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Review

Environmental Sustainability in Third-Party Logistics Service Providers: A Systematic Literature Review from 2000–2016

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Abstract: Despite the increasing interest toward environmental issues in the freight transport and logistics service sector, a comprehensive and updated assessment of the existing literature is still missing. This paper aims to fill this gap by presenting the results of a systematic literature review of publications in the area of environmental sustainability in third-party logistics service providers (3PLs) between the years 2000 and 2016. The review offers insight into the critical dimensions of green matters in transport and logistics service companies using an analytical framework based on the following five topic areas: influencing factors, green actions and the impact on performance, Information and Communication Technology (ICT) tools supporting the green actions, energy efficiency in road freight transport and shipper's perspective and collaboration. The results indicate that, despite the number of published papers having grown significantly from 2008 onward, some areas remain highly under-researched such as ICT and performance measurement. Several research gaps have been identified in each topic area, and a set of propositions forming an agenda for future research directions has been suggested.

Keywords: third-party logistics service provider (3PL); logistics service provider (LSP); systematic literature review; influencing factors; green initiatives; impact of green initiatives on performance; Information and Communication Technology (ICT); green supply chain collaboration; procurement of green logistics services

1. Introduction

Over the last few decades, sustainability issues have gained an increasing interest from society and the business community as sustainable development is seen as a promising paradigm for achieving a more equitable and wealthier world in which natural resources and the environment are preserved for future generations. These key concepts have been popularized by the UN Brundtland Commission, which defined sustainable development as " ... development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987) [1]. The concept of sustainability is based on the integration of social, economic and environmental pillars that are broadly known as the triple-bottom-line (Elkington, 1999) [2]. From the business and management perspective, the environmental dimension of the sustainability concept involves all activities and decisions necessary to minimize the environmental pollution caused by a company (Oberhofer and Dieplinger, 2014) [3]. The need to reduce the negative impact on the environment has become a significant priority for companies operating in supply chains due to several factors such as government regulators' pressures [4], concerns about the scarcity of critical energy resources [5] and the increase of Greenhouse Gas (GHG) emissions [6]. In this scenario, the environmental management of logistics operations is an important element for achieving a more green supply chain, and companies are required to adopt measures to reduce negative externalities (mainly carbon emissions) of their own logistics activities along the supply chain [7]. In the logistics service sector, environmental concerns have become more stringent due to a number of factors. Firstly, transport and logistics activities are the second biggest contributor to GHG after electricity production [8]. Secondly, the demand for moving goods has grown considerably in recent years and it is expected to continue to grow in the coming years [9]. Finally, the rise of global warming and the recent economic crisis have imposed a greater need for more sustainable logistics services [10]. As a result, environmental sustainability has fast become an expected dimension of the 3PLs' service offering, requiring operations and strategies to be adapted from a green perspective in order to reduce negative externalities for the environment [11]. From the research point of view, most studies on environmental issues in logistics and supply chain management have focused on manufacturing sectors, while little attention has been paid to the service sectors [12], as in the case of the 3PL industry [13,14]. Despite a wide range of research having been conducted on logistics outsourcing and 3PLs strategies, there are relatively few studies on environmental sustainability in the logistics service industry. In fact, environmental issues were hardly mentioned in previous 3PL literature reviews [15–17]. A number of literature reviews on this topic have been published [18–22]. Nevertheless, several limitations plague these reviews. The most relevant limitation concerns the different focuses adopted by these studies. Some reviews have used a wide focus as in the cases of Marchet et al. (2014) [18] and Abbasi and Nilsson (2016) [20], who studied themes concerning environmentally sustainable activities of companies involved in logistics and transportation processes. Other reviews are based on a more narrow focus such as environmental sustainability and knowledge management in 3PLs [19], carbon management in the logistics and transportation sector [21] and environmentally-sustainable freight transportation [22]. More recently, Centobelli et al. (2017) [23] published a literature review entirely based on topic areas that are similar to those proposed by Evangelista et al. (2013) [24], Evangelista (2014) [25] and Evangelista (2016) [26]. Nevertheless, Centobelli et al. (2017) [23] analyzed a number of papers (46) that is much lower than the number of papers considered in our literature review (88). In addition, the time span used by the two literature reviews is different, as Centobelli et al. (2017) [23] considered the time interval 2000–2014, while our review provided a more updated state of the current literature in the field (from 2000 until 2016). Unlike Centobelli et al. (2017) [23], our review is based on an accepted definition of 3PL that has informed the research process and clearly delimitated the research field. Furthermore, in our review, the original frame proposed by Evangelista (2014) [25] has been further developed through identifying a novel set of sub-topic areas and categories. This allows highlighting new and specific aspects concerning environmental issues in the 3PL industry that have been little investigated by previous studies. Such aspects have been incorporated in several propositions to be explored in future research.

The different focuses adopted by the reviews indicated above are reflected in the different classification frameworks used, the different sample size of the articles identified and the different time scale periods considered. Due to these limitations, the findings emerging from the existing reviews cannot be generalized. As a result, from the collective analysis of these literature reviews, it is hard to derive a comprehensive and updated picture of the evolution of the literature in this area. Hence, there is the need to clarify what is the state of the existing research in this field in a comprehensive, organized, replicable and synthesizable manner. Accordingly, this paper aims to fill this gap, and its main objectives are: (i) carrying out a systematic and comprehensive literature review on environmental sustainability in 3PLs; (ii) suggesting a novel and analytical framework for classifying the existing literature; (iii) identifying a set of propositions and directions for future research. More specifically, this paper aims to address the following two Research Questions (RQ):

RQ1: How has the literature on environmental sustainability in 3PLs evolved from 2000 until 2016?

RQ2: How can the literature on environmental sustainability in 3PLs be classified into different topic areas?

For the purposes of this study, the following definition of 3PL provided by Evangelista (2014, p. 66) [25] is adopted, "Third-party logistics are activities carried out by a logistics service provider on behalf of a shipper and consist of at least transportation. In addition, other activities can be integrated into the service offering, such as warehousing and inventory management, information-related activities like tracking and tracing, and value-added supply chain activities, including secondary assembly and product installation." The section following this Introduction describes in detail the review methodology and the search strategy adopted. The classification approach and the results achieved through both descriptive and content analysis are then presented in Sections 3 and 4. In Section 5, such results are discussed and a set of propositions forming an agenda for future research is identified. The answers to the research questions together with the limitations of the study are described in the concluding section.

2. The Method Adopted to Conduct the Systematic Literature Review

This section describes the methodology adopted in conducting the systematic literature review in the field of environmental sustainability in the logistics service industry. The literature review is a necessary phase in any research work, and its main aim is to analyze the state of knowledge in a particular topic in order to detect areas for developing future research. As such, a literature review has a number of features. According to Easterby-Smith et al. (2012) [27], there are three main features of a literature review. The first concerns the need to provide a rigorous and rational explanation of the extant research contributions. The second consists of writing the literature review in a descriptive way focusing on the research topic to be investigated. Thirdly, the literature review is an ongoing process that requires refinements and modifications along the entire length of the search process. Many literature reviews in the management fields often adopt a traditional narrative approach that provides a general overview and interpretation of research on a specific topic. However, following this approach, the scientific articles are selected on the subjective criteria, making the authors vulnerable to implicit biases in the overall review process [28,29]. The systematic approach to the literature review allows avoiding these biases through more rigorous and objective criteria. In fact, as outlined by Tranfield et al. (2003, p. 209) [30], systematic reviews " ... differ from traditional narrative reviews by adopting a replicable, scientific and transparent process, in other words a detailed technology, that aims to minimize bias through exhaustive literature searches of published and unpublished studies and by providing an audit trail of the reviewers decisions, procedures and conclusions." Therefore, the approach adopted in this paper has been adapted from the works of Tranfield et al. (2003) [30] and Seuring and Müller (2008) [4]. The work of Tranfield et al. (2003) [30] informed the organization of the overall review process into three main phases. On the other hand, the framework of Seuring and Müller (2008) [4] has been used to identify the different steps in each of the three main phases. For example, the descriptive analysis, category selection and material evaluation of the Seuring and Müller (2008) [4] framework informed the steps included in Phase 3 of the review framework proposed in this paper. Accordingly, the review process has been organized into the following three phases that have been further structured in a number of steps:

1. Planning
2. Implementation
3. Analysis and results

The entire process (see Figure 1) is in line with the principles suggested by Rousseau, et al. (2008) [31]. In fact, the approach adopted in this paper is comprehensive (all relevant studies are included in the analysis), transparent (all phases and steps are replicable) and applies specific searching criteria.

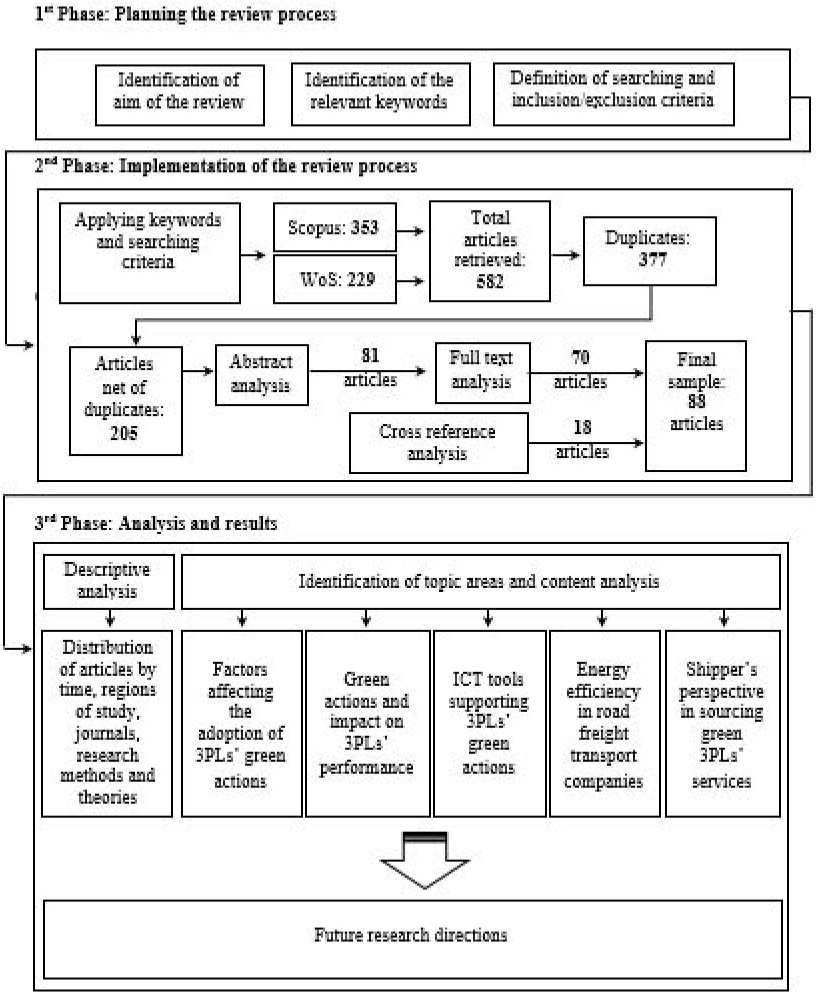

Figure 1. The systematic literature review process.

2.1. Planning the Review Process

This phase includes three main steps. The first step consists of defining the aims of this review, which are to analyze the state of the literature on environmental sustainability in the logistics service industry, provide an analytical framework for classifying the existing literature and identify relevant research gaps to be addressed through appropriate propositions for future research. To accomplish the above goals, relevant keywords have been identified in the second step. An initial set of eligible keywords was identified based on previous research and the authors' experience on the topic. In order to test the suitability of the keywords identified, a focus group meeting was set up involving ten experts with different competences and professional background in the area of green logistics and sustainable supply chain management (four managers of logistics companies, three researchers, three consultants). The meeting was developed as two different phases. Firstly, the author briefly introduced the topic investigated and the main objective of the literature review in order to familiarize focus group participants. Subsequently, the list of the keywords previously identified was submitted to the panelists. In the second phase, each panelist in isolation was requested to: (i) evaluate the relevance of the original keywords, (ii) suggest possible new keywords and (iii) rank them in a final list. Finally, in the third phase, a plenary session moderated by the authors was held to discuss and identify the most relevant and eligible keywords. Only the keywords recognized as the most inherent by the focus group participants were selected and then organized in the following two different strings: environmental sustainability and logistics service industry. The first string concerning environment-related elements includes the following seven keywords: "Green", "Sustainab*", "Energy efficiency", "CO_2 efficiency", "Carbon footprint", "Carbon emissions", "Carbon management". The second string concerns the logistics service industry and includes the following nine keywords: "Logistics service providers", "Third-party logistics", "3PL", "LSP", "Road freight transport", "Road freight hauler", "Shipper", "Logistics service customer", "Logistics service buyer". Using the above sets of keywords, 63 combinations have been obtained and applied to the Scopus and Web of Science databases. The two database were selected because they provide a broad coverage of management journals. This searching procedure is widely accepted and has been adopted in previous literature reviews [18,21,22,32,33]. The third step includes the definition of both searching and the inclusion/exclusion criteria. The following two searching criteria have been identified: (1) time span and (2) type of research product. The paper by Rondinelli and Berry (2000) [34] was the first article published on the topic, and it served as a starting point for the papers' analysis. Accordingly, the time span of this review is the period 2000–2016. Secondly, the type of research product considered was peer-reviewed published journal articles in the English language only [35]. Moreover, three inclusion/exclusion criteria have been applied. The first criterion related to the inclusion of articles strictly concerned with environmental issues in the logistics service industry. As a result, papers dealing with other sustainability pillars (e.g., social or economic) were excluded. The second criterion concerns the inclusion of articles with a management focus only (e.g., articles with a focus on technical or political aspects were excluded). The third criterion was based on the inclusion of articles in which 3PLs or the relationship between 3PLs and other supply chain participants (e.g., customers) was the main focus of research (e.g., articles in which 3PLs are not the core of the research were excluded).

2.2. Implementation of the Review Process

The second phase allowed obtaining the final sample of papers to be analyzed through a three-step approach. In the first step, the combinations of keywords and related search criteria were applied and 582 peer-reviewed articles were collected from the two databases. After filtering out duplicates papers (377), the numbers of articles decreased to 205. In the second step, the inclusion/exclusion criteria identified were applied. This reduced the sample to 70 journal articles. In the third step, a cross-reference analysis on those 70 articles was conducted and a further 18 articles were found. As a result, the final sample comprised 88 articles in total that were all relevant for the relationship between environmental sustainability and the third-party logistics service industry. In order to reduce the degree of subjectivity in the process (e.g., include irrelevant articles or exclude appropriate articles) and increase its reliability, abstract, full text and cross-reference analyses were conducted separately by the authors. The results were discussed, and different judgments were jointly resolved by the three authors.

2.3. Analysis and Results

In the third phase, the sample of the selected journal articles was analyzed using a two-step approach. In the first step, a descriptive analysis was conducted to identify some key features of the entire final sample. This analysis was based on the distribution of articles by time, geographical regions, type of journals, research methodology and theories applied (see Section 3). In the second step, the content of the articles included in the final sample was analyzed (see Section 4). In this step, the selected articles were classified using the seminal framework suggested by Evangelista (2014) [25]. Such a framework summarizes the dominant research streams in the existing literature into five topic areas, and it may be considered a holistic analytical framework. Each paper was assigned to one topic area only, on the basis of its major focus. To achieve this, each article was compared, contrasted and critically evaluated by the authors. To summarize the themes addressed by the papers belonging to each topic area and thus facilitate the identification of the research gaps, further classifications were identified. In fact, reading the papers assigned to each topic area, it was possible to identify some common themes. This allows further classifying these papers in homogeneous sub-topic areas.

Subsequently, for each sub-topic area, various categories proposed by the existing literature on green logistics and sustainable Supply Chain Management (SCM) were used to further classify the papers. The literature that supported the identification of the different categories is reported at the beginning of each paragraph contained in Section 4. It is worth noting that due to the extremely low number of papers contained in Topic Area 3, it was not possible to identify further categories.

3. Descriptive Analysis

3.1. Literature over Time

The distribution of papers by publication year across the period 2000–2016 (see Figure 2) shows an increasing interest of researchers in the topic. The trend in the literature reveals two different phases. The first phase (from 2000 until 2007) is characterized by a low number of articles, including some years in which no articles were published. In the second phase (from 2008 until 2016), the number of published papers rapidly increased, with an average of nine articles per year. It is interesting to note that the two phases match with the time path of the Kyoto Protocol (KP) implementation that commits countries to reduce GHG emissions. The Kyoto Protocol was initially discussed in Kyoto (Japan) on 11 December 1997, but it was only entered into force on 16 February 2005. However, in this phase, the academic and research interest for the environmental issues in the logistics service industry was still negligible.

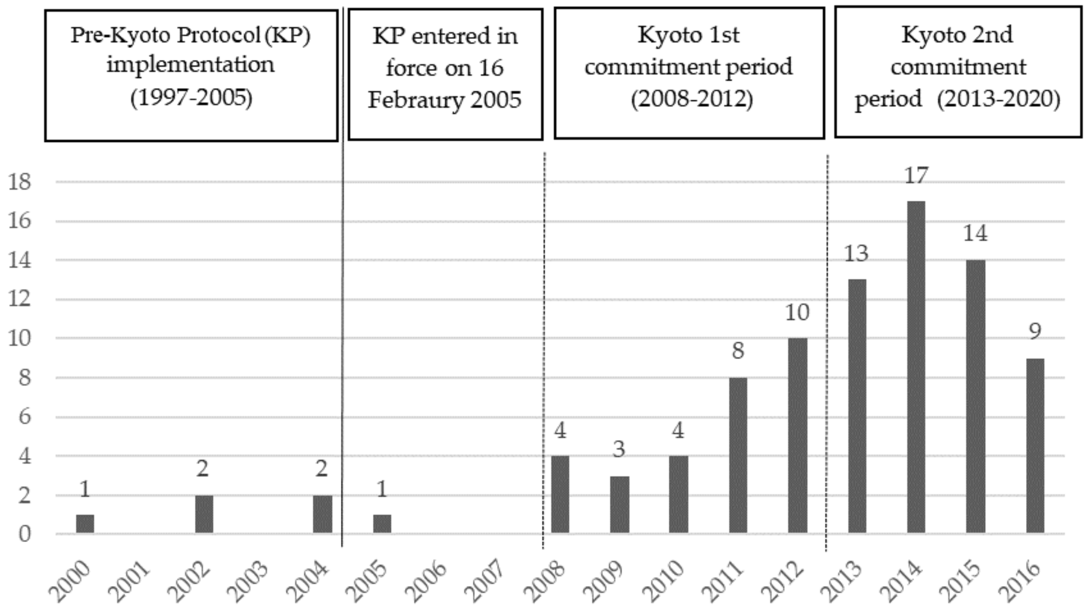

Figure 2. Distribution of articles over time.

A growing interest in this topic arose starting from 2008 onward, when the first period of commitment of the Protocol (2008–2012) came into force. The resulting greater attention towards environmental compliance may have stimulated scholars' interest in research related to the green logistics topic. However, the greatest scientific output about this topic emerged in the last four years of the time span considered (2013–2016), when the second KP commitment period entered into force requiring a more stringent regulatory pressure in each acceding country.

3.2. Literature by Regions of Study

Considering the articles reporting empirical studies only (70 articles out of 88), it is interesting to investigate the main geographical areas in which such studies have been conducted. Although the environmental sustainability in the freight transport and logistics sector is a matter of common concern at the global level, in some geographical areas, this topic has been investigated more than in others (see Table 1).

Table 1. Distribution of articles by country of the study.

Geographical Area of Study	Number of Articles
Sweden	12
Multiple European countries [1]	10
Germany	8
Austria	4
Italy	4
Finland	3
U.K.	2
France	1
Denmark	1
The Netherlands	1
Southeast Europe	1
Slovenia	1
Spain	1
Total European countries	**48**
China	7
Taiwan	3
Malaysia	2
Korea	1
United Arab Emirates	1
Total Asian countries	**14**
North America	4
Brazil	1
Total American countries	**5**
Multiple continents [2]	**3**
Total	**70**

[1] These articles mostly concern the Nordic countries. [2] Two of these studies are based on the simultaneous analysis of North America, Europe and Asia, while one study is based on America and Europe.

This may be attributed to different reasons such as the accession to the KP, industrial catastrophes or the adoption of more stringent environmental legislation in some countries, as in the case of Sweden [36]. Considering the Asian context, China and Taiwan show the highest number of studies about environmental matters in logistics. It is surprising that a low number of articles was related to the American continent.

3.3. Literature across Journals

The 88 selected papers have been published in 53 international journals. Table 2 only lists the 14 journals that have published two articles at least. The highest number of papers has been published by the International Journal of Physical Distribution and Logistics Management (10 papers), followed by the Journal of Cleaner Production (five papers).

Grouping the journals publishing the articles included in the final sample by their main specialization, the following five groups have been identified: transport/logistics/Supply Chain Management (SCM) journals; innovation and operations management journals; business and management journals; engineering and technology management journals; environmental and energy-related journals. Figure 3 reports the distribution of the papers published in each of the five groups identified. It reveals that most of the papers were published in transport/logistics/SCM journals (47 papers) followed by the environmental and energy-related journals (15 papers) and innovation and operation management journals (14 papers). A lower number of works was published in engineering and technology management journals (four papers) and business and management journals (eight papers).

Table 2. Distribution of articles by journals.

Journal	Number of Articles
International Journal of Physical Distribution & Logistics Management	10
Journal of Cleaner Production	5
Research in Transportation Business and Management	4
Transportation Journal	4
Transportation Research Part D: Transport and Environment	4
International Journal of Logistics Management	4
Journal of Purchasing and Supply Management	3
Business Strategy and the Environment	3
International Journal of Logistics: Research and Applications	2
International Journal of Logistics Systems and Management	2
Supply Chain Management: An International Journal	2
Transportation Research Part E: Logistics and Transportation Review	2
Energy Policy	2
Resources Conservation and Recycling	2
Total articles in journals with two articles published at least	**49**
Total articles in journals with one article published only	**39**
Total	**88**

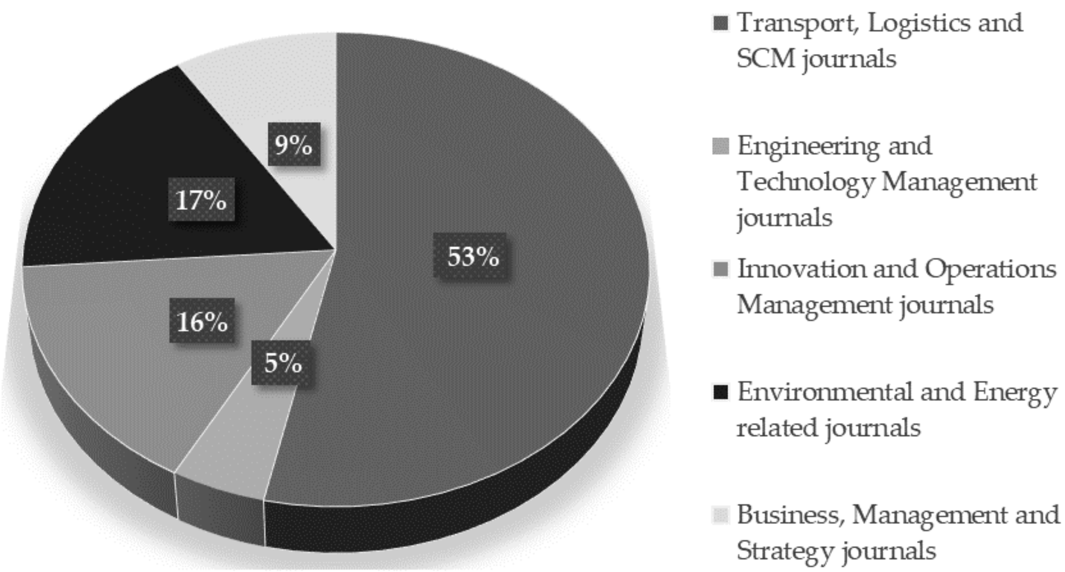

Figure 3. Distribution of articles by journal types.

3.4. Literature by Research Methods

In relation to the research methodology adopted by the selected papers (see Figure 4), most of the articles were based on quantitative methodologies (52 papers).

Among these, 41 papers were based on questionnaire surveys, whereas 11 papers used mathematical models or simulations. Fewer papers used qualitative methods (22 papers), of which 18 papers are based on case study analysis and four papers used other qualitative methods (e.g., semi-structured interviews). Five papers proposed the theoretical/conceptual framework. Finally, seven papers used mixed methods, and two papers provided literature reviews.

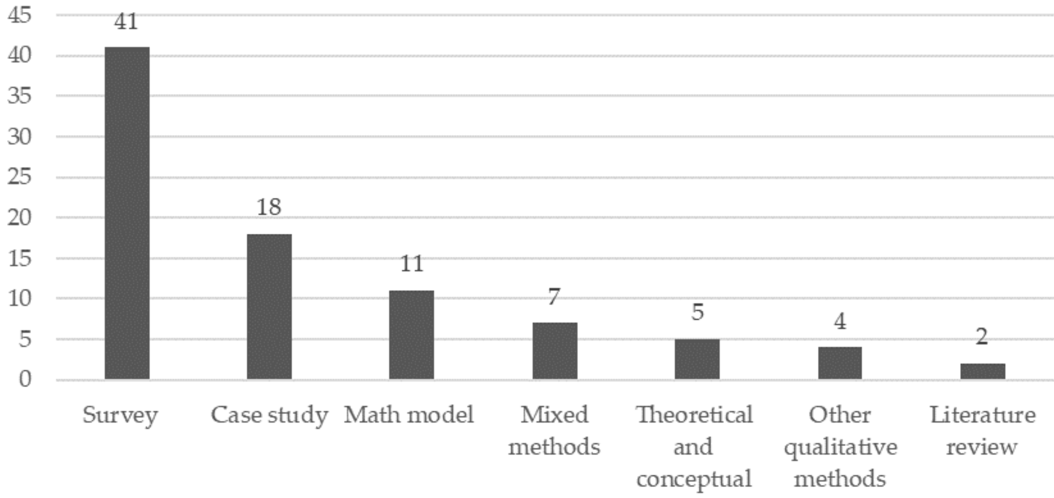

Figure 4. Distribution of articles by research methods.

3.5. Literature by Theories Applied

Only a few of the articles included in the literature review were based on an established theory. As shown in Table 3, the Resource-Based Theories (RBT) comprise the main theoretical perspective adopted.

Table 3. Distribution of articles by theories applied.

Theory Applied	Reference	N. of Papers
Resource-based theories	Colicchia et al. (2013); Lai et al. (2013a); Maas et al. (2014); Shaharudin et al. (2014); Laari et al. (2016)	5
Agency theory	Kudla and Klaas-Wissing (2012)	1
Behavioral theory	Furst and Oberhofer (2012)	1
Fuzzy set theory	Efendigil et al. (2008)	1
Information theory	Bai and Sarkis (2013)	1
Institutional theory	Ellram and Golicic (2015)	1
Network theory	Shaharudin et al. (2014)	1
Relational view	Laari et al. (2016)	1
Stakeholder theory	Ferguson, D. (2011)	1
Topology theory	Venus Lun Y.H. (2011)	1
Transaction cost theory	Shaharudin et al. (2014)	1

The resource-based theories encompass the resource-based view theory adopted by three papers [37–39] and the natural-resource-based view theory adopted by three other papers [38,40,41]. Other theories were applied in the studies focusing on the shipper's perspective in sourcing green 3PL services. For instance, Kudla and Klaas-Wissing (2012) [42] adopted the agency theory in order to address the selection criteria problem faced by shippers in selecting greener 3PLs, whereas Ellram and Golicic (2015) [43] adopted the institutional theory to study the environmental cooperation between shippers and carriers.

4. Content Analysis

This section provides details about the content analysis of the selected papers that have been grouped into five topic areas (see Table 4). In each topic area, the selected papers have been further classified through the identification of sub-topic areas and categories as described in Section 2.3.

Two literature review papers [18,19] have been excluded in this phase. Therefore, the total number of papers analyzed was 86.

Table 4. Allocation of articles by topic area and sub-topic area.

Topic Area	Sub-Topic Area	Reference	No. of Papers
Factors affecting the adoption of 3PLs' green actions	Drivers Barriers	[11,13,37,44–53]. [13,47,48,51,52,54,55].	**15**
Green actions and the impact on 3PLs' performance	Mitigation actions Adaptation actions Metrics to measure 3PLs' environmental performance Impact of green actions on 3PLs' performance	[3,14,20,25,34,39–41,56–73]. [25,40]. [74–77]. [3,38,40,41,56,61,66–80].	**34**
ICT tools supporting 3PLs' green actions	ICT directly affecting emissions ICT indirectly affecting emissions	[81,82]. [83,84].	**4**
Energy efficiency in road freight transport	Scenario assessment of energy efficiency in road freight transport Implementation of energy efficiency actions to improve road freight transport	[85–90]. [91–97].	**13**
Shipper's perspective and collaboration	Shipper's green buying behavior (including the selection of third party reverse logistics providers) Green relationship and collaboration	[98–109]. [5,42,43,110–114].	**20**

The following sections provide an overview of the papers included in each of the five topic areas identified.

4.1. Factors Affecting the Adoption of 3PLs' Green Actions

Topic Area 1 includes 15 papers that analyze factors (drivers and barriers) influencing the adoption of green actions by 3PLs. As shown in Table 5, these factors have been summarized by six categories: economic-financial, organizational, market-related, governmental and technological [48,115–117].

Table 5. Classification of articles by influencing factors.

Articles	**Drivers**					**Barriers**				
	Eco-Fin.	**Org.**	**Mkt-Related**	**Gov.**	**Tech.**	**Eco-Fin.**	**Org.**	**Mkt-Related**	**Gov.**	**Tech.**
Wong and Fryxell (2004)			●	●						
Lin and Ho (2008)		●	●	●	●					
Ho et al. (2009)		●								
Beskovnik and Jakomin (2010)						●	●			
Lieb and Lieb (2010a)		●	●							
Lin and Ho (2011)		●	●	●	●		●	●	●	●
Ho and Lin (2012)		●	●	●	●		●	●	●	●
Rossi et al. (2013)	●	●	●	●		●	●		●	
Zailani et al. (2014)		●	●	●						
Maas et al. (2014)			●							
Palsson and Kovács (2014)	●	●	●	●						
Bloemhof et al. (2015)	●	●		●		●	●	●	●	
Perotti et al. (2015)		●	●	●		●	●	●		
Palsson and Johansson (2016)						●	●		●	●
Salhieh and Abushaikha (2016)		●	●	●						

Considering the internal influencing forces, the organizational aspects are the most investigated factors, and they mainly regard the quality of human resources (i.e., employee skills), the management's involvement in the sustainability practices and the general environmental culture of the company. The vast majority of studies focused on the quality of human resources, which was found to significantly support the adoption of green actions in all the studies (Lin and Ho, 2008; Ho et al., 2009; Ho and Lin, 2012, Zailani et al., 2014) [45–47,49]. The role of management in promoting green actions has been considered as both a pressure and encouraging factor. The latter has been found to positively affect the environmental attitude of 3PLs in most of the studies (Lin and Ho, 2011, 2008; Zailani et al., 2014; Bloemhof et al., 2015) [13,45,49,51], whereas the management pressures had no significant impact on the green actions' adoption (Lieb and Lieb, 2010a; Palsson and Kovács, 2014) [11,50]. Other studies focused on the general environmental culture of the companies, such as the "corporate desire to do the right thing" (Lieb and Lieb, 2010a) [11] and the environmental awareness (Bloemhof et al., 2015; Salhieh and Abushaikha, 2016) [51,53]. All these studies found that the companies' culture has a positive impact on the adoption of environmental sustainability strategies. Only a few papers analyzed the organizational barriers, such as the lack of competence and motivation of employees (Perotti et al., 2015; Palsson and Johansson, 2016) [52,55], missing or wrong information sharing among the company departments and the cultural aspects in the collaborative environmental activities (Bloemhof et al., 2015) [51].

Little attention has been dedicated to the economic-financial factors. Two papers only (Rossi et al., 2013; Bloemhof et al., 2015) [48,51] focused on economic-financial drivers and barriers simultaneously. These studies found both a triggering effect of cost saving and a detrimental effect of high investment costs underlying the environmental actions. Interestingly, Palsson and Kovács (2014) [50] highlighted how the company profitability and the long-term competitive advantage positively trigger the green actions' adoption. On the contrary, the few papers focusing on the economic-financial barriers found that the main economic-financial barriers are the high investment costs and the lack of financial resources requested to implement green activities (Bloemhof et al., 2015; Perotti et al., 2015) [51,52]. More specifically, Pålsson and Johansson (2016) [55] found that high investment costs mainly act as a barrier for some green actions, such as using closer suppliers and relocating production plants and warehouses, rather than for other actions, such as eco-driving and traffic control technologies.

Considering the external factors, several papers focused on the market-related elements, such as pressures from customers, stakeholders and the environmental uncertainty. Most of the studies (Lieb and Lieb, 2010a; Wong and Fryxell; 2004; Rossi et al., 2013) [11,44,48] found that environmental requirements from the market are among the main drivers triggering 3PLs to engage in the green actions, whereas other papers (Palsson and Kovács, 2014; Perotti et al., 2015) [50,52] have not found any significant influence of these pressures. Only a few studies analyzed the market-related factors as barriers in adopting green actions. Some studies (Lin and Ho, 2011; Ho and Lin, 2012) [13,47] found that the green actions' adoption has been hindered by the general environmental uncertainty rather than by specific customer pressures. Bloemhof et al. (2015) [51] analyzed various barriers related to the market, such as the contract terms with clients, the characteristic of the industry and the economic crisis, and any influence on the 3PLs environmental strategy has not been found. Perotti et al. (2015) [52] found that the main barrier for 3PLs operating at the national level was the scarce interest in green products and services by their customers and suppliers.

Considering the influencing factors related to the government intervention, the extant literature focused on drivers rather than barriers. Regulatory pressure and financial support have been found to motivate the 3PLs' adoption of green actions in some studies [44,45,48,52], whereas no significant influence has been found by (Ho and Lin, 2012; Palsson and Kovács, 2014) [47,50]. On the contrary, the extant literature on governmental barriers (Ho and Lin, 2012; Rossi et al., 2013; Pålsson and Johansson, 2016) [47,48,55] seems to provide a nuanced evidence about the effect of contradictory laws and regulation on the adoption of environmental activities. Some studies [47,55] found that an unclear regulatory framework has no significant detrimental effect on the green initiatives' adoption, whereas Rossi et al. (2013) [48] found that the lack of well-defined regulations act as a barrier to the adoption of more sustainable measures in logistics. The negative effects of an unclear regulatory framework have been also suggested by other studies not strictly focused on influencing factors, such as the papers of Evangelista (2014) [25] and Tacken et al. (2014) [66].

Finally, only four papers have considered the technological aspects as influencing factors. The study of Lin and Ho (2008) [45] focused on the triggering aspects of the technology and found that the explicitness and the accumulation of technology boost green innovations in 3PLs. Other studies (Lin and Ho, 2011; Ho and Lin, 2012) [13,47] found that the compatibility and the relative advantage (in terms of economic and environmental benefits) of technology have a positive effect on green practices' adoption, whereas the complexity of technology has a negative effect.

Considering the detrimental factors, the study of Pålsson and Johansson (2016) [55] identified the lack of IT solutions, technical know-how and commercial solutions as the main technological barriers.

4.2. Green Actions and the Impact on 3PLs' Performance

Topic Area 2 concerns the green actions and the impact on 3PLs' performance. It is the most discussed topic in the existing literature, as it comprises the largest number of papers (34 articles) among the areas identified. In order to analyze the papers included in this topic area, this section has been divided into two parts. The first one analyzes the papers concerning the adoption of green actions by 3PLs, while the second one considers the papers relating to the impact of green actions on 3PLs' performance. In relation to the articles concerning the adoption of green actions, they have been categorized using the mitigation and adaptation framework as defined by IPCC (2014a, pp. 17–18) [118]: "Mitigation and adaptation are complementary approaches for reducing risks of climate change impacts over different timescales (high confidence). Mitigation, in the near term and through the century, can substantially reduce climate change impacts in the latter decades of the 21st century and beyond. Benefits from adaptation can already be realized in addressing current risks, and can be realized in the future for addressing emerging risks". Accordingly, Table 6 reports the distribution of the articles concerning the green actions adopted by 3PLs. Overall, the vast majority of the papers included in this topic area relate to mitigation actions, while only two papers deal with adaptation actions.

The mitigation actions have been grouped into six different categories according to the extant literature (Jorsfeldt et al., 2016; McKinnon et al. 2015; Hsu et al., 2016) [5,119,120]. They range from basic measures such as transport (vehicle energy efficiency and intermodality) and warehousing, to more structured actions (such as recycling materials, waste reduction and environmental management systems) and collaborative green initiatives involving customers and other 3PLs.

The transport-related measures are the most discussed topic in this literature stream. These papers are predominantly based on empirical (both quantitative and qualitative) and conceptual approaches. The importance attributed to the transport-related measures in the existing literature is evident considering the results of a number of surveys conducted in the last few years. The study of Lieb and Lieb (2010b) [14] was based on two annual surveys carried out on 40 CEOs of large U.S. 3PLs in 2008 and 2009. The results showed that, despite the global recession, many large 3PLs increased their commitments to building environmental sustainability programs that include transportation-related actions, administrative and analytical initiatives. Perotti et al. (2012) [61] conducted a study on 15 3PLs operating in Italy. The results revealed that the adoption of green supply chain actions was substantially low, whereas the most implemented green actions referred to vehicle energy efficiency and recycling materials. In a similar fashion, Colicchia et al. (2013) [40] investigated the environmental reports of ten 3PLs. The findings allowed the authors to classify the environmental practices implemented by the interviewed companies into two macro categories: "intra-organizational" practices (including distribution strategies and transportation execution, warehousing and green building, reverse logistics, packaging management and internal management) and "inter-organizational" practices (including collaboration with customers and external collaborations). The results showed that initiatives related to transportation activities and distribution strategies were the most widely implemented, while initiatives involving internal management and collaboration with customers were less used. On the other hand, Pieters et al. (2012) [62] investigated how the changes in the 3PLs' sustainability strategy influenced the development of new types of physical distribution networks in the Dutch market. The survey findings showed that most of the green actions adopted by the 145 logistics companies interviewed were focused on internal approaches, rather than external approaches.

Table 6. Classification of articles by green actions.

Articles	Mitigation Actions						Adaptation Actions
	Vehicle Energy Efficiency	**Inter-Modality**	**Warehousing and Green Building**	**Recycling Materials and Waste Reduction (Including Reverse Logistics)**	**Environmental Management Systems (EMS) and Green Certifications**	**Environmental Collaboration**	**Supply Chain Environmental Planning and Re-Configuration**
Rondinelli and Berry (2000)		●			●		
Facanha and Horvath (2005)	●						
Min and Ko (2008)				●			
Lieb and Lieb (2010b)	●	●	●				
Ferguson (2011)	●		●	●			
Lai et al. (2011)				●			
Zailani et al. (2011)	●		●				
Perotti et al. (2012)	●	●	●	●	●	●	
Pieters et al. (2012)	●	●	●	●		●	
Colicchia et al. (2013)	●	●	●	●		●	●
Isaksson and Huge-Brodin (2013)						●	
Lai et al. (2013a)	●			●		●	
Oberhofer and Fürst (2013)	●	●		●			
Eng-Larsson and Norrman (2014)		●					
Evangelista (2014)	●	●		●	●	●	●
Oberhofer and Dieplinger (2014)	●	●					
Shaharudin et al. (2014)				●			
Tacken et al. (2014)	●	●				●	
Venus Lun et al. (2014)	●			●		●	
Bajec et al. (2015)					●		
Lieb and Lieb (2015)	●						
Piecyk and Bjorklund (2015)	●			●			
Shaharudin et al. (2015)	●			●			
Abbasi and Nilsson (2016)	●					●	
Massaroni et al. (2016)	●	●				●	
Mehmann and Teuteberg (2016)	●						

Focusing on a specific typology of actions, many authors identified the reduction of empty running and the improvement of the vehicle loading phase as the most effective actions for reducing the environmental impact of transport activities (e.g., Lieb and Lieb, 2010b; Abbasi and Nilsson, 2016; Diabat and Govindan, 2011; Rossi et al., 2013) [14,20,48,116]. Other authors focused on the use of lower energy transport modes and intermodality. For example, Rondinelli and Berry (2000) [34] provided a conceptual framework for understanding the interactions between the adoption of multimodal transport and proactive environmental management of 3PLs. The study of Lammgard (2012) [110] indicates that customers and competitors are crucial in driving 3PLs to use intermodal road-rail transport services for reducing carbon emissions and improving environmental performance. The importance for 3PLs to be energy efficient in transportation has been found by a number of other papers. Oberhofer and Dieplinger (2014) [3] found that energy-efficient vehicles is one of the most used measures in the sample of logistics companies they analyzed in Austria. Similarly, the findings of Evangelista (2014) [25] showed that energy efficiency measures were used by the Italian 3PL companies having a higher level of green concern. Few studies investigated the use of alternative fuels as a measure to reduce the negative impact on the environment of 3PLs' transport activities. Tacken et al. (2014) [66] found that some of the companies that they surveyed were skeptical about the use of biodiesel due to the potential loss of truck manufacturer guarantees and the eventual damages it could cause to the engine. On the other hand, Lieb and Lieb (2010b) [14] found that the use of alternative fuel was considered as an important energy-efficient transportation-related action by the CEOs of 3PL companies that they investigated in the U.S.

Beyond transport-related measures, there are other research works mentioning recycling materials and packaging and waste reduction in their investigation (Lieb and Lieb 2010b; Colicchia et al. 2013; Zailani et al., 2011; Gold et al. 2009) [14,40,60,117]. However, these measures are neglected in some cases. For example, Colicchia et al. (2013) [40] noted that packaging management initiatives are more limited than green initiatives concerning distribution strategies and transportation execution in their case study analysis of Italian 3PLs. Such initiatives are often associated with reverse logistics actions. Despite the increasing interest that the reverse logistics approach gained in recent year, few studies have been dedicated to this theme from the 3PL perspective. The paper of Min and Ko (2008) [57] addressed the problem of determining the number and location of repair facilities where the returned products from retailers or end-customers were inspected, repaired and refurbished for redistribution in the reverse logistics context. On the other hand, Shaharudin et al. (2015) [71] proposed a theoretical framework to investigate the strategies adopted by 3PLs in reverse logistics activities. Based on the company objective to be achieved, the authors identified three different green reverse strategies such as innovation, efficiency or reputation.

Little research has been carried out on warehousing and green building. Such actions have been incorporated in a number of studies exploring the environmental sustainability programs undertaken by 3PLs operating in different countries: in Italy (Colicchia et al., 2013; Perotti et al., 2012) [40,61], in Malaysia (Zailani et al., 2011) [60], in the Netherlands (Pieters et al., 2012) [62] and in the U.S. (Lieb and Lieb 2010b) [14]. The results of the above investigations provide contrasting results. The studies conducted in Italy indicated that most of the companies investigated have concentrated their efforts towards warehousing and green building, while the evidences from the Netherlands and Malaysia provided a different picture, as these kinds of initiatives have not been used extensively by the 3PL companies interviewed. The U.S. study highlighted the establishment of pilot programs to reduce energy consumption in the 3PLs' warehouses.

Similarly, little research has been dedicated to the use of Environmental Management Systems (EMSs) and green certifications. EMSs have been incorporated in a number of studies that generally indicate the low use of such actions in the context of 3PLs. One single paper only has been dedicated regarding this action. Focusing on the relationship between environmental standard and green actions undertaken by 3PLs, Bajec et al. (2015) [68] found a weak correlation between ISO 14001 and EMSs' implementation and environmental efficiency. On the one hand, the study found a low influence of quality standards on the investment in environmental protection.

Environmental collaboration concerns the development of actions undertaken by 3PLs in collaboration with other supply chain actors (namely with customer) to address environmental issues. Several papers have touched this theme providing different evidence. Perotti et al. (2012) [61] found that collaborative initiatives developed with customers are not in use at all by the 3PLs they investigated.

Similar findings emerged from the study conducted by Lai et al. (2013a) [41] and Venus Lun et al. (2014) [67] from their studies conducted on shipping firms. A possible reason for this is that shipping firms need time to understand the operational benefits of the environmental cooperation with customer requiring both parties to learn and improve their green efforts to gain benefits in terms of financial performance. In contrast, Tacken et al. (2014) [66] found that 3PLs adopt different collaborative approaches including collaboration within logistics alliances or with the customers in focused projects. Colicchia et al. (2013) [40] observed a higher variability in the collaboration of 3PLs with customers and other external actors due to a number of inhibitors that influence the adoption of collaborative practices. The survey conducted by Evangelista (2014) [25] revealed that the most advanced 3PL companies investigated have some collaborative actions in place with customers (e.g., in the area of emission off-set programs and setting lower GHG targets), but they need to improve such collaboration through aligning their perception of environmental issues with those of their customers. Finally, Pieters et al. (2012) [62] found that some of the 3PLs surveyed aimed at improving the efficiency of collaborative programs, while some others have a collaboration in place with customers in the following areas: awareness programs to inform customers about the CO_2 footprint of their shipments; a discussion on delivery time schedules; actions to avoid empty running. Some other 3PL companies indicated that they were cooperating with other 3PLs by sharing delivery routes and had programs for both customers and competitors.

The articles dealing with the impact of green actions on 3PLs performance have been grouped into the following two sub-topic areas (see Table 7) adapting the approaches suggested by Gunasekaran and Kobu (2007) [121] and Lam and Dai (2015) [77]: papers dealing with metrics to measure the environmental performance of 3PLs and papers discussing the impact of green actions on 3PLs' performance. The latter have been further categorized in papers dealing with the impact on environmental performance [3,122] and papers dealing with economic and financial performance and operational performance [38,123].

Table 7. Classification of articles dealing with performance.

Articles	Metrics to Measure 3PLs' Environmental Performance	Impact of Green Actions On 3PLs' Performance		
		Environmental	Economic and Financial	Operational
Facanha and Horvath (2005)		●	●	
Kim and Han (2011)	●			
Venus Lun (2011)			●	●
Perotti et al. (2012)		●	●	●
Björklund and Forslund (2013a)		●		
Bjorklund and Forslund (2013b)	●			
Colicchia et al. (2013)		●		
Lai et al. (2013a)			●	●
Lai et al. (2013b)	●			
Oberhofer and Dieplinger (2014)		●		
Tacken et al. (2014)		●		
Venus Lun et al. (2014)		●	●	
Lam and Dai (2015)	●			
Venus Lun et al. (2015)			●	●
Laari et al. (2016)			●	●

Regarding metrics for measuring 3PLs' environmental performance, few papers have been published in this area. The study of Kim and Han (2011) [74] was aimed at developing a scale for measuring Environmental Logistics Practices (ELPs) in South Korea. The authors divided ELPs into three different components such as Internal Environmental Management (IEM), Environmental Sourcing and Packaging (ESP) and Environmental Process Design (EPD). The results evidenced that all three components are strongly correlated with ELPs. Bjorklund and Forslund (2013b) [75] investigated the inclusion of environmental performance in transport contracts in Sweden. The evidences indicated that CO_2 emissions and energy consumption are the metrics more widely used. The paper of Lam and Dai (2015) [77] defined systematic metrics to develop environmental performance of 3PLs. Combining the analytical network process with quality function deployment, the authors derived a list of green criteria to develop environmental performance.

In relation to the papers concerning the impact of green actions on 3PLs' performance, most of these research works are focused on the assessment of different performance levels. For example, Facanha and Horvath (2005) [56] used the Life Cycle Assessment (LCA) of an automobile to show that the outsourcing of logistics to 3PLs provides better opportunities to improve environmental performance in terms of reducing energy use, global warming potential and fatalities in comparison with the management of logistics in-house. Oberhofer and Dieplinger (2014) [3] identified a number of green actions and provided for each of them a quantitative measure of their environmental performance in terms of GHG emissions saved often compared with the cost of investments. Based on this, the authors found relevant differences between the 3PLs analyzed, distinguishing between proactive and reactive environmental behavior. The work of Perotti et al. (2012) [61] investigated the impact of green supply chain practices on 3PL performance. The evidence indicated a general positive impact of green efforts on company performance, even if limited. Environmental (e.g., energy consumption, air emissions and fuel consumption) and economic performance (e.g., energy costs, waste treatment costs and materials' purchasing costs) are the areas mainly influenced by the implementation of green actions, while operational performance has been influenced in a marginal way. The study identified some major elements preventing a wider use of performance measurement such as the lack of suitable indicators and shared performance metrics. The study conducted by Colicchia at al. (2013) [40] reached a similar conclusion. The lack of a standard methodology for environmental performance measurement inhibits companies to share the costs and benefits of environmental initiatives. The authors also found that the scope of environmental performance measurement is different in the sample of firms analyzed. The authors used the framework proposed by the World Resources Institute - World Business Council for Sustainable Development protocol (WRI/WBCSD, 2013) [124], which is based on Scope 1 (which includes direct GHG emissions generated by sources owned or controlled by the company. For example, emissions generated by manufacturing activities managed directly by the company), Scope 2 (indirect GHG emissions from the generation of electricity purchased from external suppliers) and Scope 3 (indirect GHG emissions that are related to the activities carried out by other organizations, such as in the case of outsourced activities). Some of the companies adopted an approach based on Scopes 1, 2 and 3, while others limited the GHG emissions sources to Scopes 1 and 2. Different methodologies are adopted ranging from the Global Reporting Initiatives (GRI, 2011) [125] to the Bilan Carbone system to a self-developed measurement system. The work of Tacken et al. (2014) [66] also found the use of different standards and protocols to measure environmental performance in German logistics companies. The main environmental indicator used by the surveyed companies is the CO_2 emission, whereas energy consumption and vehicle utilization are seldom adopted. The carbon footprint is the technique most used. Finally, smaller companies show a lower use of performance measurement in comparison to larger counterparts, because of a limited availability of an environmental management system and difficulties in implementing emission auditing and reporting activities. The work of Venus Lun et al. (2015) [80] surveyed 107 shipping companies in Hong Kong to test the relationships between their greening capability, customer involvement and sales growth. The findings achieved show that the involvement of customers is a key pre-requisite to develop a "greening propensity" to achieve environmental performance and economic gains. On the other hand, the presence of a "greening propensity" produces a positive impact on firm performance in terms of profitability and customer satisfaction. Finally, Laari et al. (2016) [38] conducted a survey on 311 Finnish 3PLs in order to test the relationships between environmental practices and firm performance. More specifically, the authors analyzed the relationships between internal and external environmental collaboration on a number of both financial (e.g., EBIT, ROI and ROA) and operational (e.g., empty mile percentage, transport performance, length of haul and load factor in domestic and international shipments) performance indicators. The results indicate that internal environmental collaboration has a negative impact on ROI, while external environmental collaboration has a positive influence on all the financial indicators considered. On the other hand, both internal and external environmental collaboration have a significantly low influence on firm operational performance.

4.3. ICT Tools Supporting 3PLs' Green Actions

Only four studies have been published in this topic area concerning the role of ICT in supporting the adoption of green actions by 3PLs. Several researches have put in evidence the critical role that ICT plays in green logistics and sustainable supply chain management (Frehe and Teuteberg, 2014) [126]. Moreover, such research highlighted that ICT may substantially affect GHG emissions. In this context, adapting the framework proposed by Thoni and Tjoa (2017) [127], it may be possible to distinguish between the direct and indirect effects of ICT on environmental sustainability actions. ICT tools have a direct effect when their use is aimed at explicitly reducing carbon emissions. ICT tools have an indirect effect when the use of ICT influences an intermediary variable and carbon emissions are not the primary focus. Accordingly, the papers included in this topic area have been categorized into two sub-topic areas (see Table 8).

Table 8. Classification of articles dealing with ICT tools supporting 3PLs' green actions.

Articles	ICT Directly Affecting Emissions	ICT Indirectly Affecting Emissions
Baumgartner et al. (2008)	●	
Iacob et al. (2013)		●
Kang et al. (2013)		●
Wang et al. (2015)	●	

In relation to the two papers included in the first sub-topic area, Baumgartner et al. (2008) [81] conducted a study aimed at investigating how Computerized Routing and Scheduling (CRS) systems could improve emission reduction in using trucks. The authors proposed a qualitative analysis on both the demand and the supply sides of the market based on ten German trucking companies and ten leading software and hardware manufacturers. The results highlighted that the combination of CRS and vehicle telematics systems can improve CO_2 efficiency. More recently, Wang et al. (2015) [82] analyzed the impact of the Transportation Management System (TMS) on the reduction of CO_2 emissions within a distribution network of three British grocery retailers. The results revealed that improving driving behavior and route optimization, the telematics applications at the vehicle and load level have a positive impact on CO_2 emissions' reduction. However, the main obstacles preventing the full utilization of the ICT potential are the complexity of collaborative ICT tools and the lack of trust in sharing information with other supply chain actors.

In the second sub-topic area, Iacob et al. (2013) [83] proposed an integrated software architecture for building up a Logistics Carbon Management System (LCMS) able to calculate the fuel consumption and GHG emissions of trucks during theirs trips. The paper of Kang et al. (2013) [84] designed an RFID-based methodology for allocating the CO_2 emissions generated from each shipper along a supply chain, depending on the share of cargo weight, fuel consumption and transport distance.

This methodology could be considered a first response to the carbon tax system, which is expected to be introduced in many countries in the next few years.

4.4. Energy Efficiency in Road Freight Transport

Topic Area 4 encompasses 13 articles focusing on energy efficiency in road freight transport (see Table 9).

Table 9. Classification of articles dealing with energy efficiency in road freight transport.

Articles	Macro Level (Assessment of Energy Efficiency in Road Freight Transport Scenarios)		Micro Level (Implementation of Energy Efficiency Actions in Road Freight Transport)			
	Present	*Future*	*Eco Driving*	*Vehicle Efficiency*	*Collaborative Actions*	*Actions Spurred by Government*
Ang-Olson and Schroeer (2002)		●				
Leonardi and Baumgartner (2004)			●	●	●	
Pérez-Martínez (2009)	●					
Fürst and Oberhofer (2012)			●	●		
Oberhofer and Fürst (2012)			●	●	●	
Liimatainen et al. (2012)			●	●		
Arvidsson et al. (2013)			●	●	●	●
Liimatainen et al. (2014a)			●	●		
Liimatainen et al. (2014b)	●					
Liimatainen et al. (2014c)		●				
Mraïhi and Harizi (2014)	●					
Liimatainen et al. (2015)		●				
Sanchez Rodrigues et al. (2015)			●	●		

Considering the extremely high contribution to GHG emissions of road freight transport in both developed and developing countries, (International Energy Agency—IEA, 2017) [8], a specific topic area has been dedicated to this transport mode. In fact, the GHG emissions of road freight transport at the global level account for 1500 mega-tonnes out of 2500 mega-tonnes of total freight transport CO_2e emissions (World Economic Forum—WEF, 2009) [128]. In the U.S., the Environmental Protection Agency (U.S. EPA, 2016) [129] estimates that the GHG emissions from road freight transport have increased by 76.3% from 1990–2014, more quickly than other GHG sources.

The papers belonging to this topic area have been classified into two sub-topic areas using the framework suggested by McKinnon (2015) [130] that distinguish between the micro and macro level according to the different perspectives adopted in the analysis. The papers belonging to the first sub-topic area provided scenario analyses at the country level, whereas the papers of the second sub-topic area focused on the implementation of energy efficiency actions at the company level.

Considering the first sub-topic area, the work of Pérez-Martínez (2009) [86] explored some energy efficiency indicators in the Spanish road freight transport. The research highlighted a low-level reduction of emissions intensity per kilometer (0.2%) and an increasing in the fuel consumption and CO_2 emissions (9.8%). Improvements in energy efficiency should be mainly led by incentive or deterrent policy measures, for instance by forcing haulers to pay for the externalities of their activities or encouraging the renewal of the truck fleet. Based on a comparison of four European Nordic countries, the work of Liimatainen et al. (2014b) [87] revealed that energy efficiency practices in road freight transport are mainly influenced by territorial, demographic and industrial features of countries, as well as by governmental policies. Mraïhi and Harizi (2014) [89] found that road freight transport remains the main culprit for CO_2 emissions in Tunisia. The authors suggested some energy efficiency actions, such as the reinforcement of rail mode, new transport infrastructures and the introduction of clean fuel and less polluted vehicles, as well as a strong support of fiscal policy.

Shifting the attention to possible future scenarios, the work of Ang-Olson and Schroeer (2002) [85] described eight affordable strategies proposed by the U.S. EPA, such as wide-base tires or speed reduction, which can allow a reduction of fuel consumption and carbon dioxide. However, the authors found that even a large-scale adoption of these strategies by truck drivers would lead to a partial reduction of GHG emissions only. In a similar fashion, Liimatainen et al. (2014c) [88] argued that the use of alternative transport modes and biofuels could not ensure the expected benefits, even in the most environmentally-sensitive countries. A greater reduction of CO_2 emissions in road freight transport may be achieved through the adoption of state-of-the-art technology, a closer cooperation with shippers and new environmental public policies and regulations (Liimatainen et al., 2015) [90].

The second sub-topic area includes seven articles concerning the implementation of energy efficiency actions in road freight transport companies. These actions are often categorized as eco-driving (e.g., McKinnon, 2015) [119], vehicle efficiency (e.g., Kobayashi et al., 2009) [131], collaborative initiatives with other supply chain actors (e.g., Mason et al., 2007) [132] and actions spurred by government (e.g., Stelling, 2014) [133]. The study of Leonardi and Baumgartner (2004) [91] analyzed specific activities adopted by German haulers to reduce the CO_2 emissions. Driving training, technical improvements and informal cooperation are the most implemented activities, whereas actions at the vehicle level are considered still inadequate. Focusing on Austrian road transport companies, the study conducted by Fürst and Oberhofer (2012) [92] revealed that few companies attributed high priority to environmentally-oriented management. This result calls for public interventions to overcome the barriers discouraging the adoption of environmental sustainability actions and to promote the dissemination of information about improvements of environmental performance. Oberhofer and Fürst (2012) [93] analyzed the stimulus of Austrian road haulers to reduce greenhouse gas emission. The findings revealed that the attitude toward environmental sustainability is widespread among the companies interviewed. However, the most implemented green measures are at the vehicle level, whereas the driving training and the green collaboration along the supply chain are less important. The work of Liimatainen et al. (2012) [94] analyzed the results of different energy efficiency actions adopted by Finnish road transport firms. The authors found that the adoption of hybrid vehicles, load optimization and aerodynamics allows obtaining a higher percentage of fuel savings, whereas eco-driving incentives are more effective than eco-driving training. Liimatainen et al. (2014a) [96] replicated the previous study in a wider European Nordic context, and different evidence emerged. The authors found that hybrid vehicles and the eco-driving bonus scheme are less efficient than other green actions, such as limiting driving speed or regular monitoring of tire inflation. Finally, Arvidsson et al. (2013) [95] analyzed a wide set of measures for energy efficiency improvement in the Swedish road freight transport sector. The study highlighted that the energy efficiency of each measure also depends on some external factors, such as the market competition conditions, the relationship network and policy/regulation factors.

4.5. Shipper's Perspectives and Collaboration

This topic area includes 20 articles discussing the shipper's perspective and collaboration in sourcing more environmentally-sustainable logistics services. As shown in Table 10, these articles have been grouped into the following two different sub-topic areas: shippers' green buying behavior [102,134] and the green relationship and collaboration among shippers and 3PLs [110,135].

Table 10. Classification of papers by shipper's perspectives and collaboration.

Articles	Shipper's Green Buying Behavior (Including the Selection of Third Party Reverse Logistics Providers)	Green Relationship and Collaboration	
		Shipper-3PL	3PL-other 3PLs
Meade and Sarkis (2002)	●		
Efendigil et al. (2008)	●		
Kannan et al. (2009)	●		
Wolf and Seuring (2010)	●		
Bjorklund (2011)	●		
Philipp and Militaru (2011)	●		
Eng-Larsson and Kohn (2012)	●		
Kudla and Klaas-Wissing (2012)		●	
Lammgard (2012)			●
Martinsen and Bjorklund (2012)		●	
Bai and Sarkis (2013)	●		
Large et al. (2013)	●		
Lammgård and Andersson (2014)	●		
Martinsen and Huge-Brodin (2014)		●	
McKinnon (2014)	●		
Ellram and Golicic (2015)		●	
Kellner and Igl (2015)	●		
Jørsfeldt et al. (2016)		●	
Sallnas (2016)		●	
Vieira et al. (2016)		●	

Considering the first sub-topic area, a group of papers deals with the selection process of shipper in identifying third party logistics service providers for reverse logistics. The paper of Meade and Sarkis (2002) [98] proposed a decision model for selecting appropriate 3PLs in reverse logistics programs. The model includes a set of qualitative, quantitative, strategic and operational factors that may affect 3PLs involvement in making reverse logistics decisions. The issues concerning the 3PLs' selection were also addressed by Efendigil et al. (2008) [99] with a specific focus on the outsourcers' requirements. The authors proposed a methodology in which environmental factors are included in the selection process of a reverse logistics provider. Similarly, the paper of Kannan et al. (2009) [100] proposed a structured multi-criteria decision making model for evaluating and selecting the best 3PLs for reverse logistics depending on logistics outsourcing, cost of service, flexibility and environmental-related factors (e.g., packaging, recycling, disposal etc.). Finally, Bai and Sarkis (2013) [105] identified the most information-rich flexibility performance measures to be used for evaluating 3PLs' performance in reverse logistics activities. Other articles analyzed the shipper's green buying behavior through investigating the relative importance, among other factors, of environmental issues influencing the purchasing of traditional logistics services. The study of Wolf and Seuring (2010) [101] highlighted that the logistics purchasing process of buyers is mainly driven by traditional performance aspects, such as price, quality and timely delivery, rather than by environmental concerns. Lammgard and Andersson (2014) [107] explored the relative importance assigned by Swedish large shippers to the environmental efficiency in purchasing freight transport services, as well as economic and logistical aspects. Comparing the results of two surveys conducted ten years later, the authors found that the importance of environmental aspects did not increase over time, while the top priority in selecting transport providers remained price, followed by reliability and transport quality. McKinnon (2014) [108] found similar results surveying a sample of 34 large U.K. shippers using deep-sea container transport. The results showed that a low importance is assigned to environmental criteria in selecting a deep-sea carrier, while the most important criteria are logistical aspects, such as the space utilization and the choice of port. Different aspects of the environmental sustainability have been included in the study of Large et al. (2013) [106]. The authors explored how much purchasers of logistics services take into account three different aspects of ecologically-sustainable actions, such as the reduction of transport intensity and emission, reduction of land use and the choice of carrier under the consideration of sustainable aspects. It was found that purchasing companies place high importance on all fields of ecological activities, but they exert only a minor influence on 3PLs' sustainability initiatives.

Other articles of the first sub-topic area were aimed at analyzing the factors influencing the shippers' purchasing of green logistics services. The study of Bjorklund (2011) [102] analyzed five categories of factors influencing the green buying behavior, such as internal management, company image, resources of the company, customer demands and governmental means of control. The evidence highlighted that the most influencing factors arise from the surrounding business environment of the company. Philipp and Militaru (2011) [103] found that the compatibility between traditional and ecological logistics services and the green brand image trigger the purchasing of green logistics services more than the relational aspects and regulatory constraints. Eng-Larsson and Kohn (2012) [104] investigated the contextual factors affecting the shift to intermodal road-rail transportation by six shippers in Sweden. The findings reveal that the amount of transport purchasing resources allocated for the tender, the low volatility of demand and the centralized control system are perceived as key factors in shifting to intermodal transportation. The article of Kellner and Igl (2015) [109] aimed at identifying which factors mainly boost the shippers' green buying choices and the environmental impact of these choices. The authors suggested a quantitative distribution network model in order to estimate GHG emissions arising when a shipper selects a specific 3PL. Analyzing more than 100,000 shipment data of a manufacturing company through a simulation model, the evidence indicates that the vehicle load factor is the most important element orienting the choice toward 3PLs' green network.

Considering the second sub-topic area, some papers focused on the mismatches between 3PLs and shippers in dealing with environmental issues. The paper of Kudla and Klaas-Wissing (2012) [42] analyzed the mismatches of stimuli and responses about the green activities in a dyadic relationship between 3PLs and shippers. The authors found that shippers' stimuli for sustainability (i.e., selection criteria and incentives) are at an early stage, while the sustainability initiatives of 3PLs have a stronger environmental focus. Similarly, Martinsen and Bjorklund (2012) [111] attempted to identify the main gaps between logistics companies' green supply and the shippers' green demand. The authors found that the first gap addresses the 3PLs' view about their offers and how they perceive the demand from the shippers. A further gap is also identified between the 3PLs offering and the shippers' perception of the offers, and it indicates that even if the 3PLs are aware of their over-achievements, the shippers are not. Similar discrepancies have been also found in the study of Martinsen and Huge-Brodin (2014) [112].

Other papers analyzed the influencing factors and the effects of the green relationship between 3PLs and shippers. The study of Ellram and Golicic (2015) [43] explored both influencing factors and the effects of the environmental partnership between shippers and carriers in the U.S. market. The results revealed that this partnership is triggered by coercive, mimetic and normative pressures and encourages the adoption of environmental transport practices. Jørsfeldt et al. (2016) [5] explored how the introduction of an environmentally-sustainability target affects the relationship between buyers and 3PLs. The authors found that the buyer has to increase cross-functional and cross-organizational activities in order to preserve its performance. Regarding the coordination aspects of the environmental practices between shippers and 3PLs, Sallnas (2016) [113] found that 3PLs generally depend on shippers in setting the coordination conditions, but the shippers are subjected to 3PLs to achieve successful environmental practices. Focusing on the environmental awareness, Vieira et al. (2016) [114] analyzed the relationship among shippers, 3PLs and carriers in managing green actions. The authors found that the major obstacle in fulfilling environmental regulations is the carriers' lack of awareness.

The paper of Lammgard (2012) [110] shifted the focus on the relationship between two different 3PLs in the collaborative management of decarbonization actions. The results highlighted how the role of customers and competitors is crucial in driving the adoption of intermodal road-rail transport services for reducing carbon emissions and improving environmental performance.

5. Discussion and Propositions to Be Explored in Further Research

In this section, the study findings are discussed. Interesting elements emerged from the results of the descriptive analysis. In relation to the year of publication, the data indicate a significant growth of articles in this area over the last few decades, suggesting that this topic has received an increased interest from academics and researchers in this field, and it may be considered mature. About the country of study, the data suggest that most of the published articles refer to developed countries and specifically EU countries (48 papers out 70). A lower number of articles refer to developing countries in South East Asia (14 articles out 70) and American countries (five articles out of 70). There is a scarcity of papers analyzing green issues in the 3PL industry of countries with a relevant environmental footprint such as India, Brazil, the U.S. and China. Future research should provide evidence from comparative analysis conducted in developed and developing countries. About the journals, all the selected articles have been published in leading academic journals. The International Journal of Physical Distribution and Logistics Management and the Journal of Cleaner Production are the journals that have published the highest number of papers included in the final sample (15 articles out of 88). As expected, the vast majority of articles have been published in logistics and SCM-related journals, but it is surprising that a low number of articles has been published in environmental and energy-related journals. The data concerning the research methodology reveal that quantitative methods were mostly used to investigate green issues in the logistics service industry (52 articles out of 88), while qualitative methods have been used in 22 articles. Only seven papers used mixed methods. The distribution of papers by research methods over time indicates that the use of qualitative methods increased significantly from 2009 until 2016, whereas such methods continue to have a lower share in comparison with quantitative methods. This trend leads to belief that the literature in the future should shift from a quantitative approach to a more qualitative and explorative emphasis. This should also facilitate the publication of articles based on multiple research methods. In relation to the theories applied in the selected articles, it is surprising that 76 papers out of 88 have not used any theory. The Resources-Based Theory (RBT) is the most frequently-used theory. The papers adopting RBT have been mainly used to explain the 3PLs' engagement in environmental actions and programs [40,41]. Authors investigating the involvement of 3PLs in reverse logistics have used other theories such as fuzzy set theory [99], network theory [39] and information theory [105]. A couple of papers used multiple theories. Shaharudin et al. (2014) [39] used RBT, network theory and transaction cost theory to study the role of 3PLs in offering sustainable services to customers, while Laari et al. (2016) [38] used both the natural-resources-based theory and the relational view theory to explore the impact of green actions on financial and operational performance in Finnish 3PLs. Finally, considering the distribution of papers using theories over time and excluding the paper of Efendigil et al. (2008) [99], the remaining papers have been published from 2011 onward. This further evidence corroborates the idea that research in this area is mature, and it may be forecasted that the theoretical foundations of this research stream will be reinforced in the near future.

From the content analysis point of view, the analysis of the articles included in each of the five topic areas allows summarizing different perspectives concerning environmental sustainability in the logistics service industry and identifying research gaps. This classification, in turn, leads to developing a set of propositions for each topic area (P1–P16) that may form an agenda for future research in this field (see Table 11).

Table 11. Topic areas and propositions.

Topic Area	Propositions for Future Research Directions
Influencing factors	**P1.** Analysis of the interaction among the key organizational actors in the company's environmental strategy.
	P2. Analysis of the inter-connection between the economic-financial factors and single green actions adopted.
	P3. Analysis of specific technological influencing factors and identifying the mechanism by which to overcome the technological barriers.
Green actions and performance	**P4.** A greater focus on adaptation actions and analysis of the link with mitigation measures.
	P5. Analysis of mitigation actions beyond the purely transport phase.
	P6. Investigation of CO_2 emissions deriving from the 3PL activities at the supply chain level.
	P7. Identification of leverages for encouraging small 3PLs to adopt environmental sustainability practices.
	P8. The study of how the development of green capability may improve the efficiency of green 3PLs' services offering.
	P9. Identification of standard metrics to measure green 3PLs' environmental performance.
	P10. Quantification of the 3PLs' environmental commitment and the impact on financial and operational performance.
ICT for green actions	**P11.** Analysis of how ICT tools can influence the reduction of CO_2 emissions in an integrated way.
Energy efficiency in road freight transport	**P12.** Better evaluation of the efficacy of green measures, using alternative environmental performance indicators in the road freight transport sector.
	P13. Study of the outcomes of green actions stimulated by government regulations and incentives.
	P14. In-depth analysis of the supply chain collaborative measures adopted by road haulers.
Shipper's perspective and collaboration	**P15.** Analysis of specific shippers' environmental requirements in outsourcing logistics services and related environmental performance achieved by 3PLs.
	P16. More in-depth investigation of collaborative mechanisms between buyers and logistics service providers.

The articles belonging to Topic Area 1 analyzed a plethora of internal and external factors influencing the adoption of green actions. Nevertheless, some sub-topic areas and categories are still under-examined or missing. The organizational factors have been analyzed considering the role of management, the quality of human resources and the environmental culture of the organization. As suggested by Walker et al. (2008) [115], organizational drivers influencing the environmental sustainability strategy entail the simultaneous engagement of different actors, such as leaders, middle management and employees. Surprisingly, there are no papers in this topic area analyzing in an integrated way the role of all actors involved in the 3PL environmental strategy. Moreover, no attempt was made to explore the mechanisms through which the actors of the organization may influence the adoption of green actions. Similar gaps arise from the analysis of the studies focusing on the organizational barriers. Thus, the following proposition may be posited:

P1. Future research should analyze the key organizational actors involved in the green actions and focus on the interaction among them, in order to explore their different role in the company's environmental strategy.

Furthermore, little interest has been devoted to the economic-financial dimension of the environmental sustainability actions undertaken by 3PLs. The literature in this area has been limited to analyzing the cost savings or the long-term profitability as drivers, on the one hand, and the high investment costs and the lack of financial resources as the main barriers, on the other. Other economic-financial factors have been neglected from the extant literature. Two papers only (Rossi et al., 2013; Bloemhof et al., 2015) [48,51] considered economic and financial factors as both barriers and drivers simultaneously. Finally, one paper only (Palsson and Johansson, 2016) [55] investigated how the economic-financial barriers differently affect specific types of green actions. The economic-financial factors play a key role in influencing the adoption of the green actions, especially for small companies that usually have poor financial resources to be devoted to environmental sustainability. The approach proposed by Palsson and Johansson (2016) [55] should be extended to the analysis of all relevant influencing factors. In fact, this approach is crucial to understand which influencing factors should be leveraged to adopt a more effective green strategy. Thus, the following proposition may be posited:

P2. Future research should in-depth analyze the interconnection between the economic-financial factors and single green actions undertaken by 3PLs.

Another important research gap emerged from the analysis of the existing literature concerning the technological factors. In fact, only four papers have addressed this issue. The analysis of these papers put in evidence that the role of technology as a driver or barrier has been investigated in a very general way. As a result, these studies did not investigate how single technological factors may act as drivers or barriers, also neglecting the adaptation problems associated with the use of green logistics technology. Thus, the following proposition may be posited:

P3. Further research needs to analyze specific technological factors influencing the 3PLs'green actions and identify the mechanisms by which to overcome technological barriers.

Topic Area 2 is focused on the adoption of green actions and the impact on 3PLs' performance, and it comprises the highest number of papers in comparison with the other four topic areas (34 papers). In relation to the papers concerning the adoption of green actions, the analysis carried out evidences that most of the studies deal with mitigation, rather than adaptation actions. This is in line with IPCC (2014b, p. 622) [136], which stressed the lack of research on the adaptation strategies in the transport and logistics service sector. As a result, it is possible to suggest the following proposition:

P4. Further research should focus on adaptation actions and analyze the link with mitigation measures to design a comprehensive and effective 3PL environmental strategy.

The literature in the area of mitigation actions has substantially evolved over the last few years. In the first part of the time span considered, the attention of scholars was focused on single actions, such as the role of intermodal transport to minimize the environmental impact of 3PLs' operations (e.g., Rondinelli and Berry, 2000; Lammgard, 2012) [34,110]. From 2010 onwards, several papers assumed a more general perspective analyzing multiple measures to investigate the range of possible actions that 3PLs may implement to reduce the negative effects on the environment. The analysis of these papers evidenced that most of them focused on mitigation initiatives aimed at reducing the environmental impact of the transport phase such as vehicle energy efficiency and intermodality [25,40,61,62,72]. On the other hand, there were few research works devoted to analyzing actions beyond transport (e.g., warehousing, environmental management systems and collaboration). Considering the above discussion, it is possible to suggest the following proposition:

P5. Future research should investigate mitigation actions beyond the purely transport phase in order to identify additional opportunities to reduce CO_2 emissions.

From the analysis of the papers included in this area, a number of other research gaps emerged. A clear gap consisted of the lack of studies providing an estimation of emission reduction that can be achieved through implementing specific green actions. This relevant issue is not addressed by the extant literature. There is only one paper providing an estimation of the emissions savings connected with the implementation of green actions (see Oberhofer and Dieplinger, 2014) [3]. Nevertheless, the paper provides a quantification of emissions savings at the company level rather than at the supply chain level. A broader view of emissions generated by different supply chain stages is necessary, and it is an even more important dimension of 3PLs' services offering (WEF, 2009) [128]. Considering the above discussion, it is possible to suggest the following proposition:

P6. In order to provide a more accurate and broader view of 3PL emissions, further research should analyze CO_2 emissions deriving from the 3PL activities at the supply chain level.

Another missing dimension is the company size. Most of the studies concern large 3PL companies [14,40,61] that generally have enough financial, technological and human resources devoted to environmental sustainability. Nevertheless, in most countries (especially in the EU), the vast majority of 3PLs are small and medium-sized companies (European Commission, 2017) [137], and they have a relative disadvantage in the adoption of green practices. There is a lack of studies aimed at investigating the environmental sustainability practices of these companies, which often act as subcontractors for larger logistics groups and are responsible for carrying out the most polluting activities such as transportation (Nilsson, et al., 2017) [138]. As a result of the above discussion, it is possible to posit the following proposition:

P7. Further research should identify leverages for encouraging small 3PLs to adopt environmental sustainability practices.

Most of the papers highlighted that 3PLs have generally shown difficulties in implementing green strategies and practices. This may be explained by the lack of adequate capabilities in this area (Liu et al., 2017) [139]. In fact, as suggested by Lun et al. (2015, p. 51) [80], " ... better greening capability enables LSPs to deliver logistics services to their customers more efficiently." The role of the people dimension in 3PLs' green operations is an aspect that has not been investigated in the extant literature. This gives the opportunity to suggest the following proposition:

P8. Further research should investigate how the development of green capability may improve the efficiency of green 3PLs' services offering.

In relation to the papers analyzing the environmental performance of green 3PL's initiatives, four papers are focused on the developing of metrics, while 11 papers provide evidence about the impact of green actions on 3PLs' performance. The first group of papers provides fragmented and heterogeneous approaches that prevent the identification of shared metrics. Thus, the following proposition may be posited:

P9. There is a need to develop research aimed at identifying standard metrics to be used in order to measure green 3PLs' environmental performance at both the company and supply chain level.

The papers belonging to the fourth sub-topic area focused on the impact of green actions on 3PLs' performance. Most of these papers deals with environmental and financial performance, while the impact of green actions on operational performance is a little bit neglected. From a general perspective, this issue seems to be at an early stage and needs to be assessed more in-depth. For example, most of the papers in this area provide qualitative and indirect measures of the impact of green initiatives on 3PLs' performance [38,40,61,66,78]. One paper only provides a direct measure of emissions savings deriving from green actions adopted (see Oberhofer and Dieplinger, 2014) [3]. This leads to the conclusion that a more thorough assessment of the impact of green action on performance is necessary. Finally, there are no papers linking the development of appropriate metrics and their application in measuring the performance of 3PLs and other supply chain participants such as customers. The above discussion allows suggesting the following propositions:

P10. Future research should be aimed at developing frameworks and applications that may quantify 3PLs' environmental commitment and the impact on financial and operational performance.

Topic area 3 encompasses the lowest number of articles compared to the other topic areas. Only four papers focused on ICT tools in supporting the 3PLs' green actions. Despite previous research having pointed out that ICT plays a key potential role in reducing GHG emissions in green logistics (see for example Frehe and Teuteberg, 2014) [126], it is surprising how the adoption of ICT tools to support the 3PLs' green actions is still an under-explored theme.

The two articles included in the first sub-topic area [81,82] focused on ICT tools that may be used to reduce the CO_2 emissions in transport and logistics activities. Nevertheless, such papers did not provide any quantitative measure of the emission savings to be achieved using such tools. In contrast, the papers of Iacob et al. (2013) [83] and Kang et al. (2013) [84] suggest ICT tools (e.g., software applications) to calculate CO_2 emissions savings. The main limitation of these papers is that they did not provide any assessment about the actual impact on CO_2 emission reduction.

Therefore, there is a clear gap concerning an integrated analysis of the environmental benefits deriving from the ICT tools' adoption. Taking into account the above arguments, the following proposition is posited:

P11. Future research should be directed toward analyzing how ICT tools influence the reduction of CO_2 emissions in an integrated way.

Topic Area 4 comprises articles focusing on energy efficiency in road freight transport. Considering the articles based on scenario analysis (macro level), it was found that there is an increasing fuel consumption and CO_2 emissions that are not balanced enough by the reduction of emissions intensity (quantity of CO_2 from road freight per added value in euro). This situation is caused by the growth rate of the economy (and the related growth in the road freight transport demand) that is faster than the outcome of green actions. Furthermore, the benefits of technological and managerial innovations often influence the productive efficiency of a company without any visible effect on CO_2 emissions reduction. For instance, just-in-time deliveries are usually in contrast with green measures, such as load optimization [86,87]. Although this sub-topic area addressed the environmental issues by analyzing several measures and the related effects in different contexts of analysis, what it is lacking is a rational explanation of the reasons underlying the inadequacy of such measures and suggestions for alternative measures to improve the energy efficiency in the sector. Moreover, the existing literature has not considered alternative CO_2 emission indicators; for example, indicators based on volume units rather than weight units. Such indicators could allow improving the energy-efficient use of road freight transport. In light of the above arguments, the following proposition is posited:

P12. Future research should better evaluate the efficacy of green measures through using alternative environmental performance indicators in the road freight transport sector.

Most of the articles adopting a country perspective highlight how the government should further boost the adoption of actions aimed at improving energy efficiency in the road freight transport. On the one hand, the government influence should be reflected in promoting energy efficiency or discouraging pollutant actions [86,88,90] and, on the other hand, in improving transport infrastructures [89]. However, this aspect is quite neglected in this topic area. Only one article deals with the haulers' adoption of green actions spurred by government [95]. The environmental policies of national government or international institutions have evolved in the last few decades, and several policy instruments have been deployed to reduce the GHG emissions from the road freight transport industry (IEA, 2009) [8]. In light of the above arguments, the following proposition is posited:

P13. To better understand the effect of environmental policies on the energy efficiency strategies of road haulers, future research should investigate the outcomes of green actions stimulated by government regulations and incentives.

Furthermore, only three articles analyze green initiatives adopted in collaboration with other actors of the supply chain, such as shippers or 3PLs. Many road haulers' actions that may improve the energy efficiency, such as route optimization or better vehicle utilization, need to be carried out in collaboration with other actors of the supply chain [8,140]. Accordingly, it is crucial to study the relationship among these actors to improve energy efficiency through collaborative activities. As a result, it is possible to suggest the following proposition:

P14. Future research should analyze in-depth supply chain collaborative measures adopted by road haulers that increase energy efficiency in road freight transport.

Topic Area 5 relates to the literature on the shipper's perspective and the relationship among the shippers and 3PLs in the adoption of green actions. Considering the articles belonging to the first sub-topic area, some articles analyzed the factors influencing the shippers' purchasing of green logistics services, whereas other articles explored the relative importance of the environmental concerns in shippers' purchasing of traditional logistics services. Both groups of articles highlighted the scarce importance assigned by the shippers to the environmental issues in overall terms. Only one paper (Kellner and Igl, 2015) [109], in fact, analyzed the main green actions considered by shippers in the purchasing process of green logistics services, as well as the GHG emissions resulting from the choice of a specific 3PL. However, the authors did not consider other green actions that may stimulate the shippers in purchasing greener logistics services. Furthermore, the authors analyzed the environmental performance arising from the choice of a specific 3PL, rather than by single green logistics services purchased by the shippers. Therefore, the research gap in the existing literature concerns the lack of studies aimed at identifying a set of green requirements in the selection process of 3PLs and the resulting environmental performance achieved by the selected 3PLs for each of these requirements. Considering the above discussion, it is possible to posit the following proposition:

P15. Further research should analyze specific shippers' environmental requirements in outsourcing logistics services and related environmental performance achieved by 3PLs.

Finally, the analysis of the literature on buyer perspectives in purchasing environmentally sustainable 3PL services demonstrates that there is a general consensus on the fact that buyers' influence on 3PLs' green initiatives is limited. Consequently, there is a great challenge in incorporating sustainability and environmental management principles in the 3PL service sourcing decision process. In order to facilitate this, it is necessary to change the mindset of the purchasing managers in customer companies, as well as those of the managers in 3PL companies. Another fundamental missing theme is the lack of research aimed at analyzing the mechanisms that may be put into practice for collaborative green initiatives investigating dyadic buyer-3PLs relationships.

P16. To incorporate environmental sustainability in the buying decision process, further research is needed to investigate more in-depth the collaborative mechanisms between buyer and logistics service providers.

6. Conclusions

This paper explored the existing body of knowledge in the field of environmental sustainability in the 3PL sector. This has been accomplished through a systematic literature review based on 88 articles. From this analysis, it was possible to identify five main topic areas in which the selected articles have been classified. A number of research gaps have been detected, and a set of research propositions has been identified, which indicate future avenues for research in this area. This literature review contributes to increasing the understanding of recent developments in environmental sustainability issues in the logistics service industry. A further contribution of this paper consists of providing a systematization of the existing knowledge on environmental sustainability in 3PLs. On the basis of the analysis developed in this study, it is possible to conclude that environmental sustainability in 3PLs is a mature research stream, and it is gaining increasing interest over time. The hope is that this paper may be a useful source inspiring future research in this field. The results achieved allow providing an answer to the two research questions of this paper.

In relation to the first research question, "RQ1: How has the literature on environmental sustainability in 3PLs evolved from 2000 until 2016?", the evidence emerging from the literature analysis indicates that publications in this area have increased in recent years, reaching a peak in 2014. The articles included in the analysis dealt with a number of different topics and applied several types of research methods. The vast majority of these papers are based on quantitative and qualitative methods, while few papers use multiple methods. Moreover, most of the articles were published in transport/logistics/SCM journals, environmental and energy-related journals and innovation and operation management journals. A small number of papers applied an established theory, but from 2013 onwards, the number of papers using a specific theory increased.

With regard to the second research question, "RQ2: How may the literature on environmental sustainability in 3PLs be classified into different topic areas?" the analytical framework of Evangelista (2014) [25] based on five topic areas was adopted. Such a framework has been further developed identifying additional sub-topic areas through the analysis and consolidation of the extant literature on environmental sustainability in 3PL research. This allowed achieving the basic objective of the work, which was to carry out a systematic literature review on environmental sustainability in 3PLs and identify a set of propositions to provide directions for future research. The findings indicate that the lowest number of papers has been published on ICT tools in supporting green 3PLs' actions in comparison with other topic areas, although several studies indicated the increasing important role of ICT tools in supporting green actions and strategies of 3PLs (e.g., Harris et al., 2012) [141]. This issue is under-represented in the extant scientific literature, presenting a relevant research gap. This leads the conclusion that future research efforts are needed to investigate this issue more in-depth.

This paper suffers from some limitations. One limitation concerns the number of papers included in this study. The Scopus and Web of Science databases provide broad coverage of the academic literature, but they could not cover all peer-reviewed publications, and it is possible that some papers were missed. Further knowledge could be found in conference papers or PhD theses. Even if the list of papers included in this study may not be considered exhaustive, it is comprehensive and provides a reasonable representation of the research conducted on environmental sustainability in the 3PL industry. Another limitation is related to the keywords used. Although the keywords were collectively identified by a number of experts during a focus group meeting, the use of different keywords could generate different results. Finally, although topic areas and categorizations of papers were identified following a rigorous research process, the identification of different topic areas and sub-categorizations could provide opportunities for additional interpretations and insights. However, the categorization framework used is relevant for this study and reflects the more recent views of research developed in the field. Building on the research findings described in this literature review, this paper contributes to further research in the development of environmental sustainability issues in the context of 3PLs.

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