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RESEARCH

Horizontal Logistics Collaboration in Greek Retail: A Stage-Wise Approach to Supply Chain Innovation

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Abstract *Horizontal logistics collaboration enables suppliers and retailers to streamline distribution networks, reduce transportation inefficiencies, and improve shared logistics operations. However, organizations still struggle to capture its full value, and successful cases remain rare. Drawing on the innovation management, this study applies a data-informed innovation process to generate and evaluate horizontal logistics collaborative schemes within the Greek retail sector. Involving nine multinational suppliers and two retailers in the fast-moving consumer goods sector in Greece over a 3 year project, this study highlights the need for a systematic analytically supported approach to logistics innovation. It proposes a stage-wise innovation approach as a "blueprint" for identifying and advancing the most promising collaborative schemes to implementation. By integrating insights from innovation management and logistics collaboration and by highlighting the specific conditions of the Greek logistics landscape, it offers a fresh perspective on approaching the traditional challenges and barriers of horizontal logistics collaboration. This flexibility ensures that collaborative models can be adjusted as business environments change, promoting sustainability.*

Keywords Flexible collaboration models · Data-informed logistics collaboration · Implementation challenges · Innovation funnel model · Innovation management · Supply chain management

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Introduction

The logistics industry is undergoing profound transformation, driven by rising transportation costs, limited capacity, and increasing demand for just-in-time deliveries. In parallel, companies are expected to comply with stricter environmental and safety regulations, meet shifting consumer expectations, and remain competitive in increasingly dynamic markets (Chowdhury et al., 2024; Dhillon et al., 2023; Zarghami & Dumrak, 2024). In response to these challenges, logistics collaboration has emerged as a strategic tool to enhance efficiency, reduce costs, and support sustainable operations (Garcia Speranza, 2018; Mangla et al., 2014; Rawat et al., 2025; Wang et al., 2024).

While such collaboration has traditionally occurred vertically—between suppliers, manufacturers, and retailers—increasing attention is now being directed toward horizontal logistics collaboration (HLC). HLC refers to voluntary partnerships between companies operating at the same level of the supply chain, including competitors, who coordinate logistics activities and share resources (Mason et al., 2007; Pan et al., 2019; Wilson & Goffnett, 2022). Theoretical work has linked HLC to improved asset

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utilization, cost reduction, service-level enhancements, and emissions reductions (Basso et al., 2019; Rodrigues et al., 2015).

Despite this promise, real-world implementation of HLC remains rare and complex with unmet expectations. Empirical studies have shown that many HLC initiatives fail to scale or sustain impact, often due to misaligned incentives, governance and trust issues, or lack of structured processes (Basso et al., 2021; Leitner et al., 2011; Pomponi et al., 2015). Although prior research has made important contributions through optimization models (Lafkihi et al., 2019) and case-specific studies (Palmieri et al., 2019), there is still limited understanding of the step-by-step process through which firms can generate, evaluate, and implement HLC schemes—particularly in operational environments such as the fast-moving consumer goods (FMCG) sector.

This study seeks to address this gap by exploring how HLC can be implemented effectively in practice. We examine the full lifecycle of HLC—from opportunity identification to pilot testing—using an innovation-driven, structured approach that supports decision-making at each stage.

We argue that HLC should not be treated as a one-time agreement or static solution but rather as a governed, iterative innovation process. Firms need structured mechanisms to generate HLC schemes, evaluate their feasibility, pilot them in real conditions, and continuously adapt. Without such a process, collaboration efforts are unlikely to succeed or scale.

To support this argument, we apply the innovation funnel model (Bessant & Tidd, 2015) and propose a stage-wise framework that guides firms through ideation, evaluation, and implementation. In doing so, the study contributes to both the HLC literature and innovation theory by integrating principles from diffusion of innovation into logistics collaboration.

Our research is guided by the following research questions (RQs):

- **RQ1**: How can firms systematically generate and evaluate HLC schemes to ensure practical feasibility and long-term success?
- **RQ2**: What are the key challenges in implementing HLC, and how can they be addressed through structured innovation processes?
- **RQ3**: How does the application of the innovation funnel model contribute to the successful design and implementation of HLC schemes?

To address these questions, we adopt a mixed-methods research approach (Creswell et al., 2018), combining qualitative and quantitative techniques. The study unfolds in three phases: (1) a context analysis of existing distribution models and stakeholder views; (2) the use of the innovation funnel to generate and evaluate HLC opportunities; and (3) the development of a structured, innovation-driven framework that guides decision-making throughout all stages—from opportunity identification to pilot testing.

This study has important implications for both theory and practice. It provides a theory-informed yet practical roadmap for firms navigating the complexity of logistics collaboration. For researchers, it bridges two distinct bodies of knowledge—HLC and innovation management—through an integrative process model. For practitioners, it delivers concrete tools and guidance to help design, evaluate, and scale collaborative logistics schemes with lower risk and higher potential for sustainability. For society at large, it demonstrates how structured HLC can contribute to more efficient, greener, and resilient supply chains.

The remainder of the paper is organized as follows: Sect. "Logistics Collaboration in Retail" discusses related studies in HLC, Sect. "Research Methodology" provides the research methodology, Sect. "HLC Current State, Challenges, And Opportunities" elaborates on the context analysis, and Sect. "The Innovation Funnel Model for HLC" describes the application of the innovation funnel model to HLC and the results thereof. Sect. "Formulating A Stage-Wise HLC Innovation Approach" proposes the HLC innovation process, and Sect. "Conclusion and Discussion" provides several conclusions and further research aims.

Logistics Collaboration in Retail

Horizontal Logistics Collaboration: Definitions and Implementation Challenges

Supply chain management refers to the management of the flow of goods and services, which includes all the processes that transform raw materials into final products. Collaboration is believed to be one of the most important factors to make supply chain management successful (Singh et al., 2019; Srinivasan et al., 2021) and an important driver of operational efficiency and responsiveness in supply chains. Collaborative practices, especially in distribution, are increasingly becoming integral to modern supply chain configuration strategies, as recent evidence shows the impact of collaboration on performance and sustainability (Afraz et al., 2021; Grazia Speranza, 2018; Mangla et al., 2014; Wang et al., 2024; Wilson & Goffnett, 2022).

Collaboration in logistics can be categorized into two primary forms: vertical and horizontal collaboration, whereas vertical collaboration deals with entities on

different supply chain levels such as suppliers and retailers, working toward mutual objectives (Mason et al., 2007). In contrast, horizontal collaboration occurs when partners that operate on the same supply chain level, either as competitors or as organizations differing in form and scale,-cooperate in pooling resources and reaching mutual objectives (Badraoui et al., 2022, 2024a, b; Mason et al., 2007).

The concept of collaboration in logistics has been discussed in the literature for several decades. One early contribution is that of Lambert et al. (1999), who characterized collaboration as a structured business relationship built on mutual trust and shared benefits that is designed to enhance collective performance beyond what firms could achieve independently. Around the same time, the European Union (2001) described horizontal collaboration as occurring when firms operating at the same level of the value chain work together in non-competitive.

Academic interest in horizontal collaboration within logistics grew significantly during the mid-2000s. Studies such as Cruijssen et al. (2007) and Mason et al. (2007) explored practical arrangements in which companies—often competitors—joined forces to coordinate distribution, share logistics assets, and reduce inefficiencies. In the years that followed, the term horizontal logistics collaboration (HLC) gradually emerged in the literature as a way to describe these collaborative practices (Pomponi et al., 2013).

Although often used alongside related terms such as "horizontal alliances" or "carrier coalitions," HLC refers to a distinct form of cooperation. Unlike formal logistics alliances, which tend to be long-term, contractually defined partnerships, HLC typically involves more flexible, voluntary collaborations focused on specific logistics activities. These initiatives may be temporary, operationally focused, and designed without the need for formal legal structures (Cruijssen et al., 2007). In this study, HLC is understood as a pragmatic and adaptable form of logistics cooperation among companies at the same supply chain level.

Recent literature has highlighted the importance of HLC as a strategy for greater efficiency and cost reduction in shared logistics resources (Cozzolino et al., 2023; Soysal et al., 2022). HLC has gained traction in recent years, but compared to the body of knowledge available on vertical collaboration, research about HLC remains limited (Argyropoulou et al., 2023; Badraoui et al., 2024a, b; Chen et al., 2017; Zhang et al., 2023). Recent studies describe a variety of forms of HLC that are purported to enhance operational efficiency, including bilateral carrier collaboration, carrier alliances, and logistic pooling (Justiani & Wibowo, 2022; Pan et al., 2019).

HLC can take various forms depending on the nature of the collaboration (Pan et al., 2019). These forms include (a) bilateral carrier collaboration which occurs when two carriers coordinate and share transportation resources to enhance efficiency; (b) carrier alliances and coalitions which involve groups of carriers pooling their networks and coordinating schedules to optimize operations; (c) auction-based exchange systems which are digital marketplaces where carriers bid for shipping jobs to optimize fleet usage; (d) shippers' collaboration that involves multiple companies consolidating freight to maximize transportation efficiency; (e) logistics pooling, which refers to the shared utilization of logistics assets, such as warehouses and transport fleets, to achieve economies of scale; and (f) the physical internet, which represents a globally standardized logistics framework inspired by digital networks, that aims at creating seamless and sustainable transportation (Pan et al., 2019). In our study these typologies offer a foundational lens to understand the diverse forms of HLC, providing a basis for interpreting empirical findings and situating them within the broader theoretical landscape.

To effectively implement HLC, companies must address several strategic and operational factors. Key considerations include network design and optimization, equitable gain sharing, and the alignment of organizational and governance structures (Luthra et al., 2022). Furthermore, technology and data integration are crucial for facilitating seamless communication and coordination among collaborating firms. Recent research has underscored the role of digital platforms and information-sharing systems in enhancing the effectiveness of HLC (Katsoulas et al., 2022). Additionally, the ability of firms to build resilience through flexible supplier practices is gaining recognition as a critical factor in turbulent environments. Recent research suggests that justice-oriented supplier relationships—particularly those emphasizing procedural and distributive fairness—can significantly enhance resilience through supplier flexibility mechanisms (Chowdhury et al., 2025).

The benefits of HLC are well documented, including cost reduction through optimized load sharing, improved service levels, enhanced market competitiveness, and contributions to environmental sustainability (Aloui et al., 2021; Leitner et al., 2011; Mason et al., 2007; Norheim-Hansen, 2023). For instance, collaborative logistics can significantly reduce transportation costs and emissions, thereby promoting greener supply chain practices (Mrabti et al., 2022). Moreover, the integration of reverse logistics within HLC frameworks has been shown to enhance resource recovery and minimize waste, further supporting sustainability objectives (Brix-Asala et al., 2016).

Although HLC is widely acknowledged as an approach to improve supply chain efficiency, the transition from theoretical models to practical implementation remains underexplored. Most existing research focuses on identifying various HLC frameworks, such as logistics pooling and digital marketplace solutions, and there is a lack of empirical evidence addressing key implementation challenges. Trust building, governance structures, and profit sharing continue to pose significant obstacles that continue to hinder the widespread adoption of HLC (Basso et al., 2021; Pomponi et al., 2015; Raue & Wieland, 2015). Moreover, while HLC has shown potential in reducing costs and improving sustainability, limited research has investigated its long-term viability and the mechanisms needed to sustain these collaborations over time.

To bridge these gaps, this study shifts attention from whether HLC delivers results to how firms can successfully implement HLC. While previous research has primarily focused on theoretical optimization models or descriptive case studies, this study explicitly highlights the need for a process-oriented framework that facilitates the transition from concept to execution. Specifically, we explore the process of generating, evaluating, and implementing HLC schemes in real-world settings. By applying an innovation management perspective, this study proposes a structured, stage-wise innovation approach that serves as a blueprint for HLC implementation. This framework moves beyond static collaboration models by incorporating iterative feedback loops, decision-making checkpoints, and mechanisms for assessing feasibility at different stages of the collaboration process. By integrating insights from innovation management and supply chain management, this research aims to offer actionable guidelines that firms can adopt to systematically design, evaluate, and implement successful HLC schemes.

Toward an Innovation-Centered Approach to Horizontal Logistics Collaboration

Building upon the previous section, which mapped the conceptual foundations and typologies of HLC, this part of the review turns to the persistent challenge of implementation. While the benefits of HLC are well documented—ranging from cost savings and reduced emissions (Leitner et al., 2011; Mason et al., 2007) to improved delivery performance and service levels (Rodrigues et al., 2015)—practical applications remain limited, fragmented, and often short-lived (Basso et al., 2019; Cleophas et al., 2019).

A critical reason for this gap is the lack of innovation-driven frameworks that support firms not just in defining collaborative opportunities but in structuring and managing them as part of a dynamic process. While have been made with respect to optimization models and profit-sharing mechanisms (Gansterer and Hartl, 2018; Lafkihi et al., 2019), there is little guidance on how companies can operationalize HLC—particularly in complex, competitive retail environments like that of Greece.

This paper directly addresses this gap that void by proposing a stage-wise innovation approach, grounded in the innovation funnel model (Bessant & Tidd, 2015), to guide the end-to-end development of HLC schemes—from ideation to pilot testing and refinement. In contrast to most existing studies, which often treat collaboration as a static arrangement or a one-time optimization problem, this approach reconceptualizes HLC as an innovation process: iterative, evaluative, and adaptable over time.

By applying principles from innovation management, such as co-creation and divergent thinking, the study introduces a roadmap that helps firms navigate the multi-stakeholder complexity of real-world logistics collaboration. This contribution is particularly important given the consistent findings in the literature that trust issues, cultural misalignment, and unclear governance structures are among the most cited reasons for HLC failure (Badraoui et al., 2024a, b; Pomponi et al., 2015).

Moreover, the approach proposed in the paper addresses a broader research gap by merging two largely siloed literatures: those of logistics collaboration and innovation management. While past works such as Palmieri et al. (2019) have identified enabling factors and success conditions in HLC, few have operationalized these factors in a step-by-step innovation framework. In doing so, this paper extends the field's understanding beyond why HLC matters to how to move from potential to performance.

Another novel element of this contribution is its emphasis on retrospective and prospective evaluation, incorporating both quantitative logistics indicators (e.g., distance, cost, CO_2 emissions) and qualitative dimensions (e.g., stakeholder alignment, IT integration, trust-building mechanisms). This dual lens provides a more holistic assessment of feasibility and impact, moving beyond theoretical feasibility to real-world applicability.

In summary, while previous literature has largely covered what HLC can offer and where it can be applied, this study advances the field by addressing how firms can systematically implement and scale these collaborations through structured innovation practices. This study not only adds a new way of thinking to supply chain research but also offers clear, practical steps for companies working in complex and fragmented markets.

Research Methodology

This study employs a mixed-methods research approach (Creswell & Plano Clark, 2018), integrating qualitative and quantitative methods to explore HLC. While HLC has received growing attention in recent literature, there remains limited empirical and process-oriented research on how firms design, evaluate, and implement HLC schemes in practice—particularly in the context of the Greek FMCG sector. This gap justifies the use of a mixed-methods design, which ensures research validity through data triangulation (Lincoln & Guba, 1985). The combination of methods allows for a comprehensive and richer understanding of HLC, fostering cross-fertilization between research phases (Creswell & Plano Clark, 2018; Polyviou et al., 2024).

The research was conducted over a 3 year period (2019–2021), involving nine FMCG suppliers operating in the EU—Nestlé, Procter and Gamble, Unilever, Barilla, Johnson and Johnson, Beiersdorf, Mars, Minerva, and Delta (Vivartia Group)—and two major Greek grocery retailers—AB Vassilopoulos (Ahold Delhaize Group) and METRO.

Our sample includes globally recognized multinational corporations alongside leading regional suppliers and retailers, offering locally grounded insights within the Greek retail context, with potential for international transferability. Notably, the two retailers included in this study account for over 31% of the total grocery market in Greece and are among the top six players in the Greek retail industry.[1] The participating suppliers represent approximately 30% of the national market for food and consumer goods.[2] Within the Greek context, this constitutes a robust and representative sample of the industry. The suppliers span a wide range of product categories, ensuring a comprehensive and well-rounded view of the sector's collaborative dynamics.

Through this combination of retailers and suppliers, the study incorporates upstream and downstream perspectives from the value chain, thereby enhancing the analysis and strengthening the findings. It is important to note that this project was a so-called ECR Greece project. ECR Greece[3] periodically collaborates with academic institutions to support applied research that promotes supply chain efficiency, innovation, and sustainability. As part of the global ECR[4] initiative, ECR Greece promotes voluntary, non-competitive collaboration between suppliers and retailers, aiming to better serve consumer needs—faster, better, at lower cost, and in a more sustainable way.

In this context, ECR Greece acted as a neutral facilitator, bringing together key industry stakeholders—suppliers and retailers—who might otherwise be hesitant to engage in joint initiatives, particularly in areas where commercial interests differ. While the research team initiated, designed, and coordinated the project, ECR Greece played a crucial role in creating a trusted environment for cross-company collaboration and enabling access to relevant participants. The research team (the authors) was responsible for defining the research objectives, designing the methodology, facilitating the collaborative innovation process, and coordinating all project phases—from stakeholder engagement to pilot implementation.

The study was structured in three phases, integrating both qualitative and quantitative data collection methods to ensure cross-validation. Figure 1 depicts the research design and the methods employed in each phase. Below, each phase is described in further detail.

Phase 1: Understanding HLC–Current State, Challenges, and Opportunities (1/2019–10/2019)

The goal of this phase was to analyze existing distribution models and collaboration practices in FMCG, identify key challenges in developing HLC, and explore potential opportunities. To achieve this, we conducted semi-structured interviews with 11 key stakeholders, covering both suppliers and retailers. These interviews provided in-depth insights into current supply chain operations, obstacles to collaboration, and opportunities for HLC.

To mitigate bias and maintain objectivity, this phase incorporated reflective discussions with participants, allowing them to evaluate and refine the study's findings as a form of respondent validation (or "member checking") (Lincoln & Guba, 1985). The participatory nature of the qualitative studies including focus groups and brainstorming sessions ensured that participants' perspectives remained central rather than being shaped by the researchers' interpretations (Stake, 1995).

Phase 2: Developing an HLC Innovation Funnel Model (11/2019–3/2021)

Building on the findings from Phase 1, this phase aimed to develop and evaluate alternative HLC models using the innovation funnel model (Bessant & Tidd, 2015). The process started with brainstorming sessions with supply chain and logistics managers to generate creative ideas for HLC schemes. To ensure diverse input, we applied nominal group techniques, facilitating equal participation and preventing dominant voices from overshadowing discussions.

[1] https://www.mononews.gr/business/souper-market-pos-mirazete-i-pita-apo-tous-6-top-pektes-tis-agoras

[2] https://www.thetotalbusiness.com/2023/10/16/10-2-megaliteres-epixirisis-trofimon-poton-ellada

[3] https://www.ecr.gr

[4] https://www.ecr-community.org/about/

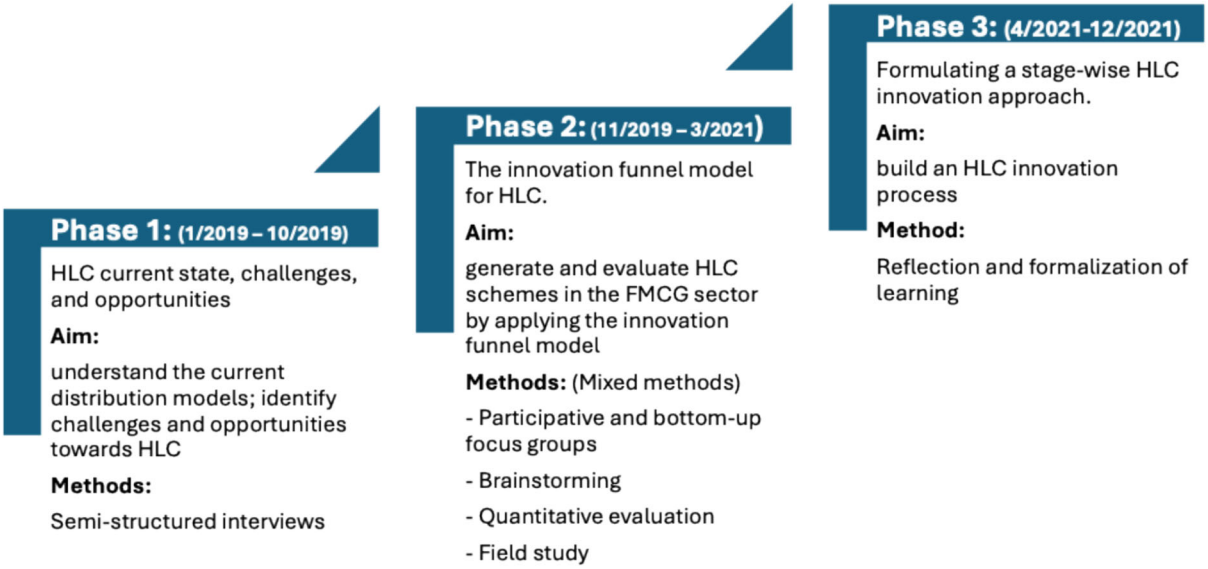

Fig. 1 Research design and methods

Following idea generation, we conducted co-creation sessions with key stakeholders to refine and structure HLC schemes. These sessions utilized scenario mapping to explore the feasibility of different models under various market conditions. To validate the proposed concepts, we employed quantitative methods, including.

- Gathering and analysis of distribution datasets from all stakeholders, including details on shipment volumes, frequencies, routes, and costs. We performed descriptive analysis to understand the distribution of key variables and created network diagrams to identify patterns in distribution flows and potential logistical synergies.
- Simulation modeling to predict performance and cost reductions in different collaboration scenarios. Specifically, we used "what-if scenarios" to simulate different models and assess their impact on performance metrics.

The final stage of this phase involved a pilot implementation, where a one-month field trial was conducted with selected suppliers and two third-party logistics (3PL) providers. The two 3PL companies were involved to provide feedback on the feasibility and validation of the suggested strategy. The pilot aimed to test the feasibility of a specific HLC scheme in real market conditions, evaluating operational challenges and measuring potential efficiency gains. Data collected from the pilot were used to refine the framework before scaling implementation.

Table 1 provides an outline of each stage of the innovation process.

Here, we would like to note that not all concepts from the idea generation progress to implementation. This reflects the inherent complexity and exploratory nature of innovation processes such as HLC. In innovation-focused research, it is common to start with a wide array of concepts and potential opportunities, which are gradually refined through iterative phases of screening and evaluation (Tidd & Bessant, 2009). In our study, the initial phase focused on generating diverse HLC schemes to ensure a comprehensive exploration of possibilities. These schemes were then filtered and narrowed down through collaboration with the participating companies, using perceptual data and qualitative insights. This filtering approach allowed us to move from a broad exploration of ideas to actionable HLC models (Cooper, 1990). This approach aligns with established practices in innovation research, where the early stages often involve a wide variety of ideas that are subsequently refined to produce actionable insights and meaningful findings (Brown, 2009).

Phase 3: Formulating a Stage-Wise HLC Innovation Approach (4/2021–12/2021)

The final phase synthesized insights from Phases 1 and 2 into a structured HLC innovation framework, providing a systematic approach for designing, evaluating, and implementing HLC schemes. To further enhance credibility, the framework was iteratively refined through reflective discussions, enabling participants to validate the findings (Lincoln & Guba, 1985).

This phase focused on

- Defining evaluation criteria for selecting viable HLC schemes.
- Establishing transition mechanisms between different stages of implementation.

Table 1 Description of the stages of the innovation process

Innovation process stage	Activities	Methods	Participating companies
Opportunity framing and idea generation (11/2019–2/2020)	Generate creative ideas for HLC schemes	Brainstorming techniques with senior supply chain and logistics managers from retailers and suppliers	11 suppliers and retailers
Collaborative design and feasibility assessment (3/2020–8/2020)	Design actual logistics concepts as different configurations of horizontal collaboration	Focus group to co-create and agree on specific HLC schemes Distribution data analysis to define potential synergies and configure HLC schemes	11 suppliers and retailers
Proof of concept and implementation readiness (9/2020–12/2020)	Verify the HLC schemes' feasibility and their expected impact and decide on whether the HLC schemes should be launched in the actual field	Formulating three focus groups consisting of two suppliers Quantitative validation of specific HLC schemes by analyzing suppliers' distribution datasets	5 suppliers and 2 3PLs
Pilot implementation for scalability and organizational readiness (1/2021–3/2021)	Conduct a one-month pilot implementation to quantify the expected benefits and identify the implementation challenges in the actual field	Field study and quantitative evaluation of the expected benefits of a specific HLC scheme	2 suppliers and 1 3PL

- Developing guidelines for structured co-creation, validation, and pilot testing.

Recognizing that not all concepts generated in the brainstorming sessions progressed to implementation, we adhered to established innovation research practices (Tidd & Bessant, 2009). In line with this approach, our study began with a broad exploration of potential HLC opportunities, which were gradually filtered and refined through perceptual data, qualitative insights, and quantitative validation. This step-by-step process ensured that we focused on the most viable and impactful HLC models for further analysis (Cooper, 1990).

While complete neutrality is unattainable, our methodological rigor, participant validation, and diverse data sources helped mitigate bias and enhance the robustness of the study. Moreover, the use of multiple data collection methods facilitated data triangulation, reducing the influence of individual biases and strengthening the reliability of the findings (Creswell & Plano Clark, 2018). By formalizing this approach, we provide a practical tool for managing HLC innovation while ensuring methodological rigor and theoretical grounding.

HLC Current State, Challenges, and Opportunities

In this phase (Phase 1), we examined the distribution models and collaboration practices of 9 multinational suppliers and 2 Greek grocery retailers. In interviews, they shared their views on HLC implementation challenges and identified potential HLC opportunities. All participants serve a wide range of delivery points across Greece, including urban and suburban areas, islands, and various stores. Most suppliers import products to meet domestic demand, with a few producing locally for export.

Our context analysis revealed that logistics outsourcing, including both distribution and warehousing, is widely applied; seven out of eleven companies outsource the distribution of at least one product category and collaborate with a 3PL company, while four of them use 3PLs' warehouses. Only four out of the eleven companies use their own fleet, while seven companies have their own warehouses. All companies use a combination of centralized distribution and direct store delivery methods, albeit to differing extents. Centralized distribution from suppliers' to retailers' warehouses is the dominant practice in terms of volume, while direct store delivery is used for specific product categories. Thus, supplier distribution models often differ depending on the product category requirements; 5 out of eleven companies follow different distribution processes or direct delivery for at least one product that requires special treatment, for example fresh milk, suntan lotion, ice cream, chocolate, gum, or animal feed. Reverse logistics is a separate category in the distribution processes, and 5 out of eleven companies follow reverse logistics practices to some extent. Vertical collaborative distribution, or backhauling, is common in FMCG, with occasional partnerships between multinational and local suppliers. While HLC is gaining interest for its cost-saving, efficiency

Table 2 HLC challenges based on interviews with stakeholders

Challenge (C)	Details
C1: Internal optimization	High internal optimization in the FMCG sector limits potential for HLC
C2: Existing 3PL contracts	Current 3PL relationships could complicate HLC implementation
	Changes in distribution could affect 3PLs' existing optimization processes
C3: Volume and gain Sharing	Need for agreement on volume and gain sharing between suppliers with different 3PL partners
	Formulas for splitting distributed volume must be established
C4: Geographic proximity	Collaboration requires close proximity of companies, warehouses, and delivery locations
	Cross-docking and product loading/unloading processes affect feasibility
	Special quality requirements for some products (e.g., temperature control) may limit HLC opportunities
C5: Harmonization of delivery processes	Aligning delivery processes, time windows, and cut-off times is challenging
	Addition of extra steps due to HLC can disrupt daily routines and operations
C6: Routing system integration	Integrating routing systems between collaborating companies or with third-party organizations is complex
C7: Control and autonomy	Risk of losing control and autonomy, potentially compromising service quality
	Need for thorough evaluation of data and service guarantees before HLC adoption
C8: Investment and scale	Initial investments are required, which can be a barrier
	Preference for limited-scale HLC applications to minimize initial costs
C9: Legislative issues	Managing invoicing and administrative processes for multi-company itineraries is problematic
C10: Collaboration culture	Building and maintaining a collaborative culture and trust among partners is difficult
	Aligning business ethics and values is important for successful HLC and difficult to achieve

Table 3 HLC opportunities based on interviews with stakeholders

Opportunity (O)	Details
O1: Centralized deliveries	Full trucks used in centralized deliveries can be optimized by grouping products with varying characteristics (e.g., light and heavy items). This approach improves volume and weight utilization, shares distribution costs, reduces the number of vehicles used, and minimizes distance travelled
O2: Reducing empty kilometers	Suppliers' warehouses and factories, often located in the Attica metropolitan area, use transport that frequently returns empty. By coordinating shipments, suppliers can use return trips to transport orders from other suppliers, reducing empty kilometers and distribution costs
O3: Coordinated urban deliveries	Retailers' stores in city centers are served independently, often resulting in multiple deliveries from different suppliers. Coordinating deliveries and combining routes for these stores can increase vehicle fill rates, reduce additional routes and vehicles, lower CO2 emissions, and achieve cost benefits
O4: Remote area synergies	Greece's geography includes many remote and inaccessible areas with low volumes and high distribution costs. By identifying synergies and combining deliveries to these areas, suppliers can achieve economies of scale, improve delivery frequency and service levels, and keep costs reasonable
O5: Consolidating returns	Suppliers handle returns (e.g., seasonal items and packaging materials) independently. Consolidating return flows can create economies of scale in reverse logistics, reduce costs, lower the number of routes, minimize distance travelled, and shorten the collection process
O6: Imports and export	HLC could enhance efficiency in exports and imports, as suppliers typically handle large volumes of imports. Collaborating on these logistics processes can optimize operations and reduce costs

boosting, and sustainability benefits, implementation challenges remain a concern.

Table 2 provides a summary of the various challenges around HLC, while Table 3 summarizes the opportunities identified in the stakeholder interviews.

It is important to note that while the challenges and opportunities associated with HLC are inherently interconnected, they were presented separately to reflect how they naturally emerged from the interviews with stakeholders. Many of the opportunities identified in Table 3 can stem from addressing the challenges outlined in Table 2.

For instance, resolving the issue of gain sharing (Challenge C3) enables companies to unlock synergies and cost savings through coordinated deliveries (Opportunity O1). Similarly, overcoming geographic proximity constraints (Challenge C4) creates opportunities for centralized deliveries or coordinated urban logistics (Opportunity O3). By separating challenges and opportunities, we aim to provide a clearer understanding of the barriers that hinder HLC implementation and the potential benefits that can emerge when these barriers are addressed. This approach avoids imposing artificial connections not explicitly present in the data while still acknowledging the dynamic interplay between the two.

The Innovation Funnel Model for HLC

Opportunity Framing and Idea Generation

In this Phase 2 of our study, we focused on understanding the process of successfully implementing HLC. To do so, we initially invited the participating companies to ideate alternative HLC schemes based on the collaboration opportunities that had been identified. These schemes took into consideration the distribution model (e.g., centralized deliveries, direct store delivery); the product categories (e.g., heavy categories such as water and suntan lotion); the distribution areas (e.g., urban, islands); and the delivery points (e.g., retailers' stores, pharmacies or cosmetic stores). Table 4 provides the set of generated HLC schemes. Having generated eight HLC schemes, we mapped them to existing typologies from the literature on HLC (Pan et al., 2019) to align our empirical findings with theoretical constructs (see second column of Table 4). This mapping provided a structured framework to evaluate the schemes within the broader theoretical landscape, ensuring that our work contributes to and builds upon established knowledge. Following this, we applied an initial screening that was based on the envisioned joint benefits as well as the effective matchmaking and compatibility between the companies. At this stage, our evaluation was primarily based on perceptual data rather than quantitative measures, providing a qualitative assessment of feasibility. Ultimately, we concluded with four schemes to proceed to the next stage, refining our empirical approach through the theoretical lens provided by the literature.

Collaborative Design and Feasibility Assessment

We translated the four selected HLC schemes into concepts by selecting suppliers, distribution areas, delivery points, and product categories. Table 4 also provides an overview of each scheme. Having identified these four HLC schemes, we then evaluated each scheme based on the geographic proximity of the suppliers' warehouses or factories, their delivery locations, the existence of a common customer base and delivery points, the existence of directional imbalances, and the compatibility of specific product categories.

Proof of Concept and Implementation Readiness

At this stage, we evaluated the feasibility of implementing three of the four HLC schemes from the previous stage by quantifying potential synergies, such as shared customers or delivery points, and providing empirical evidence of the benefits. We focused on refining the role of 3PL companies responsible for implementation by discussing challenges and potential cost reductions with them. Table 4 also summarizes the validation method for each scheme.

Pilot Implementation for Scalability and Organizational Readiness

Scheme 1 was chosen for a one-month small-scale pilot. Both suppliers' products were consolidated at the second supplier's 3PL warehouse and distributed to customers using shared vehicles. The first supplier provided next-day routing plans to the 3PL, including routes, delivery points, product details (boxes, volume, weight), and estimated pallet numbers. Deliveries from the first supplier to the 3PL occurred daily. The 3PL created a collaborative routing plan and jointly distributed the products. Lead times and shipment frequency remained unchanged to avoid impacting inventory levels. To evaluate the HLC scheme, we collected daily data on the common routing plan, including routes, delivery points, pallets per delivery, truck number, and vehicle capacity. The first supplier also provided the non-collaborative routing plan as a baseline. Since the 3PL also handled deliveries for other companies, about 50% of the routing data came from them, which we included for a more accurate assessment of the HLC scheme's benefits and feasibility. Results showed a 6% reduction in total routes, 4% in distance traveled, 3% in CO_2 emissions, and 2% in costs. The small difference from the expected HLC benefits was due to the inclusion of deliveries from other companies served by the 3PL, which slightly affected routing optimization.

The HLC implementation revealed challenges. Stricter cutoff times for the first supplier reduced flexibility for last-minute orders, and pallet count variations complicated consolidation, as the final numbers were known only after packing. Administrative issues also emerged, with delivery notes and invoices sent via email rather than through automatic data exchange. However, a full-scale rollout could overcome such challenges.

Table 4 Innovation funnel model for HLC

Idea generation	Theory mapping	Concept development	Concept validation
Idea 1: HLC in direct store delivery in urban areas–opportunity 3	Carrier alliances and coalitions; logistics pooling	*Scheme 1: HLC in direct store delivery in urban areas* Two suppliers independently serve retailers in Athens city center, with their manufacturing sites and warehouses located in industrial areas. One supplier uses its own distribution, while the other relies on a 3PL. In this scheme, the first supplier uses a subcontracted vehicle to transfer orders to the other supplier's warehouse. The 3PL then coordinates joint distribution to retailers, optimizing routing and delivery	Analyzed one month of distribution data in Attica, Greece including delivery points, pallets, and gross weight. Significant HLC potential was identified in Athens city center due to high delivery frequency and common customers. Results showed a 7% reduction in routes, a 9.4% decrease in distance traveled, and a 5% reduction in CO_2 emissions. Distribution costs remained unchanged. Challenges included the need for an extra truck and overcoming collaborative routing and systems integration issues with one 3PL
Idea 2: HLC in aller et tour deliveries–opportunity 2	Bilateral carriers' collaboration	Scheme 2: *HLC in aller et tour deliveries* Two suppliers with opposite distribution flows collaborate. One supplier's trucks return empty from Athens after delivering products. These empty trucks can be used by the other supplier to transport goods from Athens to the west of Greece. The first supplier uses a 3PL, while the second has its own warehouse and subcontracted vehicles. This scheme is not product-specific	Analyzed 17 months of distribution data from the first supplier, focusing on western Greece. HLC potential was found in consolidating return trips. Results indicated only 60% of deliveries were full-truck, and potential savings were minimal. Expansion was limited by commitment issues and unrealistic expectations. Larger savings could be realized with broader coverage, but the second supplier was hesitant to expand
Idea 3: HLC in reverse logistics for seasonal products–opportunity 5	Shippers' collaborations; logistics pooling	Scheme 3: *HLC in reverse logistics for seasonal products* Two suppliers collect seasonal sun care products from various sales points at the end of summer. They work with a 3PL to coordinate returns from August to September. The suppliers agree on specific collection times and cut-off points, and the 3PL manages the collection process	Analyzed three months of returns data from 358 zip codes. High overlap in return locations (92% and 80% for the two suppliers). Variations in return request processes and collection methods were significant. Alignment of processes and centralized data collection were needed. The involvement of two 3PLs added complexity. Due to these challenges and limited cost savings, the scheme was deemed immature for pilot implementation
Idea 4: HLC in centralized and direct store deliveries in areas with specific logistics characteristics, such as the Greek islands–opportunity 4	Physical internet	*Scheme 4: HLC in centralized and direct store deliveries in areas with specific logistics characteristics, such as the Greek islands* Focused on Crete, the largest Greek island, this scheme involves two suppliers. Due to the island's size, distribution is required after trucks arrive by boat. HLC is applied to coordinate deliveries to the same or neighbouring points on the island, optimizing logistics for remote areas	Not feasible
Idea 5: HLC in centralized deliveries in suburban areas–opportunity 1	Logistics pooling	Not selected	–

Table 4 continued

Idea generation	Theory mapping	Concept development	Concept validation
Idea 6: HLC in direct store delivery for specific product categories to small (in terms of volume) delivery points such as pharmacies or cosmetic stores in urban areas–opportunity 3	Shippers' collaborations	Not selected	–
Idea 7: HLC in reverse logistics for packaging materials–opportunity 5	Shippers' collaborations and logistics pooling	Not selected	–
Idea 8: HLC at imports or exports–oportunity 6	Carrier alliances	Not selected	–

Formulating A Stage-Wise HLC Innovation Approach

This section presents a structured, stage-gate innovation framework tailored to the implementation of HLC. Drawing on established innovation management theories (Cooper, 1990; Tidd & Bessant, 2009) and building upon models of innovation diffusion, the framework provides a systematic approach to guiding firms from ideation through to pilot implementation. It addresses the practical challenge of translating theoretical HLC models into real-world collaboration schemes, especially in fragmented and operationally complex environments such as retail logistics.

The framework is inspired by stage-gate innovation logic, which breaks down the innovation journey into manageable phases, each followed by a decision gate that ensures only viable concepts proceed (Cooper, 1990). While traditional diffusion of innovation research has focused on factors influencing adoption, this model adds processual depth by embedding innovation stages into the actual development and validation of HLC schemes. In doing so, it operationalizes innovation not only as adoption but as structured experimentation and learning, which is critical for inter-organizational settings where collaboration must be carefully constructed, tested, and governed.

The core aim of the proposed stage-gate framework (Fig. 2) is to guide the structured development and evaluation of HLC schemes by addressing 3 key objectives: (1) ensuring the generation of a diverse range of collaborative logistics concepts, (2) selecting the most promising schemes for in-depth analysis, and (3) assessing the critical factors that influence their successful implementation. In essence, the framework facilitates progression through successive stages by defining specific evaluation criteria and expected outputs at each phase. Thereby enabling informed decision-making and reducing the risks associated with HLC implementation.

Stage 1: Opportunity Framing and Idea Generation

The first stage focuses on identifying untapped opportunities for HLC through creative exploration. Building on the understanding that innovation diffusion begins with knowledge and persuasion, this stage aims to stimulate awareness and generate a wide portfolio of ideas. To enhance ideation quality and diversity, the framework introduces four structured ideation dimensions:

- Distribution models (e.g., centralized deliveries, direct store delivery, aller-retour, reverse logistics)
- Product categories (e.g., fresh goods, heavy items, seasonal or temperature-sensitive products)
- Distribution areas (e.g., urban, suburban, islands, exports/imports)
- Delivery points (e.g., retail stores, pharmacies, distribution hubs)

Participants engage in facilitated brainstorming sessions to develop HLC concepts. A critical component here is "matchmaking"—ensuring strategic compatibility between suppliers based on distribution flows, service levels, product types, and business models.

Gate 1—Strategic fit and matchmaking: Concepts that lack alignment in strategic priorities or operational flows are filtered out to avoid resource waste in later stages. This gate echoes the "compatibility" element in Rogers' diffusion model—where innovations must align with the values and needs of adopters to move forward.

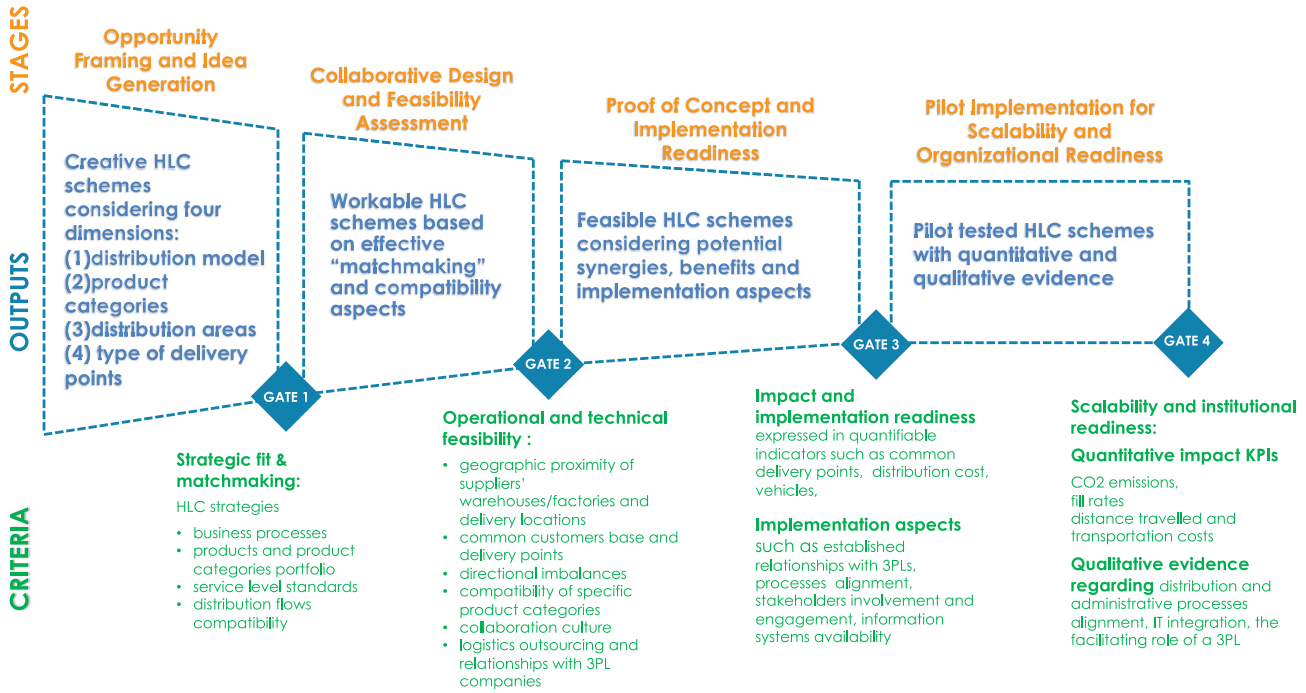

Fig. 2 A stage-wise approach for innovation in horizontal logistics collaboration

Stage 2: Collaborative Design and Feasibility Assessment

Once a pool of promising ideas has been generated, the second stage focuses on refining them through co-creation. This is a deliberate effort to foster joint ownership and reduce implementation resistance, which are important enablers in diffusion theory (Palmieri et al., 2019).

This stage encourages divergent thinking across participating firms and 3PL providers. Through co-creation sessions, stakeholders contribute complementary knowledge to shape feasible HLC configurations. Particular attention is paid to:

- Geographic proximity and overlapping delivery points
- Product compatibility and logistics complexity
- Route integration and shared 3PL infrastructure

In doing so, participants not only generate technically viable concepts but also build a shared understanding of each scheme. This increases the perceived compatibility of the innovation among participants, enhancing the likelihood of further commitment and adoption.

To further refine each proposal, stakeholders engage in structured information sharing, prioritizing geospatial data, delivery patterns, and operational constraints. The aim is to enhance the quality of matchmaking between partners by evaluating.

- The proximity of supplier warehouses or factories
- Commonalities in customer bases and delivery points
- The existence of directional imbalances in delivery flows
- The compatibility of product categories and service-level standards

Gate 2—Operational and technical feasibility: At this decision point, HLC schemes are evaluated based on their logistical soundness and technical viability. This includes routing efficiency, IT system interoperability, and the complexity of coordinating multiple 3PLs. This gate also functions as a trialability filter—allowing firms to simulate operational scenarios and test the feasibility of collaboration under controlled conditions. The goal is to reduce uncertainty before further resource commitments are made.

Beyond technical considerations, this stage places significant emphasis on the collaboration culture among stakeholders. Because many HLC initiatives involve competitors, establishing a trust-based environment is critical. This includes openly addressing legal boundaries (e.g., antitrust compliance), setting clear communication norms, and recognizing interdependencies. When managed effectively, constructive conflict at this stage can lead to stronger, more resilient schemes, as it allows for the surfacing and resolution of concerns before implementation. By fostering transparency and mutual understanding, this stage strengthens the foundation for successful implementation. It ensures that selected schemes are not only operationally viable but also institutionally supported by the stakeholders who will carry them forward.

Like the trialability principle in innovation diffusion, this stage helps reduce uncertainty by simulating real-world constraints before moving forward.

Stage 3: Proof of Concept and Implementation Readiness

The third stage focuses on generating robust evidence of value for the most promising HLC schemes. Acting as a proof-of-concept phase, it integrates quantitative analysis and qualitative assessment to evaluate both the measurable outcomes and the contextual enablers of each scheme. In line with Rogers' (2003) *observability* principle in diffusion of innovation theory, this stage aims to make the benefits of the innovation visible and understandable to all stakeholders, thereby supporting informed decision-making and reducing adoption hesitancy.

While quantitative data (e.g., reduction of costs, routes, and CO_2 emissions) can capture the "how much" of HLC's added value, it is insufficient on its own to explain why a scheme works or how it can be successfully implemented in a real-world setting. Therefore, this stage incorporates qualitative insights—derived from stakeholder interviews, process walkthroughs, and governance discussions—to understand the critical success factors, behavioral dynamics, and organizational alignment underlying each scheme. This mixed-methods approach increases the validity of results and ensures that decision-making considers both performance metrics and contextual realities.

Gate 3—Impact and implementation readiness: At this gate, HLC schemes are evaluated against a set of carefully defined quantifiable indicators, including distribution cost per unit, number of vehicles required, number of shared delivery points, total kilometers traveled and CO_2 emissions.

To assess potential synergies, process modeling and scenario simulations are employed—comparing the current ("as-is") logistics model with the proposed ("to-be") collaborative alternative. These simulations offer stakeholders a preview of operational and environmental gains, thereby enhancing confidence in the proposed transition.

In parallel, we assess qualitative readiness factors, such as the level of trust and commitment among stakeholders, the degree of alignment in logistics processes, the availability and interoperability of information systems, and the nature of contractual relationships with 3PL partners.

A crucial consideration at this stage is the role of 3PLs. As they often handle key logistics functions, including product consolidation, last-mile delivery, and routing, engaging them in the validation process is essential. Discussions with 3PLs help clarify implementation constraints, integration points, and cost implications. However, the presence of multiple 3PLs within a scheme can introduce additional complexity, particularly around cost-sharing mechanisms and operational coordination.

Importantly, we acknowledge that not all schemes will progress beyond this stage. Even if a scheme shows strong quantitative benefits, it may be rejected if it lacks organizational flexibility, stakeholder alignment, or the necessary 3PL cooperation. This reflects Rogers' notion of *reinvention*—where innovations must be adaptable to local contexts in order to be successfully adopted.

Stage 4: Pilot Implementation for Scalability and Organizational Readiness

The fourth stage serves as a retrospective validation phase, in which a selected HLC scheme is implemented and tested under real-life conditions, albeit of limited scope and duration. The primary objective is to assess the scheme's operational performance, organizational feasibility, and potential for scale-up through evidence-based learning. In agreement with the diffusion of innovation theory, this stage reinforces the *trialability* and *observability* of the innovation, offering stakeholders tangible experience and outcomes that inform future adoption decisions.

The pilot implementation is conducted in parallel with existing logistics processes, allowing firms to minimize disruption while systematically monitoring the benefits and challenges of collaboration. Evaluation at this stage integrates both quantitative and qualitative data, creating a comprehensive understanding of scheme performance.

To obtain quantitative validation, access to actual distribution flow data is essential. The following performance indicators are typically monitored: number of delivery routes executed; vehicle utilization and fill rates, total distance travelled, transportation costs, CO_2 emissions.

In parallel, qualitative insights are gathered using a variety of techniques, including direct observation of logistics and coordination activities; analysis of internal documentation (e.g., routing plans, cost reports); and informal interviews with key personnel from both suppliers and 3PL providers.

These insights focus on evaluating factors such as.

- Alignment between partners' distribution and administrative processes
- IT integration and data exchange efficiency
- Role clarity and engagement of 3PLs

Gate 4—Scalability and institutional readiness: This final decision point determines whether the pilot-tested scheme demonstrates sufficient operational viability, stakeholder support, and structural readiness for broader rollout. In addition to performance metrics, this gate assesses the institutional enablers of scale, such as

governance frameworks, contractual models, and digital infrastructure.

While some criteria evaluated here may overlap with those from Stage 3, this phase adds depth by validating the scheme in a live environment, allowing for iterative learning and continuous improvement. Moreover, it serves as a mechanism for building trust, confidence, and commitment among participants, thus reinforcing the conditions necessary for long-term diffusion and institutionalization of HLC practices.

Conclusion

This improved stage-gate framework helps companies move step-by-step from initial ideas to real implementation of HLC schemes. At each stage, clear criteria and decision points ensure that only well-designed and feasible ideas move forward. Unlike previous models, this approach treats pilot testing as an essential phase for learning and testing in real conditions before full-scale adoption. It also highlights the importance of neutral facilitators, such as ECR, in helping companies coordinate, build trust, and make decisions together.

In addition, we show that this framework is not just about deciding whether to adopt an idea: it is a full process model that includes structured idea development, collaboration between partners, testing, and continuous learning. These elements are often missing from other HLC studies. This makes our approach unique, as it brings together two separate areas—logistics collaboration and innovation management—into one combined, theory-based method.

Overall, the framework offers value to both researchers and practitioners. It is based on innovation theory but also designed to work in the complex, real-world environment of supply chain. It provides a clear and practical way to design, evaluate, and scale HLC schemes while taking into account key organizational, technical, and relational factors at every step.

Conclusion and Discussion

Theoretical Contribution

Despite growing academic interest and industry experimentation, real-world examples of HLC remain limited. Most existing literature focuses either on theoretical benefits or optimization models, treating collaboration as a static agreement rather than a dynamic, evolving process (Badraoui et al., 2022; Basso et al., 2021; Pomponi et al., 2015). This study addresses this gap by proposing and empirically validating a structured, stage-wise innovation framework for the development and implementation of HLC schemes.

By doing so, the study contributes to innovation theory in two important ways. First, it reconceptualizes HLC as a structured process model, integrating elements of diffusion of innovation theory such as *trialability*, *observability*, and *compatibility*. Rather than focusing solely on the adoption decision, our framework covers the full innovation lifecycle—starting from opportunity framing and ideation, moving through collaborative design and validation, and culminating in real-world piloting and iterative refinement. This aligns with more recent process-based perspectives in innovation management, which highlight that adoption is only one phase in a broader system of experimentation, learning, and scaling (Cooper, 1990; Tidd & Bessant, 2009).

Second, the study bridges two traditionally separate bodies of knowledge—logistics collaboration and innovation management—by applying stage-gate principles to a field that has largely treated innovation informally or opportunistically. The use of structured decision checkpoints (gates), data-informed evaluation criteria, and iterative testing mechanisms ensures that only viable HLC models progress to implementation. This contributes a novel methodology to the supply chain innovation (SCI) literature, providing a concrete pathway for turning collaborative concepts into operational reality.

Addressing RQ1, the findings emphasize that structured ideation and multistage evaluation are essential for identifying feasible HLC schemes. Rather than treating collaboration as a predefined structure, the study reveals that it must evolve dynamically in response to operational conditions, stakeholder alignment, and technological readiness. The innovation funnel approach supports progressive filtering, ensuring that schemes are not only theoretically promising but also logistically compatible and organizationally accepted.

In relation to RQ2, the study identifies governance flexibility, trust-building, and transparency as critical factors for overcoming common resistance to interfirm collaboration. These are operationalized through structured co-creation workshops, early-stage matchmaking, and shared evaluation metrics. The framework further provides a mechanism for resolving misalignment—through staged development and collaborative adjustment—thereby reducing the risks typically associated with collaborative ventures. Recent research highlights a shift toward agile and collaborative strategies to enhance supply chain resilience in uncertain environments, reinforcing the need for flexible, context-driven HLC approaches (Kocaoglu and Ulucay, 2025).

Moreover, addressing RQ3, the study empirically demonstrates how the innovation funnel model can serve as

a decision-support tool for refining and scaling HLC schemes. Through the integration of qualitative insights, simulation-based validation, and small-scale pilots, companies can systematically reduce uncertainty and adapt strategies based on real-world feedback. This *adaptive learning loop* strengthens the long-term viability of HLC initiatives and reflects the dynamic nature of innovation diffusion in complex environments.

In addition, by examining multiple types of HLC, including carrier alliances, bilateral collaborations, and reverse logistics pooling (Pan et al., 2019), the study shows that real-world configurations often blur the lines between typologies. For instance, Scheme 1 combines elements of carrier coalitions and logistics pooling, highlighting the need for more fluid classifications in future research.

Ultimately, this study challenges traditional static approaches to logistics collaboration by presenting HLC as a governed innovation process, where success depends not only on strategic intent but also on structured development, experimentation, and stakeholder alignment. It extends both the HLC literature and the SCI domain, offering a transferable model for designing, validating, and scaling collaborative logistics solutions in complex, fragmented markets.

Practical Implications

In addition to providing a new framework for HLC development and implementation, this study has sought to improve the practical understanding of the process toward the real implementation of HLC. Companies should perceive and position HLC as a catalyst for better shared distribution processes and not as a voluntary responsibility. They should determine a transparent strategy for their approach to HLC.

Therefore, before allocating significant funding to implement an HLC scheme, organizations should consider HLC as a large-scale process redesign and evaluation project not to be overlooked or underestimated. Incorrect expectations about the effort required and the benefits offered by HLC may leave companies reluctant to implement HLC in their day-to-day processes. Indeed, strong stakeholder involvement, even at the high levels of management and ownership, should be prioritized to identify the potential synergies and drive successful HLC implementation. Hence, this study also provides some recommendations to companies that intend to invest in HLC:

Understand the process toward HLC and evaluate alternatives: Companies should study how processes are redesigned due to HLC, and then evaluate performance. The integration of HLC within business processes—i.e., HLC-enabled process redesign—can serve as a significant mediator between HLC and firm performance. Furthermore, companies should explore the numerous ways in which processes can be flexibly redesigned to incorporate HLC, considering all possible HLC schemes. Each scheme presents its own value, requirements, and cost implications, making flexibility a key factor in optimizing outcomes.

Look for both the "system" and the "local" changes due to HLC. Companies should evaluate HLC implementation in each individual process while also maintaining a system view to assess the effect of local changes on the entire system. This approach allows for the identification of implicit dependencies between different parts of the system. Flexibility is crucial, as focusing solely on one part may underestimate the broader impact of HLC. A flexible, system-wide perspective ensures that changes in one area are aligned with overall business objectives and can be adjusted as needed.

Consider the partners' approach to HLC. Companies should consider HLC as an investment in the relationship with key supply chain partners. Otherwise, there is the risk of underestimating the impact of HLC.

Conduct field trials and test feasibility. Before committing to formal business case development, companies should conduct field trials to test HLC implementation issues in real conditions. Such trials can be regarded as a valuable learning process that helps companies make better-informed decisions and decide whether or not to start a rollout.

Contributions to Society

This study promotes sustainable logistics by establishing HLC as a systematic process to improve environmental, economic, and social well-being. This can be achieved by optimizing supply chain processes, reducing distances for transportation, improving vehicle utilization, and consolidating deliveries. HLC directly contributes to lowering greenhouse gas emissions and reducing urban congestion, creating a green and effective logistics environment. In addition to this, the collaborative method of HLC helps in strengthening partnerships among supply chain actors and improving the level of trust, developing common values, and optimizing resources. Such optimizations lead to resilient supply chains, cost savings, and consequent price drops for customers. In addition, HLC enhances accessibility to essential goods in cities and beyond, improving service reliability and enhancing quality of life. Further, through the analysis of systemic inefficiencies in logistics, HLC can catalyze sustainable economic development while providing both businesses and communities with smarter forms of responsible logistics.

Limitations and Future Research

While this study offers valuable insight into the HLC innovation process, it is not without limitations. First, although multiple measures were taken to mitigate bias and ensure that observed improvements stemmed directly from HLC initiatives, it remains challenging to eliminate the influence of external or overlooked factors entirely. Nevertheless, the robustness of our methodology and the strong alignment of our findings with HLC objectives provide confidence in the conclusions drawn. Second, our research primarily focuses on large multinational suppliers and major retailers, raising questions about the feasibility of HLC for small and medium-sized enterprises (SMEs). Given their resource constraints and potential need for external support, future research should explore tailored strategies for SME participation in HLC.

Third, our findings are based on the FMCG sector, which has unique operational characteristics. Further studies should examine whether the proposed HLC innovation process can be effectively applied in other industries, such as pharmaceuticals or e-commerce logistics. Additional research should investigate how HLC schemes can be scaled across different industries beyond FMCG to assess generalizability. Fourth, while this study tested small-scale implementation, ensuring the long-term sustainability of HLC remains a challenge. Future research should investigate strategies for maintaining collaboration over time and scaling HLC initiatives effectively. In particular, analyzing how trust and governance structures evolve over time would provide valuable insight into the stability and adaptability of HLC partnerships. Furthermore, further studies should investigate how AI-driven analytics and real-time data integration can optimize HLC partner selection and routing efficiency.

Finally, while the study discusses innovation, it does not explicitly integrate diffusion theories. Examining factors such as innovation adoption, the role of early adopters, and the development of critical mass could provide a more comprehensive understanding of how HLC schemes transition from pilot projects to widespread adoption. Additionally, literature on roadmapping could enhance our understanding of long-term strategic planning in collaborative logistics, helping firms structure their innovation trajectories more effectively.

Moreover, while our study introduces reflection as the final stage of the innovation funnel, future research could explore additional mechanisms, such as the multiplication of results and continuous improvement. Investigating how HLC models scale beyond pilot implementations and ensuring long-term adaptability through iterative refinements would provide a more comprehensive perspective. These extensions would contribute to the evolution of a more dynamic and sustainable innovation framework for HLC.

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Author Contribution All authors contributed to the article as shown in the alphabetical sequence. EZ: conceptualization, methodology, wrote main manuscript, manuscript review, project management AK: conceptualization, methodology, wrote main manuscript, manuscript review, visualization AG: wrote main manuscript, methodology, manuscript review, visualization.

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Data Availability The data supporting the findings of this study are not publicly available due to confidentiality agreements and non-disclosure agreements (NDAs) signed with participating organizations. As the study involved industry partners and commercially sensitive information, data access is restricted.

Declarations

Conflict of interest The authors declare no conflict of interest.

Ethical Approval This research was conducted with the intention of contributing positively to the field while safeguarding the rights and interests of all participants. The study involved expert interviews, not questionnaire-based data collection. Informed consent was obtained from all respondents, who were fully briefed on the purpose of the study, their voluntary participation, and how their responses would be used and stored. No personally identifiable information was retained, and all collected data were securely destroyed after one year in accordance with data minimization principles. The study was overseen by ECR Hellas, a non-profit association that facilitated non-competitive collaboration among suppliers and retailers in the fast-moving consumer goods (FMCG) sector.

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Key questions for further reflection

1. How can flexible collaboration models be designed to adapt to evolving supply chain environments and uncertainties?
2. What contextual factors most significantly influence the effectiveness of horizontal logistics collaboration in practice?
3. How can firms balance the need for standardized innovation processes with the demand for adaptability in logistics networks?
4. What are the main barriers to implementing and sustaining flexible, innovation-driven collaboration in the FMCG logistics sector?

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