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Environmentally Sustainable Logistics Performance Management Process Integration between Buyers and 3PLs †

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Abstract: To ensure environmentally sustainable logistics, organizations need to have an environmentally sustainable logistics performance management (ESLPM) process. In line with supply chain management (SCM) literature, there is a desire towards integrating processes with supply chain partners to increase performance. The purpose of this paper is to propose a framework for ESLPM process integration and to illustrate this framework in practice between buyers and third-party logistics (3PLs) providers. The method used is multiple case studies of three dyads of 3PLs and buyers from the public and private sector. Data were collected through 10 semi-structured interviews. Our major result is a proposed framework with criteria for the degree of ESLPM process integration between buyers and 3PLs. It includes six activities: Selecting environmentally sustainable logistics performance (ESLP) variables, defining ESLP metrics, setting ESLP targets, measuring ESLP metrics, ESLPM feedback, and analyzing ESLP outcomes and processes. It considers suggested operationalization of each activity and the corresponding degree of integration. The framework can provide guidelines for practitioners in identifying current degree of process integration. It may also support decisions regarding actions needed to advance to a higher degree. This framework is the first to address logistics performance management process integration including environmental sustainability.

Keywords: environmental sustainability; performance management process; integration; dyads; multiple case study

1. Introduction

An increasing pressure from government and customers on environmentally sustainable operations has stimulated organizations to cooperate in order to improve their environmental work. To do so, third-party logistics providers (3PLs) need to transform buyers' requirements into environmentally sustainable logistics related offerings and pursue them in interplay [1]. To illustrate, 3PLs working closely with their buyers can better understand buyers' environmental requirements and can develop efficient business processes that can contribute to achieving these requirements in a better way [2]. Business processes related to logistics services can be core processes like transportation processes, or support processes such as performance management processes.

Reference [3] stated that 3PLs adopting environmental transportation achieved enhanced transportation planning, lower inventory cost, and better inventory and warehouse management. Similarly, reference [4] demonstrated that in the logistics context, environmental sustainability (such as emission tracking data and freight efficiency) relates to improved future operating performance (such as sales growth and cost

efficiency). According to [5], there is a need to manage environmentally sustainable logistics activities between organizations, that is, to integrate them. Particularly, the growth of 3PL and the development of logistics solutions have forced 3PLs to collaborate with buyers. Once the buyers consider environmental sustainability and incorporate it into their business, 3PLs are required to do likewise [6]. Such an integration corresponds to supply chain management literature, which encourages integration of different business processes with supply chain partners, in order to increase performance [7,8].

However, changing from "the traditional way" of carrying out logistics activities to a more "holistic environmentally sustainable way'" is regarded as challenging in the literature. Several studies show the difficulties in reaching different environmental targets. For example, the compression of transit times for freight is one of the most persistent logistics trends, but it may not be compatible with different climate change strategies to reduce greenhouse gas emissions [9]. This situation of logistics makes organizations more and more interested in performance management processes [10,11], stating that it is important for supply chain actors to manage performance through not only internal but also external resources (such as suppliers), which requires process integration. A performance management (PM) process implies that a number of activities, from selecting performance variables to analysis, are viewed as a whole (e.g., [12,13]). It encourages organizations to improve their performance [12] and widens the scope from measurement to management. The PM process was, by an extensive literature review, adapted to include environmental sustainability, resulting in descriptions of the characteristics of the environmentally sustainable logistics performance management (ESLPM) process [14]. However, that study did not cover integration of the ESLPM process.

The knowledge of ESLPM process integration across an organization's boundaries is in its infancy from both practical and theoretical perspectives. There is lack of agreement among researchers on how such process integration should be managed with supply chain partners (e.g., [15,16]), in order to increase environmental performance for both 3PLs and buyers, in line with [7,8]. Processes can be integrated to different degrees. Reference [13] suggested a framework with criteria for the low–high degree of logistics PM process integration, building upon descriptions of "not-environmentally sustainable" PM processes between manufacturing companies. Reference [17] suggested that performance management processes could be integrated in low–medium–high degree. Reference [14] provided the start for a framework by descriptions of the ESLPM process.

Reference [18] concluded that there is a need to gain an increased knowledge on measuring the environmental sustainability within logistics, and also on how this can be conducted in practice. In the context of 3PLs and their buyers, using an ESLPM process for integration is neither a short-lived trend nor an established practice, although it is a potential business opportunity [19]. Reference [20] emphasized that measuring 3PLs' environmental performance is highly under-researched. Specifically, the authors call for development of standard metrics to be used to measure 3PLs environmental performance at both an organizational level and across the supply chain.

Reference [13] found that high degrees of PM process integration were related to high logistics performance levels. Consequently there is managerial relevance in expanding this knowledge also to the ESLPM process, in order to reach higher environmental performance levels. Moreover, reference [21] reviewed 234 articles on supply chain performance metrics from the past 24 years and highlighted the need to develop more applied frameworks that originate from the interaction of scholars and practitioners. To do so, [21] suggested conducting interviews to understand how and what metrics are used in practice compared to existing literature. Few studies provide guidelines for managers concerning to what degree certain processes should be integrated [22], and no identified study illustrated how buyers and 3PLs integrate the ESLPM process.

The purpose of this paper is to propose a framework with criteria for the degree of ESLPM process integration, and to illustrate the degree of integration between buyers and 3PLs.

The remainder of the paper is organized as follows: Frame of reference, initial framework and method are presented in Section 2. Results are presented in Section 3. Analysis and discussion take place in Section 4. The paper ends in Section 5 with conclusions.

2. Frame of Reference, Initial Framework and Method

2.1. Frame of Reference

The first section describes integrating environmentally sustainable logistics performance management with supply chain partners. The second section describes the ESLPM process. The literature search was carried out in OneSearch and Google Scholar. Search terms like performance management, environmental performance, logistics performance were combined with processes and integration. The results led to finding further articles.

2.1.1. Integrating Environmentally Sustainable Logistics Performance Management in Supply Chains

Reference [23] argued that measuring performance of a single organization is not sufficient. The focus has to be shifted towards measuring performance of the supply chain, in which the organization is a partner. Previous research emphasizes an integrated perspective when designing a supply chain performance measurement system (PMS) reaching beyond a single organization. The rationale is that insufficient quality anywhere in the supply chain has a negative effect on customer satisfaction, profitability, and eventually leads to higher costs for downstream businesses and for the end-customer [8]. However, a seamless integration is rarely implemented in practice. This also applies for integration of the PMS across organizations [8,24].

Environmental sustainability issues reach beyond an organization's boundaries, but there is a lack of process-based approaches to performance management across organizations, that focus on environmental considerations [7]. A number of SC frameworks and approaches with environmental focus have been developed during the last decade. Rather recently, reference [25] used Balanced Scorecard (BSC) to develop a model allowing for environmental transportation performance evaluation and supporting an implementation of environmental transportation strategies. Reference [15] proposed a conceptual framework for structuring the development of metrics in sustainable SCM, based on an extensive analysis of 2555 unique performance metrics from previous research. However, these frameworks do not consider the process perspective or performance management process integration between buyers and 3PLs.

Green SCOR (Supply Chain Operations Reference) model version 9.0 has been updated with environmental management elements such as environmental processes, metrics and best practice. The metrics are categorized in five performance attributes; reliability, responsiveness, agility, costs and asset management efficiency. This model possesses a challenge for an organization to define, align and prioritize the competitive requirements within each attribute [23]. Moreover, reference [26] argued that the SCOR model has been developed in a manufacturing context and is less available for service-based industries like 3PLs. Integration of environmental performance management process across organizations is also supported by guidelines for the phased implementation of an environmental management system ISO14005: 2010. This international standard includes stepwise implementation approach of PMS, communication of metrics to external stakeholders, and the use of environmental performance evaluation [27]. Although the standard provides useful guidelines and addresses communication of metrics to external stakeholders, the focus is mainly internal and the approach is obviously generic.

The existing environmental performance management frameworks and approaches are lacking in addressing the performance management process integration beyond organizational boundaries.

References [24] and [28] concluded that there is a lack of studies on sustainability evaluation, measurement and the degree of implementation of environmental aspects in the 3PL context.

Thus the existing research provides only limited support for practitioners in terms of how the appropriate metrics can be identified, implemented and used across a supply chain, following the definition of performance management process in [29]. Consequently, reference [30] concludes that the lack of integration approaches prevent organizations from sharing the costs and benefits of environmental initiatives.

Due to the lack of studies on ESLPM process integration between 3PLs and buyers, we rely in this study on the integration framework of the performance management process between manufacturers by [13] complemented by [17]. Reference [17], however, studied the degree of performance measurement integration on an aggregated level, not on activity level as did [13]. Integration was low when delivery service was measured in some parts of the supply chain. A medium degree of integration occurred when more metrics, such as lead-time and service levels, were included and when a joint measurement was conducted in some interfaces. Integration was high when measurement was focused on process performance with an end-customer perspective and when performance data were shared across the supply chain [17]. To serve the purpose of this paper, the ESLPM process is complemented to include integration of environmental performance and to address 3PL as one supply chain actor.

2.1.2. Integrating the ESLPM Process

The framework used for integration is the ESLPM process which consists of five activities: (1) Selecting environmentally sustainable logistics performance variables (selecting ESLP variables), (2) defining environmentally sustainable logistics performance metrics (defining ESLP metrics), (3) setting environmentally sustainable performance targets (setting ESLP targets), (4) measuring environmentally sustainable logistics performance metrics (measuring ESLP metrics), and (5) analysis and action of environmentally sustainable logistics performance metrics (analysis and action of ESLP metrics) [14]. The study by [14] developed the ESLPM process by an extensive literature review.

The first activity, selecting ESLP variables, is guided by strategic priorities and by the level of value-added necessary at the 3PL to satisfy the buyer's requirements on environmentally sustainable logistics services. The relevance of different logistics variables depends on unique characteristics of both suppliers (i.e., 3PLs) and buyers (e.g., [1,13]). An abundant number of logistics services performance variables exist in different frameworks. Examples of ESLP variables are fill rate, loading factors, vehicle technology (e.g., hybrid vehicles), type of fuels and transportation (e.g., transportation modes, transportation network efficiency, route optimization), logistics system design (e.g., coordination of goods), choice of partners based on environmental performance, emissions (e.g., air emissions, greenhouse gas emissions, CO_2 emissions), pollution (e.g., control and prevention) and energy consumption that can take place in other parts of the business like in warehouses [15]. The ESLPM process was found to have a focus on transportation rather than logistics variables [14]. A study of PM in 3PL [31] found that the studied 3PLs saw environmental performance variables as under development, and focused on CO_2 emissions in transportation.

The second activity, defining ESLP metrics, reflects the characteristics of the environmental logistics services in detail. This activity is usually done differently by the suppliers (i.e., 3PLs) and buyers. To arrive at common definitions of these metrics is complex and needs to be coordinated between the 3PLs and buyers (e.g., by jointly define what to measure, how to measure it) [13,14,32,33]. In practice, this is highly difficult due to the low maturity in using environmental metrics. Some examples of the metrics related to (i) energy: Total fuel consumption from non-renewable sources, and fuel use; (ii) 3PLs' environmental assessment: Percentage of new suppliers using environmental criteria; (iii) fleet compositions: Vehicle type, total number and age of fleet, and average fuel consumption; (iv) emissions: CO_2 emissions (fuel used x heating value x emission factor, distance travelled x emission factor, and average fleet CO_2 emission per unit driven); (v) congestion: Off-peak distribution, percentage of delivery by modes of alternative transportation; and (vi) mode of transportation: Number of freight deliveries by mode per unit of time [14]. Reference [31] found that 3PLs have simplified and schematic definitions for CO_2 emissions.

The third activity, setting ESLP targets, is influenced by demands from government and buyers. Each performance metric needs a specifically formulated performance target to enhance the overall accuracy and effectiveness of performance management. Targets are expected to drive the environmentally sustainable logistics development forward for both 3PLs and buyers, and reflect the buyer's requirements. They need to be specific and set to a timeframe [34,35]. This can be achieved by setting the target jointly with the buyer. The target's figures can be expressed in terms of an average (i.e., the same target level applied for

buyers or suppliers) or as a specific target (i.e., individual targets for specific buyers and suppliers). In case an average target is not jointly determined by both partners, this indicates a low degree of integration in the activity of target setting [13]. In literature, there are several groups of environmentally sustainable logistics target; for example, (i) quantitative targets: Reduce absolute energy from non-renewable sources by 30 percent by 2025; (ii) absolute targets: Reduction of CO_2 over time in a specified quantity; (iii) intensity target: Reduction of CO_2 per square meter; (iv) top-down targets: Organizational level targets for emission reduction used uniformly across all functions; and (v) bottom-up targets: Assessment of different aspects internally in an organization and their potential to reduce emissions on an organizational level. It is also important to determine the target boundary, choose the target base year, and define the length of the target commitment period. Finally, the scope of the environmental targets should ideally include supply chain partners to achieve positive effects (e.g., industry-wide emission reduction) [14]. Few buyers discussing targets with their 3PLs were found by [31].

The fourth activity measuring ESLP metrics includes data collection and reporting feedback. Reference [13] identified four issues related to integration of this activity: (i) measurement reports generation: Performed directly from systems like ERP or indirectly by using spreadsheets for reports creation; (ii) measurement frequencies: Daily, weekly or monthly; (iii) performance outcome: Average for all buyers or 3PLs, or individual one; and (iv) performance feedback: Conducted by other partner, commented, adjusted and accepted to arrive at common agreement of the performance outcome, prior to starting the subsequent activity of analyzing. There are several tools for measuring ESLP metrics such as the GHG (Greenhouse Gas) protocol for accounting and reporting of the greenhouse gases. For 3PLs in Sweden, the organization Network for Transportation Measures (NTM) developed standards for calculation of environmental performance of various transport modes. EcoTransIT is another organization which offers calculation methods for tracking of environmental impact of freight transportation (e.g., direct and indirect energy consumption and emissions of vehicles). Yet another calculation method is the SÅKlimat Calc which provides tools for monitoring of 3PLs' energy consumption and environmental performance of employed resources [14]. Using tools for measuring ESLP metrics is important; reference [36] stated that it is vital to create routines and robust measurements. Reference [31] found 3PLs to have good real-time data collection possibilities, but varying report-making capabilities. Performance feedback can be commented on, adjusted and accepted by the other partner [13].

The last activity is analyzing ESLP metrics includes improvement actions. According to [13], it aims at reviewing the performance output in relation to the corporate and supply chain strategies. The analysis can consider the performance output on dyadic level by jointly determining corrective actions. In practice, 3PLs and buyers operating in Sweden have difficulties identifying what methods to use for analysis and follow up activities. Organizations conducting the environmental performance analysis reported a lack of benefits of doing so [14]. The study by [31] found low demand from buyers on analysis of performance results. Reference [37] concluded that risk and rewards sharing between shippers and carriers is of low importance when building partnerships.

2.2. An Initial Framework for ESLPM Process Integration

Reference [13] applied certain criteria to the degree of integration of PM process activities (referred to as high or low). Selecting performance metrics was highly integrated if the same metrics were applied by supplier and customer, and low if the same metrics were not applied. The adaptation to the ESLPM process is concluded in Table 1.

We suggest using the same logic for the ESLPM process. Defining metrics was, for mature logistics performance metrics like lead time and on-time delivery, described using four issues (measurement object, measurement point, time unit and comparison). Integration was coded as low if there were differences between customer and supplier in two or more issues, and high if not more than one issue differed. This study focused upon environmental performance metrics which are less mature, less well-defined and cannot be operationalized into few specific issues. We therefore suggest a high degree of integration

to be characterized as if definitions are jointly discussed and agreed, and a low degree of integration if they are not discussed/agreed. Integration in setting targets was coded as high if targets were jointly discussed/agreed and low if they were not. Measuring integration was coded as low if performance was measured as an average for all suppliers or customers. To be coded as high, specific (for the 3PL or buyer) measurement of performance was required, together with performance feedback between the partners. Analyzing integration was coded as high if both analysis and improvement were conducted in a joint manner.

Table 1. An initial framework of the degree of environmentally sustainable logistics performance management (ESLPM) process integration.

ESLPM Process Activity	Theoretical Operationalization of the ESLPM Process Activities		Degree of Integration of ESLPM Process	
			High	**Low**
Selecting ESLP variables	Fill rate, loading factors, vehicle technology, type of fuels and transportation, logistic system design, choice of partners, CO_2 emissions, pollution, and energy consumption		Apply the same ESLP variables	Do not apply the same ESLP variables
Defining ESLP metrics	*Energy:* Total fuel consumption from renewable sources, distance x fuel economy factor *3PL:* % of new suppliers using environmental criteria *Fleet:* Vehicle type, total number and age of fleets, engines, average fuel consumption, total distance driven and total fuel consumption *Emissions:* Fuel used x heating value x emission factor, distance travelled x emission factor, average fleet CO_2 emission per unit driven, % of vehicles in fleet with pollution-abatement technology *Congestion:* Off-peak distribution, % of delivery by modes of alternative transportation *Transportation mode:* Number of freight deliveries by mode per unit of time		Jointly discussed and agreed ESLP metrics definitions	Not jointly discussed and agreed ESLP metrics definitions
Setting ESLP targets	- Quantitative - Absolute - Intensity	- Top-down - Bottom-up	Jointly discussed and agreed ESLP targets	Not jointly discussed and agreed ESLP targets
Measuring ESLP metrics	- Measurement reports generation - Measurement frequencies - Performance outcome - Performance feedback - Average, specific measurement	*Specialized tools for measuring* GHG protocol NTM, EcoTransIT SÅKlimat Calc	Specific measurement of ESLP metrics and performance feedback is commented, adjusted and accepted	Average measurement of ESLP metrics and no performance feedback
Analyzing ESLP metrics	Joint analysis Jointly determined corrective actions		Joint analysis and improvement	No joint analysis and improvement

2.3. Method

Case study [38] was selected as method, corresponding to the exploratory character of the purpose and enabling in-depth insights of empirical phenomena in context. A multiple-case study was chosen in order to see the phenomenon through multiple lenses.

2.3.1. Sample Selection

To study integration of ESLPM processes between buyers and 3PLs, dyads were the study object. To identify dyadic cases, help was taken from a Swedish transportation association to first sample 3PLs. In order to qualify for the study, 3PLs had to possess the following criteria: they should have an environmental coordinator, perform environmental measurements, be conveniently located, preferably be from different industries and furthermore willing to participate in the study. The 3PL's environmental coordinator selected one buyer each, based on the criteria that they had a good relationship and their assumed work with environmentally sustainable logistics. The environmental coordinator suggested respondents within the own and the buyer's organizations. The buyer respondent could suggest additional respondents. This is shown in Table 2.

Table 2. Studied organizations and respondents.

Buyer	Respondents	3PL	Respondents
Buyer1	Transport manager	**3PL1**	Key account manager Environmental and quality manager
Buyer2	Production manager	**3PL2**	Environmental and quality manager Key account manager logistics
Buyer3	Commodity manager Environmental coordinator	**3PL3**	Expert in logistics services Environmental coordinator

2.3.2. Data Collection

An interview guide (Appendix A) was shaped by the frame of reference and particularly Table 2. The interview guide focused on describing the ESLPM process in each organization. Semi-structured interviews, implying both structure and flexibility, were carried out. The first interview was carried out by two researchers together, and the remaining interviews by one researcher. In total 10 interviews were carried out. The interviews took between one and two hours, and mainly took place at the organization's headquarters. The interviews were transcribed, validated by the respondents and translated into English. Secondary data like annual reports, sustainability reports and tender information were collected to complement the interviews. All data was organized into a case study database [38].

2.3.3. Data Analysis

When performing a multiple-case study it is necessary to define the unit of analysis, that is, the entity where analysis takes place. Within this study, the unit of analysis is the ESLPM process between 3PLs and buyers, not the ESLPM process in each individual organization. The structured interview guide aided in coding and turning the empirical data into illustrative descriptions. Then the proposed framework was applied to analyze the degree of ESLPM process integration, by comparing each ESLPM activity between 3PL and buyer. The data was coded and analyzed by two researchers separately and then compared and discussed to reach an agreement. This was focused upon classifying the degree of ESLPM process integration in each unit of analysis (or each dyad of 3PL and buyer). The following cross-case analysis looked for similarities and differences between the cases with a pattern-matching approach [30], and aimed for developing and proposing a more applicable framework for ESLPM process integration. As our cases exhibited a rather low degree of ESLPM process integration we also relied heavily on our initial framework when proposing the final framework.

2.3.4. Research Quality

Several authors (e.g., [38,39]) list criteria to ensure research quality. In this study, we collected primary data by interviewing several respondents in most case. To triangulate the responses, the interview data was supplemented by secondary data. The analysis and results were reviewed by peer researchers. A case study protocol and several tables were created as a part of the research database, including the full version of the interview guide, the research protocol, the recorded and transcribed interviews, the data coding and analysis, and the quality evaluation criteria (available upon request from the authors).

3. Results

3.1. Illustrating Dyadic ESPLM Process Integration

The ESLPM process in the three dyads are illustrated, structured after the ESLPM process activities. The section is finalized with classifications of the degree of integration in each activity and in the overall ESLPM process (see Table 3).

3.1.1. The ESLPM Process between Buyer1 and 3PL1

Buyer1 is a large, privately owned manufacturer in the food industry. 3PL1 is a SME (small and medium-sized company with max 249 employees), owned by its partners. Buyer1 is focusing on building long-term relationships. 3PL1 sees the relationship as important since it has been ongoing for more than five years.

Selecting ESLP Variables

Buyer1: No environmental performance variables exist with any 3PL they are buying services from. They expect 3PL1 to perform well anyway (Transport manager). 3PL1: There are no environmental performance variables in the contracts, but there are many environmental requirements in the request for quotation (RFQ), such as tires, engines and fuel, which are like order qualifiers. They measure CO_2 emissions. "If Buyer1 wants to add performance variables, we would not hesitate to do so." (Key account manager).

Defining ESLP Metrics

Buyer1: They expect 3PL1 to perform well without any metrics definitions from them (Transport manager). 3PL1: "When we measure metrics like delivery times together with our customers, then they define metrics generously, with large time windows". To adapt definitions of metrics might be difficult, since they do not always have the data necessary. Fill rate is something that is discussed intensively with buyers, but not how to define that metric (Key account manager).

Setting ESLP Targets

Buyer1: The overall targets for Buyer1 are not broken down so they can be used in the contracts. The reason for not doing this, according to the Transport Manager is "We do not see it as a necessary task to do. We are taking it for granted that they are resource effective". 3PL1: "Neither we nor the buyers are there yet, when it comes to target setting" (Key account manager).

Measuring ESLP Metrics

Buyer1: For data collection, Buyer1 gets the environmental report from 3PL1 quarterly, and this is included in their own sustainability report (Transport manager). 3PL1: They measure emissions based upon SÅKlimat Calc and distribute them to buyers in a schematic way. The content of the environmental report was decided by 3PL1, who simply asked if their own environmental report was acceptable for Buyer1, and it was (Environmental and quality manager). The environmental requirements in RFQ, such as tires, engines and fuel, are seldom followed up by Buyer1.

Analyzing ESLP Metrics

Buyer1: They do not have much ongoing contact with 3PL1, but "if there is a problem we call each other and we solve it" (Transport Manager). 3PL1: Between the deliveries of the environmental report, there are no joint activities such as discussions or meetings around the results either from 3PL1 or from Buyer1. They often analyze and evaluate the services they perform for Buyer1 internally (Key account manager).

3.1.2. The ESLPM Process between Buyer2 and 3PL2

Both Buyer2—a waste service organization—and 3PL2 are SMEs which are privately owned. 3PL2 performs many different logistics services for Buyer2.

Selecting ESLP Variables

Buyer2: They select emissions that they want 3PL2 to present (Production manager), but have not done this together with 3PL2. In their tender document, it is stated that the bidder shall have environmental metrics and targets for significant environmental considerations from the bidders

business, as well as an action plan with assigned responsibilities. Environmental requirements in the contract include conditions like vehicles used are EURO 5 and vehicles must be equipped with a feedback system for eco-driving. 3PL2: Have a large number of environmental variables; for example, different emissions, fuel consumption and energy consumption. "As we are ISO14001 certified we have to . . . , but we do not have joint variables with Buyer2" (Quality and environmental manager).

Defining ESLP Metrics

Buyer2: They have defined emissions as fuel consumption per ton (Production Manager). Furthermore it can be seen in the tender document that the eco-driving system results shall be compiled per car per month, and fuel consumption and emissions per kilometer and vehicle. 3PL2: This is seen as difficult as 3PL2 wants the many carriers that perform the logistics services for Buyer2 to provide the same types of data, but as they do not, the data is vague. "We have just started to discuss this with the carriers, to meet our buyers' demands" (Quality and environmental manager).

Setting ESLP Targets

Buyer2: In the contracts they have a fine and bonus system, but no targets. They have internal targets for emissions, which is why they have an emission calculation requirement in the contract with their suppliers (Production manager). 3PL2: The environmental manager proposes targets for all their metrics, which are used unless the buyer has requested other targets in the contract.

Measuring ESLP Metrics

Buyer2: There is nothing in the contract that tells 3PL2 how to measure. However, the tender document says when, that fuel consumption and emissions shall be reported annually to Buyer2, which is done. They receive data from 3PL2 through e-mail, in a spreadsheet or in a Word document, and transfer it to their own system. "We trust in 3PL2, we don't care about how they collect or analyze the data" (Production manager). The data is aggregated and presented in the environmental report. It is easy to follow up what type of vehicles are used but it is more difficult to follow up on the fuel that is used. It is up to the 3PL to live up to the requirements in the contract (Production manager). 3PL2: Not only do the carriers measure differently, furthermore they deliver just about 60% of the data 3PL2 is asking for. They schematically measure emissions. They are developing IT support for the drivers for better measurement (Quality and environmental manager).

Analyzing ESLP Metrics

Buyer2: 3PL2 needs to work with continuous improvement. Buyer2 has meetings and training conferences with 3PL2. At these meetings, emissions are presented and discussed in relation to previous years. "As a buyer we set the requirements, but it is a teamwork that has to take place together with the supplier" (Production manager). If the contract is broken a fine can be charged. A bonus is paid if 3PL2 is performing better than the environmental requirements in the contract. 3PL2: It is important that we work together with our buyers to improve the environment. Every year Buyer2 and 3PL2 have a training conference, the participants of that conference are all employees and partners (Quality and environmental manager). The analysis of environmentally sustainable logistics has been better thanks to these conferences (Quality and environmental manager, Key account manager logistics).

3.1.3. The ESLPM Process between Buyer3 and 3PL3

Buyer3 is a large municipality. 3PL3 is a large 3PL, and the relation started in 2014.

Select ESLP Variables

Buyer3: The environmental expert gives advice how to include environmental considerations in the RFQ process (Commodity manager). According to the tender document for logistics services, it can

be trucks which at least meet the emission requirements for EURO 4. These recommendations are aligned with the environmental variables in the environmental program (Environmental coordinator). 3PL3: They have emissions variable based upon GRI, UN Global Compact and ISO26000. "If the buyer sets environmental requirements on their own, they can be impossible to fulfill. But we seldom discuss this with the buyers, even if it gets slowly better." However, they have variables that focus on their own suppliers (Expert in logistics services).

Defining ESLP Metrics

Buyer3: No environmentally sustainable logistics performance metrics are defined with 3PL3. All environmental metrics are extracted from the environmental program (Commodity manager, Environmental coordinator). 3PL3: Metrics calculation can be seen in our annual and sustainability report. However that is not perfectly clear. No definitions are done together with Buyer3 (Expert in logistics services).

Setting ESLP Targets

Buyer3: In a purchasing situation, the purchasing unit can search for environmental targets at the national agency for public procurement (Commodity manager). "When giving input to purchasing, let us say about fossil fuel, we always have our long-term target of being fossil fuel free by 2030 in our mind, but we do not stipulate targets" (Environmental coordinator). "Even if we do not have environmental targets in the contracts or set any targets together with our suppliers, we are evaluating the RFQs much more now against environmental considerations—now the bidders have to explain how to reach our environmental targets, like 'The municipality organization will be fossil fuel free by 2030'" (Commodity manager). 3PL3: "We have to be much better at this, work with environmental targets with the buyers. I do not have any procedures for this, unfortunately" (Expert in logistics services).

Measuring ESLP Metrics

Buyer3: Environmental coordinator asks 3PL3 once a year about the emissions from the logistics services. "We ask for statistical data for our overall target of being fossil fuel free by 2030" (Commodity manager). "If we were clearer in the RFQ about what we measure and how we want suppliers to measure, it had been easier to get the information from them. Today they just put a check in a box saying that "we shall follow up the environmental requirements", but some supplier do it and other suppliers do not"(Commodity manager). "Maybe we should try this next time" (Environmental coordinator). 3PL3: "We don't have any joint activities when it comes to environmental measurements, but you can say that all our activities are sustainable—we want to drive as little as possible because that is the best economic and environmental thing to do" (Expert in logistics services). 3PL3 delivers data to the environmental coordinator at Buyer3 once a year (Expert in logistics services).

Analyzing ESLP Metrics

Buyer 3: Buyer3 wants to stimulate suppliers to be more environmentally friendly to achieve long-term sustainable development (Environmental considerations for procurement). "3PL3 is so good in what they do, so we do not meet them often, maybe once a year" (Commodity manager). 3PL3: "Most of the RFQ is about the lowest price, so there is not really any proactive environmental work, even if it is getting better" (Expert in logistics services).

3.2. Current Degree of ESLPM Process Integration

This section is initiated with Table 3, which summarizes the classifications in the three dyads. The degree of ESLPM process integration was found to be low in the studied dyads which is in line with literature (e.g., [8,24,31]). Dyad 1 and 3 had 4.5 activities each, integrated to a low degree. The dyad with the most integrated ESLPM process was dyad 2, with 2.5 activities highly and 2.5 activities

lowly integrated. The 3PLs are overall doing better and seem more mature in their environmental measurement than the buyers. This observation is in contrast to previous research, which stated that it is the buyer who initiates such activity, and requires the 3PL to do likewise [1,2,6]. Reference [1], however, found that mature buyers with expressed requirements imply increased environmental practices from 3PLs, while relatively uninterested buyers get environmental practices of standard type.

Table 3. Degree of ESLPM process integration in the dyads.

ESLPM Activity	Dyad 1—Food Industry	Dyad 2—Waste Management Sector	Dyad 3—Public Sector
Selecting ESLP variables	Low—the same ESLP variables are not applied. However the same requirements are selected and applied	High—the same ESLP variable is applied. Also the same requirements are selected and applied	Low—the same ESLP variables are not applied. However the same requirements are selected and applied
Defining ESLP metrics	Low—ESLP metrics definitions are not jointly discussed/agreed	Low—ESLP metrics definitions are not jointly discussed/agreed	Low—ESLP metrics definitions are not jointly discussed/agreed
Setting ESLP targets	Low—ESLP targets are not jointly discussed and agreed	Low—ESLP targets are not jointly discussed and agreed	Low—ESLP targets are not jointly discussed and agreed
Measuring ESLP metrics	Low—average measurement of ESLP metrics	Low—average measurement of ESLP metrics	Low—average measurement of ESLP metrics
	High—performance feedback exists but it is not commented, adjusted or accepted	High—performance feedback exists but it is not commented, adjusted or accepted	High—performance feedback exists but it is not commented, adjusted or accepted
Analyzing ESLP metrics	Low—no joint analysis or improvements	High—joint analysis and improvements	Low—no joint analysis or improvements

4. Discussion

4.1. Proposed Framework for ESPLM Process Integration

It can be concluded that the most observed ESLPM activities were integrated to a low degree, and were mainly about transportation services rather than logistics services. Therefore, as shown in Table 4, we altered the initial framework only with two major aspects. We suggested introducing a medium degree of integration alongside high and low, in order to show more nuances and adapt more to the state found in the empirical study. This accords to the way [17] handled process integration. Moreover, to provide an overview on how to operationalize the ESLPM process activities, we included in the framework a column with "Suggested operationalization of the ESLPM process activities", coloured by the empirical study. Nevertheless, the proposed framework is the first one that, to our best knowledge, considers the integration of the ESLPM process and its different degrees between buyers and 3PLs. It can provide some guidelines to practitioners in how to carry out the integration of the ESLPM process.

4.1.1. Criteria for the Degree of "Selecting ESLP Variables Integration"

Just dyad 2 qualified for high degree of integration in selecting ESLP variables, by selecting the variable emissions. This result is in line with the findings of [31]. ESLP variables (examples could be fill rate and energy consumption, e.g., [15]) that were possible to measure on an ordinal scale were hence scarce. The application of these variables might depend on specific business strategies of buyers and 3PLs (e.g., [1]). Instead it was found that the organizations work with requirements, which were more of a binary or yes/no character. Some examples were the use of a certain vehicle technology (EURO4/5) and eco-driving (e.g., [15]). Requirements were expressed and exchanged in all dyads. We see selecting and applying the same ESLP requirements as a development step towards selecting ESLP variables, and proposed that medium integration in this activity could imply that buyers and

3PLs apply the same requirements. High and low degree of integration remain the same. In Table 4, a number of possible variables from the literature review are shown. Those found in this small study were labeled frequent variables. Literature also stressed other variables, which rather are requirements. We clustered them as requirements.

4.1.2. Criteria for the Degree of "Defining ESLP Metrics Integration"

Some requirements were standardized, like EURO-classed vehicles, which implies that the partners' joint definitions were not necessary. For standardized requirements, a high degree of integration can take place without discussion or agreement. A high degree of integration, to jointly discuss and agree on definitions of variables, was also kept. For non-standardized requirements, such as eco-driving, discussion and agreement are necessary; when this takes place, a medium degree of integration is suggested. A low degree of integration means that no joint discussion and agreement on either variables or requirements take place. In general, the defining of metrics can be based on name, objective, scope, target, definition, unit of measure, frequency, data source, owner, driver, etc. [13]. In Table 4 we suggest a number of metrics.

4.1.3. Criteria for the Degree of "Setting ESLP Targets Integration"

According to existing research [13,14], target setting is seen as difficult and it is recommended to discuss and agree this together with a buyer, as targets are based on buyer´s requirements. Several types of targets including quantitative, absolute, intensity, top-down and bottom-up were suggested in previous literature. However, across all studied cases, targets were not determined jointly; at best they were decided internally and independently applied on the other partner. Targets could be part of RFQ, but were not usually included in contracts with 3PLs. To create a medium degree of integration, we propose to jointly discuss targets, while a high degree of integration implies agreement on jointly agreed ESLP targets, possibly in a contract. A low degree of integration is indicated by no discussion or agreement on the targets.

4.1.4. Criteria for the Degree of "Measuring ESLP Metrics Integration"

The reference [13] framework contained two integration criteria for measuring (specific/average measurement and performance feedback or not). In our study, those two criteria were not linked together; to acknowledge this practice, we suggest splitting measurement into two separate ESLPM process activities. In all dyads the actual measuring was integrated to a low degree, as the 3PLs measured emissions in an average, schematic way, which did not qualify as a measurement for each specific buyer. Specific measurement would require stronger data collection, which was being implemented by 3PL2. Tools for measuring used by the cases included mainly less specialized ones like Excel. In dyad 1 the specialized tool SÅKlimat Calc was utilized; we suggest this or other specialized tools like GHG protocol and NTM standards [14] to be a sign of medium degree of integration.

4.1.5. Criteria for the Degree of "ESLPM Feedback Integration"

Performance feedback between the partners was common among the dyads, in the shape of different environmental reports. As observed in our cases, reports can be provided to the buyers quarterly or annually.

Table 4. A proposed framework with criteria for the degree of ESLPM process integration.

ESLPM Process Activity	Suggested Operationalization of the ESLPM Process Activities	High Degree of Integration if Buyer and 3PL	Medium Degree of Integration if Buyer and 3PL	Low Degree of Integration if Buyer and 3PL
Selecting ESLP variables	- *Frequent variables:* (CO_2) emissions, fill rate, energy consumption *Requirements:* Vehicle technology (engines, tires), vehicle inspections, traffic safety, eco-driving, type of fuels and transportation	Apply the same ESLP variables	Apply the same requirements	Do not apply the same ESLP variables or requirements
Defining ESLP metrics	*Examples of metrics:* - *Energy:* Total fuel consumption from renewable sources, distance x fuel economy factor, average fuel consumption, total distance driven and total fuel consumption - *Emissions*: Fuel used x heating value x emission factor, distance travelled x emission factor, average fleet CO_2 emission per unit driven, % of vehicles in fleet with pollution-abatement technology - *Congestion*: Off-peak distribution, % of delivery by modes of alternative transportation - *Transportation mode:* Number of freight deliveries by mode per unit of time	Jointly discussed and agreed ESLP metrics and requirements definitions	Jointly discussed and agreed ESLP requirements definitions	Not jointly discussed and agreed ESLP metrics or requirements definitions
Setting ESLP targets	- *Targets:* Quantitative, absolute, intensity, top-down, bottom-up	Jointly agreed ESLP targets	Jointly discussed ESLP targets	Not discussed or agreed ESLP targets
Measuring ESLP metrics	*Type of measuring:* - Average, specific *Tools for measuring* - Specialized (GHG protocol, NTM, EcoTransIT, SÅKlimat Calc.) - Less specialized (spreadsheets)	Specific measurement of ESLP metrics using specialized tools	Average measurement of ESLP metrics using specialized tools	Average measurement of ESLP metrics and using less specialized tools
ESLPM feedback	*Performance feedback (PF):* Provided/commented/adjusted/accepted - Frequency - Fine and bonus system	PF is adjusted and accepted by the receiver; fine and bonus system is applied	PF is commented by the receiver	PF is provided
Analyzing ESLPM	- Jointly analyze and improve - Review the ESPLM process	Joint review, analysis and improvement	Separate review, analysis and improvement	No review, analysis and improvement

Performance feedback can further be commented, adjusted or just accepted by the receiving partner.

While performance feedback was exchanged, fulfilling one criteria of high degree of integration, in none of the dyads did the buyer comment, adjust or accept the feedback. We suggest a low degree of integration be to just providing performance feedback, while a medium degree of integration corresponds to commented feedback and a high degree corresponds to adjusted and accepted feedback. In the most mature case, dyad 2, a fine and bonus system was applied which is a sign of high degree of integration.

4.1.6. Classifying "Analyzing ESLPM Integration"

The results suggest that analyzing environmental performance measurement between buyers and 3PLs are under development, which accords with the findings of [31]. Only dyad 2 jointly discussed actual emissions versus targets and defined corrective actions, as suggested by [13]. The low degree of integration was also confirmed by [14] who concluded that organizations operating in Sweden lack knowledge about the benefits of conducting such analysis. Reference [13] meant that analysis also implied reviewing the ESLPM process. We suggest keeping the initial degrees of integration, but add a medium degree for separate analysis and improvement.

4.1.7. Criteria for the Degree of "ESLPM Process Integration"

Many of the studied organizations acknowledged the area of ESLPM process integration as important, but said that they were "not there yet" and explained a development to take place. The observed lack of process-oriented approaches when integrating environmental aspects across dyads was also confirmed by [7].

5. Conclusions

This study started by pointing out a lack of process-based approaches for integrating the ESLPM process between buyers and 3PLs (e.g., [15,24]). The integration of this process is seen as a vital in conforming to ever increasing environmental requirements both from authorities and from consumers. Ultimately, a successful implementation can translate into a competitive business opportunity [19]. The purpose of this study is to undertake the initial step in this direction, namely, to propose a framework with criteria for the degree of ESLPM process integration, and to illustrate this integration between buyers and 3PLs.

The suggested framework for ESLPM process integration extends the existing limited research on environmental performance management frameworks and approaches (see frameworks by [14,15,17,23,26,27]). The framework adapts the process perspective from [13], for example, by including six ESLPM activities such as selecting variables, defining metrics, setting targets, measuring, feedback and analyzing the ESLPM process. To allow for the classification of current degree of integration, each of the activities are then defined in terms of their suggested operationalization and corresponding high, medium and low degree of ESLPM process integration. The proposed framework is the main scientific contribution of the paper; building further on the PM process integration framework by primarily [13]. It adds to [13] by expanding integration into an environmentally sustainable context and also by including 3PLs as one supply chain actor. It also expands the ESLPM process descriptions by [14] as it adds process integration criteria.

By doing so, this study also contributes to development of guidelines for managers, to identify their and their supply chain partners' current integration degree (maturity) and also what actions are needed to advance to a higher degree [22].

This study further shows that the current integration degree of ESLPM process in the studied Swedish dyads is low. This finding corresponds to previous studies (e.g., [24,31]). This finding has societal implications, and indicates that there is a need for further integration efforts in order to improve environmental performance levels. Comparing the environmental measurement maturity of the analyzed buyers and 3PLs, the 3PLs seem more mature than the buyers. This contradicts previous research, which determined that it is buyers who initiate this activities and the 3PLs are expected to adapt to the requirements [1,2,6]. Some limitations should be related to the study. The sample selection has influenced

the results, and other cases may well show different patterns. However the purpose was not to give a broad overview of the field, but rather illustrate practices and give input to the development of the proposed framework. To further evaluate the proposed framework, dyads should be sampled out of environmentally more mature buyers who can guide the way to 3PLs. Then results more in line with [1,2,6] may be achieved. This is one suggestion for further research. Another suggestion would be to carry out a large scale survey-based study to evaluate the degree of integration of the ESLPM process between buyers and 3PLs and to identify the existing challenges related to integration. Such study would not only provide a state-of-the-art description of ESLPM process integration in practice but also methodologically contribute to the call for a more mixed method approach when conducting research on performance measurement (e.g., [21]). A third suggestion for further research would be to conduct a similar study but particularly focus on non-transportation activities. The development towards more sustainable logistics implies that performance also concerning activities like warehousing and picking should be managed. This should further develop the process and its integration. Finally, to further advance sustainability, social sustainability could be included in ESLPM processes; both its characteristics and how to integrate social sustainability between 3PLs and buyers.

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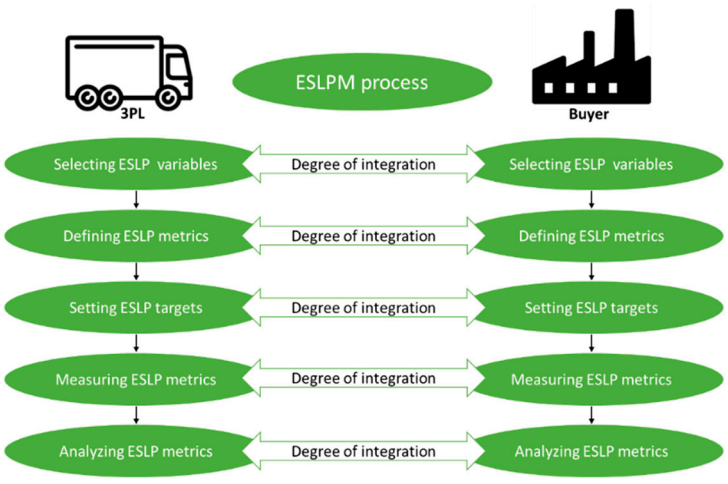
Appendix A. Interview Guide

The environmentally sustainable logistics performance management (ESLPM) process is based on performance management process [39].



I have read some background information about your organization (mostly from the website) but do you still want to tell a little about yourself?

- How many employees do you have?
- What is your turnover?
- What does the ownership structure look like in your organization?

Selecting ESLP Variables

Example of variables:
CO_2 emissions from transport (fuel but also cooling system, etc.)
Energy use in the warehouses (heating, lighting, ventilation)
Air quality
Material
Packing
Education
Other variables:

1. What metrics is your measurement process based on?
2. Who has decided what metrics to use?
3. Do you use any standard to choose metrics? (GHG protocol, ISO, NTM, Eco Transit, GRI, Odette, Q3, etc.)?
4. Does the environmental strategy affect your choice of metrics?
5. How do you do when you change the metrics?
6. Who decides when to change metrics?
7. Who decides what metrics to change?

Defining ESLP Metrics

Example of definition:
CO_2 emissions from transport (fuel, tire, cooling system)—fuel type * amount * km (g/km)
Water use on premises (warehouses, distribution centers, etc.)—Purchased amount of water (l/m^2)
Energy use on premises (warehouses, distribution centers, etc.)—Purchased amount of electricity, oil, pellets etc. (Mwh/m^2)
Other definitions:

8. How do you define the metrics?
9. What do the definitions look like? Can you show some examples?
10. Who is responsible for defining your metrics?
11. How do you communicate around the definitions of the metrics?
12. How often do you revise the definitions metrics?
13. Who decides to change the definition of the metrics?
14. How do you communicate about changing the definitions of the metrics?
15. Do you use any standard to define the metrics (GHG protocol, ISO, NTM, Eco Transit, GRI, Odette, Q3, etc.)?
16. How do you use the selected standard(s) for the definition of the metrics?
17. Do you have IT system support to define the metrics?
18. How do the strategy and chosen metrics affect the definitions? (e.g., this strategy exists and then these measurements are needed to measure that; we control the chosen strategy and then the metrics must be defined as follows)

Setting ESLP Targets

19. Who is responsible for setting the targets?
20. What are the targets?
21. How do you choose target level?
22. Why are the targets reviewed?
23. How often are the targets reviewed?
24. How are the targets communicated?
25. Do the employees know about the targets?
26. To what strategy are the targets connected (the environmental strategy, the business strategy)?
27. Do you use any standard to set targets (GHG protocol, ISO, NTM, Eco Transit, GRI, Odette, Q3, etc.)?
28. How do you use the standard(s) for setting targets?
29. Do you have IT systems support for setting targets (for scenarios, etc.)?
30. How do you use the IT system for setting targets?

Measuring ESLP Metrics

31. How do you collect data for you metrics (manually, automatically, standardized way)?
32. Who is responsible for the data collection?
33. How often does data collection take place?
34. Do you have a protocol for collecting data (a description for how to collect the data)?
35. How is the collected data used (to create reports)?
36. How often do you use the collected data?
37. How do you compile the data and/or measure the data (measurement techniques, data collection techniques, type of NMTCals or Så KLimat calc)?
38. How do you use the standard for data collection (as a data collection protocol, as a calculator, for finding emission data, etc.)?
39. Do you have an IT system for data collection and/or for measuring the metrics?
40. How do you use the IT system for data collection and/or measuring the metrics?

Analyzing ESLP Metrics

41. How often are the results of the measurements analyzed?
42. Who is responsible for analyzing the results of the measurements?
43. What improvement work can you see as a result of the measurements?
44. Who is responsible for the improvement work?
45. If the result is negative in relation to the target, what actions take place?
46. If the result is positive in relation to the target, what actions take place?
47. Do you use any standard(s) to analyze and follow up on the results?
48. How do you use the standard(s) for analyzing and following up on the results?
49. How do you communicate the results (annual reports, sustainability reports, environmental reports, and other ways?)
50. How do you report the data (sustainability report, Excel, Word, other)?
51. How do you create your reports of your measurement results? (IT system, manually, Word, Excel, etc.)?
52. Do you have IT system support to analyze and follow up on the results?

Finally, do you think we have forgotten something?

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