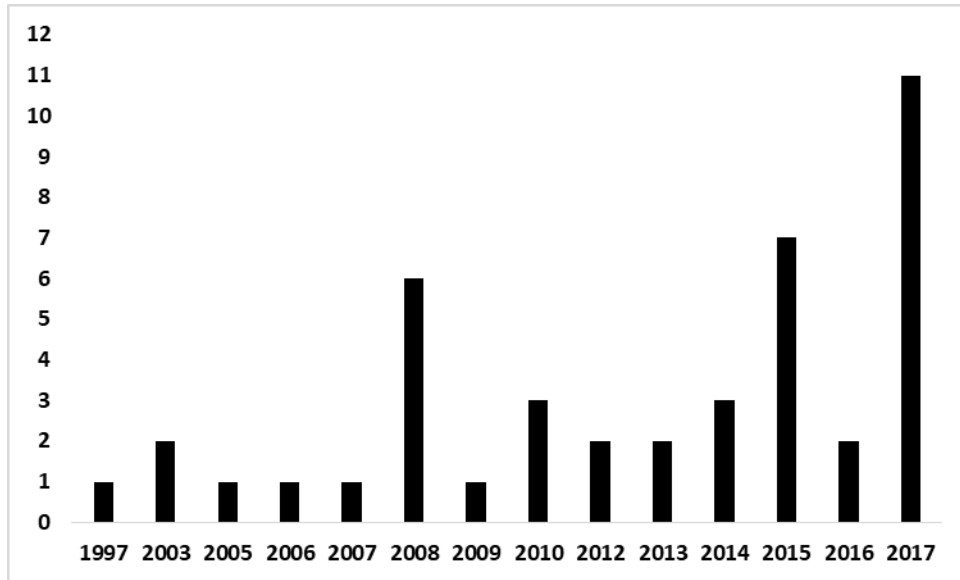
Source	Search results (n° of articles)	Number of selected articles
Scopus	167	4
Seuring (2013)	36	14
International Journal of Production Research (IJPR)	108	6
International Journal of Logistics Research (IJLR)	52	1
Supply Chain Management: an international journal	11	2
International Journal of Physical Distribution & Logistics Management (IJPDLM)	142	1
Journal of Supply Chain Management (J Supply Chain Manag)	57	2
International Journal of Production Economics (IJOPE)	32	3
European Journal of Operational Research (EJOR)	6	1
Journal of Cleaner Production (jclepro)	454	13
Decision Support Systems (DSS)	83	1
Total	1148	48

Fonte: Authors (2018)

### 3 Analysis and findings of the literature review

The 33 articles published between the years 2013 and 2017 are mostly from the International Journal of Production Research, the Journal of Cleaner Production and the International Journal of Production Economics (Table 2). The year 2017 stands out among the others as the year with the highest number of publications (12) on the subject studied. Next are the years of 2015, with 8 publications and 2008 with 6. In the year 2008, 83.33% of articles are numerical examples, different from the years of 2015 and 2017 that have their majority (90%) constituted of articles classified as Empirical data.

Figure 1: Number of articles per year



Fonte: Authors (2018)

Of the articles classified as Empirical data, 90% of them addressed, with the sustainability dimensions (Table 2). The environmental dimension prevailed. For the Numerical example, Economic and Environmental prevail, and in the case of Theoretical half approach Environmental and the other half Social. From the results it is possible to emphasize that the social dimension is still less studied when compared to the others (economic and environmental).

Table 2: Sustainability dimensions

Sustainability dimensions	Number of papers (N=48)
Economic and Social	2
Economic and Environmental	9
Economic, Environmental and Social	11
Environmental	16
Environmental and Social	6
Social	4

Fonte: Authors (2018)

Table 3 shows the number of articles found for each type of research, and Table 4 presents the definition for each type of search used in this article.

Table 3: Type of research

Type of research	Number of papers (N=48)
Behavioural empirical	1
Behavioural empirical and rational normative (prescriptive decision making)	9
Conceptual paper	5
Rational normative	33

Fonte: Authors (2018)

Table 4: Definition of type of research in SSCM.

Behavioural empirical	Studies with descriptive models in unstructured–complex or unstructured–chaotic context. These studies analyses cognitive factors or social context in SSCM (BUSSE et al., 2017; FRENCH et al., 2009; KULL et al., 2014)
Rational normative	Studies with normative models in structured-complicated and structured-simple context. Decision makers have the knowledge of the problem, clear vision and sufficient skills to optimize the choices of the suppliers (FREITAS; MAGRINI, 2013; RUBINSTEIN,1998).
Behavioural empirical and rational normative (prescriptive decision making)	Studies present prescriptive decision making, including descriptive and normative models (WU; BARNES, 2011; ALEXANDER, 2014).
Conceptual paper	Studies with a conceptual framework on theoretical review without empirical research.

Fonte: Authors (2018)



Among the 33 articles classified as rational normative the one developed by Kamalahmadi and Mellat-Parast (2016) examined the optimal allocation of demand across a set of suppliers in a supply chain. Authors use two-stage mixed-integer programming model to analysis supplier selection and demand allocation with transportation channel selection to mitigate disruptions and environmental impact. They employed sensitive analysis to examine how the flexibility and reliability of suppliers can affect the final results of the selection and allocation of suppliers. The findings suggest that developing contingency plans using flexibility in suppliers' production capacity is an effective strategy for firms to mitigate the severity of disruptions. Generally, the highly flexible suppliers receive less allocation, and their flexible capacity is reserved for disruptions.

Among the behavioral empirical and rational normative papers (prescriptive), Hirsch and Meyer (2010) developed a decision model employing game theory, transaction cost economics and constructs of reputation and ethical values as drivers of behavioral uncertainty reduction on risk of partner's opportunistic behavior in a large drugstore chain and its suppliers. As a result, a decision tree was devised that specifies the notion of behavioral uncertainty, and according to the framework outlined, a decision maker can successively consider the impact of three different components influencing behavioral uncertainty in cooperative relationships: (1) financial benefits from opportunism, (2) reputation and (3) ethical values.

Hall et al. (2012) argued sustainable supply chain are conceptualized as complex systems because there are many interacting variables. It involves the coordination of supply chain members and the interactions among financial, environmental and social elements. For example, the economic, social and environmental risk may involve ambiguous risks, as stakeholders can have different interpretations. These authors employed Kauffman's theory to analyze interactions among sustainable elements in the Brazilian oil and gas, sugarcane ethanol and biodiesel supply chain. They found that sectors such as oil and gas have a propensity to be socially exclusive, whereas biodiesel are potentially socially inclusive, but

also encounter economizing pressures that may be at the expense of social and environmental performance.

Jakhar (2015) developed sustainable supply chain performance measures and proposed a partner selection and flow allocation decision-making model. This used structural equation modeling, fuzzy analytical hierarchy process and fuzzy multi-objective linear programming. They argued that there is a need for open methods with less-structured sustainability issues faced by practicing managers and policy makers. This research involved a survey from 278 executives and a case study in an Indian apparel manufacturer. The results of the model allow managers to make decisions on appropriate strategies based on a cost/benefit analysis of the presented trade-offs.

Yang and Xiao (2017) investigated interventions of channel leadership and governmental intervention on the pricing and green level decisions of a green supply chain (GSC). They use three scenarios: Manufacturer Stackelberg (MS), Retailer Stackelberg (RS) and Vertical Nash (VN), employing fuzzy and game theory. As results the authors have defined that to encourage the manufacturer to undergo an ecological process, a green investment cost sharing contract may be required for the GSC.

Yazdani et al. (2017) employed a Quality function deployment (QFD) model to identify the degree of relationship between the supplier selection criteria and customer requirements. These authors developed an integrated approach for evaluating supplier performance and selecting the best supplier for a reputed Iranian dairy company. Additionally, they use the integrated approach consisting of decision-making trial and evaluation laboratory (DEMATEL), complex proportional assessment (COPRAS) and multi-objective optimization on the basis of ratio analysis (MOORA). Based on the results, it is figured out strong management commitment is the key driving force for sustainable developments in infrastructure, facility and quality.

Regarding conceptual papers, Bai and Sarkis (2010) introduced the formal model using rough set theory to investigate the relationships between organizational attributes, supplier development program involvement attributes, and performance outcomes. As results the

authors explains that even with practical and methodological limitations and the concern that rough set theory is a relatively new field, the variations of approaches are constantly growing as the field matures. It is becoming a powerful tool for decision makers and researchers, especially in complex decision environments associated with sustainability and greening.

Ni and Li (2012) present a conceptual paper with a numerical example that uses game-theoretic analysis to investigate the interaction of suppliers on Corporate Social Responsibility Behavior (CSRB). The authors concluded that this research, helps to understand how businesses interact with each other with respect to their Corporate Social Responsibility (CSR) conduct. As stated in the basic model settings, information asymmetry is not considered for the CSR budget or operational efficiency.

Muduli et al. (2013) have identified and ranked the behavioral factors that affect GSCM implementation in mining supply chains by using interpretive structural modeling (ISM) to extract the interrelationships among the identified behavioral factors. The article concluded that top management support is identified as the key behavioral factor that drives other factors. Top management's initiative and support can lead to success of GSCM related training and educational programmer. Employee motivation, teamwork, and dedication will lead to technological innovations which will, in turn, lead to improved GSCM effectiveness.

Moxham and Kauppi (2014) examined organizational theories in social sustainable supply chain management by focusing on fair trade, and as result they developed seven research questions that enable and encourage the further examination of the factors impacting fair trade supply chains, as well as identify approaches to improve social sustainability in SCM practice.

Petersen and Lemke (2015) build upon the concept of reputational risks generated in the supply chain. They propose a model theorizing how member activities may affect the reputation of partnering firms. They concluded that the process begins with a commitment by tier-one partners to an association with a set of corporate policies and practices. They in turn influence their partnering firms, who in turn exercise their influence over partnering firms and

so on and so forth, and this mitigating action can have a domino effect that spreads up and downstream.

We noticed that these five articles introduced a discussion on the unstructured context of decision making, by using (a) rough set methodology, involving an incomplete information approach in data poor environments (Bai and Sarkis, 2010); (b) institutional theory and extended resource based view of fair trade (Moxham and Kauppi, 2014); (c) an interpretive structural modeling for a problem consisting of a large number of variables with complex relationships (Muduli et al., 2013); (d) game theory to analyse the behaviors of suppliers on corporate social responsibility, mutual incentives and commitments (Ni and Li, 2012); and (e) a theoretical models that resulted from a qualitative investigation, highlighting how practicing managers perceive the reputational risks generated in the supply chain (Petersen and Lemke, 2015).

The decision methods were classified based on the study of Brandenburg et al. (2014), who defined analytical categories of the structural dimension of the mathematical models used in SSCM research (Table 5).

Table 5: Decision methods

<b>Decision methods</b>	<b>Number of papers</b>
Data Envelopment Analysis (DEA)	2
Data Envelopment Analysis (DEA) and Fuzzy Theory	1
Fuzzy theory and DEMATEL-Analytical network process (ANP) (DANP), PROMETHEE	1
Fuzzy theory	5
Fuzzy and Stackelberg scenario (Equilibrium model)	1
Fuzzy Clustering Scenarios	1
Equilibrium model	4
Analytical Hierarchy Process (AHP)	11
Analytical Hierarchy Process (AHP) and Linear programming	1
Analytical Hierarchy Process (AHP) and Structural equation modeling (SEM)	2
Analytical hierarchy process (AHP) and Analytical network process (ANP)	1
Analytical network process (ANP)	1
Single objective: Linear programming	2
Multi objective: Linear programming	1
Multi objective decision making (MODM), Multi attribute decision making (MADM) and Life cycle assessment (LCA)	1
TODIM method	1
Rough set theory	1
Systemic models: Input–output modeling of social impacts	1
Game Theory	3

Stackelberg game	1
Multicriteria optimization	2
Theoretical lenses	1
Interpretive Structural Modelling (ISM)	1
Conceptual model	1
Procedural model	1

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Fonte: Authors (2018)

#### 4 Final Remarks

This paper conducted a systematic review of on behavioral decision theory and analytical decision support models in sustainable supplier chain management. The motivation for our research was to explore: what kinds of methods have been used in decision support models for sustainable supplier chain management, and how have they developed over time? In this context, our findings concern to: (a) the rational normative models for decision making are prevalent among the forty eight studies analysed, although current studies have employed behavioural empirical and rational normative models (Jakhar, 2015, Reimann et al., 2017, Wu et al., 2017, Yang and Xiao, 2017, Yazdani et al., 2017); (b) recent studies have used more than one method for decision making and one less structured context is emergent; (c) the environmental dimension is clearly dominant in the articles studied while the social aspects are widely ignored, and; (d) the most frequently used decision method among the articles studied was the AHP and the second most used was the Fuzzy Theory, both classified as rational normative in their majority.

The implication for theory is based on Pagell and Shevchenko (2014)'s suggestions that the future of sustainable supply chain management theory relies on how innovative the methodology of forthcoming research is. In this context, this research found that AHP and Fuzzy Theory are the most popular methods, however, it would be important to add methodological diversity to this picture. Consequently, it is vital to increase the variety of methodologies adopted by researchers. By originally combining the already existing methods,

researchers will be able to enhance the knowledge on the topic, enriching the state of the art literature.

In terms of managerial implications, we point out that managers in charge of sustainable supplier selection should pay more attention to a truly sustainable set of selection criteria rather than the apparently limited bias on the environmental dimension of sustainability.

Managers should also be aware of the linkages between sustainable supplier selection the other organisational initiatives, such as stakeholders' engagement and corporate social responsibility.

Our study's limitation is that it focuses on sustainable supply chain studies and it does not include research on supply chain management in general. Another limitation is that it concentrates only on particular approaches of decision making processes. The articles found in this systematic review are available and can be requested from the authors.

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