

This is the accepted version of: Creazza, A., Colicchia, C. and Evangelista, P. (2023), "Leveraging shippers-logistics providers relationships for better sustainability in logistics: the perspective of SMEs", The International Journal of Logistics Management, Vol. ahead-of-print No. ahead-of-print.

<https://doi.org/10.1108/IJLM-03-2022-0103>

©2023 This manuscript version is made available under the CC-BY-NC-ND 4.0 license.

**TITLE: Leveraging Shippers-Logistics Providers Relationships for Better Sustainability in Logistics: the perspective of SMEs**

## **ABSTRACT**

**Purpose:** The organization of services can affect the adoption of sustainable practices within the relationship between a buyer (e.g., a shipper) and a supplier (e.g., a logistics service provider - LSP). The purpose of this paper is to analyse, within this relationship, the mechanisms affecting collaboration between shippers and LSPs towards adopting green logistics practices to reduce the negative environmental effects of logistics processes. We take the perspective of small and medium enterprises (SMEs), which represent – although less investigated than large enterprises - a relevant field of investigation given their impact on the environmental sustainability of logistics processes.

**Design/methodology/approach:** We conducted a multiple case-study investigation on a set of dyads involving shippers and LSPs. We explored the antecedents shaping the approach to sustainability in logistics and, adopting the Absorptive Capacity (AC) theory, the learning and knowledge transfer processes leading to the adoption of green practices.

**Findings:** Collaboration between shippers and LSPs for better sustainability in logistics seems not to work when relationships are limited to simple annual (or pluriannual) contracts, and when shippers do not show ambition to improve the level of sustainability of their logistics processes (regardless of whether they show an interest in general sustainability matters). On the other hand, successful cases show higher commitment in the dyadic relationship with respect to improving logistics sustainability, good levels of communication and a more structured process of knowledge sharing, enabled by IT integration, shared performance monitoring, and creation of inter-organizational teams.

**Originality/value:** While most of the existing research focuses on the perspective of shippers or LSPs, this work is original since it explores collaborative mechanisms within a buyer-supplier relationship simultaneously taking the perspective of both parties, according to the lens of the AC. It identifies directions for improving collaboration within the shipper-LSP relationship in the context of SMEs to foster the adoption of collaborative green logistics practices to impact sustainability positively.

**Keywords:** Environmental sustainability, Buyer-supplier relationship, Logistics service providers, Absorptive capacity, Small to medium-sized enterprises, Case study

## **1. Introduction**

The logistics industry is a key contributor to the economic growth, however, it implies negative impacts on the environment and society (McKinnon, 2018). According to the International Energy Agency, the emissions generated by freight transport account for 8% of global greenhouse gas emissions and can reach 11% if warehouses and ports are considered (IEA, 2018). Firms are being increasingly considered accountable for the environmental and social impacts of their logistics operations and their suppliers' operations (Kusi-

Sarpong et al., 2019). Hence, sustainability has become a strategic priority for companies. Interventions and policy options have been proposed to revert the course of damage of the logistics industry. These actions are mainly focused on the internal side of firms (Koberg and Longoni, 2019). Enhancing the effectiveness of sustainability strategies requires adopting a perspective that goes beyond the boundaries of firms to embrace supply chains (Kusi-Sarpong et al., 2019). Given the increasing outsourcing of logistics activities, logistics service providers (LSPs) play a paramount role in enabling a step change towards better sustainability (Evangelista et al., 2017).

The management of services can affect the adoption of sustainable practices within the relationship between a buyer (e.g., a shipper) and a supplier (e.g., an LSP) (Liu et al., 2019). Collaborative relationships benefit the involved parties (Whipple and Russell, 2007) in terms of improved environmental, social, and economic performance (Werneck Barbosa et al., 2022). Successful collaboration initiatives require harnessing both internal knowledge and external knowledge exchange (Abareshi and Molla, 2013). The theory of Absorptive Capacity (AC) provides a valuable lens for investigating how a firm utilizes external knowledge to develop capabilities and improve operations (Liu et al., 2019);

Research on this theme mainly focuses on the perspective of either shippers or LSPs (Jazairy et al., 2021). Knemeyer and Murphy (2005) state that there is a need to simultaneously consider the perspectives of both shippers and the LSPs to decrease the risk of key perceptual differences. Notwithstanding a number of studies have been published on the environmental alignment between shippers and LSPs (e.g., Hüge-Brodin et al., 2020; Sallnäs and Hüge-Brodin, 2018), little research has been conducted on collaboration mechanisms and related learning processes within the relationship between LSPs and shippers (Haag et al., 2022).

This research aims to analyse the mechanisms/factors affecting collaboration for sustainability in logistics between shippers and LSPs using the theoretical lens of AC through a multiple-case study investigation.

These collaboration mechanisms will be studied focusing on Italian manufacturing small-medium enterprises (SMEs) and their LSPs. SMEs represent the majority of enterprises in Italy, generating 66.9% of the total value added in 2019 (European Commission, 2019). Existing research investigates sustainability initiatives mainly in large firms because these are often considered a prerogative of large businesses. Studies calculate that SMEs are responsible for almost 70% of global pollution: they could have a major effect on reducing pollution (Curado and Mota, 2021). Green practices are becoming a critical success factor for SMEs to gain and keep competitive advantage. Still, these practices are challenging to be implemented by SMEs because of several barriers. According to Johnson and Schaltegger (2016), the low priority assigned by SMEs to sustainability implications/benefits can be attributed to their limited awareness of environmental impacts. Many SMEs' managers consider sustainability a cost rather than a strategic driver (Cantele and Zardini, 2020) and often lack knowledge to assess the benefits of sustainable practices (Mishra et al., 2022). Another barrier concerns the lack of time and resources: the small number of employees in SMEs forces staff to be involved in more business functions, which makes it challenging to perform additional tasks (Johnson and Schaltegger, 2016). Small firms often suffer from a lack of financial resources, limiting their investment capacity (Ullah, et al. 2022). While large companies have formal strategies, SMEs use less formal and more flexible strategies (Martin, et al., 2019). Large companies invest and spread costs over a vast production network, while SMEs are mostly restricted to a single market. Hence, SMEs are often unaware of their impact on the environment (Blundel et al., 2013).

The remainder of this paper is organized as follows: Section 2 presents the theoretical background of the work, while Section 3 outlines the adopted empirical methodology. Section 4 describes the research findings, and Section 5 critically discusses them. Section 6 provides concluding remarks and directions for future research.

## **2. Theoretical background**

We developed our theoretical background referring to four topics that inform the mechanisms of collaboration in the buyer-supplier relationship with reference to sustainability:

- the company's approaches to sustainability and related antecedents (Solomon et al., 2019): these constitute the basis of the relationship between the counterparts and affect/reflect the level of organizational compatibility.
- the learning and knowledge transfer process (Abareshi and Molla, 2013; Saenz et al., 2014): it allows investigating how companies develop and leverage their capabilities internally and externally within a buyer-supplier relationship.
- the adoption of sustainable practices (Abareshi and Molla, 2013;): collaboration mechanisms can lead to sustainable practices, which can be adopted by supply chain partners.
- the impacts on performance (Solomon et al., 2019): the performance impact of the adoption of collaborative sustainable practices in logistics should be evaluated in the relationship.

### ***2.1. Company's approaches to sustainability and related antecedents***

As a first step to unveil the mechanisms leading to successful adoption of green practices within the shipper-LSP relationship, it is necessary to investigate the antecedents that shape the approach to sustainability in logistics (Wu et al., 2014).

The antecedents set the level of compatibility of the approaches/strategies of the involved parties (McKone-Sweet and Lee, 2009). Compatibility allows organizations to align with supply chain partners to improve capabilities (Saenz et al., 2014). Lane et al. (2001) posit that organizational compatibility can facilitate coordinated actions and alignment of relational norms. Sallnäs and Hüge-Brodin (2018) address compatibility of the approaches/strategies also in terms of level of interest of the involved counterparts in including green logistics practices in the relationship.

The antecedents can be classified into:

- Resources: financial, human, technological, and organizational means (including the relational capital) available to the companies for sustainability in logistics (Liu et al., 2019). The literature posits that the level of resources invested positively affects the adoption of sustainability practices.
- Influencing factors: internal and external drivers, stimuli, and barriers affecting the approach to sustainability in logistics. These include upstream and downstream pressures coming from the supply chain (such as institutional pressures – Solomon et al., 2019), cost reduction, investments and financial resources, regulations, top management involvement, capabilities, and environmental awareness (Kudla and Klaas-Wissing, 2012).
- Strategy: in terms of the role of sustainability in logistics within the organization, and the taken approach to sustainability, i.e., proactive, if the company collaborates within the relationship going beyond the compliance to regulations, or reactive, if sustainability is just monitored, by complying to the agreements defined in the contracts (Saenz et al., 2014).

### ***2.2 Learning and knowledge transfer process***

While, traditionally, the internal side of organizational capabilities has been looked at from a static perspective, often through the lens of the Resource Based View (RBV), growing awareness of a competitive environment moving at a brisk pace led to adopt a view embracing evolving competitive environments. A dynamic capabilities view was introduced, particularly appropriate for the challenges of logistics and supply

chain management, where inter-organizational relationships play a fundamental role (Defee and Fugate, 2010).

New cross-organizational relationships can be created, leading to new capabilities and value-creating strategies, thanks to the reconfiguration of resources (Eisenhardt and Martin, 2000). In these relationships, exchange and transfer processes are employed to recombine resources (mainly knowledge-based) and develop capabilities.

The capabilities' development can be seen as the result of a learning and knowledge transfer process between companies, which can be interpreted through the theoretical lens of the AC.

AC refers to the ability of a firm to recognise the value of internal and external information, assimilate it, and transform it to commercial ends. It can help understand sustainability-oriented innovation, particularly since sustainability requires understanding cross-disciplinary knowledge (Abareshi and Molla, 2013).

The study of Abareshi and Molla (2013) demonstrated that companies operating within a logistics process need to improve their AC to increase green logistics practices adoption and apply new environmental knowledge to new green practices.

In terms of mechanisms to develop environmental capabilities, Saenz et al. (2014) show that the creation of value deriving from a buyer-supplier relationship depends on how firms open up to buyers or suppliers to take advantage of their knowledge and collaboratively develop AC. Learning with (and from) partners, offered by deploying their dynamic capabilities, allows organizations to capitalize on the potential available with compatible partners.

The involved parties can focus their efforts on two types of capabilities (Silvestre et al., 2020):

- Exploration capabilities: the ability to adopt new processes, products, and services that are unique from those used in the past.
- Exploitation capabilities: the ability to continuously improve existing resources and processes.

Abareshi and Molla (2013) identify five main steps of AC reported in Table 1. The development of AC entails that organizations build knowledge by leveraging acquisition, assimilation and transformation to foster the development of new capabilities through exploitation.

### **Take in Table 1 - Table 1 Main steps of AC mechanisms for environmental sustainability, adapted from Abareshi and Molla (2013)**

#### ***2.3 Green logistics practices***

While most of the current studies focus on initiatives adopted by LSPs, a smaller number of papers concerns sustainability actions of shippers. At the same time, few studies investigate sustainability actions related to collaboration between LSPs and shippers (Huge-Brodin, et al. 2020).

Concerning sustainable practices adopted by LSPs, Evangelista et al. (2017) distinguished between "point initiatives" (predominantly having effects within the boundaries of the focal company – which include changing vehicles specifications, use of different transport modes, energy efficiency, recycling of packaging and green building solutions) and "supply chain initiatives" (collaborative actions extending their impact on different stages of the supply chain – which include environmental training and information, supply chain reorganization, transport planning and route optimization, shared green targets, planning and environmental

control). Several studies indicate that LSPs more implement point initiatives than supply chain initiatives (Evangelista, et al., 2018;).

Considering the actions adopted by shippers, existing research explored the elements related to purchasing sustainable logistics services. Multaharju et al. (2017) investigated how companies manage sustainability and related risks when buying services from LSPs. Results indicated that the buyers of logistics services use sustainability as a criterion when selecting logistics providers.

Existing papers provide evidence about environmental collaboration between shippers and LSPs. Lun et al. (2014) found that collaborative initiatives are not in use by the LSPs they investigated. Conversely, Tacken et al. (2014) found that LSPs adopt different collaborative approaches, including collaboration within logistics alliances or with customers in specific projects. Colicchia et al. (2013) discovered a significant fluctuation in the collaboration forms between LSPs and customers due to several influencing factors. Pieters et al. (2012) argued that the LSPs they investigated focused on improving the efficiency of collaborative actions in the following areas: awareness programs to inform customers about the CO<sub>2</sub> footprint of shipments, delivery time schedules, and empty running. Sallnäs and Hüge-Brodin (2018) indicate that logistics paradoxes may be the main reason for the disappearing of environmental practices between LSPs and shippers. The findings also suggest that when paradoxes are relaxed, this may positively influence the development of environmental practices in the relationship.

## **2.4 Impacts on performance**

The literature on this area is limited. The study of Bjorklund and Forslund (2013) investigated the inclusion of environmental performance in transport contracts in Sweden. The findings indicated that CO<sub>2</sub> emissions and energy consumption are the most widely used metrics. In addition, Colicchia et al. (2013) argued that the lack of a standard methodology for environmental performance measurement inhibits companies from sharing costs and benefits of environmental initiatives. Tacken et al. (2014) also found the use of different standards and protocols to measure environmental performance. The primary environmental indicator used by the surveyed companies is CO<sub>2</sub> emissions, whereas energy consumption and vehicle utilization are seldom adopted. Smaller companies show a lower use of performance measurement than larger counterparts because of the limited availability of environmental management systems and difficulties in implementing emission auditing and reporting activities.

Lun et al. (2014) found that customers have a role in developing a greener attitude that positively impacts profitability and customer satisfaction. Laari et al. (2016) found that internal environmental collaboration has a negative impact on ROI. In contrast, external environmental collaboration (e.g., with customers) positively impacts the financial performance with small effects on the operational performance.

The survey conducted by Bálint et al. (2021) found that collaboration with customers and other stakeholders stimulates the adaptation to environmental knowledge, while those capabilities enabling the integration and transformation of sustainability-related knowledge should help LSPs to improve green performance.

## **3. Methodology**

We adopted a qualitative research approach and developed a multiple case study investigation. This methodology can be considered suitable for exploring topics that require deeper understanding (Yin, 2018). Case study research is advantageous because it enables direct interaction with informants (Miles and Huberman, 1994).

### **3.1 Case Selection**

Considering the unit of analysis of this study, which is the relationship between shippers and LSPs concerning the collaboration for green logistics, the unit of observation are the dyads formed by shippers and logistics providers. The case selection process created a "diverse but coherent sample for the exploration on a focused matter" (Robinson, 2014). The adopted inclusion criteria were: small-medium companies with headquarters or a branch in Italy to have comparable environments. Factors such as regulations, legislation, and stakeholder pressure strongly differ among countries. Plus, shippers needed to have at least one logistics activity outsourced to an external company (the LSP). These activities can be, for example, distribution, transportation, and warehousing. The next step was to contact the shippers' LSPs. An additional criterion was adopted to form the dyads: the relationship between the shippers and the LSPs must be well-established and long-lasting (to ensure enough time to activate learning processes in the relationship). For building the sample, cases of successful and unsuccessful collaboration must be included, according to the principle of polar types (Pettigrew, 2013). This allows comparing and contrasting situations where collaboration worked and where collaboration did not work, and let the mechanisms explaining these situations emerge.

The final sample was formed of six dyads. We limited the number of cases because our objective was not to generalise but to shed light on a specific phenomenon through contextual insights (Järvensivu and Törnroos, 2010). Polar cases allow for a certain variety of analysed contexts and a deep comparative structured analysis.

For confidentiality, the names of the companies and their LSPs have not been disclosed. Table 2 provides an overview of the sample.

## **Take in Table 2 - Table 2. Profile and background of the case companies**

### ***3.2 Data collection, data analysis, and validation***

A data collection instrument (i.e., questionnaire) was designed, and a formal interview protocol was developed (Yin, 2018). Two questionnaires were created: one for the shippers and one for the LSPs (see Appendix). The questionnaires were composed of four sections:

1. Company's approaches to sustainability
2. Learning and knowledge transfer process
3. Green practices
4. Impact on performance

Data were collected from July 2021 to July 2022, and semi-structured interviews were conducted at the companies' premises or, based on the preference of respondents, by video call. Interviewees were the company's owners, shareholders, logistics managers, supply chain managers or health, safety, and environment (HSE) managers. The interviews had an average duration of one hour. After obtaining consent, they were audio-recorded and transcribed. Interview reports were prepared for data analysis. Information was also triangulated through secondary sources such as firm webpages, reports, and news. Interview reports were shared with the interviewees and respondents were contacted by e-mail or phone to resolve discrepancies (Yin, 2018).

The information from each dyad was examined to highlight emergent topics, similarities, and key differences (Miles and Huberman, 1994). The empirical research's outcomes were validated through Yin's (2018) four indicators (construct validity, internal validity, external validity, and reliability).

## 4. Findings

### 4.1 Dyad F1-L0

Both companies show proactive environmental strategies, as they adopt voluntary green initiatives. They show an interest in environmental sustainability, but green logistics is not a priority: this constrains a collaborative relationship on green logistics. The limited collaboration is confirmed by the fact that the relationship between F1 and L0 is limited to annual contracts with conditions renewed every few years. In selecting LSPs, environmental criteria are considered as "additional factors" by F1: the most important criteria are cost, delivery speed and management of the cold chain.

As regards the involved resources:

- Financial resources: none of the two companies presents a budget allocated to sustainable logistics. Company L0 sticks to regulations, without a budget supporting environmental actions. Company F1 does not have a budget large enough to address environmental issues.
- Technological resources: both companies have a monitoring/management system for their photovoltaic solar panel systems. Company L0 has ICT systems monitoring refrigerated warehouses, and related energy consumption. This technology is aimed at managing internal environmental matters, and it is not adopted for managing/developing the relationship with the counterparts.
- Human resources: neither company has an environmental team, and no personnel is allocated to managing environmental matters in logistics within the buyer-supplier relationship. In Company L0, the health, safety and environment (HSE) department takes care of environmental issues. Neither company has a structured approach regarding how top management contributes to implementing sustainable practices. In Company F1 the board of directors raises employee awareness in periodical meetings, but without proper planning. The same can be highlighted in Company L0: the management approach is natural rather than structured, with attention given to energy consumption only. Company L0 perceives that the employees' awareness level about environmental topics is relatively high (they know that green actions are necessary). However, there is no plan for the firm's environmental sustainability. On the shipper's side, employees are sensitive to these issues, but without education. However, the firm plans to provide more training on these topics. Currently, there is no joint training in the dyad.
- Relational resources: in Company F1, there is not a procedure to share sustainability information with their LSPs: they don't have enough bargaining power, and green logistics is not a priority. As regards the LSP, communication procedures depend on the type of client company. Some of them may have environmental certifications requiring specific standards. This happens with large clients, and it's a structured process: Company L0 is contacted by the client company, from which they receive requirements. In the case of this dyad, the relationship is transactional because F1 shows low interest in developing green logistics practices and the contract implies the provision of basic warehousing services.
- Influencing factors: the most relevant barriers perceived by the shipper are high investments and uncertain economic returns. Regulation is perceived as an element creating confusion in managing environmental aspects. The most significant drivers are governmental incentives. Another influencing element is market pressure, which has recently increased. On this, the two companies agree, since also for Company L0, the main barriers are represented by high costs and complex regulations. The main drivers for the LSP are the pressures from their clients, but also incentives facilitate the adoption of green initiatives.
- Learning and knowledge transfer processes: the sources of knowledge about sustainable innovation for F1 are universities, fairs, conferences, larger companies, and market research. Being part of industrial associations, for L0, the primary sources of knowledge are those company networks. Other important sources are clients and consultants. Both companies agree on the importance of sharing information about market

changes for knowledge acquisition: however, while the LSP would prefer a more structured approach to improve these processes, the shipper does not show the same need. For the internal knowledge transfer, every time sustainable innovations are made, Company F1 prefers informal and verbal mechanisms because it doesn't require structures to manage communication between departments. In Company L0 information is "disseminated" by each department head.

- **Initiatives:** both companies make decisions through joint discussions with partners. According to Company F1, this is "normal" since they don't have enough bargaining power. For Company L0 making decisions based on joint discussions is a way to develop new skills. The initiatives involving partners or clients are more complex than internal ones, and the decisions made must be based on joint discussions. This is also because the partners may have better competencies. However, in both companies, there are limited exploitation capabilities since no routines to exploit the acquired/transformed knowledge into their operations are present. The low level of priority given to green logistics in the relationship prevents the two organizations from developing real collaboration.
- **Impact on performance:** neither firm has methods to evaluate their logistics sustainability programs. Company L0 has only quality certifications (ISO 9001). Some clients have other certifications, including environmental ones: the LSP is contractually committed to respecting their standards. Neither of the two companies has Key Performance Indicators (KPIs) that measure the impacts of the partner companies. As regards the internal impacts, none of the two companies has KPIs to measure their environmental performance. Company L0 measures the economic impact of its green practices. This is also the case of Company F1, which has financial estimates related to the use of their photovoltaic solar panels, packaging, and production waste.

#### **4.2 Dyad F1-L1**

Company F1 has already been analysed in Section 4.1. Company L1 perceives strong involvement in environmental issues. The strategy is proactive because they undertook voluntary initiatives, still mainly internal or of interest to a small number of large clients. Both companies in the dyad show interest towards environmental sustainability from a general business perspective, but the low priority allocated to green logistics by company F1 affects the extent of the collaboration in the dyad (limited to the transactional level, without green logistics practices).

As regards the resources:

- **Financial resources:** L1 has no budget for green investments "a priori" because it depends on the projects to be undertaken every year (i.e., occasional investments such as LED lights substitution).
- **Technological resources:** the only ICT system used by L1 monitors electricity consumption. This system, used to optimize consumption, communicates with an external energy manager who remotely checks for faults/malfunctions. This technology is aimed at managing internal optimization of energy consumption, and it is not adopted for managing or developing a green logistics collaborative relationship.
- **Human resources:** L1 has no team dealing with environmental issues. They refer to external specialists. The company has three departments that look after sustainability: the technical unit, which includes the energy manager, the workplace safety department, and the HSE department. These people only suggest/provide improvement solutions by engaging with the operational branches. The Top Management fosters sustainability by providing guidelines to local branches. This happens through monthly communications. The environment is a priority, but mainly at an internal level, as no human resources are allocated to managing this in logistics within the buyer-supplier relationship.



- Relational resources: the LSP does not communicate or share sustainability information with its clients; it is not perceived as necessary because clients do not require such initiatives. L1 provides information on sustainability through their website: every client company has its reserved area where to find information about green initiatives and/or news. Considering F1, they are linked by simple contracts that only concern the handling of goods, without including any environmental concern. L1 generally doesn't involve clients in environmental projects for the nature of the relationship. The only green initiative proposed to customers was the dematerialization of documents. There are no other green projects involving clients because their priority is not sustainable logistics but fast logistics.
- Influencing factors: the drivers in implementing sustainable initiatives come from the management, while there is no significant pressure from their client companies. Another driver could be regulation, also because currently, the main barriers are represented by investments and bureaucracy,
- Learning and knowledge transfer processes: L1 keeps up to date in the field of sustainability thanks to training courses. There is no communication with clients or other partners regarding updates on sustainability. Regarding internal communication mechanisms, the contact is continuous and informal. No routines for assimilating, transforming, and exploiting knowledge are present in this company.
- Initiatives: most of the initiatives embraced by L1 are point (internal) initiatives with no collaboration with clients.
- Impact on performance: L1 has no specific certifications yet. None of their KPIs goes beyond the company's boundaries, so they cannot check their partners' environmental impact (not requested or perceived as a priority). None of their KPIs quantifies the impacts of green initiatives. However, for the economic performance, they have some high-level estimates about costs, and their energy manager can quantify the energy savings.

#### **4.3 Dyad F2-L2**

F2 and L2 have collaborated since the pasta producer's opening in 2012. Both companies show a proactive approach by adopting voluntary green initiatives. Still, green initiatives are not included in the relationship between the two organizations about green logistics, given that the latter is not a priority for F2. This affects the level of interest of both organizations in developing and including green logistics practices in the relationship. About the involved resources, they show similarities too:

- Financial resources: none of them has a pre-determined budget devoted to sustainability. As pointed out by L2, a part of the yearly budget will be used for replacing diesel vehicles with methane vehicles. They introduce two new vehicles a year. In F2, instead, the annual budget is allocated to corporate macro-areas, and is rarely allocated for specific projects like environmental initiatives. Financial resources are allocated to developing internal optimization projects that do not regard the relationship between the firms.
- Technological resources: both companies have an ICT system that monitors their photovoltaic solar-panel systems. L2 uses a vehicle travel optimization system, to decrease fuel consumption and emissions. Technological resources are devoted to internal optimization rather than sharing information and opportunities for green logistics in the relationship.
- Human resources: a sustainability team is not present in either company, and the owners take care of sustainability. In F2, there are periodic meetings on green projects, then the marketing manager deals with internal communication to employees. In F2 there is a high level of awareness among sales professionals and those in contact with customers/suppliers, while often, "green communications" do not reach workers or

administrators. There is a willingness to improve this. In L2, a low level of awareness of employees is perceived, but also in this case, they are willing to improve this aspect.

- Relational resources: in F2, there is no procedure to communicate and share information on sustainability with the logistics partners since logistics is not perceived as a priority: F2 focuses on packaging and manufacturing. In case of joint projects, there is a communication procedure that involves the reference person of the LSPs, in an informal way. L2 also perceives informality.
- Influencing factors: L2 perceives pressures from their large clients. Still, the main driver is constituted by European and State incentives (helpful in case of investments – e.g., methane vehicles). But bureaucracy can be an obstacle and incentives can become disincentives. F2 recognises the relevance of economic barriers and the lack of "green" competencies. The main drivers are the pressures from the market, the need to improve business performance, green certifications, and ethics.
- Learning and knowledge transfer processes: to stay up to date on innovations, their main sources of knowledge for F2 are customers, universities, fairs, and suppliers. For L2, the principal sources are training courses, trade associations, seminars, and clients, informing about current trends through their requests (they provide input to their annual strategy). L2 highlighted the importance of sharing information because the firm's annual strategy is driven by the customers' inputs through their communications. Sharing information with LSPs is not perceived as necessary in F2 because logistics is not considered a priority. Focusing on internal knowledge mechanisms, F2 informs employees through newsletters and meetings in case of green initiatives. L2 takes advantage of annual and, more rarely, extra meetings. No specific routines allowing exploiting the acquired or transformed knowledge into their operations are present, so there are limited exploitation capabilities.
- Initiatives: F2 embraces green initiatives. However, they are all done internally by the company without their logistics counterpart. F2 has one internal green initiative (e.g., a photovoltaic solar-panel system) and two initiatives in collaboration with other stakeholders.
- Impact on performance: neither company has environmental certifications. Their KPIs are internal, so they cannot measure their partners' environmental performance. This is coherent with the idea that logistics is not a priority for F2. As for the impacts on environmental, economic, or operational performance, both companies have ICT tools estimating energy savings. However, there are no KPIs that quantify the environmental impact of their green initiatives. Focusing on the economic performance, F2 does not have KPIs to measure how much a project can improve the economic performance. L2, besides cost savings coming from their photovoltaic solar panels, estimates fuel savings through the monitoring system on vehicles.

#### **4.4 Dyad F3-L3**

F3 outsources only a part of their total distribution to external companies, running their methane vehicles for the remainder. F3 defines itself as a "closed circular economy": the company performs almost all activities internally. The firm's strategy is an "environmental leadership strategy": products and processes are re-designed to minimize the ecological footprint along the life cycle. Investments in the last 10 years have been made in the environmental area, and 100% of the annual company's budget is allocated to these issues. The external transport providers are called on a transactional basis. F3 and L3 companies' approaches appear to be quite the opposite: the shipper has a strong engagement in environmental issues, the LSP shows a reactive strategy, limiting its green initiatives to those required by law. Environmental sustainability is not a priority in the relationships with L3's clients and this affects collaboration on green logistics.

Focusing on the resources of the two companies:

- Financial resources: if almost all the investments are made in a green perspective by F3, L3 has no budget allocated to environmental initiatives.
- Technological resources: the LSP has no ICT tools for managing environmental aspects for a lack of funds and competencies; F3 has an ICT system for the management of water and another one to remotely monitor their vehicles (to reduce emissions and fuel costs). They also have a monitoring system for their photovoltaic solar panels. Technology is used to optimize internal processes rather than feeding information and development opportunities in the relationship.
- Human resources: in neither company an internal, inter-functional team for managing sustainability is present. F3 collaborates with external consultants specialized in environmental issues and addresses shareholders regarding new trends and opportunities. Shareholders can encourage sustainable practices since they represent the "top management" in the company. Still, no structured method to promote or raise awareness exists, except for training requested by law. L3's employees show average awareness of sustainability. In F3, there is low-medium awareness too, since employees simply apply the instructions from the top management. Still, they know they should minimize energy and water waste following the company's culture.
- Relational resources: both parties agree on a lack of procedures to communicate and share sustainability information. According to L3, information procedures are quite informal since they had been collaborating for many years, and there is a friendly relationship. Instead, F3 perceives a lack of information about sustainability from L3 because they think L3 is "close-minded". This lack of alignment of views affects the collaboration level in the dyad. However, whenever it's required, information is shared by contacting the reference person of the other company in an informal way. The two companies agree that the decisions are joint, even if there are no joint projects ongoing. Despite the strong environmental strategy of F3, the company does not adopt environmental criteria when selecting their logistics providers.
- Influencing factors: L3 perceives strong economic barriers (high investments and uncertain returns). Another obstacle is bureaucracy and confusing/complex regulations. The only perceived driving force is pressure from some clients, but not that strong (yet). Regulations are not perceived as a barrier by F3. Still, State's and European Union's incentives had been a strong push in the last years, supporting their ecological transition. As for L3, the major obstacle is the economic aspect, along with the cultural dimension. Together with incentives, another driving force are retail customers.
- Learning and knowledge transfer processes: the main sources of knowledge for F3 are external consultants, their energy manager, start-ups, and training courses; for L3 the main sources are training courses required by law, and more rarely clients. Focusing on the internal environmental knowledge process, both companies share information in an unstructured way, verbally or with internal meetings. There are little acquisition, assimilation, transformation and exploitation capacities within this relationship, with no routines.
- Initiatives: in line with the focus on internal optimization of F3, all its environmental initiatives have been undertaken internally (point initiatives).
- Impact on performance: neither company has methods to assess their logistics sustainability programmes, and there are no KPIs that extend beyond the firm's boundaries. F3 quantifies the internal impact of its green initiatives from an economic point of view: they have repayment plans, so they know how much they have saved. From the environmental perspective, instead, they cannot say how CO<sub>2</sub> emissions have decreased or how much water or energy they are saving.

#### **4.5 Dyad F4-L4**

The two companies have a long-standing collaboration on environmental issues. The collaboration in the supply chain upstream concerns the outsourcing of warehousing. In the downstream part of the supply chain, the collaboration focuses on optimizing road transport to reduce GHG emissions.

As regards resources:

- **Financial resources:** Despite L4 does not have a specific budget devoted to environmental sustainability, the company invested in intermodal transport to reduce the freight moved by road and in solar panels to increase the share of renewable energy. F4 invests around 1% of its annual budget in sustainability mainly on technology to reduce emissions in the coffee production/roasting stage. No specific budget is allocated to greening logistics, and environmental collaboration is considered part of the logistics outsourcing contract.
- **Technological resources:** L4 shows a higher level of digitalisation compared to F4. The IT department of L4 allow connecting with any other IT system through several applications including: Warehouse Management System (WMS) that can be integrated with any ERP and WMS systems, a Real-Time Visibility package to provide complete online tracking of stock movements and update in real-time, a radio frequency system, real-time on-line warehouse mapping, and a Carbon Management System (CMS) to estimate fuel consumption and GHG emissions for road freight transport.
- **Human resources:** In the relationship, F4 usually identifies areas where initiatives are needed to improve environmental performance and L4 plays a more reactive role. The two companies created a team supervising collaboration that includes one employee from L4 and the purchasing manager and marketing manager of F4.
- **Relational resources:** The exchange of information happens through regular meetings involving the three team members. In the meetings they discuss solutions for reducing the environmental impact of inbound and outbound logistics. Generally, F4 identifies specific areas of improvements. L4 designs tailor-made solutions for F4. Once L4 found a possible solution, it is discussed and validated in a meeting with F4. If the proposal is accepted, L4 implement the project, and progresses are discussed in further meetings.
- **Influencing factors:** For F4 the most relevant driver is the staff green awareness. Other barriers concern governments that are often not sensitive to environmental issues and this slows the adoption of green initiatives down. Economic and financial barriers also prevent the implementation of green initiatives. For L4, the most influencing barriers are high investment, lengthy payback periods and lack of economic incentives. The main drivers are the local legislation on recycling (influencing the warehousing activity). These driving forces seem not to affect the relationships with other customers as the main criteria to sign logistics outsourcing contracts are still based on price and service quality. In addition, sustainability is not a priority when selecting logistics providers. Both companies declared that they do not receive pressures from competitors.
- **Learning and knowledge management processes:** L4 collaborates with local universities, in the area of ICT. The company's staff regularly participate in the main national logistics fair trades and industry events. F4 produces most of the knowledge internally. The two companies use different approaches to share information and knowledge. F4 shares information and knowledge mainly through informal mechanisms such as periodical meetings with managers. No specific tools for knowledge storing and dissemination are used. Verbal and informal communication is considered the most effective channels. L4 prefers to leverage external parties for new knowledge creation (e.g. consultants, researchers, industry events, etc.). Knowledge sharing occurs through formal mechanisms including knowledge mapping, sharing best practices, after-action review, and knowledge management systems (e.g., knowledge based software, online community forums, and learning management systems). About environmental collaboration, L4 drives the knowledge

management processes. Once the specific needs of F4 have been identified, L4 presents a report containing actions to reduce emissions. The report is discussed in meetings and finally approved. After that, L4 introduces routines to inform the F4 staff about progresses in the project and discussed with employees to get new ideas for improving actions. This allows combining existing knowledge in F4 with new knowledge created by L4, resulting in higher potential for transformation and exploitation capacities in both companies.

- Initiatives: considering the internal focus of F4, the green collaborative initiatives implemented are point initiatives.
- Impact on performance: F4 obtained the ISO9000 certification in 1996 and the ISO14001 environmental certification in 2002. The company is committed to mainly reduce emissions and raising sustainability awareness among its staff. However, environmental sustainability does not play a key role in guiding the company's strategy. For this reason, no particular tools/methodologies for measuring their sustainability performance are used. L4 achieved the ISO14001 environmental certification in 2015. L4 uses a set of structured KPIs to measure the impact of green initiatives on environmental performance, while F4 has no tools for measuring this.

#### **4.6 Dyad F5-L5**

F5 established a long-term relationship with L5 to better control both upstream (procurement is a critical function to ensure the quality of raw materials) and downstream (logistics plays a crucial role as products have a fairly short shelf life) supply chain processes through the outsourcing relationship. In a further stage, F5 recognised the importance to adopt a green logistics strategy and was willing to pay an extra price for buying greener logistics services.

As regards resources:

- Financial resources: F5 generally devotes 2% of the total annual budget to environmental sustainability for developing more recyclable packaging. No financial resources have been invested in greening logistics. L5 invested in energy-saving initiatives such as the optimisation of the distribution network, intelligent use of energy in warehouses, digitalizing paperless processes. Photovoltaic solar panels were installed on the roofs of warehouses, and old lighting has been gradually replaced with LEDs.
- Technological resources: L5 heavily invested in digital innovation to simplify processes and activities, minimize errors, and improve information flow transparency to achieve greater visibility of processes and performance. The main technologies used are radio frequency, the ability to connect customers on the web, track and trace service, email/SMS notifications, web-based orders, transport management system, business intelligence, and automatic identification (RFID). Investments have also been directed toward data analysis systems (e.g., big data). From the software side, visibility, traceability, and control solutions (e.g., digital twin, 3D printing, and augmented reality) supported by the 5G technology were adopted. From the hardware perspective, L5 the applications used for green logistics are transport management system, network optimization software, and software for calculating CO2 emissions.
- Human resources: F5 does not have human resources and an organizational unit capable of coordinating and supervising the management of environmental aspects. For L5, sustainability and green aspects are perceived as strategic drivers. For this reason, L5 created a sustainability office with a manager who coordinates five employees. The sustainability manager reports on all the green projects directly to the supply chain and operations managers, who are members of the company board.
- Relational resources: There is no specific procedure in F5 for exchanging sustainability information with their LSP. F5 is a small company, and informal communication is the rule. With the development of the green

logistics project proposed by L5, joint collaborative workshops are introduced to provide training support to F5 staff. This makes it easier for L5 to obtain the information necessary for the development of the green logistics project and increase the level of environmental awareness of F5 employees. The use of digital applications provided by L5 allows F5 staff to obtain information on the progress of the project in real time.

- **Influencing factors:** For L5, the main drivers are the high level of environmental awareness of employees and the management support. The main internal barriers are the high investment cost and the uncertain payback time. The most relevant external barriers are unclear national regulation supporting the investment in green aspects and the financial and fiscal incentives. For F5, the lack of skills and competencies is the most influential barrier. As for L5, the lack of a clear national regulation facilitating green logistics initiatives is another important barrier. F5 saw the awareness of shareholders and managers as the most powerful trigger for adopting a green approach. In addition, the development of green programs by competitors acted as a powerful driver for F5 to accelerate the adoption of a greener approach in managing the business.

- **Learning and knowledge management processes:** L5 collects and evaluates information about new logistics and sustainability trends, mainly by attending events at universities, research institutes, industry associations, and trade fairs. Governmental reports, regulatory bodies, and scientific reports are other sources of knowledge. F5 considers knowledge as the experience accumulated along the work activity, and most of the knowledge produced is implicit, non-codified and internally produced. Accordingly, non-codified and informal exchange of experiences between managers and employees (including best practices) is the norm. L5 places more emphasis on external networking and collaboration such as the relationship with consultancy companies and universities for knowledge creation. To retain critical knowledge, the results of projects and meetings are always documented and stored in a company repository. L5 also uses informal channels to share knowledge such as informal meetings with employees. To transfer knowledge externally, L5 uses a mix of formal and informal means such as documents, reports, and face-to-face meetings. In the case of the green logistics project developed in collaboration with F5, the intermediate results of the project are transferred through regular workshops attended by the L5 project team and staff of F5. L5 develop short training courses for the F5 staff involved in the project. The topics of these courses reflect different project phases and activities (e.g., how to estimate route emissions in relation to the transport mode used). The short courses increase the knowledge of transformative opportunities of F5 as they can combine new knowledge with the (limited) knowledge they have on green logistics. On the other hand, L5 can exploit the knowledge acquired externally through relationships with experts, consultants, and university researchers.

- **Initiatives:** L5 achieved the ISO9001 and ISO14001 since 2001. L5 proposed to F5 a green logistics project based on the decarbonisation of freight transport activities. The project was organised into three phases: 1) data analysis and visibility, 2) network optimization, and 3) performance measurement. In addition, the project included training F5's staff and exchanging knowledge on green logistics practices (from L5 to F5).

- **Impact on performance:** F5 does not measure green performance. Thanks to the collaborative project, L5 provides a set of structured KPIs to measure the environmental performance of the undertaken green initiatives.

## 5. Discussion

In Table 3 we include the features of the six dyads and relationships, focusing on the relational elements adapted from Sallnäs and Hüge-Brodin (2018) and Abareshi and Molla (2013).

### Take in Table 3 - Table 3. Main features of the six investigated dyads and relationships

Two groups of dyads seem to emerge: dyads able to activate a successful collaboration in relation to green logistics (dyads 5 and 6), and dyads unable to activate any collaboration on green logistics (dyads 1 to 4). The second group seems to confirm the literature (Evangelista et al., 2017), according to which green collaborative practices among SMEs are not widely implemented. These companies focus on a limited breadth of initiatives (mainly point initiatives such as increasing energy efficiency of the firm and decreasing waste and environmental impact of production activities) with an intra-organizational perspective. However, the first group shows cases where collaboration happened, which brings novelty to the existing knowledge, offering insights on the differences between situations where collaboration in sustainability in logistics among SMEs happened and others where collaboration did not work.

Four dyads out of six seem to be compatible in terms of their approach to sustainability as their environmental strategy is proactive on both sides. The fourth dyad (F3-L3) and the fifth dyad (F4-L4) represent cases in which the shipper is highly involved while the LSP is reactive in implementing green initiatives.

If, with regard to the F3-L3 dyad, poor communication is foreseeable, this poor communication emerges also in other dyads, despite the apparent compatibility of approaches. Good communication is present in dyads 5 and 6, and this seems not to depend on the compatibility of the approaches. In line with the literature (Saenz et al., 2014), it seems that good communication leads to better success of the collaboration between shippers and LSPs.

It appears that the organizational compatibility and length of the relationship between shippers and LSPs do not necessarily determine the level of communication (and collaboration). Rather, the importance given by the shipper to the relationship with the LSP when dealing with green logistics initiatives, coupled with a specific budget allocated by shippers to green initiatives, can facilitate communication and collaboration.

In other cases where some interest in sustainability is present, it can also happen that collaboration did not work. This could be explained by a lack of resources to further invest in green aspects, but also by a common perception that green logistics is not a priority for the shippers, being more focused on other environmental sustainability business areas.

The literature indicates that shippers show weaker ambition for greening logistics than LSPs and emphasize more general requirements such as cost and service level (Huge-Brodin et al., 2020). We saw something similar in dyads 1 to 4, also in companies such as F3 declaring strong interest in sustainability - but not in sustainable logistics, and this seemed to prevent the collaboration with the LSP from happening. Instead, when the ambition for improving the level of sustainability of logistics is strong for shippers (and supported by an allocated budget or dedicated resources), shippers can be the trigger to initiate collaboration on green logistics with LSPs. Shippers see the latter as partners with specific knowledge and competencies or able to develop new competencies through the learning process.

When shippers perceive logistics as a service with no added value and the relationship is set at a transactional level, it is difficult to start a collaborative relationship on green logistics. This can also happen in cases where the shipper relies on an LSP already expert in green logistics or with a customer-centric LSP available to develop green services and solutions, but engaging with a non-interested shipper. It does not seem that the size and the typology of LSPs along with the breadth of the offered service and the approach to green logistics affect the success of the collaboration (see Table 3): this seems to contradict existing literature supporting that these elements impact on the feeling of urgency in relation to environmental issues and the potential for successful collaboration (Sureeyatanapas et al., 2018).

From our evidence, other elements can influence whether collaboration will work in the buyer-supplier relationship. The sample companies showing cases of unsuccessful collaboration have no internal inter-functional or inter-company teams responsible for green aspects (human resources), or a budget allocated to green investments (financial resources). Instead, dyad 5 shows an intercompany team dedicated to the management of green logistics joint initiatives, while in dyad 6 this is not present, but F5 shows an inter-functional team communicating with L5. The companies composing these dyads have a specific budget or are prone to investing in green initiatives.

Regardless of the budget, it seems that the environmental sensitivity of the sample companies is translated into some technological resources. Shippers and LSPs in the first four dyads use ICT systems to manage green issues, but internally. Dyad 5 and 6 adopt ICT that goes beyond internal purposes and gives visibility and transparency on the joint green initiatives, their progress, management and achieved performance. In those cases, ICT has a role in enabling collaboration, creating a virtuous circle in communicating the results of collaboration to foster the development of further initiatives, as suggested by the literature (Mageto, 2022).

Another common pattern is that shippers and LSP strongly perceive economic uncertainties when dealing with green investments, which often represent high costs and uncertain financial returns, confirming the current literature (Evangelista et al., 2017; Fresner et al., 2017). This especially applies to SMEs when they perceive sustainability not as a strategic priority, but as a cost (Siegel, et al., 2022). Those companies belonging to the successfully collaborating dyads see sustainability as an investment and not as a cost when green logistics is concerned.

A result partially confirming the current studies is that most of the LSPs perceive pressures from their clients, mainly the largest ones, becoming a strong driver in implementing green practices (Colicchia et al., 2013). Since the smallest companies show strong interest in green practices, they could potentially become a new driver for the LSP. Still, it is essential to translate this interest in general sustainability matters into logistics and transform their relationships from transactional into strategic partnerships. The relationships within dyads 1 to 4 are limited to annual/pluriannual contracts that do not include environmental elements, confirming the absence of strategic orientation in establishing the relationship and of collaboration. Dyads 5 and 6 confirm that when a strategic partnership exists, along with strong priority assigned to green logistics, the shipper's needs/requirements lead the LSP to leverage their skills and competencies for delivering existing or tailored green services for the shipper (dyad 6), or to develop new initiatives for accommodating, according to a customer-centric approach, the shipper's request (dyad 5).

By looking at the adoption of initiatives (Table 4), it appears that point initiatives are more adopted across the whole sample compared to SC initiatives. Only the companies involved in dyad 5 and 6 seem to emphasize interorganizational practices too. This is in line with the literature (Evangelista et al., 2017), which reports that the adoption of collaborative SC initiatives in the Italian context is still underdeveloped.

#### **Take in Table 4 - Table 4 Green practices implemented by the companies interviewed**

As supported by the literature (Saenz et al., 2014; Abareshi and Molla, 2013), knowledge transfer is one of the main mechanisms driving successful collaborations. Before transferring knowledge, this knowledge needs to be acquired and assimilated through the learning process.

If we refer to the AC framework by Abareshi and Molla (2013), as regards the "firm's capability to identify and acquire externally generated knowledge that is critical to its green logistics operations (GLKAC – Green Logistics Knowledge Acquisition)" results show that companies are able to acquire knowledge about sustainability issues from different external sources. Among these, the most important is represented by



customers, which for shippers are buyers, consumers, and retailers, while for LSPs are the shippers themselves. The second most common source of external knowledge can be reconducted to training courses, often required by law. Other sources are universities, fairs, seminars, external consultancy firms, and trade and industrial associations. An example of this concerns L5 that periodically organises workshops to transfer to the managers and staff of the shipper (F5) the intermediate results of their ongoing green logistics projects. As regards “firm’s routines and processes that allow it to analyse, process, interpret and understand the information obtained from external sources (GLKAS – Green Logistics Knowledge Assimilation)”, whenever there is a green innovation within the firm, companies show different ways to process it across departments and employees. One of the ways is through the participation of employees in training courses on environmental issues. In general, it appears that there is an unstructured, verbal way to the assimilation of the acquired knowledge by employees or the departments’ heads. As explained by some respondents, this is due to the small size of the firms, in which often there are no departments, thus information is freely processed across employees. This confirms the literature, according to which SMEs are often unstructured, flexible organizations in which internal communication is mainly shared informally (Curado and Mota, 2021). Looking at the “Capability to develop green practices that facilitate combining the existing and newly acquired or assimilated environmental knowledge (GLKT – Green Logistics Knowledge Transformation)” and at the “capability that is based on the routines to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations (GLKE – Green Logistics Knowledge Exploitation)”, it appears that companies belonging to the “unsuccessful” dyads have a limited capabilities. These companies adopt point initiatives, implemented taking into account each firm’s specific context, but they rarely succeed in going beyond the boundaries of their organization and they do not develop green practices in collaboration with the partners or even share practices with them.

To exploit environmental initiatives, a more strategic level of involvement and a major integration of processes are needed (Whipple and Russell, 2007). The companies belonging to the group of “successful” dyads seem able to transform and exploit the acquired and assimilated knowledge thanks to better integration of processes and involvement of both companies in the relationship. Dyad 5 and 6 adopt, formally and informally, initiatives for sharing information and exchanging knowledge and experiences. The production of documents, training courses, and workshops that see the participation of the staff of both companies are used for presenting the progress of the projects to improve green logistics practices and transferring knowledge. This allows for combining existing and new knowledge for the adoption of green logistics practices and the development of new ideas/initiatives stemming from the lessons learned. These dyads suggest that to support this fruitful collaboration it is essential to measure and provide evidence on the results of the undertaken initiatives.

The successful cases show that it is necessary to enhance the level of communication and make the process of knowledge sharing more structured. To improve this level, we found evidence that confirms the literature, which suggests periodic meetings involving the decision-makers of the companies, ICT integration, shared performance monitoring, and inter-organizational teams’ creation (Jazairy et al., 2021).

In addition, this requires strong commitment from both parties, and the awareness of the importance of assigning strong priority to green logistics to drive the interest in including green logistics practices in the relationships (Sallnas and Hüge-Brodin, 2018).

While it is common to think that green issues are mainly a prerogative of large businesses (Curado and Mota, 2021), this study shows that also SMEs have an appetite for improving their level of sustainability. When their ambition regards logistics, SMEs can trigger collaborative relationships and initiatives with their LSPs. This, in turn, can improve their competencies and knowledge. Our evidence confirms some barriers reported in the literature on SMEs, such as constraints on resources (e.g., financial and ICT resources - del Brío and Junquera, 2003; expertise of managers - Roberts et al., 2006), but it adds to the existing knowledge showing that not all SMEs are uninterested in sustainability and see it as mere cost – also when logistics is concerned. When ambition for improvement is present, also a limited amount of initial resources dedicated to greening logistics

(e.g., small budgets, basic ICT systems) is sufficient to initiate a collaborative relationship with an LSP – which often has better environmental competencies to share and more developed ICT systems, along with more general sustainability capabilities. Data gathering and processing capabilities emerge as essential to enable the measurement of the outcomes and assess the financial and operational impact of the implementation of sustainability actions (Roberts et al., 2006). From our evidence, the collaborating dyads rely on data sharing and measurement of performance, while the unsuccessful ones do not engage in any of these actions. This is an interesting point highlighting the importance of knowledge management in the development of collaboration in the field of green logistics also when the actors are SMEs. The findings emerging from this study corroborate the existing literature only in part. LSPs operating in unsuccessful dyads confirm the results of previous research in this area. In fact, despite some adoption, the reluctance to adopt a knowledge management-oriented approach by some of the investigated small LSPs leads to conclude that the potential of knowledge management is far from being fully exploited (Durst and Evangelista 2018). Both LSPs and shippers involved in successful dyads show the adoption of a mix of formal and informal knowledge exchange mechanisms supported by integrated ICT systems together with the use of formal tools to exchange and share knowledge on collaborative green projects. While the literature on SMEs argues that they typically use an informal approach (Martin et al., 2019), we also found that this is not a prerogative of larger enterprises. Our evidence shows that these formal mechanisms can help SMEs in the buyer-supplier relationship to produce documentation useful to feed the performance measurement process, which is essential for not losing momentum in the relationship and fostering collaboration in the dyad.

## **6. Conclusions**

### ***6.1 Theoretical implications***

Our study extends the current knowledge by addressing collaboration and knowledge transfer mechanisms in green supply chains through the lens of AC, focusing on the underexplored area of SMEs: this study fills a research gap by investigating the relationship between manufacturing SMEs and their LSPs by concurrently examining resources, influencing factors and strategies related to sustainability. Under certain conditions (e.g., the presence formal and informal knowledge mechanisms, availability of an acceptable level of technology at least in one of the two companies, and the availability of at least a small budget allocated to sustainability) barriers to collaboration for sustainability may be relaxed. This study also highlights the role of technology as a driver of collaboration for sustainability. Our work can be a stepping stone for developing a maturity model on environmental sustainability in SMEs to support companies in their attempts to implement sustainable practices.

### ***6.2 Managerial implications***

This study showed that the SMEs involved in successful dyads could achieve their sustainability goals by developing environmental practices through collaboration with LSPs having competencies in green logistics. Our findings provide directions for managers to select the most appropriate LSP to support them in the implementation of sustainable logistics. Our results highlight the key role of knowledge management, creation and sharing in collaborative arrangements with LSPs. SMEs' managers need to be aware of the importance of such processes and leverage knowledge management tools and training for the staff involved in collaborative activities. Our results provide support for SMEs and LSPs who are approaching the green transition: we offer information about possible approaches of SMEs towards green logistics and the knowledge transfer processes that can lead to successful buyer-supplier collaboration. SMEs' managers should enhance communication with their SC partners and make knowledge transfer processes more organized, with periodic meetings, deeper learning exchange, digital integration, shared performance monitoring, and inter-organizational teams' creation. This could improve knowledge transformation and exploitation capabilities. Our study allows shippers to appreciate the approach/strategy of LSPs in relation to

green logistics and how to engage in the relationship; and it allows LSPs to appreciate the role they can have in supporting shippers towards better logistics sustainability.

### **6.3 Limitations and future research directions**

Further research should involve a larger number of companies, also from different countries and different sectors and examine different types of LSPs. This paper studied collaborative green practices among shippers and LSPs using case studies. It may be useful to adopt a mixed approach combining both qualitative and quantitative techniques. This may allow analysing some critical dimensions of sustainable collaboration in the shipper-LSP relationship emerging from this research (e.g., antecedents of the relationship between shippers and LSPs and causal relationships in the learning and knowledge transfer process). It could be interesting to investigate the potential role of the size and typology of LSP, and of the breadth of the provided service range in affecting the priority/urgency allocated to green logistics – for which the existing literature does not provide conclusive insights. Future research may explore further mechanisms for developing collaboration for green logistics in the shipper-LSP relationship. It would be interesting to also investigate the social dimension of sustainability since this paper focused on the environmental one.

### **References**

- Abareshi, A. and Molla, A. (2013), "Greening logistics and its impact on environmental performance: an absorptive capacity perspective", *International Journal of Logistics Research and Applications*, Vol. 16 No. 3, pp. 209-226.
- Bálint, M., Silva, J., Moehring, M.M. (2021), "Investigating stakeholder engagement and absorptive capacity as drivers of green innovations at German 3PL companies," proceedings of the 28<sup>th</sup> EurOMA Conference, University of Sussex (UK).
- Björklund, M., Forslund, H. (2013), "The inclusion of environmental performance in transport contracts. *Management of Environmental Quality International Journal*, Vol. 24, pp. 214–227.
- Blundel, R., Monaghan, A., Thomas, C. (2013), "SMEs and environmental responsibility: a policy perspective," *Business Ethics*, Vol. 22, No. 3, pp. 246-262.
- Cantele, S., Zardini, A. (2020), "What drives small and medium enterprises towards sustainability? Role of interactions between pressures, barriers, and benefits", *Business Strategy and the Environment*, Vol. 27, Issue 1, pp. 126-136.
- Colicchia, C., Marchet, G., Melacini, M. and Perotti, S. (2013), "Building environmental sustainability: empirical evidence from Logistics Service Providers", *Journal of Cleaner Production*, Vol. 59, pp. 197-209.
- Curado, C. and Mota, A. (2021), "A Systematic Literature Review on Sustainability in Family Firms", *Sustainability*, Vol. 13 No. 7, pp.3824.
- Defee, C.C. and Fugate, B.S. (2010), "Changing perspective of capabilities in the dynamic supply chain era", *The International Journal of Logistics Management*, Vol. 21, No. 2, pp. 180-206.
- Del Brío, J.Á. and Junquera, B. (2003), "A review of the literature on environmental innovation management in SMEs: implications for public policies", *Technovation*, Vol. 23 No. 12, pp. 939-948.
- Durst S., Evangelista P. (2018), "Logistics knowledge management: state of the art and future perspectives," *Knowledge Management Research & Practice*, Vol. 16, No 4, pp. 427-434.
- Eisenhardt, K. M. and Martin J.A. (2000), "Dynamic Capabilities: What are They?" *Strategic Management Journal*, Vol. 21 No. 10, pp. 1105–1121.
- European Commission, (2020), "2019 Small Business Act Fact Sheet: Italy," Eur. Comm., pp. 1-19 (available at: <https://ec.europa.eu/docsroom/documents/38662/attachments/16/translations/en/renditions/native>)

- Evangelista P., Santoro L. and Thomas A. (2018), "Environmental Sustainability in Third-Party Logistics Service Providers: A Systematic Literature Review from 2000-2016," *Sustainability*, Vol. 10, No 5, pp. 1627.
- Evangelista, P., Colicchia, C., and Creazza A. (2017), "Is environmental sustainability a strategic priority for logistics service providers?," *Journal of Environmental Management*, Vol. 198, pp. 353-362.
- European Commission (2005). The New SME Definition. User Guide and Model Declaration. Bruxelles: European Commission, DG Enterprise & Industry
- Fresner, J., Morea, F., Krenn, C., Uson, J.A. and Tomasi, F. (2017), "Energy efficiency in small and medium enterprises: Lessons learned from 280 energy audits across Europe", *Journal of Cleaner Production*, Vol. 142, pp.1650-1660.
- Haag, L., Sandberg, E. and Sallnäs, U. (2021), "Towards an increased understanding of learning: a case study of a collaborative relationship between a retailer and a logistics service provider", *International Journal of Retail & Distribution Management*, Vol. 50 No. 13, pp. 44-58.
- Huge-Brodin, M., Sweeney, E. and Evangelista, P. (2020), "Environmental alignment between logistics service providers and shippers—a supply chain perspective". *The International Journal of Logistics Management*, Vol. 31, No. 3, pp. 575-605.
- International Energy Agency - IEA (2018) CO<sub>2</sub> Emissions from Fuel Combustion. Available at: <https://www.iea.org/data-and-statistics/charts/fuel-share-of-CO2-emissions-from-fuel-combustion-2018>
- Järvensivu, T., and Törnroos, J.Å. (2010), "Case study research with moderate constructionism Conceptualization and practical illustration", *Industrial Marketing Management*, Vol. 39 No. 2, pp. 100–108.
- Jazairy, A., von Haartman, R. and Björklund, M. (2021), "Unravelling collaboration mechanisms for green logistics: the perspectives of shippers and logistics service providers", *International Journal of Physical Distribution & Logistics Management*, Vol. 51, No 4, pp. 423-448.
- Jazairy, A. and von Haartman, R. (2020), "Analysing the institutional pressures on shippers and logistics service providers to implement green supply chain management practices", *International Journal of Logistics Research and Applications*, Vol. 23, No. 1, pp. 44-84.
- Johnson, M.P., Schaltegger, S., (2016), "Two decades of sustainability management tools for SMEs: how far have we come?," *Journal of Small Business Management*, Vol. 54, No. 2, pp. 481-505.
- Knemeyer, A.M. and Murphy, P.R. (2005), "Exploring the potential impact of relationship characteristics and customer attributes on the outcomes of third-party logistics arrangements", *Transportation Journal*, Vol. 44 No. 1, pp. 5-19.
- Koberg, E. and Longoni, A. (2019), "A systematic review of sustainable supply chain management in global supply chains", *Journal of cleaner production*, Vol. 207, No. 3, pp. 1084-1098.
- Kudla, N.L. and Klaas-Wissing, T. (2012), "Sustainability in shipper-logistics service provider relationships: A tentative taxonomy based on agency theory and stimulus-response analysis", *Journal of Purchasing and Supply Management*, Vol. 18, No. 4, pp. 218-231.
- Kusi-Sarpong, S., Gupta, H. and Sarkis, J. (2019), "A supply chain sustainability innovation framework and evaluation methodology", *International Journal of Production Research*, Vol. 57 No. 7, pp. 1990-2008.
- Laari, S., Solakivi, T., Toyli, J., Ojala, L. (2016), "Performance outcomes of environmental collaboration Evidence from Finnish logistics service providers. *Baltic Journal of Management*, Vol. 11, pp. 430-451.
- Liu, L., Zhang, M. and Ye, W. (2019), "The adoption of sustainable practices: A supplier's perspective", *Journal of environmental management*, Vol. 232 No 4., pp. 692-701.
- Lun, Y.H.V., Lai, K.H., Wong, C.W.Y., Cheng, T.C.E. (2014), "Green shipping practices and firm performance," *Maritime Policy and Management*, Vol. 41, pp. 134–148.
- Mageto, J. (2022), "Current and Future Trends of Information Technology and Sustainability in Logistics Outsourcing," *Sustainability*, Vol. 14, No. 13, 7641.

- Martin, D. Romero, I., Wegner, D. (2019), "Individual, organizational, and institutional determinants of formal and informal inter-firm cooperation in SMEs," *Journal of Small Business Management*, Vol. 57, No. 4, pp. 1698-1711.
- McKinnon, A.C., 2018, "Decarbonizing Freight Transport: A Review of Technical, Managerial and Operational Options". In Decarbonising Road Freight Transport Workshop, June 2018.
- McKone-Sweet, K. and Lee, Y.T. (2009), "Development and analysis of a supply chain strategy taxonomy", *Journal of Supply Chain Management*, Vol. 45 No. 3, pp.3-24.
- Miles, M.B. and Huberman, A.M. (1994), *Qualitative data analysis: An expanded sourcebook*. Sage.
- Mishra, R., Kumar Singh, R., Govindan, K., (2022), "Barriers to the adoption of circular economy practices in Micro, Small and Medium Enterprises: Instrument development, measurement and validation", *Journal of Cleaner Production*, Vol. 351, 131389.
- Multaharju, S., Lintukangas, K., Kähkönen, A.K., Hallikas, J. (2017), "Sustainability related risk management in buying logistics services: An exploratory cross-case analysis," *International Journal of Logistics Management*, Vol. 28, Issue 4.
- Pettigrew, A.M. (2013), "The conduct of qualitative research in organizational settings", *Corporate Governance: An International Review*, Vol. 21, No. 2, pp. 123-126.
- Pieters, R., Glöckner, H.H., Omta, O., Weijers, S. (2012) "Dutch logistics service providers and sustainable physical distribution: Searching for focus," *International Food Agribusiness Management Review*, Vol. 15, pp. 107-126.
- Roberts, S., Lawson, R., Nicholls, J., (2006), "Generating regional-scale improvements in SME corporate responsibility performance: lessons from responsibility northwest," *Journal of Business Ethics*, Vol. 67, No. 3, pp. 275-286.
- Robinson, O.C. (2014), "Sampling in interview-based qualitative research: A theoretical and practical guide", *Qualitative research in psychology*, Vol. 11 No. 1, pp.25-41.
- Saenz, M.J., Revilla, E. and Knoppen, D. (2014), "Absorptive capacity in buyer-supplier relationships: empirical evidence of its mediating role", *Journal of Supply Chain Management*, Vol. 50 No. 2, pp. 18-40.
- Sallnäs, U., Hüge-Brodin, M. (2018), "De-greening of logistics? Why environmental practices flourish and fade in provider-shipper relationships and networks", *Industrial Marketing Management*, Vol. 74, pp. 276-287
- Sezer, S. and Abasiz, T. (2017), "The impact of logistics industry on economic growth: An application in OECD countries", *Eurasian Journal of Social Sciences*, Vol. 5 No. 1, pp.11-23.
- Siegel, R., Antony, J., Govindan, K., Garza-Reyes, J.A., Lameijer B., Samadhiya, A. (2022), "A framework for the systematic implementation of green-lean and sustainability in SMEs," *Production Planning & Control*, pp. 1-19.
- Silvestre, B.S., Silva, M.E., Cormack, A. and Thome, A.M.T. (2020), "Supply chain sustainability trajectories: learning through sustainability initiatives", *International Journal of Operations & Production Management*, Vol. 40, No. 9, pp. 1301-1337.
- Solomon, A., Ketikidis, P. and Koh, S.L. (2019), "Including social performance as a measure for resilient and green freight transportation", *Transportation Research Part D: Transport and Environment*, Vol. 69 No. 1, pp. 13-23.
- Sureeyatanapas, P. Poophiukhok, P. Pathumnakul, S. (2018) "Green initiatives for logistics service providers: An investigation of antecedent factors and the contributions to corporate goals". *Journal of Cleaner Production*, 191, 1-14.
- Tacken, J., Sanchez Rodrigues, V. and Mason, R. (2014), "Examining CO2e reduction within the German logistics sector", *The International Journal of Logistics Management*, Vol. 25 No. 1, pp.54-84.
- Ullah, R., Ahmad, H., Rizwan, S., Sualeh Khattak, M. (2022), "Financial resource and green business strategy: the mediating role of competitive business strategy", *Journal of Sustainable Finance & Investment*. <https://doi.org/10.1080/20430795.2022.2031850>.

Wang, J., Lim, M.L., Chao Wang, C., Tseng, M.-L. (2022), "Comprehensive analysis of sustainable logistics and supply chain based on bibliometrics: overview, trends, challenges, and opportunities", *International Journal of Logistics Research and Applications*. <https://doi.org/10.1080/13675567.2022.2052823>

Werneck Barbosa, M., Bronzo Ladeira, M., Valadares de Oliveira, M.P., Martins de Oliveira, V., Renato de Sousa, P. (2022), "The effects of internationalization orientation in the sustainable performance of the agri-food industry through environmental collaboration: An emerging economy perspective". *Sustainable Production and Consumption*, Vol. 31, pp. 407-418.

Wu, T., Wu, Y.C.J., Chen, Y.J. and Goh, M. (2014), "Aligning supply chain strategy with corporate environmental strategy: A contingency approach", *International Journal of Production Economics*, Vol. 147 No. 4, pp.220-229.

Yin, R.K., (2018), *Case study research: Design and methods*. Sage.

# APPENDIX

## Interview questionnaire – shippers

1. Can you please list the names of the most important logistics service providers of your company and the type of the relationship with each of them?
2. What is in your opinion the best description of your environmental strategy?
3. What percentage of the total company budget was allocated to sustainability practices in 2020 (if any)? If yes, is this percentage increased in comparison to the past? Does it will increase in the future? Why or why not?
4. Does your company use any ICT tools/systems for monitoring and managing sustainability? If no, why?
5. In your company, how does top management contribute to the implementation of sustainable practices?
6. Is there a dedicated, internal, inter-functional team for managing sustainability practices within your organization? If yes, how is organized? If no, who's responsible/liable/accountable for the management of sustainability practices?
7. Does the "team" have some power to encourage sustainable practices, or to correct unsustainable behaviours?
8. In your company what is the level of awareness of sustainable issues among employees? How willing is your company to increase this level in the future?
9. Is there any (formal or informal) procedure to communicate and share sustainability information with the logistics service provider? If yes, how often? If no, why not?
10. In your opinion, what factors are most likely to drive your company to adopt sustainable initiatives and what factors could hinder their adoption? (for example cost reduction, reduction of company risks or large investments)
11. Can you give me examples of projects your company has implemented with the goal of collaborating with suppliers or logistics service providers?
12. Does your company adopt environmental criteria during the selection process of suppliers and logistics service providers? (for example, having obtained ISO or other certifications)
13. Has your company developed projects to involve suppliers and logistics service providers in sustainable practices? If so, what are they?
14. How does your company keep up-to-date with the latest developments in the field of sustainability?
15. Do you consider it necessary, in order to increase knowledge, to exchange information about market changes with your LSP and partners? If yes, what are the mechanisms you use to exchange this info?
16. Within the company, whenever sustainable innovations are made, how are they communicated to the different departments and employees?
17. In order to develop and adopt sustainable practices, does your company prefer to adopt mechanisms of direct control over its LSPs/partners or to take joint decisions? Could you give some examples?
18. Has your company any routine in place to transform knowledge about sustainability into more sustainable practices?
19. Is your company capable of sharing its expertise to develop new sustainable practices and has it got routines for developing new knowledge or services to address sustainability concerns?
20. Could you please describe the sustainability initiatives undertaken/planned with your partners, taking into account the description, the main impacts and their time horizons and the progress level?
21. Do you have any specific methods in place to assess your logistics sustainability programmes (e.g. GRI, ISO)? If yes, can you please provide details and why do you use them? If no, what are the reasons hindering the set-up of a measurement system?
22. Are your sustainability performance measurement systems (KPIs) extending also beyond the boundaries of your company?
23. Are your performance measurement systems (KPIs) able to quantify any beneficial impacts of logistics sustainable initiatives on your financial/environmental/operational performance?

## Interview questionnaire – logistics service providers

1. Can you please list the names of the most important customers of your company and the type of the relationship with each of them?
2. What is in your opinion the best description of your environmental strategy?
3. What percentage of the total company budget was allocated to sustainability practices in 2020 (if any)? If yes, is this percentage increased in comparison to the past? Does it will increase in the future? Why or why not?
4. Does your company use any ICT tools/systems for monitoring and managing sustainability? If no, why?
5. In your company, how does top management contribute to the implementation of sustainable practices?
6. Is there a dedicated, internal, inter-functional team for managing sustainability practices within your organization? If yes, how is organized? If no, who's responsible/liable/accountable for the management of sustainability practices?
7. Does the "team" have some power to encourage sustainable practices, or to correct unsustainable behaviours?
8. In your company what is the level of awareness of sustainable issues among employees? How willing is your company to increase this level in the future?
9. Is there any (formal or informal) procedure to communicate and share sustainability information with your customers? If yes, how often? If no, why not?
10. In your opinion, what factors are most likely to drive your company to adopt sustainable initiatives and what factors could hinder their adoption?
11. Can you give me examples of projects your company has implemented with the goal of collaborating with customers?
12. Specifically, with your customers, what types of partnerships does your company put in place?
13. Has your company developed projects to involve its partners in sustainable practices? If so, what are they?
14. How does your company keep up-to-date with the latest developments in the field of sustainability?
15. Do you consider it necessary, in order to increase knowledge, to exchange information about market changes with your customers and partners? If yes, what are the mechanisms you use to exchange this info?
16. Within your company, whenever sustainable innovations are made, how are they communicated to the different departments and employees?
17. In order to develop and adopt sustainable practices, does your company prefer to adopt mechanisms of direct control over its customers or to take joint decisions? Could you give some examples?
18. Has your company any routine in place to transform knowledge about sustainability into more sustainable practices?
19. Is your company capable of sharing its expertise to develop new sustainable practices and has it got routines for developing new knowledge or services to address sustainability concerns?
20. Could you please describe the sustainability initiatives undertaken/planned with your partners, taking into account the description, the main impacts and their time horizons and the progress level?
21. Do you have any specific methods in place to assess your logistics sustainability programmes (e.g. GRI, ISO)? If yes, can you please provide details and why do you use them? If no, what are the reasons hindering the set-up of a measurement system?
22. Are your sustainability performance measurement systems (KPIs) extending also beyond the boundaries of your company?
23. Are your performance measurement systems (KPIs) able to quantify any beneficial impacts of logistics sustainable initiatives on your financial/environmental/operational performance?



Table 1 Main steps of AC mechanisms for environmental sustainability

Source: Abareshi and Molla (2013)

1.	<b><i>Green logistics knowledge acquisition (GLKAC)</i></b>	Capability to identify and acquire externally generated environmental knowledge that is critical for green logistics practices. For example, in the logistics context it can be the existence of organisational routines to capture emerging environmental regulations.
2.	<b><i>Green logistics knowledge assimilation (GLKAS)</i></b>	Firm's routines and processes that allow it to analyse, process, interpret, and understand the environmental information obtained from external sources. In the logistics context, GLKAS can include an organisation's training programmes, plans to achieve environmental targets, and analytical tools to identify environmental impacts such as life cycle measurement.
3.	<b><i>Green logistics knowledge transformation (GLKT)</i></b>	Capability to develop green practices that facilitate combining the existing and newly acquired or assimilated environmental knowledge.
4.	<b><i>Green logistics knowledge exploitation (GLKE)</i></b>	Environmental capability that is based on the routines to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations
5.	<b><i>Green logistics performance (GLP)</i></b>	The effects of the organisation's logistics operations on the environment

Table 2. Profile and background of the case companies

Source: authors' own elaboration

CASE	PROFILE	N. OF EMPLOYEES (2020)	ANNUAL TURNOVER (2020)	DYAD
<b>F1</b>	Founded in 1970, the company's origin was trading fish from a small lake, which was then transformed in a fish farm with original environmental conditions. Then, as a response to market demand, they started making also packaged, ready-to-eat products.	20-49	€ 1.5–2.5 m	Dyad 1: F1-L0 Dyad 2: F1-L1
<b>L0</b>	Founded in 1988, the company is a social cooperative specialized in goods handling and integrated logistics management. It operates with handling services and management of logistics centres at the customer's premises or in dedicated property facilities. One of their specializations is warehousing with controlled temperature cells especially for the wine, food and pharmaceutical sectors.	857	€ 47 m	Dyad 1: F1-L0
<b>L1</b>	Italian branch of a European corporation, specialized in temperature-controlled transportation and logistics. It is present in the Italian scenario since 1983. Currently it has a network of 34 branches throughout Italy, and in the last years it showed an important growth with multiple acquisitions.	742	€ 281 m	Dyad 2: F1-L2
<b>F2</b>	Pasta factory founded in 2010 starting from a small family firm that has been cultivating durum wheat since 1938. Currently it produces pasta using its own durum wheat, that grows and harvest annually in the fields surrounding the company itself. Good Agricultural Practices are constantly applied to ensure eco-friendly and sustainable management of agricultural activities.	10-20	€ 3–4 m	Dyad 3: F2-L2
<b>L2</b>	Company founded in 1966, specialized in freight road transport and logistics services. They work for companies of different industries, from fashion to agri-food. They are able to reach all the country through a national network in collaboration with other logistics companies.	20-30	€ 5.5 m	Dyad 3: F2-L2
<b>F3</b>	Agricultural cooperative founded around 30 years ago from the merger of two distinct agricultural firms. They own around 20 trucks with methane gas. Their mission is becoming a "closed circular economy", where closed refers to the chain because all the production phases are done directly by the company organization, from the seed to the final product.	240	€ 30 m	Dyad 4: F3-L3
<b>L3</b>	Company specialized in road freight transport and in integrated and customized logistics solutions.	10-20	€ 1.5–3 m	Dyad 4: F3-L3

<b>F4</b>	The company was founded on 1979 and it produces coffee for bar and the HORECA sectors. The company has a strong control over the downstream part of the supply chain (bars) through 100 sale agents. The geographical reach is mainly based on the domestic market.	50-60	€ 29 m	Dyad 5: F4-L4
<b>L4</b>	The company was established in 1974 and works with about 100 subcontractors, mostly truck drivers. The services provided include inbound services, warehousing, distribution and outbound services. The core service is warehousing. Products moved are books, cosmetics, food, medical and mechanical products. The market focus is mainly national.	20-30	€ 15 m	Dyad 5: F4-L4
<b>F5</b>	Founded on 1990, the company is specialised in producing physiological products and food integrators. The company main activities are product design and marketing and coordination of suppliers and distribution channels (wholesalers, pharmacies and herbalist shops). The market focus is mostly on the domestic market.	15-20	€ 5 m	Dyad 6: F5-L5
<b>L5</b>	The company was established in 1988 and it provides a full range of services including warehousing, transport, distribution, information and administrative logistics services. It developed long-term relationships with a selected few trusted suppliers and local and multinational customer. The geographical reach is regional (Europe)	40-50	€ 23 m	Dyad 6: F5-L5

Table 3. Main features of the six investigated dyads and relationships

(source: authors' own elaboration adapted from Sallnäs and Hüge-Brodin, 2018 and Abareshi and Molla, 2013)

Dyad and actors	Company size*	Activities carried out in the relationship	Length of relationship	Length of contract	Interest in including green logistics practices in the relationship	Inclusion of green logistics practices in the relationship	Absorptive capacity capabilities in the relationship**
<b>Dyad 1: F1-L0</b>							
Shipper F1 (fish farm)	Small	Warehousing	>10 years	Annual	Both companies show little interest. L0 is open to include green logistics practices but only if required by clients.	<ul style="list-style-type: none"> <li>No inclusion of green practices in the relationship</li> <li>Joint discussions when the contract is renewed</li> </ul>	GLKAC GLKAS
LSP L0 (handling and integrated logistics services)	Large						
<b>Dyad 2: F1-L1</b>							
Shipper F1 (fish farm)	Small	Distribution	>10 years	3 years	Both companies show little interest. L1's proactive approach is mainly aimed at internal optimisation.	<ul style="list-style-type: none"> <li>No inclusion of green practices in the relationship</li> <li>Green actions adopted internally especially by Company L1</li> </ul>	GLKAC GLKAS
LSP L1 (temperature-controlled transport and logistics services)	Large						
<b>Dyad 3: F2-L2</b>							
Shipper F2 (Pasta maker)	Small	Distribution	>10 years	3 years	Little interest from both companies	<ul style="list-style-type: none"> <li>No inclusion of green practices in the relationship</li> <li>Green actions adopted internally by the companies</li> </ul>	GLKAC GLKAS
LSP L2 (road transport and logistics services)	Small						
<b>Dyad 4: F3-L3</b>							
Shipper F3 (Agricultural cooperative)	Medium	Distribution	>30 years	Annual	F3 shows more interest than L3	<ul style="list-style-type: none"> <li>No inclusion of green practices in the relationship</li> <li>F3 implements green actions internally in line with its own environmental strategy</li> <li>L3 shows a more reactive approach adopting only actions required by the existing regulation</li> </ul>	GLKAC GLKAS

LSP L3 (road transport and integrated logistics solutions)	Small						
Dyad 5: F4-L4							
Shipper F4 (Coffee maker)	Medium	Warehousing and distribution	>10 years	5 years	Higher interest from F4 in comparison with L4	<ul style="list-style-type: none"> <li>Green actions related to warehousing and transport are included in the relationship</li> <li>F4 trigger the collaboration while L4 play a more reactive role</li> <li>The two companies regularly exchange information on actions</li> <li>L4 drives the communication process and provides information about green performance to F4 (e.g. emission data)</li> <li>F4 is not willing to pay an extra price for green services</li> </ul>	GLKAC GLKAS GLKT GLKE
LSP L4 (transport, warehousing and logistics services)	Small						
Dyad 6: F5-L5							
Shipper F5 (physiological and food integrators company)	Small	Inbound transportation and distribution	>10 years	5 years	Higher interest from L5 in comparison with F5	<ul style="list-style-type: none"> <li>Both companies show a high level of green awareness</li> <li>L5 has expertise in green logistics in comparison with F5</li> <li>Green projects have been undertaken in collaboration by the two companies with a focus on transport decarbonisation</li> <li>L5 provides a report estimating the environmental and economic impact of the project</li> <li>F5 is willing to pay an extra price for green services</li> </ul>	GLKAC GLKAS GLKT GLKE
LSP L5 (integrated transport and logistics services)	Small						

\* The company size has been defined on the basis of the number of employees using the EU SMEs definition (European Commission, 2005)

\*\* Absorptive capacity capabilities acronyms(see Table 1): GLKAC = Green logistics knowledge acquisition; GLKAS = Green logistics knowledge assimilation; GLKT = Green logistics knowledge transformation; GLKE= Green logistics knowledge exploitation

Table 4 Green practices implemented by the companies interviewed

Source: authors' own elaboration

Area	Approaches	Adopted practices	F1	F2	F3	F4	F5	L0	L1	L2	L3	L4	L5	
<b>Intra-organizational practices</b>	<i>Distribution strategies and transportation execution</i>	Use of alternative fuels or vehicles			X			X	X	X		X	X	
		Use of ICT applications for planning, routing, and fleet tracking and tracing			X						X		X	X
	<i>Warehousing and green building</i>	Energy efficiency	X	X	X				X	X	X		X	X
		Water systems		X										
	<i>Reverse logistics</i>	Waste reduction	X	X	X				X	X			X	
		Materials recycling and reuse							X	X	X			X
	<i>Packaging management</i>	Packaging recyclability	X	X			X							X
	<i>Internal management</i>	Personnel training			X								X	
	<b>Inter-organizational practices</b>	<i>Collaborations with SC actors</i>	Collaboration with suppliers	X	X		X	X						
			Collaboration with customers							X				X
Collaboration for reverse logistics and waste reduction			X							X				X
<i>External collaborations</i>		Membership in environmental programs		X		X	X						X	X
		Collaborative partnerships with competitors			X						X			