Now, then and tomorrow: green logistics practices from a proactive shippers' perspective

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Abstract

Purpose – Green transportation emerged as a prominent topic in logistics research three decades ago. Nevertheless, freight transport continues to exert considerable environmental pressure. This study addresses the scarcity of longitudinal research in the field by examining the evolution of green logistics practices (GLPs) among shippers. It compares current GLPs with those from 25 years ago and offers key insights to inform future GLP implementation.

Design/methodology/approach – The study is based on interviews supplemented by public and internal company documentation. Data were collected from four food industry shippers (14 respondents in total) during two periods: 1999/2000 and 2024/2025.

Findings – Across both periods, a wide range of initiatives aimed at greening transport were observed. Notable advancements were identified in performance management GLPs (PM-GLPs), including strengthened collaborations, improved follow-up procedures, enhanced reporting, and the centralization of routines and environmental objectives. Seven propositions are presented to guide future research and practice on GLPs.

Research limitations/implications – The study underscores the development of various GLPs and highlights the often-neglected interplay between direct transport GLPs (T-GLPs) and indirect PM-GLPs. It encourages researchers to revisit empirical data and critically reflect on developments to guide future studies.

Originality/value – The study's originality lies in its longitudinal design, offering a rare perspective on the historical trajectory and future potential of green logistics in freight transport.

Keywords Green logistics practices, Fossil-free freight, Sustainable transport management, Longitudinal case study, Transport buyer perspective

Paper type Research article

1. Introduction

> It's about remembering what we already know, so we can choose more wisely. There's a word for that: historical awareness. My understanding of the past illuminates the present and guides me toward the future.
>
> Robin Olovsson, History teacher and podcaster, Radio broadcast (Sommar i P1), 17 July 2025, Authors own translation

The environmental burden of freight transport – including climate impact, noise and emissions – has long been recognized. Despite the adoption of green logistics practices (GLPs), aimed at mitigating the environmental effects of logistics (e.g. Tetteh *et al.*, 2024; Jayarathna *et al.*, 2024), challenges persist. GLPs are a recurring theme in sustainable logistics literature, encompassing a wide array of GLPs (Miklautsch and Woschank, 2022) and conceptual frameworks (e.g. McKinnon, 1998; Jazairy *et al.*, 2021). While many studies adopt a broader supply chain perspective – encompassing sustainable consumption, green marketing,

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warehousing and material reuse (e.g. Murphy *et al.*, 1994; Tetteh *et al.*, 2024; Jayarathna *et al.*, 2024) – this study focuses specifically on transport-related GLPs.

Murphy *et al.* (1994) were early to emphasize the need for the field to incorporate environmental concerns and urged management to address the ecological consequences of logistics operations. Transport buyers (shippers), such as retailers and manufacturers, play a pivotal role in advancing sustainable logistics due to their influence over logistics service providers (LSPs), who execute logistics operations (Forslund *et al.*, 2022; Sallnäs and Huge-Brodin, 2018). However, this relationship is characterized by mutual dependency: shippers rely on LSPs to achieve environmental objectives, while their demands may simultaneously constrain LSPs' capacity to offer greener solutions (Jazairy, 2020; Wolf and Seuring, 2010; Lammgård and Andersson, 2014; Yu *et al.*, 2020).

Numerous frameworks for GLPs have been proposed, covering a wide range of practices. However, no framework has been found that offers a holistic perspective that captures the full breadth of GLPs discussed in the literature. Existing categorizations are typically tailored to the specific focus of individual studies (see, e.g. Jazairy *et al.*, 2021; Martinsen and Huge-Brodin, 2014). This highlights the need for the development of a comprehensive and more generic framework. Several frameworks (see, e.g. Jazairy, 2020; Sureeyatanapas *et al.*, 2018; Osman *et al.*, 2022) combine GLPs with a direct impact on transport greening (e.g. adoption of cleaner fuels, reduction of transport demand), here termed transport GLPs (T-GLPs) and GLPs with an indirect impact (e.g. collaboration with LSPs and performance measurement), here termed performance management GLPs (PM-GLPs), without clearly distinguishing these two characters. This study suggests a holistic framework that captures the diversity of GLPs and differentiates between two categories T-GLPs and PM-GLPs, as well as capturing their interaction.

Finally, despite that much research has targeted GLPs to build a solid knowledge base, very limited attention has been given to how these GLPs evolve over time. This study therefore examines the development of individual GLPs and identifies factors influencing the assimilation of GLPs to provide a deepened understanding of the development. Numerous adages underscore the value of historical reflection to inform present and future actions – a perspective embraced in this study and captured in its purpose: *to generate insights for future GLP implementation by assessing developments between shippers' practices today with those from 25 years ago*.

The study identifies key themes that illustrate the evolution of GLPs, offering insights relevant to both practitioners and researchers by, for example distinguishing persistent GLPs from those that are emerging. Additionally, by applying innovation diffusion theory (IDT), the article explores factors influencing the assimilation of GLPs. The study also contributes as it addresses several research gaps by employing a qualitative, historically-grounded approach focused on the food industry (see Tetteh *et al.*, 2024), incorporating a historical perspective (Wieland *et al.*, 2024), and examining a region (Sweden) that was an early adopter of green transport initiatives. Furthermore, the temporal perspective both bridges research gaps and reveals time-dependent dynamics, such as the stabilization of GLP frameworks and shifts in the salience of IDT constructs.

The article departs from a frame of reference encompassing T-GLPs, PM-GLPs, IDT and the developed framework applied to structure empirical findings. These findings derive from an interview-based study with four food industry shippers in Sweden, initially conducted in 1999/2000 and revisited in 2024/2025. The results are analyzed through IDT, followed by a discussion on the future uptake of GLP applications, articulated in seven propositions. The article concludes with practical and academic contributions, limitations and directions for future research.

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2. Frame of reference

The frame of reference starts out by synthesizing existing literature on GLPs. The theoretical lens, IDT, is introduced to support analysis of factors influencing the adoption of various GLPs. In line with the study's longitudinal approach, both contemporary and earlier sources have been considered. Last, a generic and holistic framework is proposed that differentiates between T-GLPs with direct impacts on green transportation (e.g. cleaner fuels, demand reduction) and PM-GLPs, with indirect effects, such as LSP relationship management.

2.1 Framing GLPs

Transport has been a central theme in green logistics since its early emergence around the millennium (Ren *et al.*, 2020), and since then several frameworks have been suggested to capture shippers' perspective on GLPs. For instance, Bilek *et al.* (2024) identify GLPs such as emission measurement and reporting, and the valuation of LSPs' green services. Osman *et al.* (2022) include strategic GLPs such as collaboration with transport providers, alongside decisions on logistics system design and mode/vehicle selection.

Present framework categorizations are generally influenced by the specific objectives and scope of individual studies. Examples include distinctions between strategic and operational decision-making (McKinnon, 1998), the actions that can be taken by different company functions (Wu and Dunn, 1995), the dependence of GLPs on collaboration mechanisms (Jazairy *et al.*, 2021) or their relevance at different stages of the purchasing process (Martinsen and Huge-Brodin, 2014).

Inspired by the widely acknowledged importance of various forms of collaboration for the adoption of green transport measures, and by the influence exerted by buyers through requirements and demands (see, e.g. Creazza *et al.*, 2023; Jazairy *et al.*, 2021; Forslund *et al.*, 2022; Sallnäs and Huge-Brodin, 2018; Sallnäs *et al.*, 2022), this article develops a framework that differentiates between GLPs with a direct impact on transport greening (T-GLPs) and those that indirectly influence these practices (PM-GLPs).

2.2 Transport GLPs (T-GLPs)

T-GLPs include selecting efficient transport modes, transitioning to cleaner fuels, reducing transport distances and minimizing idle time. To ensure a comprehensive view, strategic, tactical and operational decisions are considered, following Miklautsch and Woschank (2022), the early framework of McKinnon (1998) serves as a foundation. The framework outlines four levels of logistics decisions, ranging from strategic to operational. These decisions influence the environmental impact of transport. The first level concerns logistics system redesign. The second involves sourcing and distribution patterns, such as the location of customers and suppliers (included here as part of system design). The third level addresses the scheduling of freight flows, often referred to as transport management. Finally, the fourth level focuses on managing transport resources, for example through modal shifts or vehicle technologies. Another level of decision also identified in McKinnon (1998) regards decisions on product and packaging design with its potential to reduce unnecessary transport.

Shippers can change the *design of products and packaging* by, for example reducing water content in products and modifying packaging to decrease volume (Wu and Dunn, 1995). Packaging efficiency is emphasized by Pålsson and Sandberg (2022) and Santén (2017), particularly in road transport. However, much of the packaging literature focuses on material rather than its role in transport efficiency, often overlooking trade-offs between transport performance, food waste, and packaging waste (Pålsson and Sandberg, 2022).

Redesign logistics structures – such as facility number, location and capacity – affect transport distances and enable or constrains other T-GLPs (McKinnon, 1998; Ren *et al.*, 2020; Evangelista, 2014). Murphy *et al.* (1994) identified system redesign as a strategic means to reduce transport-related environmental impact.

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Green transport management, including scheduling, frequency and vehicle size, affect consolidation and utilization (Jazairy, 2020; Martinsen and Huge-Brodin, 2014). Flow scheduling, such as postponement and frequency adjustments, influences transport demand (McKinnon, 1998; Jazairy *et al.*, 2021). IT systems for routing enhance efficiency by optimizing routes and increasing payload (Sureeyatanapas *et al.*, 2018; Bilek *et al.*, 2024).

Green modal shifts are widely recognized for their environmental benefits (Sallnäs *et al.*, 2022; Pazirandeh and Jafari, 2013; Miklautsch and Woschank, 2022; Jayarathna *et al.*, 2024). Wu and Dunn (1995) highlight the increased use of sea and rail transport as highly effective. Intermodal solutions (Sureeyatanapas *et al.*, 2018), such as shifting from road to rail (Martinsen and Huge-Brodin, 2014) or sea (Rogerson *et al.*, 2020), are common. Eng-Larsson and Kohn (2012) emphasize the shipper's role in enabling modal shifts, noting that success depends on flexibility in delivery windows, administrative processes and inventory levels.

Green vehicle technologies are central to reducing transport emissions (Ellram and Murfield, 2017), and demanding greener vehicle technologies is a key purchasing performance for shippers (Pazirandeh and Jafari, 2013). Biofuels and electrification are key (Jazairy *et al.*, 2021; Jayarathna *et al.*, 2024). Additional considerations include vehicle age, efficient power transmission and exhaust technology (Miklautsch and Woschank, 2022).

Changed vehicle operation, such as eco-driving, enhance energy efficiency (Jazairy *et al.*, 2021; Sureeyatanapas *et al.*, 2018). Other practices include maintaining steady speeds, using higher gears, avoiding idling (Huang *et al.*, 2018; Jayarathna *et al.*, 2024), and employing intelligent idling control (Jazairy, 2020). Vehicle maintenance (Miklautsch and Woschank, 2022) and driver training (Pazirandeh and Jafari, 2013) are also crucial.

2.3 Performance management GLPs (PM-GLPs)

A firm's green performance management influences how environmental considerations are integrated into purchasing decisions (de Sousa Jabbour *et al.*, 2014). Unlike T-GLPs, which are often clearly delineated, PM-GLPs tend to be more intertwined.

To *form close relationships* is frequently highlighted as essential for advancing GLPs (Creazza *et al.*, 2023; Forslund *et al.*, 2022; Martinsen and Huge-Brodin, 2014). Bilek *et al.* (2024) stress the importance of designing GLPs within collaborative relationships, particularly due to trust and information gaps. Closer relationships also facilitate risk-sharing and co-investment in green technologies (Wolf and Seuring, 2010; Lammgard and Andersson, 2014; Yu *et al.*, 2020).

To *place environmental demands and require information* on T-GLPs from both potential and contracted LSPs is central (Bilek *et al.*, 2024; Forslund *et al.*, 2022; Osman *et al.*, 2022). As already outlined, there is also a major risk that shippers place demands that constrain the LSPs in their development of greener solutions (Jazairy, 2020; Wolf and Seuring, 2010).

Educating and training personnel is central to the greening of logistics (Ren *et al.*, 2020), and Björklund *et al.* (2024) highlight the development of transport suppliers as a key practice. For example, meetings to share knowledge of green projects and employee participation in courses are crucial to successful shipper-LSP collaboration (Creazza *et al.*, 2023).

Including environmental criteria in *contract agreements*, pricing structures, and considering extended contract durations can support risk-sharing and reflect a willingness to invest in greener solutions (Jazairy, 2020), as collaborative cost and risk-sharing can facilitate the implementation of more costly vehicle technologies (Gillström *et al.*, 2024).

Performance measurements enable comparison of outcomes against goals. Bilek *et al.* (2024) note that shippers often depend on LSPs for relevant data. Internal and external measuring and reporting of the environmental impact from transport is emphasized (Bilek *et al.*, 2024; Tetteh *et al.*, 2024; McKinnon and Piecyk, 2012; Björklund *et al.*, 2024). In line with this, Creazza *et al.* (2023) identify standardized measurement processes as a defining feature of successful environmental collaboration between shippers and LSPs.

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To continually *monitor* improvements is central in performance measurement (McKinnon and Piecyck, 2012), but also more qualitatively as a complement to, or instead of, trust-based practices in the procurement of green services from contracted LSPs (Forslund *et al.*, 2022). Despite this, little literature is available on the monitoring of transport suppliers.

Finally, different *frameworks and routines* guide performance management, such as environmental management systems that can provide an overview of actions taken. Certifying companies under international standards like ISO 14001 is another example. The literature puts forward many examples of standards that can guide companies, such as the framework by Global Reporting Initiative that has been used by the logistics industry to measure sustainability performance (Ciliberti *et al.*, 2008).

2.4 Innovation diffusion theory (IDT)

Innovation diffusion theory is applied in this study to deepen the understanding of factors influencing the assimilation of GLPs. Originally introduced by Rogers in 1962, IDT provides a framework for analyzing how new ideas, practices and innovations are adopted both within and across organizations (Żywiołek *et al.*, 2025; Türkeş *et al.*, 2024). The theory identifies five key characteristics – sometimes referred to as constructs, attributes or contributors (Mathauer and Hofmann, 2019; Wang *et al.*, 2018) – that influence the adoption and rate of adoption of new ideas, practices and innovations: relative advantage, compatibility, trialability, observability and complexity (Rogers, 1995, 2003). Tornatzky and Klein (1982) were among the first to emphasize the importance of relative advantage, compatibility and complexity in explaining innovation adoption. *Relative advantage* refers to the perceived improvement offered by the new practice compared to existing technologies or processes, particularly in terms of cost and quality. Rogers (1995) suggests this characteristic has the strongest positive correlation with adoption rate. *Compatibility* captures the extent to which the practice aligns with the organization's existing values, norms and past experiences (Rogers, 2003). *Complexity* reflects the perceived difficulty in understanding or implementing the innovation, while *trialability* denotes the perceived possibility of experimenting on a small scale before full adoption (Rogers, 2003; Fosso Wamba *et al.*, 2019). Finally, perceived *observability* refers to the extent to which the results are visible to others (Rogers, 2003; Fosso Wamba *et al.*, 2019). Wang *et al.* (2018) note that both trialability and observability may vary depending on the stage of adoption.

The framework has proven useful in logistics research for explaining the uptake of diverse innovations. For example, Wang *et al.* (2018) found that customers' perceived relative advantage significantly influenced the adoption of automated parcel stations. Gruchmann *et al.* (2024) showed that the acceptance of driver assistance systems – such as those supporting eco-driving – was primarily driven by social norms, compatibility and trialability. Mathauer and Hofmann (2019) further demonstrated that LSPs' adoption of technological innovations (e.g. electric forklifts, transport and warehouse management systems) depends on both technology-related factors (complexity, trialability, relative advantage) and firm-specific factors (e.g. technological compatibility).

2.5 Holistic framework

A holistic framework of GLPs relevant to greening transportation from a shipper's perspective is proposed (see Figure 1). The framework differentiates between T-GLPs with a direct impact on transport greening and PM-GLPs that indirectly influence T-GLPs. The latter are illustrated as six distinct boxes, while the former, represented by the dotted line, reflects the more interrelated nature of these GLPs. To exemplify, performance measurement can be part of the contract agreement as well as be used in monitoring.

Two directional arrows indicate the more direct impact of T-GLPs on environmental outcomes. For example, measuring environmental impact is essential for identifying areas of improvement in transport greening (Forslund *et al.*, 2022), and collaborative cost and risk-

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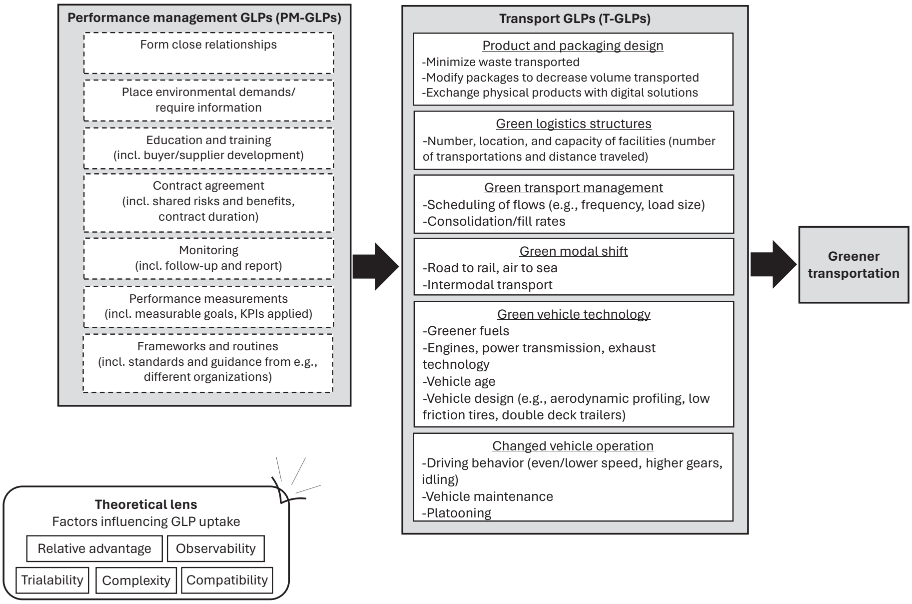

Figure 1. Framework for GLPs in green transportation and theoretical lens applied. Source: Author's own figure

sharing are critical for implementing more capital-intensive green transport technologies (Gillström *et al.*, 2024). Strong PM-GLPs can enable and strengthen T-GLP implementation. For example, shippers may set requirements or collaborate to increase uptake of specific T-GLPs, as discussed in Section 2.1. The framework illustrated in the figure is complemented by the theoretical lens of IDT, positioned in the lower left corner. The lens serves to deepen the analysis of how the uptake of GLPs has been affected by its relative advantage, observability, trialability, complexity and compatibility.

3. Method

3.1 Research approach and case selection

This study employs a multiple case study design, with data collected at two distinct points in time: (1) during the initial emergence of green logistics in 1999/2000, and (2) 25 years later in 2024/2025. This longitudinal perspective enables an exploration of the field's evolution (Wieland *et al.*, 2024; Yin, 2018). The food industry was selected due to its early recognition as a pioneer in environmental initiatives, as reflected in foundational research (e.g. Wu and Dunn, 1995).

Given the study's exploratory nature 25 years ago, a qualitative, interview-based approach was deemed appropriate (Yin, 2018). The same method was applied 25 years later to ensure comparability. Early adopters were selected, given the early stage of greening transport in both literature and practice. Four food manufacturers were identified as highly proactive in integrating environmental considerations into transport procurement in 1999, representing "extreme or deviant cases" (Miles and Huberman, 1994). Their proactiveness was evidenced through goals, policies and management systems, as detailed in the case descriptions. Convenience also influenced selection, as these firms had agreed to participate in a broader study on green transportation, of which this interview study was a part. Their continued

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engagement is evident today; for instance, three companies (C2–C4) actively participate in the “DLF Transport Initiative 2025”, pursuing ambitious fossil-free fuel targets.

The sample size is small because it relies on companies studied 25 years ago and their willingness to participate in the second study. Potential limitations regarding external validity and survivorship bias were addressed by excluding highly deviant findings and by reviewing public information on the excluded firms.

3.2 Data collection and analysis

The initial data collection (1999–2000) involved interviews with individuals responsible for strategic transport procurement (e.g. relations formed with the suppliers, development of supplier selection criteria and contract agreements), yielding one to three respondents per company. Triangulation was achieved through secondary data, including environmental and financial reports, internal documents and LSP questionnaires. Multiple methods enhanced understanding, reduced bias and strengthened credibility (Halldorsson and Aastrup, 2003). Saturation was achieved as no new practices (applying the framework) emerged in the final interviews. The final empirical sections to be presented in three different research reports were reviewed by respondents, reinforcing credibility, accuracy and confirmability.

The second data collection (2024–2025) targeted new respondents with equivalent roles, as original participants had left. Due to increased centralization, typically one respondent was interviewed, though additional participants were included in C4, as only the sustainability manager (C4−R1) first agreed to the interview. However, the sustainability manager lacked sufficient detail, and she ensured that a strategic purchasing manager was included to provide this information (C4−R2).

The first set of interviews was conducted onsite using handwritten notes due to recording hesitancy at the time. The second round was digital, used Microsoft Teams, with recorded and transcribed interviews lasting 40–90 min. Interviews began with role verification, followed by a review of historical data for respondent reflection. Two respondents (C1, C2) had over 25 years of tenure and could validate historical accounts. The other respondents considered the historical data consistent with internal narratives. However, on one occasion, a relatively new employee believed that the company had adopted alternative fuel 25 years ago. As this claim could not be verified through historical reports or similar sources, it was excluded to minimize the risk of retrospective bias.

Updated GLPs were then discussed, followed by a probing of current T-GLPs and PM-GLPs guided by the suggested framework. Transcripts were then approved by the respondents (Halldorsson and Aastrup, 2003).

A key difference in trustworthiness reflects evolving academic standards. In 1999/2000, empirical sections were finalized with respondent approval, with minimal revisions due to monograph style outputs. Today, increased demands for traceability (e.g. quotes) and responsiveness to reviewer feedback necessitate a different approach. Rockmann and Vough (2023) informed quote selection to enhance traceability. Additional quotes are provided in the Supplementary Material. Triangulation with public and internal documents was also applied in the second round to ensure consistency.

Analysis began deductively, organizing data per the framework and conducting cross-case comparisons (Chapter 4). Coding was supported by literature, enhancing credibility. IDT was added as a lens after data collection to support the analysis by deepening understanding of characteristics influencing GLP adoption.

The second analysis used pattern matching (Miles and Huberman, 1994) to identify themes reflecting the field’s evolution. Practices from both time periods were compared, focusing first on T-GLPs, then PM-GLPs. For each theme, propositions were developed and supported with selected quotes (see Supplementary material).

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3.3 Case description

The companies' proactiveness in greening transportation was evident through various initiatives. In 1999, Company 1 (C1) set a target to reduce transport-related energy use by 10% and aimed to halve energy consumption across the entire supply chain by 2002. It also aspired to be recognized as an environmental leader in its sector (C1 internal logistics report, December 1998). Company 2 (C2) incorporated transport into its environmental policy as early as 1996, stating that product and packaging transport should be conducted in an environmentally responsible manner. Company 3 (C3) set a goal for at least 15% of its vehicles to meet national environmental label standards within a decade – at the time, only rail transport met these criteria. Environmental management systems were also adopted: C3 was among the first Swedish food companies to implement such systems; C2 planned partial ISO 14001 certification and produced biogas for taxis and waste collection vehicles. C1 developed a proprietary system based on ISO 14001, while C4's environmental policy emphasized "prioritizing short transport distances and low-impact transport".

Mergers and acquisitions into larger European conglomerates reshaped the transport structures of all companies (see Table 1). By 2025, outbound flows (exports) for C2–C4 were managed by sister companies. To maintain comparability, the study focused on business units and transport systems that most closely resembled the original structures, for example Swedish market operations or, for C4, the Nordic region. At several times during the interviews, clarifications were made to ensure that the same scope was addressed as during the studies 25 years ago. Furthermore, traceability is enhanced by clarifying how transport systems as well as PM-GLPs have evolved due to mergers and acquisition.

All companies continued to outsource transport services, though C3 had insourced part of its operations, registering as a transport company with a fleet of approximately 30 trucks serving its regional market (C3 Sustainability Report, 2024). This shift was driven by the need for specialized vehicles and drivers due to product-specific requirements and dependency on a limited number of LSPs. Additionally, contract durations were extended over time: to exemplify, C1 moved from one to two years and C2 from one to two years to three years.

4. Empirical findings and analysis

This section presents the empirical findings from the first analytical step, structured according to the developed framework. It begins with T-GLPs, followed by PM-GLPs.

Table 1. Case company information

	C1	C2	C3	C4
Main food suppliers (based on volume)	Farmers Sweden (in 2025 also Europe)	Manufacturers Sweden (in 2025 also Europe)	Farmers Sweden	Manufacturers Sweden (in 2025 also Europe)
Main customers (based on volume)	Retailers Globally	Retailers in Sweden (in 2025 also Europe)	Retailers and municipalities in a Swedish region	Retailers in Sweden (in 2025 also Europe)
Inbound/outbound transport focus and responsibility	Focus outbound (much larger than inbound)	25 years ago: responsible for outbound; now: responsible for inbound	Outbound (to minor extent inbound) in Sweden	Responsible for both inbound and outbound
Transport modes	Sea dominates, road	Road dominates, sea and rail	Only road	Road dominates, sea and rail to minor extent

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4.1 Practicing T-GLPs

The environmental benefits of *product and packaging design* are elaborated on by three of the companies studied. In 1999, C3 reduced water content in products to lower transport volumes – a practice also noted by Wu and Dunn (1995). Today, C3 has extended product shelf life, enabling reduced transport frequency. C4 focuses on packaging that fits pallets and allows high stacking, thereby improving fill rates. These practices reflect a strong *relative advantage* (Rogers, 2003), driving adoption. Already in 1999, C2 highlighted tensions between packaging reduction and transport efficiency, driven by a societal shift toward less and lighter packaging.

Lighter packaging reduced stackability, lowering fill rates. This paradoxical tension between environmental goals across supply chain actors (Pålsson and Sandberg, 2022) remains relevant. In 2024, C2 noted, *"The packaging and product can't be too weak, then it is damaged"*, illustrating how *observability* still can provide a paradoxical tension that hinders adoption of greener packaging.

Greening Logistics Structures regarding facility number, location and capacity (McKinnon, 1998) was only mentioned by C3 25 years ago. C3 considered centralizing three factories into one, finding environmental benefits despite longer transport distances due to more efficient production. Over time, logistics structures changed, driven by economic factors and external pressures. C3 observed: *"The farms have become fewer and more centralized . . . they sell to their neighbor."* Mergers into European conglomerates shifted strategic decisions to headquarters, often outside Sweden. These changes were primarily motivated by *relative advantage* in cost, with environmental *compatibility* emerging as a secondary benefit.

All companies had implemented or planned *green transport management* – such as scheduling, frequency adjustments and vehicle sizing, to improve utilization. C1 placed early demands on customers and carriers to ensure full truck/container loads, a practice still in use: *"We place demands that the customers purchase at least one full loaded truck or container."* C4 noted increased customer flexibility in delivery scheduling, enhancing fill rates, suggesting that *compatibility* (Rogers, 2003) with evolving customer values may drive future adoption. While LSPs focus on cost-efficient flows, shippers also play a critical role. For example, C3 implemented computerized route optimization 25 years ago, preceding much of the related research (Sureeyatanapas *et al.*, 2018). This practice was clearly driven by *relative advantage*.

Shifting to greener modes – especially rail – was the major focus 25 years ago, identified as one of the most effective actions for greening transport (Wu and Dunn, 1995). However, C3 found rail unsuitable due to small-scale needs and time-sensitive deliveries and C2 faced similar issues. C4 put forward road transport's advantages, such as lower costs and more stable workloads (internal report on the investigation of road/rail transport, 1996). These limitations reflect a low *relative advantage*, impeding uptake. Today, modal shift remains a priority, though companies aim to sustain rather than expand its use. As C4-R1 noted, *"I wouldn't necessarily say that it is a growing trend . . . more that we're sustaining."* C1 successfully shifted some high-volume, low-frequency flows to rail. Shippers' understanding of transport offerings from rail and sea operators has improved, reducing *complexity* and facilitating adoption. This reflects increased maturity in shippers' roles, aligning with Eng-Larsson and Kohn's (2012) propositions.

Greener vehicle technologies received considerable attention in the literature 25 years ago, though only two companies actively pursued this at the time. C2 required environmentally friendly fuels when cost-neutral and specified refrigerants for cold transport. C3 used greener diesel and natural gas (C3 Environmental Report, 1998). Today, all companies prioritize greener vehicle technologies. C3 and C4 report nearly 100% fossil-free transport using HVO100 and gas. C2, C3 and C4 are conducting or planning small-scale electrification trials (one truck), as also highlighted in their sustainability reports and websites. C3 stated that *"On our own vehicle we use HVO100 and we run tests on electrification, for purchased transport we/ . . . /have collaborated with the suppliers for an increased use of gas."* C4 emphasizes

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biofuel use across all transport modes, including ocean freight. C1 has installed a small-scale HVO fueling station at its premises, as noted in a sustainability success story on its homepage. These initiatives highlight two key drivers for adoption: trialability, enabled by small-scale testing and *observability*, as electric vehicles are highly visible to customers and society, both of which enhance uptake. However, shippers tend to equate vehicle technology with fuel type, rarely considering other innovations such as vehicle design, tire materials or exhaust treatment. These aspects are generally viewed as the responsibility of LSPs and vehicle manufacturers. However, exceptions exist: 25 years ago, C1 emphasized using ships with catalytic converters. More recently, C2 began discussions with an LSP to increase utilization by installing staplers in vehicles.

Changed vehicle operation were more prominent 25 years ago. C2 required adherence to legal speed limits, and C3 ensured driver training. Additionally, C1 viewed poor vehicle maintenance as a warning sign of LSPs financial instability. Today, interest in this T-GLP has declined, likely due to technological advancements that reduce dependence on behavioral aspects. This reduced *complexity* increases uptake potential, particularly among transport operators for whom fuel efficiency represents a major cost driver, highlighting *relative advantage*.

C3, which partly operates its own fleet, continues to invest in driver training and monitoring: "*We train all drivers in this and have a lot of monitoring technology*". The low *compatibility* between shippers' current focus and values and the operational practices of LSPs may explain the limited attention to this T-GLP today.

4.2 Practicing PM-GLPs

Placing environmental requirements and requiring information are especially emphasized during the sourcing phase, both historically and currently. Placing demands on LSPs has resulted in improved transport technology and fuel usage. Companies increasingly adjust delivery service requirements to enable T-GLP implementation, acknowledging that overly constraining demands may hinder uptake, thereby nuancing prior literature on obstructive demands (Jazairy *et al.*, 2021; Wolf and Seuring, 2010; Lammgård and Andersson, 2014). Such adjustments reflect *compatibility* as an IDT driver, extending beyond intra-organizational alignment to the shipper–LSP dyad.

Twenty-five years ago, the nature of *relationships with LSPs* varied across the companies studied. Only C3 maintained a close relationship, enabling influence over suppliers' vehicle purchases throughout the contract period. This suggests that greening was not merely a "one-time opportunity" during tendering as discovered in a study by Björklund *et al.* (2024), but a continuous process. However, 25 years later C3 notes: "*There is no ongoing dialogue (regarding T-GLPs) between procurement occasions.*" Today, collaboration is emphasized both rhetorically and practically. As C4-R2 notes, "*Procurement has moved from demands to working in collaboration*". Furthermore, closer relationships can increase *compatibility*, as LSPs better understand the shipper's ambitions and values, which may boost T-GLP adoption.

Education and training were emphasized by two of the companies, particularly in illustrating collaborative efforts to co-create solutions through knowledge exchange. C3 highlighted limited awareness among smaller haulers regarding governmental subsidies for green technology, motivating informational support. This complements Björklund *et al.* (2024) by further elucidating the evolving role of transport suppliers. C3 also stressed driver education for eco-driving, aligning with established links between personnel training and logistics sustainability (Ren *et al.*, 2020). C4 emphasized the need for awareness of existing sustainable solutions to enable informed service demands. These examples illustrate *relative advantage* as a key for T-GLP uptake, with cost benefits for LSPs being most salient.

Contract agreements involve sharing risks and costs. C2 emphasizes extended contracts: "*Sometimes when large investments are in play, such as in the transfer towards electric freight, five-year contracts are applied.*" This underscores the importance of close collaboration

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(Martinsen and Huge-Brodin, 2014), longer contract durations (Jazairy, 2020), and willingness to pay premium prices for greener technologies (Gillström *et al.*, 2024; Yu *et al.*, 2020). While contract periods have generally increased from one to two–three years, long-term contracts necessary for costly innovations like electrification are still limited to select assignments and LSPs.

Power dynamics also influence the greening of transport. C3 put forward their power leverage as suppliers must sign their code of conduct in all transport agreements. C1 enforces order quantity requirements on customers, while C2 and C4 lack such leverage. This provides further illustration on how power, combined with customer unawareness or disinterest, can hinder the uptake of T-GLPs, as put forward by Sallnäs and Huge-Brodin (2018).

Regarding *performance measurement*, environmental performance goals have evolved significantly. C4 aims for 100% fossil-free transport by the end of 2025, already exceeding 95% (C4-R1). C3 shares this goal, reporting 96% in its environmental report for 2024. Compared to earlier years, there is a streamlined focus on fossil-free fuels, whereas previous concerns on hazardous substances and acidification gained similar attention 25 years ago. Today companies are more active in measuring but remain dependent on LSP data. Notably, no respondent questioned the *compatibility* between the LSPs and the company's measurement approach or underlying assumptions.

Historically, only a few companies *monitored* LSPs' environmental performance. C1 once used consultants to calculate transport-related energy use and C4 evaluated a modal shift's impact, ultimately rejecting rail (Environmental seminar report, 1996). Furthermore, follow-ups have become more frequent: "*When gas became expensive, many (LSPs) switched without informing us /—/. Previously, follow-ups were done annually; now we do them quarterly.*" Historically, companies did not disclose transport-related environmental performance on external channels (e.g. sustainability reports or websites), a practice that has changed significantly. This increased transparency emphasizes *observability*, driven by enhanced performance measurement and reporting, as a key factor in the uptake of T-GLP.

25 years ago, companies developed *frameworks and routines* for green LSP selection, though C1 and C4 were reluctant to share their criteria. These were often created by environmental specialists with limited logistics expertise, sometimes in dialogue with LSPs (C4). C2 used questionnaires during tendering to assess environmental performance, treating it as an order qualifier: "*It was a bit tentative back then, but information started to be gathered. It wasn't as structured as it is now.*" (C2). Today, companies benefit from more recently developed national and international frameworks and association memberships. C2's sustainability report from 2024 and C3's statement reflects this: "*We receive a lot of guidance from Fair Transport.*" This suggests that recent frameworks help reduce the IDT factor of *complexity* in executing the PM-GLPs of measuring and reporting, though they may not fully offset the growing complexity of the practices themselves.

Finally, decision-making on environmental goals, measurement, reporting and contracts is increasingly centralized at European headquarters, though national subsidiaries retain discretion over which GLPs to implement (C2, C4).

5. Propositions for future GLP application

By examining shippers' historical and contemporary GLPs, seven insights have been identified and are presented as propositions. The propositions follow an order informed by the structure of the frame of reference and the empirical finding and analysis chapters: the first addresses GLP frameworks broadly, four focus on T-GLPs and the final two concern PM-GLPs. More underlying support for the propositions can be found in Supplementary Material, part A.

Proposition 1. Traditional GLP frameworks for transportation remain relevant today and are also applicable to the future.

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The empirical findings reveal strong continuity in the types of transportation GLPs applied across both time periods. Although technological advancements have shifted the focus toward specific green fuels, respondents 25 years ago already demonstrated a broad spectrum of practices. Today, the same categories of GLPs – such as greener fuels and modal shifts – remain central, suggesting that existing models (e.g. Wu and Dunn, 1995; McKinnon, 1998) continue to effectively capture both historical and current practices. The continued relevance of older frameworks reflects a substantial degree of the IDT characteristic of *compatibility* with current practices. This alignment stems from their strong connection to past experiences and the dynamics of path dependency, whereby traditional frameworks remain congruent with both historical and contemporary contexts despite ongoing technological change.

Proposition 2. Every T-GLP is of relevance for shippers today and in the future.

While some studies attempt to differentiate the relevance of GLPs based on actor roles (e.g. Bilek *et al.*, 2024), this study shows that shippers engage with all T-GLPs as well as vehicle operation. T-GLPs traditionally viewed as core to the logistics industry – such as transport management and fill rate optimization – are also actively implemented internally by shippers. Moreover, technological aspects such as tire materials and catalytic systems attracted the attention of shippers 25 years ago, whereas the current focus lies on the use of more fossil-free fuels. In this context, the shipper assumes a role defined not only by setting requirements for suppliers during the procurement of transport services, but also by active engagement through close collaboration and strategic investments, for example, in fuel infrastructure. These findings challenge assumptions in the literature that certain GLPs are exclusive to logistics providers, highlighting the potential for proactive shippers to engage across a broader spectrum of practices.

Proposition 3. It is a necessity for a shipper to combine different T-GLPs, now and in the future, to reach their own and societies' environmental targets.

Although some companies are close to achieving 100% fossil-free transport – primarily through HVO fuel – the empirical data from both time periods show that a wide array of T-GLPs is being applied. The importance of combining measures, challenging the notion that a single T-GLP (e.g. HVO or electrification) is sufficient to meet national and international environmental goals. Combined T-GLPs is necessity given the potential risks associated with relying on, for example one technology, such as future reductions in subsidies or scarcity of critical components, which could undermine long-term sustainability efforts. This insight is relevant for both researchers and practitioners aiming to design effective sustainability strategies. By recognizing the diverse roles of shippers (addressed in Proposition 2) and embracing a broader range of GLPs, organizations can overcome some of the inertia that slows the adoption of T-GLPs.

Proposition 4. The uptake of T-GLPs will continue to be shaped by perceived relative advantage, while evolving complexity, trialability, and observability will increasingly influence adoption dynamics.

IDT offers valuable insights into the uptake of T-GLPs. Relative advantage remains a dominant factor influencing adoption for several T-GLPs, while trialability and observability have become increasingly important, particularly in relation to green vehicle technologies. Over time, the role of complexity has also evolved. Increased awareness – such as understanding the challenges of modal shifts and the implications of service demands – and technological advancements (e.g. vehicle management tools) have made certain practices more accessible, thereby altering the perceived complexity and facilitating broader adoption.

Proposition 5. Proactive shippers' investment in green technologies across their transport systems will remain selective and incremental, shaped by the constraints of the business case.

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Historically and today, shippers have shown interest in supporting green transport transitions, but typically within limited segments of their transport systems. This contributes to the ongoing debate on cost versus sustainability trade-offs, and challenges assumptions about buyer-supplier collaboration and cost-sharing (Gillström *et al.*, 2024; Jazairy, 2020; Yu *et al.*, 2020). Practices with clear cost and emission reduction synergies – such as eco-driving and high fill rates – are widely accepted. However, investments in greener fuels, electric vehicles or reduced service levels for rail and sea transport are pursued only when deemed feasible. While shippers are willing to share risks, pay premiums and extend contracts, these efforts remain confined to select cases. This suggests that practices offering dual benefits tend to diffuse more readily, underscoring a clear connection to the IDT characteristic of *relative advantage.* The broader commitment required to enable large-scale transformation can be fostered through instruments that overcome inertia. Examples include future government regulations, economic incentives, and proactive companies moving beyond reliance on strong business cases.

Proposition 6. PM-GLPs will continue gaining strategic significance, yet they risk remaining conceptually underdeveloped and fragmented within the literature.

The use of PM-GLPs has evolved extensively over the past 25 years. Environmental goals and performance metrics now include scope 3 emissions from purchased transport services. Goal setting and reporting have become strategic concerns, often centralized at European headquarters, with regular monitoring and follow-up processes in place. This indicates that, unlike T-GLPs, the adoption of PM-GLPs is more contingent on organizational structures, such as centralization, and on company processes and practices, including the general development of performance measurement and reporting systems. The way PM-GLPs formalize sustainability can also reshape the roles of shippers and LSPs, influencing aspects such as decisions on reporting formats, measurement approaches and the selection of KPIs to monitor. Furthermore, the framework developed in this study offers a comprehensive view of PM-GLPs and reveals the fragmented treatment of these practices in existing transportation-focused GLP literature.

Proposition 7. The increasing centralization and standardization of PM-GLPs enhance consistency, comparability and visibility while simultaneously constraining the capacity of local forerunners to develop innovative PM-GLPs.

As companies expand and adopt international standards, transport management increasingly aligns with goals, policies and reporting formats set at strategic headquarters. While this fosters consistency, *comparability, visibility* and shared understanding, it may also limit *trialability* and constrain the ambition and expertise of national forerunners – such as those in the Nordic region. These findings provide new insights into how PM-GLPs are shaped by internationalization and centralized governance, and how paradoxical tensions may arise between global standardization and local innovation. This finding aligns with Smith and Lewis's (2011) notion that paradoxes intensify as organizations operate in increasingly global environments. It also offers novel insights into belonging paradoxes, which encompass differing values, beliefs and identities within organizations (Smith and Lewis, 2011; Björklund *et al.*, 2024), as local actors may have reactive or proactive perspectives on how PM-GLPs should be designed and implemented. Moreover, this also risks triggering a performing paradox if competing strategies emerge among local forerunners.

6. Conclusion, contribution and future research

6.1 Conclusions, contributions and new insights

This study investigates how early adopters in greening transportation have evolved their use of GLPs by comparing two points in time – today and 25 years ago – with the overarching aim of generating insights to guide future GLP applications among shippers. Interestingly, only minor

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changes were found in the T-GLPs applied today compared to 25 years ago, apart from the focus on newer technologies. In contrast, significant evolution was observed in PM-GLPs, particularly in performance measurement, contract agreements, monitoring, reporting and applied frameworks. Despite recent calls for closer relationships in contemporary research, the 25-year-old empirical findings revealed several innovative forms of collaboration, for example LSPs consulting shippers prior to every purchase of new vehicles.

One important conceptual contribution lies in the dual-layer framework developed, combining T-GLPs and PM-GLPs, illustrated in Figure 1. This framework addresses two gaps: the need for a generic and comprehensive GLP structure (as elaborated on in the introduction) and the need to bring the less-studied PM-GLPs into focus. Despite its generic nature, the framework allows integration of specific contexts and theoretical perspectives. In this study, for example, IDT is applied as a lens to capture temporal development. Furthermore, the empirical findings deepen understanding of the relationship between the two GLP types. They show how PM-GLPs can enable or constrain T-GLP uptake, for instance, close relationships and knowledge exchange facilitated the adoption of greener vehicle technologies. Moreover, the study contributes to ongoing scholarly discussions about the interplay between managerial/behavioral and technological solutions. One example is the diminishing emphasis on driver behavior in eco-driving, as technological advances have shifted the focus toward automated and data-driven solutions.

A second key contribution is how IDT deepens understanding of T-GLP assimilation. Relative advantage remains the dominant driver, while compatibility is also consistently articulated, highlighting the importance of aligning green measures with existing operational values, norms and economic interests. In contrast, trialability and observability receive more uneven attention, partly reflecting the nature of the measures themselves. Many GLPs are neither easily testable nor readily observable, as they are embedded in routine practices or technical systems rather than designed to attract visibility or public interest. IDT also explains how PM-GLPs influence T-GLPs. Through closer collaboration, PM-GLPs enhance compatibility. Through improved performance measurement and reporting, they increase observability. Both factors accelerate T-GLP uptake. Moreover, the longitudinal findings (captured in, e.g. Proposition 4) not only validate the applicability of IDT but also advance its theoretical reach by revealing dynamic shifts in adoption drivers within the logistics domain.

A third contribution, relevant to both research and practice, lies in seven propositions that guide future GLP implementation. These propositions reflect insights gained from longitudinal analysis and the value of learning from history. For example, Proposition 2 suggests that every T-GLP remains relevant for shippers in the future, while clarifying how shippers' roles shape their use of PM-GLPs and their uptake of T-GLPs.

Finally, incorporating a historical perspective – rare in this field – adds a collective memory of proactive practices and priorities from 25 years ago. The study offers methodological guidance for future longitudinal research. Covering long time frames requires adapting to evolving research norms and ensuring rigor across changing cultures. This study contributes to methodological development as it illustrates how trustworthiness measures and methodological choices have shifted over time and how repetitive studies can adjust to these changes.

New insights emerged that are particularly relevant for future research in greening logistics and supply chain management as well as in practice. First, the empirical findings reveal a broader interpretation of GLPs among practitioners than is often reflected in the definitions applied in literature. While researchers typically define GLPs as environmentally motivated actions, practitioners view them as any measures that reduce environmental impact – regardless of intent. This was especially evident in discussions on network design, where changes driven by external pressures were still considered environmental actions. This highlights the need for researchers to be mindful of differing perspectives between theory and practice. Second, the study reveals a more sophisticated environmental rhetoric among managers today compared to 25 years ago, which can blur the line between genuine progress and corporate messaging. Respondents now articulate their environmental performance with

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greater fluency, often emphasizing positive outcomes while downplaying challenges and unsuccessful actions. For example, while electric vehicle use was widely discussed and commonly the transportation GLP that first came to mind, the companies had only reached the pilot testing stage. This underscores the importance of a probing interview approach that seeks illustrative evidence behind environmental and collaboration claims.

6.2 Limitations and future research

One limitation of this study is its dyadic perspective, focusing primarily on the relationship between shippers and LSPs. However, the empirical findings underscore the importance of a third actor – the product customer or receiver – who often holds significant influence over delivery expectations but is not directly involved in transport procurement. The power dynamics between these actors, particularly the dominant role of retailers, can hinder the implementation of GLPs.

Generalization may also be affected by the selection of extreme cases in the initial interview round, the national focus, and the specific industry studied. The findings on GLPs applied today and 25 years ago are unlikely to reflect less proactive actors. The study deliberately selected forerunners in Sweden – where companies were generally environmentally proactive 25 years ago – and focused on the food industry, where environmental concern is high due to the close link between products and nature. This approach resulted in the selection of very extreme cases. However, choosing forerunners may even strengthen external validity, as the results can guide more reactive companies in identifying their next steps. Moreover, the propositions addressing future developments are likely relevant for all shippers, regardless of their current level of proactivity. The focus on one industry (food) and one country (Sweden) introduces some limitations regarding the external validity of specific empirical findings, such as today's legal requirements for reporting, and the identified paradoxical tension regarding local forerunners. Nevertheless, the developed framework, the proposed propositions and the methodological contribution are not constrained by these limitations.

Mergers and acquisitions over the past 25 years have likely influenced environmental performance in diverse ways. For example, companies that remain primarily local or national are, for example, less likely to experience the developments outlined in Proposition 7. Furthermore, the use of multiple case studies allows for some cross-case replication logic (Yin, 2018; Miles and Huberman, 1994), offering a foundation for broader generalization. Future research could explore how these developments vary across regions, particularly between Nordic countries and other contexts. Additionally, long-term involvement in a research field can shape researchers' perspectives and interpretations, which is relevant to this study and should be acknowledged.

Future research could quantitatively examine PM-GLPs as independent variables and explore their correlation with T-GLPs. Investigating the drivers and barriers behind these developments could further illuminate how organizational inertia affects environmental performance. Collaborative relationships may play a critical role in overcoming such inertia by fostering mutual learning, sharing best practices and creating supportive environments for change. Furthermore, the two types of GLPs may reinforce each other. For instance, the intention to implement a specific T-GLP could stimulate the development of PM-GLPs. This interaction is an area that merits further investigation, potentially through quantitative methods.

Finally, this study encourages researchers to revisit historical empirical data, re-evaluate it in light of current developments and compare it with new data to uncover long-term patterns and insights.

Supplementary material

The supplementary material for this article can be found online.

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