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GROUND FREIGHT LOGISTICS AS INFRASTRUCTURE FOR THE TECHNOLOGY DIFFUSION OF PHARMACEUTICAL PRODUCTS: ORGANIZATIONAL PRACTICES AND PRINCIPLES

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Acceptance Page

This thesis of **KEZIA MAINE F. LAPICEROS** titled: **GROUND FREIGHT LOGISTICS AS INFRASTRUCTURE FOR THE TECHNOLOGY DIFFUSION OF PHARMACEUTICAL PRODUCTS: ORGANIZATIONAL PRACTICES AND PRINCIPLES** is hereby accepted by the Faculty of Management and Development Studies, U.P. Open University, in partial fulfillment of the requirements for the degree **Master of Research and Development Management.**

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Biographical Sketch

Kezia Maine F. Lapiceros is a Bacolod-based operations manager who completed her Bachelor of Science in Psychology as Summa Cum Laude at Riverside College in 2015. She then took the Psychometrician board examination the same year and passed as well.

She has accumulated 5 years of professional experience in ground freight logistics, with a particular focus on the U.S. market. She has been with the same logistics firm since she started her career in the field, up to the present. At the said firm, the author started as a Logistics Coordinator and was gradually trained in the operational workflow, and later contributed to streamlining the current processes in her subsequent positions as an operations supervisor and, eventually, manager.

Prior to enrolling in the Master of Research and Development Management (MRDM) at the University of the Philippines Open University (UPOU), she pursued graduate studies in another university and in a program that was closely aligned to her original profession and undergraduate background in Psychology. However, her sustained exposure to documentation, U.S. regulatory compliance, and digital load management systems shaped her interest in the role of logistics in other fields, leading her to enroll in MRDM at UPOU.

Her professional interests include technology diffusion and commercialization, logistics and distribution systems, innovation infrastructure, and, lately, she has acquired a new interest in knowledge, specifically with cross-border compliance, which complements her strong knowledge in the regulatory aspect.

Through the MRDM program, she developed a strong foundation in research design and document analysis, which she has applied in her role as an operations

manager by examining logistics documentation for research and development (R&D) distribution infrastructure.

This thesis is an amalgamation of her current role and the program she decided to pursue. The author intends to use and apply her insights from this study to improve R&D Management practice and discipline within logistics organizations and is currently considering further research on technology diffusion metrics in operational settings.

Acknowledgement

Faith comes in a lot of ways, but I will always be grateful to the Lord for having my back, even when I thought of setting off on a different path was more of a quarter life crisis. Thank goodness, it was not!

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Finally, I thank all those who, in ways big and small, contributed to the completion of this thesis. Any shortcomings that remain are mine alone.

Dedication

For our company truck drivers:

You deliver everything else, and somehow inspired this, too.

Thank you for every unseen mile, missed dinner, and boundless patience on the road.

Спасибо за ваш труд и терпение.

Abstract

Innovation research often focuses on invention and intellectual property, while the operational systems that bring technologies to users receive less attention. This study examined how ground freight logistics functions as practice-based R&D distribution infrastructure during the technology diffusion phase. It focused on a United States (U.S)-based small and medium-sized logistics firm that supports the distribution of research-derived and technology-based products.

The study used a qualitative, document-based design informed by ethnomethodology and Communication as Constitutive of Organization (CCO) theory. It analyzed naturally occurring organizational documents, including standard operating procedures, regulatory and compliance records, digital load-management logs, shipment case files, deviation reports, and proof-of-delivery documents.

Through iterative coding, the analysis traced how everyday documentation practices create organizational order, differentiation, compliance, and coordination. The findings show that ground freight logistics becomes R&D distribution infrastructure through patterned documentary practices rather than through physical assets alone. Shipments are made classifiable, traceable, and auditable through load records, category-specific standard operating procedures (SOPs) for pharmaceutical products.

The study identified seven technology diffusion principles enacted in logistics work and concludes that ground freight logistics operates as a non-traditional R&D support infrastructure by preserving the conditions under which developed, regulated, and sensitive products can move from production toward practical use during technology diffusion.

Keywords: ground freight logistics; R&D distribution infrastructure; technology diffusion; ethnomethodology; Communication as Constitutive of Organization (CCO); documentation practices

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Chapter I

RATIONALE

R&D Infrastructure

Innovation as a key driver for sustainable success in today's economy has been widely described in literature. Nevertheless, research and development (R&D) goes beyond invention and intellectual property protection, as it involves the process of creating the necessary structures to make the technology useful and profitable (Venditti et al., 2023). Though a great deal of effort has been invested in idea creation and intellectual property protection, much less attention has been paid to the system aspects of innovation implementation (Alibekova et al., 2024; Kireyeva et al., 2020).

In this research, innovation will be defined as an array of technological inventions or improvements related to product attributes, packaging, safety measures, regulatory systems, price policy and distribution systems. Diffusion mechanism, in turn, will be seen as a set of processes allowing innovations to be delivered to those who need it.

Among the array of research-derived and technology-based products that move through ground freight logistics, pharmaceutical products were used in this study as the focal case because they are a clear and traceable output of research and development. Pharmaceutical products carry documented formulation, regulatory approval, and quality specifications that can be linked directly back to an R&D origin, in a way that is far more difficult to establish for undifferentiated or generic cargo. Establishing this connection at the outset situates pharmaceuticals as a credible entry point for examining how logistics practices link R&D output to eventual use, and it is

on this basis that the R&D-to-logistics link explored throughout the study was established.

Successful diffusion of technology will require organizational capacity, institutional framework, diffusion strategy and other factors but it will depend also on organizational procedures that will link output of R&D processes to people and organizations who can use it. In the context of this study, transportation and logistics were important for ensuring the availability of innovations at appropriate time and place but, however, this aspect is understudied in R&D management research (Endalew et al., 2020; Tafesse et al., 2020).

Studies of manufacturing firms also show that the successful technology diffusion of new innovations depends on cross-functional alignment and capability development (Jiang et al., 2020). These results show that innovation output is not only a function of R&D investments but also organizational infrastructure present in everyday practice. Therefore, R&D infrastructure goes beyond laboratories, research centers and IP management system to include processes, information systems, compliance systems, and distribution systems that will make output of R&D available in practice.

Organizational disclosures and operations give evidence about the existence of technology diffusion and diffusion efforts (Sato et al., 2025). The infrastructure that is used to facilitate technology diffusion is derived from the organization's ability to document, comply, report, logistically operate, and digitally track processes. Similarly, research on technology transfer offices stresses the importance of developing processes and systems to facilitate diffusion (Kireyeva et al., 2020).

The literature sometimes describes the gap between technology development and market transfer as a “valley of death.” In this study, the term is used cautiously as a contextual metaphor rather than as an analytical construct, because the study did not examine financing or technology diffusion failure directly. Instead, the study focused on the operational mechanisms—coordination, documentation, compliance, and delivery—through which logistics can support the movement of developed technologies into the distribution stage.

Although transportation systems, information systems, and regulations can be defined as innovation infrastructure elements, the significance of logistics operations is highly underestimated (Bobryshev et al., 2022; Neto et al., 2024; Wolfert et al., 2023). This raises a question of the extent to which documentation of standard operating procedures, regulatory documentation, digital tracking documentation, and delivery documentation comply with the R&D management rules (Li-Ying et al., 2022; Pujotomo et al., 2023).

The Role of Logistics

One instance where the transition from development to use takes place can be seen in ground freight logistics. Even though transport companies do not qualify as R&D facilities, they have the potential to serve as non-traditional R&D support infrastructure through providing conditions under which developed, regulated, sensitive, or technology-based products can be transported safely. However, even though their role in R&D infrastructure has been acknowledged, little has been explored about the way in which situated practices, documentation, and compliance of ground freight organizations create the distribution infrastructure required for the technology diffusion.

The study aimed to bridge this gap through exploring how the situated practices of ground freight handling create infrastructure for the technology diffusion in the post-development distribution stage. The focus was on the organizational practice of classification, documentation, coordination, monitoring, verification, and closure of shipments in order to keep the visibility, compliance, and integrity of products throughout the process up until reaching the designated user.

More specifically, the study aimed to identify organizational practices of R&D distribution infrastructure; to explore how standard operating procedures (SOPs), documentation, and records in digital systems uncover differentiation criteria and triggers of special handling; to uncover the compliance and accountability mechanisms present in logistics documentation; and to interpret technology diffusion principles in the organization and implementation of the support practices.

The study was bounded to one specific U.S. based small and medium-sized ground freight logistics organization, and to the post-development distribution stage of the innovation cycle. The data used in the study were restricted to naturally occurring organizational documents only and included SOPs, regulatory and compliance documentation, digital system records, shipment case files, and company reports. Interviews, surveys, direct observations, and experimental manipulation were beyond the study boundaries.

Therefore, the findings provided by the study cannot be generalized to all logistics organizations but should be considered theoretically plausible and transferable. Moreover, since the organization's digital load-management system defaults to the Freight All Kinds (FAK) commodity category, the relevance of the products to the study was established according to the information in case-files such

as rate confirmation, compliance attachment, equipment specification, and regulation documentation rather than the default commodity label.

Through expanding the discussion of R&D infrastructure beyond formal laboratories and technology transfer units, the study contributes to diffusion research by extending Rogers' Diffusion of Innovations Theory toward the post-development distribution stage. It treats technology diffusion not only as an adoption-oriented process but also as a continuing organizing process sustained through logistics practices such as documentation, compliance, coordination, monitoring, and delivery. This perspective may enable innovation managers to recognize distribution requirements as part of the diffusion process, help policy makers and ecosystem designers recognize logistics readiness as a component of innovation infrastructure, and provide future researchers with a document-based approach to examining the practical organization of technology diffusion.

This study was also informed by the researcher's positionality as an organizational insider. The researcher occupies a unique position within the organization under study, holding routine, authorized access to the naturally occurring operational, regulatory, and compliance documentation examined in this research. This insider access made possible the collection of a rich, detailed, and otherwise difficult-to-obtain documentary corpus; an external researcher would typically face far greater constraints in gaining access to proprietary shipment records, internal SOPs, and compliance documentation of this kind, making the depth of this study's data feasible specifically because of the researcher's organizational position.

The researcher works at the organization whose documents were analyzed in the study. The insider position might raise a potential conflict of interest, particularly when the findings might cast a negative light on the operational practices or

organizational performance. In order to minimize the bias, the analysis was based only on the structural and thematic patterns of documentation; the findings will be presented in an aggregated form; the documentary meaning will be uncovered only from what the records reveal; and no proprietary specifications, product identity, customer information, or carrier identifying details were preserved or reported. Such measures complied with the ethnomethodological approach that emphasized the observable documentary evidence.

Chapter II

REVIEW OF LITERATURE

Infrastructure Determinants of Technology Diffusion

Rogers' Diffusion of Innovations Theory

Rogers' Diffusion of Innovations Theory provides a foundational explanation of how an innovation is communicated through channels over time among members of a social system, leading to its adoption (García-Avilés, 2020). The theory emphasizes that diffusion is not simply the movement of a new technology from its developer to a user; it involves communication, social processes, organizational conditions, and the innovation-decision process. This perspective is relevant to the present study because the movement of developed technologies through logistics requires coordinated activities that connect the innovation with the organizational and market settings in which it can be used.

Rogers' Diffusion of Innovations Theory is historically rooted in agricultural extension research, where early studies traced how farmers adopted new seed varieties, farming techniques, and agricultural technologies within rural communities. Much of the diffusion literature that follows this tradition, including several studies cited in this review, continues to draw on agricultural and agribusiness contexts, such as wheat and teff marketing (Tafesse et al., 2020; Endalew et al., 2020; Abate et al., 2022; Anteneh & Endalew, 2023). While this body of work demonstrates the continuing relevance of Rogers' framework, it also reveals a gap: diffusion-of-innovation research has rarely been extended to regulated, technology-based product sectors such as pharmaceuticals. By applying Rogers' theory to pharmaceutical ground freight logistics, this study positions pharmaceutical distribution as a novel application niche

that has not been previously explored in the diffusion-of-innovation literature, extending the inquiry beyond the agricultural sector in which the theory has predominantly been applied.

Attributes Influencing the Rate of Adoption

Besides understanding diffusion as a mode of generalized communication, it posits that in a given social system five perceived characteristics of an innovation influence rates of adoption, which are: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003, as cited in Stone, 2023). These elements continue to be implemented heavily within current diffusion-based studies to explain patterns of organizational and technological adoption, the characteristics offer a lens within which to situate the current research on the logistics system of pharmaceutical ground freight transportation as an arena of ongoing diffusion.

Relative advantage is the extent to which an innovation is seen as preferable to the status quo—be this, economic, utilitarian or convenience aspects (Stone, 2023). In this research, the relative advantage of recorded, verifiable ground freight practice is represented by both reduced risk of non-compliance, as well as maintenance of product integrity in comparison with more informal distribution processes.

Compatibility is the extent to which an innovation is similar to the existing values, previous practices, and needs of the adopting system (Stone, 2023). Jin et al (2024) the degree to which an innovation can “fit in” to the existing regulatory and operational regimes affects whether it is perceived as compatible. Think about the way current ground freight documentation procedures would integrate with existing compliance regulatory and operational schemes for pharmaceuticals.

Complexity refers how difficult an innovation is to understand and/or use; the higher the complexity, the slower the rate of adoption (Stone, 2023). This attribute is also significant for the operational aspect of the study because the tasks involved in classification, documentation and compliance verification may be accomplished with ease or difficulty, and this could influence the consistency with which they are maintained.

Trialability refers to the degree of feasibility for the innovation to be tried or experimented with on a limited scale before it can be adopted (Stone, 2023; Jin et al., 2024). Adoption is likely to be smoother where practices can be introduced on a small scale, e.g., the introduction of new documentation or tracking practices can be phased in.

The level of observability is how readily the outcomes of an innovation can be seen or demonstrated to others (Overbye-Thompson et al., 2025; Stone, 2023). In the current study, this feature becomes more significant in the context of a theme which is extended in Chapter V: the theme of traceability and proof retention in which observability is redefined not only as visibility of the benefits of an innovation to potential adopters, but as the permanent visibility of the state of a product and its custody throughout the distribution chain.

These five attributes helped to clarify the meaning of Rogers' term "rate of adoption" and provide the conceptual vocabulary for this study as it explored how pharmaceutical logistics practices continue to maintain diffusion beyond the initial point of adoption in later chapters.

Rogers' framework is particularly useful for situating the post-development distribution stage examined in this study. While the theory provides a strong basis for

understanding adoption and the spread of innovations, less attention is given here to the mundane organizational work that sustains diffusion after a technology has entered distribution. In ground freight logistics, classification, documentation, compliance verification, digital tracking, coordination, and delivery are not merely supporting activities; they are recurring practices through which the conditions for continued circulation and use of technology are maintained (Silva et al., 2022).

Accordingly, this study positions its contribution as an extension of Rogers' diffusion perspective. Rather than treating diffusion as effectively completed once adoption occurs, the study conceptualizes diffusion as a continuing organizing process that must be sustained through situated organizational practices. The study does not measure end-user adoption directly; instead, it examines the documentary and operational practices that support the continued availability, integrity, compliance, and movement of technology after development. In this way, logistics is positioned as part of the organizing infrastructure through which diffusion is sustained beyond the initial adoption decision (Mbatha, 2024).

Diffusion of technology does not happen automatically following innovation. Rogers' Diffusion of Innovations Theory explains diffusion as a process through which an innovation is communicated over time within a social system, with adoption forming a central part of the innovation-decision process. Building on this perspective, the present study focuses on the organizational conditions that sustain diffusion after technology has entered the post-development distribution stage. Institutional support, operational processes, and infrastructure are therefore treated as important conditions through which diffusion can continue in practice.

The required infrastructure and operational processes are the basis of effective diffusion. According to Tafesse et al. (2020) the major factors for entering the market

in Offa District, Ethiopia are market access, infrastructure, and output scale. The authors' findings show that the presence of appropriate infrastructure and organized processes is important for producers to be able to deliver their products to the market quickly. In terms of ground freight logistics companies, it is also important that those companies deliver innovations created during R&D by providing the necessary infrastructure. Therefore, the need for organized processes can be considered as the condition for technology diffusion.

The use of transportation and planning tools is important for the transformation of production into the marketable product. The results of research by Endalew et al. (2020) on technology diffusion of wheat production by smallholders have revealed factors such as access to transportation, storage, and group collaboration.

From those findings it can be concluded that the success of marketing depends on logistics management and on collaboration. Speaking about R&D logistics operations, it should be said that the activities performed by those logistics make it possible to link creation of ideas with market release through organized processes, reliable transportation, and coordinated workflows. It proves the significance of logistics as infrastructure for technology diffusion.

The quality of operational processes and infrastructure has an impact on market participation. Abate et al. (2022) researched commercialized small-scale wheat farmers and found out that the factors that are important for market participation include access to transportation network, compliance with market regulations and collaboration with middlemen. The authors' findings prove that organized processes are important for technology diffusion. In case of ground freight logistics, SOP, digital coordination processes, and documentation protocols operate together to ensure

reliable delivery of R&D goods that influences the diffusion process by making it faster and aligned with market and legal regulations.

Cooperation and accountability constitute the core components of technology diffusion.

In this context, Pujotomo et al. (2023) researched university-industry cooperation and established that planned operational systems and proper organization of technology play critical roles in diffusion. These results clearly show that controlled and planned transfer and distribution process is vital for market success rather than innovation alone. Like the ground freight logistics which depend on SOPs, digital processes, and compliance, logistics operations indicate that the logistics system is much more than movement of materials.

Systematic record keeping and institutional support contribute to the successful diffusion process. According to the study of Anteneh and Endalew (2023) on teff marketing, infrastructure, documentation, and institutional interaction have a significant role in determining market access. This study proves that operational processes supported by documentation and process management increase the chances of diffusion. The ground freight logistics depends on infrastructure, processes, digital processes, and compliance monitoring to transport R&D products.

Organizational Infrastructure in Innovation Ecosystems

Innovation ecosystems involve organizational infrastructures as a key factor that drives innovation in practice. Bobryshev et al. (2022) suggest that infrastructures, including transport, information and regulation infrastructures, help reduce difficulties in implementing innovations. The article suggests that any successful diffusion of

innovations necessitates a proper organization that aligns with the concept of distribution infrastructure for technological products in ground freight logistics.

Collaboration between different actors and resource management in innovation ecosystems is another organizational feature that determines their efficient functioning. According to Li-Ying et al. (2022), the combination of infrastructure, knowledge flows, and business practices allows companies to make use of R&D outcomes effectively. From the standpoint of the findings of the researchers, innovation participants need to use proper organizational approaches and transportation networks in order to convert innovations into products, while in the field of logistics this process involves organized paperwork, rule compliance and information transfer through digital means.

Therefore, the importance of logistics in innovation ecosystems can be traced since it helps transform technological goods.

In order to maintain the efficiency of innovation ecosystems, clear organizational structure should be developed. Dias Sant'Ana et al. (2020) state that the processes of resource allocation and cooperation are influenced greatly by the infrastructures used in the processes. The results of the research conducted by the authors prove that the effectiveness of the organizational infrastructure determines the way innovations are supplied and adopted by the market entities. In the framework of R&D logistics, ground freight operations provide such organizational features as organized procedures, automation systems, and compliance documents required for technology diffusion.

In order to enhance the development of innovation ecosystems, comprehensive organizational model should be used. Neto et al. (2024) emphasize the significance of

infrastructure and organizational alignment for effective functioning of innovation communities. As a result, the findings provided by the researchers reveal that innovations require organizational alignment and coordination in order to be distributed properly. In case of ground freight logistics, the concepts can be represented by organized procedures, digital processes and regular rule checking. In this way, technological innovations become available in the market as a result of logistics operations.

Organizational models combining technology, cooperation and infrastructure should be used for the development of digital innovation ecosystems. The findings provided by Wolfert et al. (2023) state that digital platforms, automation systems and structured processes allow innovators to collaborate and introduce innovations. Also, the results of the research reveal that in addition to innovative technologies, the systems that convert innovations into products play an important role in innovation. This aspect can be traced in the process of ground freight logistics during which well-developed SOPs, digital tracking and compliance protocols are used to distribute technological goods.

Distribution Practices and the Technology Diffusion Phase

It is important to understand strategies to overcome practical and logistical difficulties as a way to solve the technology diffusion phase issue. Ekwall and Eriksson (2025) point out that non-core technologies face distribution challenges as well, such as shipment tracking, logistics, and compliance. These factors are the reasons why it is so crucial to have the necessary infrastructure in place. Ground freight logistics uses formalized documentation, digital tracking of shipment, and standard operating procedures in order to mitigate uncertainty and assure safe transportation of research and development innovations to the customers. All these practices play an important

role in the distribution infrastructure that helps deliver the technology to the consumers (Ekwall & Eriksson, 2025).

The ability of the organization to organize innovation diffusion greatly affects the process of technology diffusion. Mamrayeva et al. (2020) say that for technological products to be delivered to the market quickly, one needs to have efficient distribution infrastructure, proper operational procedures, and efficient control systems. This approach identifies transportation infrastructure as a key player in the diffusion phase. Companies can plan their shipment of R&D products in an organized manner with the help of compliance rules, digital workflow management, and standard coordination routines. These business practices show how the infrastructure of R&D diffusion is used through the distribution channel in the process of making a marketable technology.

Technology diffusion activities based on policy demonstrate the significance of organized logistical network for the initial spreading of innovations. Vogl et al. (2021) say that the diffusion of green steel in the European Union will depend on proper transportation, control systems, and coordination routines. In ground freight logistics, the paperwork, digital tracking, and regulation compliance allow for the spreading of new ideas. Moreover, such practices will guarantee quick and safe delivery of the innovations developed by research and development to the target market. Logistics serves as infrastructure driving the diffusion phase of R&D.

Disruptions of supply chains cause challenges in selling and spreading new innovations. The distribution and transportation systems are very important to deliver innovations, especially in rural energy systems, to those who need it in uncertain times. Ground freight logistics provides an example of how structured workflows, automatic tracking of the shipment, and compliance standards can reduce the risk,

guarantee efficiency of operation, and facilitate diffusion of the R&D results. Logistics supports marketing through ensuring that the innovations of manufacturing are adopted by the market. This practice creates stable infrastructure (Min, 2023).

Networked collaboration combining the organizational infrastructure and logistics planning speeds up the diffusion of innovations. Aarikka et al. (2021) explain how the collaboration between production units and marketing takes place and how this collaboration helps with the diffusion process. In ground freight logistics, it is demonstrated in the form of SOPs, digital coordination routines, and compliance monitoring. This allows for quick and consistent delivery of technological goods and shows that logistics is not just transportation but the part of the infrastructure for R&D distribution, which facilitates the transfer of ideas into products.

Thus, the examined literature describes R&D infrastructure mostly on strategic, institutional, or ecosystem level, while the situated documentary practices that logistics firms use to organize technology diffusion have not been studied enough yet. It is understood in the literature that transportation, information systems, regulation, and coordination are the enablers of diffusion, although there is very little explained about how the everyday practices of records keeping, classification, proving, and compliance routine serve as the infrastructure in the distribution phase. None of the literature in this research review uses ethnomethodology or Communication as Constitutive of Organization (CCO) theory in relation to ground freight logistics as R&D distribution infrastructure.

Chapter III

RESEARCH FRAMEWORK AND RESEARCH QUESTIONS

Building on the reviewed literature in Chapter II, this chapter presents the theoretical and conceptual framework anchoring the study and the research question that guides the analysis. Rogers' Diffusion of Innovations Theory provides the conceptual lens for positioning the study's contribution. While ethnomethodology and CCO Theory provide interpretive resources for examining the situated documentary practices through which diffusion is organized and sustained.

Theoretical Framework

Diffusion of Innovations as a Conceptual Lens

Rogers' Diffusion of Innovations Theory was used as a conceptual lens for locating the study within the broader literature on technology diffusion. Rogers (2003) explains diffusion through the communication of an innovation over time within a social system and identifies adoption as a central part of the innovation-decision process. The present study extended this perspective by directing attention to the organizational work that continues after a technology has entered the distribution stage. Specifically, it examined how logistics practices sustain diffusion through recurring acts of classification, documentation, coordination, compliance verification, monitoring, and delivery. Rogers' theory therefore provided the conceptual context for the study's contribution, while ethnomethodology and CCO remained the interpretive resources for examining how these practices are accomplished in naturally occurring organizational documents.

Ethnomethodology served as the foundation for the present study. According to Harold Garfinkel (1967), ethnomethodology focuses on everyday activities within social groups in order to explore the process of creating organized social norms through regular behavior. The idea of the approach is not in considering the infrastructure as the preexisting element but seeing it in the context of being continuously constructed through regular actions. As it is explained by Mlynář (2023), the routine paperwork, digital logging, reporting on compliance, and following proper procedures are among the examples of visible regular actions in the logistics operations that help to maintain the organizational order.

Instead of imposing preselected analytical frames in the very beginning, the current study paid attention to the actions of the workers in the field, which aligns with the principles of ethnomethodology. Regular organizational actions related to preparing documentation, verification of compliance, coding the regulations, tracking of digital systems, and coordinating special handling should be considered the situated accomplishment of the actors. The categories such as distribution governance, innovation protection, and compliance structure should not be assumed to be theoretical at the beginning of the study because they could be found during the empirical work based on the performance (Mlynář, 2023).

The following concepts should be taken into consideration as the key components of the ethnomethodological approach. First, reflexivity focuses on the interpretation of meaning of the work accounts. Second, indexicality demonstrates that the meanings of terms such as "on-time delivery" and "efficient coordination" depend on the context. Third, accountability makes sure that the actions are accounted for and observable. Fourth, the documentary method helps to find out that some events are taken as evidence of competence in supporting innovation. Thus, everyday

transportation activities could be seen as the part of the infrastructure that is used for the purpose of innovation diffusion.

The CCO Theory was also relevant to the current research. It suggests that the organizational structures are constructed through communication processes. From this point of view, the infrastructure should not be seen as the preexisting element but the records of the planning, compliance, and digital systems should be taken into account.

In the current research, ethnomethodology and CCO could be considered as the interpretive resources but not as preselected codes. Thus, the analysis starts with the unmotivated reading of the naturally occurring documents to see how the logistics actors achieve differentiation, compliance, and coordination and only then relate the emerging themes to concepts such as reflexivity and accountability and the constitutive nature of communication (Mlynář, 2023).

Research Question

This study was guided by the following research question:

How do the situated work practices of ground freight logistics operations constitute the technology diffusion phase of the R&D support infrastructure, and what technology diffusion principles can be identified in the organization and execution of these support practices?

Chapter IV

RESEARCH METHODOLOGY

Research Design

This paper used an ethnographic approach based on the analysis of documents to investigate the role of logistics in distributing R&D outcomes and diffusing the technology. Through the analysis of naturally occurring documents within organizations, the aim was to reveal the tacit assumptions made in the process of routine documentation. Tasks such as routing, coordination, compliance verification and documentation are part of the everyday routine of logistics workers, but their analysis reveals the foundation for technology diffusion.

In accordance with the main ideas of ethnomethodology, the priority was given to observed work practices over theoretical models. This study treated documentary practices themselves as the object of analysis rather than as indirect evidence pointing toward some prior, unknown infrastructure. Product identity, invention status, and proprietary specification were given anonymity for confidentiality and research positionality reasons, the analysis cannot verify infrastructure through the products that were hauled.

Following the ethnomethodological premise that organization order was produced through members' methods rather than inferred outcomes (Garfinkel, 1967), this study treated all documentary records, including SOP categories, load fields, compliance entries, and deviation reports, as the infrastructure under investigation. A shipments classification (GOV, PKG, HZL, PHARMA) was not an alternative option, standing in for some hidden R&D commodity—it is the tangible, accountable workflow through which the involved organization constitutes that shipment as requiring specific

requirements (i.e., special handling). This aligned with the study's limited form of unique adequacy (Mlynář, 2023), which closely aligns with the organization's operational jargon and system fields.

The frameworks for innovation management were not used as the coding schemes. Rather, the protection, compliance, and documentation mechanisms that have been developed through daily practices of logistics actors were investigated.

Research Setting

The data collection was conducted at a small to mid-size U.S. ground freight logistics company specializing in the distribution of developed, regulated, and technology-based products. This context is reflective of the post-development stage of the innovation cycle, as it involved movement of already developed or approved products under particular documentary, regulatory, quality, security, or handling conditions.

The documentary corpus included naturally occurring records generated by the organization's routine logistics and compliance operations. Following the revised scope of the study, the corpus analyzed was narrowed to pharmaceutical or temperature-sensitive shipment folders; the government or security-sensitive (GOV), hazmat-lite (HZL), and packaging-sensitive (PKG) categories were excluded from the study's scope, as combining multiple shipment categories complicated the analysis and diluted the diffusion-of-innovation conclusion the study sought to support. Specifically, it included the Pharmaceutical Shipment Handling SOP, Documentation and Order Lifecycle Management SOP, and Deviation Management SOP, pharmaceutical shipment folders, BrokerPro electronic load records, regulatory and compliance records, load confirmations, proof of delivery records, and associated

documents. The analysis used theoretical sampling throughout the course of research instead of applying it as the pre-collection technique. As patterns started emerging, additional pharmaceutical documentation was reviewed to see if similar practices were applied to various conditions of products, regulatory context, and coordination circumstances until no further major categories came out.

In the context of the ground logistics company, the digital load management system frequently employs Freight All Kinds (FAK) as the default administrative classification for load building purposes. As this broad classification does not specify any product-specific or innovation-related characteristics, the analysis was not relying on the commodity field to determine relevancy of the document. Each shipment was analyzed based on its case-file documents including rate confirmations, delivery orders, bill of lading, compliance documents, equipment specifications, regulatory documents, handling documents, and proof documents.

A shipment folder was defined as technology-diffusion relevant if at least two documentary indicators were found to occur in convergence at least in two document types. The indicators included temperature controls, regulatory or hazard classification, chain-of-custody requirements, specialized equipment, quality system language, packaging or electrostatic discharge (ESD) protections, and deviation or excursion requirements. Folders with only generic names or lack of sufficient indicators were retained as scope control documents.

Data Collection Procedure

Approval from the company was sought before accessing the organizational files. The study's exclusion from a thorough ethics review process and the approval letter are provided in Appendices A and B, respectively. Only those records that

resulted from routine logistics and compliance processes were analyzed; there were no questionnaires, interviews, observations, or researcher-generated records involved.

Each shipment was treated as an independent documentary file that had a unique code consisting of the category prefix (PHA – pharmaceutical or temperature sensitive), as well as the corresponding case number. Government or security-sensitive (GOV), hazmat-lite (HZL), and packaging-sensitive (PKG) shipment folders were part of the researcher's initial documentary access but were excluded from the study's stated scope, consistent with the panel's direction that combining categories complicated the result and that retaining only the pharmaceutical category keeps the diffusion-of-innovation conclusion supportable. Each pharmaceutical file consisted of all the available rate confirmation, delivery order, or customer instructions, BrokerPro load record, and documents pertaining to pharmaceutical compliance, handling, tracking, and deviation handling. The codes of cases analyzed in the study did not identify clients, carriers, personnel, and proprietary products.

The researcher worked through the document corpus in an iterative manner, selecting relevant documents on the basis of their contribution to developing the patterns of documentation, differentiation, compliance, coordination, and deviation handling.

Data Management

The documents from all organizations were contained in encrypted files available only to the researcher. These documents were encrypted and stored securely, while identifiers of the organizations, their employees, customers, carriers,

products, and commercially sensitive processes were removed from the documents used for analysis.

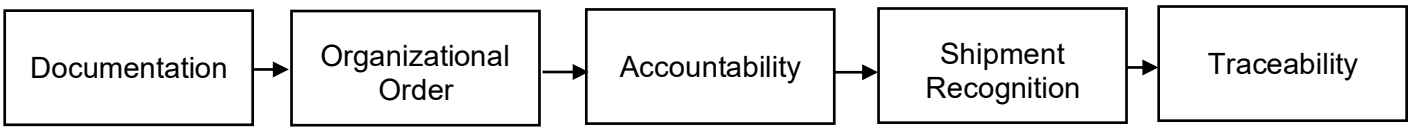
The system of document management included a classification of documents with reference to their categories, codes of cases, format, time frame, and their status in analysis. The expanded Document Corpus Inventory in Appendix D includes six SOPs, forty folders with shipments categorized into types, BrokerPro screenshots, PDF files, and others that together compose the corpus of the study. This inventory helped to track the coverage of documents and avoid any duplications of the documents analyzed.

Documents will be retained until the time when their storage becomes unnecessary according to the institutional policies and the organization's permission to use them; then they will be permanently deleted.

Data Analysis

Data analysis involved a qualitative coding process that is iterative. In the first phase, there was a relaxed reading of the SOPs and shipment folders to become acquainted with the records available and without any predetermined theoretical categories. Open coding was used to generate observable practices such as generating shipment files, classifying items, uploading documents, status updates, adherence to handling instructions, verification of compliance, maintaining evidence, digital coordination, and deviations handling.

Figure 4.1. Mind Map of Documentation as Organizational Order in R&D Distribution Logistics Work.



In the second phase, i.e., focused coding, similar observations were placed under the same practice categories. Comparison of these categories was done within the pharmaceutical (PHA) shipment cases only, consistent with the study's pharma-only scope; ambiguous and disconfirming records were analyzed, and the analysis went on until there was no newer major category identified through additional review.

Table 4.1

Analytical Coding Matrix Legend

Code	Analytical Focus	Documentary Pattern and Analytical Role
C1	Documentation and order lifecycle	Shipment-file creation, required records, status events, proof retention, and documentary closure.
C2	Differentiated handling	Category-specific requirements that make security, hazard, temperature, equipment, or packaging conditions operationally relevant.
C3	Compliance and accountability	Required entries, verifications, documents, audit trails, and retention practices that make actions observable and defensible.
C4	Digital coordination	System fields, notes, document tabs, tracking, check calls, and shared records that coordinate work across roles and time.
C5	Deviation responsiveness	Detection, reporting, containment, investigation, RCA, CAPA, disposition, and closure of disruptions or excursions.

The excerpt-level analysis was accomplished using an Analytical Coding Matrix. This matrix links the documentary excerpt with the case and its source record, the observable action, the analytical code, the subtheme and the emergent theme. There were five main codes used to categorize the findings, namely C1 for documentation and order life cycle, C2 for differential handling, C3 for compliance and accountability, C4 for digital coordination, and C5 for deviation response. C6 was just for scope control and disconfirming cases and not used as a theme.

The five dimensions on the previous table were not treated as independent categories, but as an integrated framework for reading the documentary corpus. The framework was organized into five analytical dimensions. Each dimension identified what the analyst looked for in the documents, the types of documentary evidence that were relevant, and the ethnomethodological concept through which the evidence was interpreted.

The presented framework below functioned as the working instrument throughout coding. It kept the analysis grounded in observable documentary practice rather than in the researcher’s prior assumptions about what the corpus should comprise.

Table 4.2

Analytical Dimensions Framework

Dimension	Analytical Focus	Documentary Evidence	Ethnomethodological Interpretation	Emerging Theme	Key Ethnomethodological Concept
Documentation as Organizational Order	- How does the document make the shipment recognizable as an accountable organization object? - What fields, tabs, or records constitute the shipment as a complete, traceable unit of work?	- BrokerPro load record: Load number, Customer, Carrier, Shipper, Consignee, Product/Equipment, Dispatcher, Status, Load Notes, Documents, Check-Call Section, Accounting Summary - Load Confirmation (Rate Confirmation) and Delivery Order Documents	The documents constitute the shipment as an orderly and legitimate object of logistics work, not just describe the work that occurred. This makes the documentary structure as the infrastructure.	Documentation as Practice-Based Infrastructure	**Reflexivity**

		- Proof of Delivery records (BOL, Photos of the freight) - SOP references to the “system of record” and “shipment file”				
Differentiation Mechanisms and Special Handling Triggers	- How does the document make the shipment recognizable as requiring a particular kind of work? - What category labels or SOP references activate specific handling requirements?	Pharmaceutical SOP, temperature range, reefer equipment, data logger, excursion/QA.	The meaning of 'proper handling' is not fixed; it is context-dependent. The document makes the relevant context visible and compulsory.	Differentiation Mechanisms and Special Handling Triggers	**Indexicality**	

Compliance and Accountability Mechanisms	- How does the document make an action reportable, observable, and reconstructable? - What required entries, proofs, or retention requirements ensure defensibility?	- Required document uploads (customer confirmation, carrier confirmation, BOL, POD, photos). - Status and milestone fields (assigned, enroute, delivered, completed). - Appointment and timing records. - Category-specific handling notes converted from risk to operational instruction. - Deviation records (deviation number, date, RCA, CAPA, closure documentation). - Record retention requirements (3–5 years).	Compliance is embedded in the documentary workflow itself, not added separately. Every entry is simultaneously an operational action and an accountability mechanism.	Compliance and Accountability Mechanisms	**Accountability**

Digital Coordination	- How does the digital record make the shipment visible as a shared object across different actors? - How does the system structure coordination across the order lifecycle?	- BrokerPro load page: customer, carrier, dispatcher, product, equipment, appointment, notes, document count, check calls, accounting, integrated into one view. - Document tab: files accessible to multiple roles. - Check-call section: pickup confirmed, in-transit, delivered milestones. - Notes/handling instructions: free-text field preserving context-specific requirements. - SOP references to cross-shift continuity: email	The organization is constituted through records that make actions visible to others. The digital system organizes the shipment into a shared, readable object for all roles.	Digital Coordination as Technology Diffusion Support	**Communication as Constitutive of Organization (CCO)**

		records, endorsements, task handoffs.			
Deviation Responsiveness and Protection of Product Value	- How does the document convert a disruption into a formal, reviewable, and correctable event? - What documentary practices protect product value when normal procedures are interrupted?	- Deviation Management SOP: detection, reporting, containment, RCA, CAPA, closure. - Temperature excursion records: event, QA notification, disposition decision. - Quarantine records: isolation status, hold period, release or rejection outcome. - RCA and CAPA documentation with effectiveness verification. - Incident records (PKG): damage report, indicator status, photographs, notifications.	Deviation responsiveness is infrastructure, not merely a corrective requirement. The documentary structure of deviation management makes the 'valley of death' survivable at the distribution stage.	Deviation Responsiveness and Protection of Product Value	**Accountability / Resilience**

	- Retention of closed deviation records for audit and contractual purposes.

In addition to the interpretive framework, a category-specific review checklist was used to standardize how the pharmaceutical cases were examined. This checklist ensured that the same documentary elements were addressed across cases. A folder is flagged as technology-diffusion-relevant when at least two documentary indicators are present in convergence across document types within the same folder. This procedural tool supports the rigor of the analysis by making the review of category-specific records repeatable rather than ad hoc.

Table 4.3

Category-Specific Review Checklist

Category	Documentary Indicators to Review	Convergence Threshold
PHARMA (Pharmaceutical)	☐ Pharmaceutical handling SOP reference ☐ Temperature range specification ☐ Reefer equipment requirement ☐ Data logger field reference ☐ Pre-cooling / pre-conditioning verification ☐ Excursion reporting requirement or timeline ☐ Quarantine / QA disposition language ☐ Receiving-facility temperature confirmation	≥ 2 indicators across ≥ 2 document types
Cross-Cutting (Deviation)	☐ Deviation SOP reference ☐ Deviation or excursion event record ☐ Quarantine or hold notation ☐ RCA documentation ☐ CAPA record ☐ Closure record with effectiveness verification ☐ Record retention notation	Any 1 indicator qualifies as deviation event
Scope Control / Boundary Case (Negative Case)	☐ Commodity label only (FAK / generic) with no accompanying pharma handling indicators ☐ Folder with fewer than 2 documentary indicator types present ☐ Missing proof documents with no deviation record explaining absence	Flag as C6 (scope-control) or boundary case; do not force into the pharma theme without qualification

The framework and the category-specific review checklist defined what the analysis attended to in each folder and how candidate technology-diffusion cases were identified. Once these procedures were in place, the next step was to locate how particular excerpts from the corpus manifest the five analytical codes. The next table presents the documentary corpus to which these procedures were utilized, summarizing the shipments reviewed across all pharmaceutical cases, their volume, and their relevance to technology-diffusion infrastructure.

Table 4.4

Documentary Corpus Inventory

Document Category	Document Title / Description	Format	Volume	Date Range
Standard Operating Procedures	Documentation and Order Lifecycle Management SOP	PDF	1 file	2024 - 2026
Standard Operating Procedures	Deviation Management SOP	PDF	1 file	2024 - 2026
Standard Operating Procedures	Pharmaceutical Handling SOP	PDF	1 file	2024 - 2026
PHARMA Load Case Folders	Pharmaceutical/Temperature-Sensitive Records (PHA1-PHA14)	Digital screenshots + PDF	14folders	2025 - 2026
Digital System Screenshots	BrokerPro Load Screens, Document Tabs, Accounting Views	PNG	165 files	2025 - 2026
PDF Operational Records	Load Confirmations, Proof Documents, Operational Files	PDF	144 files	2025 - 2026
Other Formats	Operational Records	JPG	1 file	2025 - 2026

As the scope and composition of the corpus is established. The analysis can now be located at the specific-level excerpts. Table 5 shows the excerpt-level Analytical Coding Matrix, which links each excerpt to its case and source record, the observable action it documented, the assigned code (C1-C5), the subtheme, and the emergent theme that it embodies.

Table 4.5

Analytical Coding Matrix

Excerpt (from Operational Record or SOP)	Code	Sub-theme	Theme
1. PHA1 / Load 11031: Paperwork after loading and pickup number were confirmed in writing. 2. PHA8-PHA10 folders: Appointment, BOL/POD, tracking, and proof records were retained. 3. PHA10: Load confirmation, BOL, POD, and export records were kept as closure evidence.	Code 1 Pharmaceutical shipment documentation and recognition	Sub-theme 1 Documented product-condition and compliance organization	**Pharmaceutical logistics as continuing technology diffusion infrastructure**

4. PHA1 / Load 11031: Reefer trailer was identified; temperature was to follow the BOL. 5. PHA2 / Load 11037: Rate confirmation specified reefer equipment and 65F-75F range. 6. SOP-LOG-PHA-001: Temperature range, reefer, logger, and excursion response were specified.visible across the full lifecycle.	Code 2 Temperature and equipment differentiation
7. PHA2 / Load 11037: POD was uploaded and transmitted after delivery. 8. PHA3-PHA5: Original BOL/POD was required for payment.	Code 3 Proof, compliance,

9. PHA7 / Load 11316: PARS record identified carrier, BOL, POE, driver, and broker.	and traceability retention	
10. PHA1 / Load 11031: PARS, POE, border ETA, BOL, and broker thread were documented. 11. PHA2 / Load 11037: Enroute and resting locations were logged. 12. PHA6 / Load 11282: Active tracking was required and verified in the record.	Code 4 Digital visibility and cross-role coordination	Sub-theme 2 Digital visibility, corrective response, and responsible inference
13. PHA1 / Load 11031: ACI data mismatch was flagged for immediate correction.	Code 5 Deviation and	

14. SOP-LOG-PHA-001: Logger review, quarantine, RCA/CAPA, and QA disposition were required.	excursion responsiveness
15. Deviation SOP: Detection, reporting, containment, CAPA, and closure were documentable events.	
16. PHA1 scope note: FAK alone was not treated as pharma evidence.	Code 6 Scope control and responsible interpretation
17. PHA5 boundary case: Incomplete support was treated cautiously.	
18. PHA8 boundary case: Thin records clarified limits of inference.	

Note: Scope-control cases (C6) reflect the negative-case handling procedure applied throughout the analysis. The complete coding legend, including code labels and descriptions, is provided in Appendix E.

The analytical coding matrix should not be read as a verbatim reproduction of every document in the corpus. It presents the main traceable coding logic from the fourteen pharma-related shipment cases and supporting SOPs. The full source records remain anonymized and confidential; the matrix functions as the visible audit trail for how the findings and principles were derived.

The matrix shows how selected documentary excerpts support each code, how related codes form sub-themes, and how the sub-themes lead to the central theme of pharmaceutical logistics as continuing technology diffusion infrastructure.

Pharma-Only Analytical Basis

The matrix should be read as the main analytical audit trail rather than as a verbatim reproduction of every reviewed document. It presents representative excerpts from the 14 pharma-related shipment cases and supporting SOPs to show the logic by which codes and principles were developed, while confidential source records remain anonymized.

The findings were therefore built from concrete documentary indicators rather than from general descriptions of logistics work. The analysis traced how several pharma-related excerpts supported each code, how related codes formed sub-themes, and how the sub-themes led to the theme of pharmaceutical logistics as continuing technology diffusion infrastructure.

Following the excerpt-level coding, the documentary corpus was catalogued to show the range and volume of records reviewed.

Table 4.6

Documentary Corpus Reviewed in the Analysis

Document group	Volume observed	Documentary contents	Ethnomethodological relevance
Standard Operating Procedures	6 PDF files	Formal procedures for documentation, deviation management, government/security-sensitive shipments, hazmat-lite shipments, pharmaceutical shipments, and packaging-sensitive shipments	Showed how the organization defined accountable and competent logistics work
PHARMA load case folders	14 folders	System screenshots and documents for pharmaceutical or temperature-sensitive shipments	Showed how temperature, equipment, timing, and monitoring requirements were documented
Digital screenshots and PDF	165 PNG files, 144 PDF files,	BrokerPro load screens, document tabs, customer/carrier/accounting	Showed how the system of record structured

operational records	and 1 JPG file	views, load proof documents, and operational files	confirmations,	coordination, evidence retention, and accountability

As shown in Table 6, the dataset contained both rule-based and case-based records. This combination was important because ethnomethodological analysis requires attention to how work is actually made observable in ordinary settings. The SOPs reflected the organization's formal expectations, while the load folders documented the traces through which shipments became visible as accountable operational tasks. Attention was also given to what the files required, emphasized, or left incomplete, because documentary absences and uneven attachments helped define the boundaries of what could responsibly be claimed from the data.

The study did not assume that every shipment presented a newly invented product. Rather, technology diffusion was examined through documented shipment cases involving developed, regulated, sensitive, or technology-based products.

The analysis progressed from category-level evidence to the specific organizational practices observed across the documentary corpus. The table below summarizes the organizational practices identified from the documents, corresponding to the first objective of the study.

Table 4.7

Organizational Practices Identified from the Documents

Observed practice	Documentary evidence	Ethnomethodological interpretation	R&D management principle
Creation of shipment files	Load records organized by load number, customer, carrier, shipper, consignee, product, equipment, notes, documents, and accounting fields	The shipment became a recognizable organizational object that could be tracked, updated, reviewed, and closed	Documentation as infrastructure
System-based classification	Load records contained fields such as load type, product, equipment, temperature, appointment	Classification made different handling requirements visible before and during movement	Differentiated governance

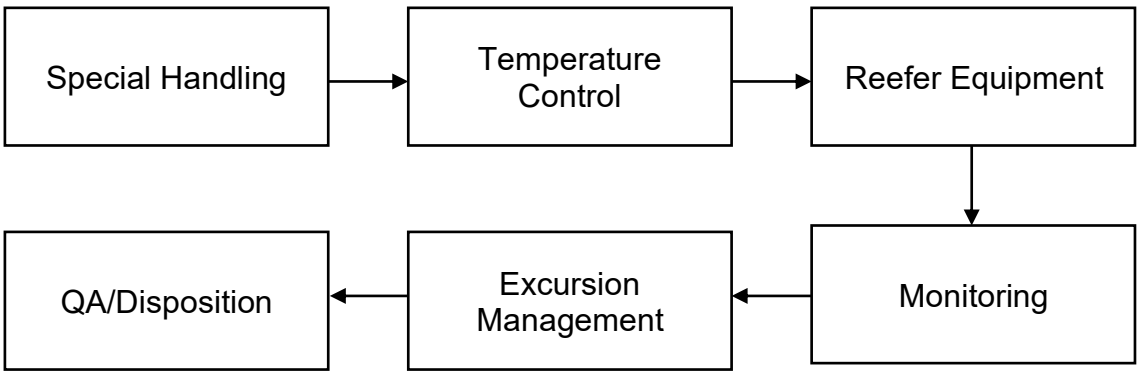
	status, and document count		
Documentation of milestones	SOPs required load notes, check calls, proof of delivery, and status events	Movement became accountable through recorded events rather than assumed completion	Traceability and auditability
Role-based responsibility	SOPs identified responsibilities of operations managers, shift leads, supervisors, service representatives, drivers, handlers, QA, and recipients	Accountability was distributed across roles and made visible through required records	Coordinated infrastructure
Deviation and exception handling	Deviation SOP required detection, documentation, assessment, escalation, quarantine where	Problems became manageable by being converted into formal records and response procedures	Resilience and learning

	applicable, RCA, CAPA, and closure

As shown in Table 7, the organizational practices found in the documents did more than support clerical administration. They made the shipment classifiable, traceable, assignable, auditable, and reviewable. These practices constituted infrastructure because they created the conditions under which technology-based or regulated products could move through distribution without losing visibility, compliance status, or operational control.

Next, the analysis examined how differentiation mechanisms and special handling triggers appeared across the four shipment categories. Figure 2 presents these findings that correspond to Objective 2 of the study.

Figure 4.2. Mind Map of Differentiation Mechanisms and Special Handling Triggers in Ground Freight Logistics.



As shown in Figure 2, differentiation allowed the organization to recognize what kind of work a shipment required. This recognition was not incidental. It was produced through SOP titles, load folder categories, digital fields, handling notes, document

tabs, and required proof records. Once a shipment was recognized as belonging to a particular category, the corresponding practices became relevant and accountable.

Compliance and accountability were also embedded directly in the organization’s ordinary workflow, corresponding to a further dimension of the first objective. The next table shows the two mentioned mechanisms identified in the analysis.

Table 4.8

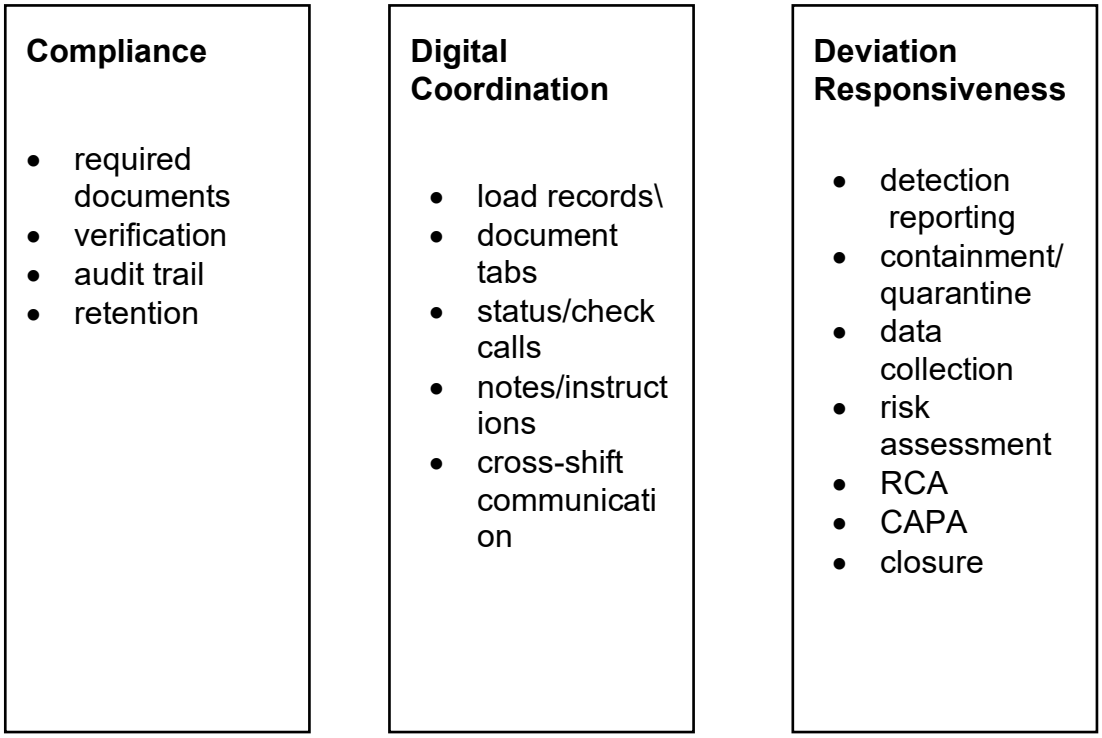
Compliance and Accountability Mechanisms

Mechanism	Documentary form	Accountability function
System of record	BrokerPro shipment file, load tabs, documents, notes, and check-call sections	Established a central reference point for shipment history
Required document upload	Customer confirmation, carrier confirmation, BOL, POD, photos, and other supporting files	Preserved evidence that shipment requirements and completion were documented
Status and milestone recording	Assigned, arrived at pickup, enroute, arrived at consignee, unloaded, delivered, completed	Made movement visible as a sequence of accountable events
Appointment and timing fields	Pickup and delivery date/time, appointment status, strict timing notes	Connected operational timing to customer and product requirements

Category-specific handling notes	Temperature range, equipment, seal, hazard, custody, packaging, and delivery instructions	Converted shipment-specific risks into instructions
Deviation records	Deviation number, date, time, location, event description, RCA, CAPA, QA review, closure	Transformed problems into reviewable and correctable events
Record retention	Retention periods for shipment records, emails, proofs, and operational files	Supported audit readiness and future reconstruction of shipment history

As shown in Table 8, compliance and accountability were accomplished through documentary mechanisms that made actions visible and retrievable. The system did not rely only on memory or informal communication. It required documents, fields, notes, uploads, status events, and proofs. Because compliance, digital coordination, and deviation responsiveness were found to operate as interdependent clusters rather than individual codes, their relationships are visualized in the mind map below.

Figure 4.3. Mind Map of Compliance Mechanisms, Digital Coordination, and Deviation Responsiveness as Analytic Clusters Informing R&D Principles.



Digital coordination and practices were the next to be examined. This corresponds with the third objective of the study. Table 10 shows the digital coordination practices found in the records.

Table 4.9

Digital Coordination Practices Found in the Records

Digital coordination practice	Evidence in the records	Contribution to technology diffusion
Load-level system record	Load number, PO number, product, equipment, customer, carrier, shipper, consignee, dispatcher, and status fields	Created a shared operational object for coordination
Document tab and document counts	Load folders and screens showed attached documents such as confirmations, BOLs, PODs, photos, and supporting records	Preserved the documentary evidence needed for verification and audit
Check-call and status structure	System sections for shipment milestones and updates	Made movement visible across the shipment lifecycle
Notes and handling instructions	Free-text notes and special requirements in load records	Carried context-specific instructions into operational practice

Accounting and cost fields	Customer charges, carrier costs, accessorials, and related financial records	Linked operational events with commercial closure and documentation
Cross-shift and communication records	SOP references to emails, labels, endorsements, and task comments	Supported continuity of work across personnel and time

As shown in Table 9, digital coordination facilitated technology diffusion by making shipments shareable across roles. The shipment existed not only as a physical product in transit, but also as a digital and documentary object that could be assigned, monitored, updated, verified, and closed.

The last to be examined was the shipments' deviation responsiveness as a distinct analytical dimension supporting the protection of product value. The next table presents the deviation-related practices identified in the analysis.

Table 4.10

Deviation Responsiveness as Protection of Product Value

Deviation-related practice	Documentary basis	R&D management relevance
Detection and reporting	SOP required immediate reporting of deviations, excursions, or incidents to supervisors, dispatch, and QA depending on criticality	Prevented silent failure during diffusion
Containment and quarantine	SOP required affected products or shipments to be isolated or placed on hold where applicable	Protected product quality, safety, and compliance status
Data collection	SOP required collection of temperature logs, GPS records, route logs, system alerts, photos, witness statements, custody records, and product information	Preserved evidence for decision-making

Risk assessment and disposition	QA review, client or sponsor consultation, and disposition decisions such as release, conditional release, rejection, or hold	Connected logistics events to product usability
RCA and CAPA	Formal investigation, root-cause analysis, corrective action, preventive action, and effectiveness verification	Converted failure events into organizational learning
Record retention	Closed deviation and CAPA records retained according to regulatory or contractual requirements	Supported audit readiness and future accountability

As shown in Table 10, deviation management reflected a principle of resilience. The organization did not assume that logistics work would always proceed without disruption. Instead, it maintained procedures for detecting, documenting, assessing, and correcting problems.

Together, Tables 1 through 10 show the full analytic basis from which the organization practices and principles, presented in the next chapter, were derived.

Chapter V narrates these findings and situates them in accordance to the research question and the literature reviewed in Chapter II.

Table 4.11

Technology Diffusion Principles Emerging from the Pharma-Only Findings

Technology diffusion principle	Basis in the pharma-related findings	Meaning for pharmaceutical diffusion
Documented product-condition requirements	Temperature fields, reefer or controlled-equipment requirements, handling notes, monitoring references, and proof records.	Diffusion requires preserving the condition and usability of pharmaceutical products during movement.
Differentiated pharmaceutical handling	Pharma classification, temperature range, equipment type, appointment timing, and shipment-specific requirements.	Diffusion depends on recognizing that pharmaceutical products cannot always be treated as ordinary freight.
Compliance-embedded coordination	Required records, status events, document uploads, regulatory or cross-border files, and QA-related procedures.	Compliance is part of the movement itself, not an external afterthought.
Traceability and proof retention	Load numbers, BOLs, PODs, confirmations, photos where applicable, status notes, and retention practices.	Pharma diffusion work must be reconstructable and defensible.
Digital visibility across the order lifecycle	Digital load records linking customer, carrier, equipment, notes, status, documents, and closure information.	Shared visibility enables coordinated movement across actors and time.
Deviation responsiveness	Excursion language, quarantine or hold, QA review, RCA, CAPA, and closure procedures.	Infrastructure must respond to disruptions without losing accountability or product-condition awareness.
Continuing organization beyond adoption	Ongoing monitoring, documentation, proof completion, and closure after the product has entered distribution.	Diffusion continues as organized work after adoption or market entry.

Table 11 summarizes the technology diffusion principles that emerged from this process. Each principle was linked to the documentary patterns that supported its interpretation and to its relevance for pharmaceutical diffusion. This was to make the analytical pathway transparent and the next chapter will present the findings and discussion in detail.

Ethical Consideration

This study did not involve human participants, respondents, interviews, surveys, observations, or any direct interaction with individuals. Accordingly, ethical obligations were focused on three areas:

- The confidential handling of organizational documents and proprietary operational information.
- The protection of the study organization's identity and personnel from any identifiable disclosure.
- The transparent declaration of the researcher's positional relationship to the study setting.

Several key ethical premises underpinned the study: confidentiality of the name and operation of the company, limitation of the analysis only to structural patterns revealed in the document, and complete disclosure of the researcher's employment in the investigated organization.

Since the analysis took into account the internal documents of the organization, there was a number of confidentiality procedures in place. There was no release of proprietary shipping information, specifications, or information about technology diffusion. Only structural documentation patterns were analyzed and reported.

The name of the organization was kept confidential in all written material. There were no names of any employees, no pictures of computer systems that would reveal employees' identities, and no regulatory references that would reveal employees in the thesis. Access to the documents was limited to authorized persons by the organization.

Although there was no direct participation of participants through interviews or interactions and therefore no risk to people involved, protection of intellectual property still remains a key issue. All results were reported in the form of themes to ensure no disclosure of the actual operational process which is potentially harmful to the business. The study conformed to the ethical principles of the institution in terms of privacy, confidentiality, and secure handling of personal information. The data were collected, analyzed, and reported ethically and honestly.

There were secrecy procedures, restricted access systems and controlled information flow in the logistics documentation that served as an indicator of distribution of innovations. Conflicts about confidentiality and protection of intellectual property indicated technology-based products dissemination in the diffusion cycle.

Chapter V

RESULTS AND DISCUSSION

This chapter presents the results and discussion of the qualitative, document-based analysis of pharmaceutical ground freight logistics as practice-based R&D distribution infrastructure during the technology diffusion phase. In line with the revised scope, the results are limited to pharma-related shipment records and the organizational procedures directly supporting their movement, monitoring, documentation, and closure. The findings do not treat GOV, HZL, or PKG shipments as part of the main analysis, because the defensible connection between the data and technology diffusion is strongest in the pharmaceutical case set.

The analysis uses cautious language. It describes documentary indicators that are visible in the records and avoids frequency claims unless the evidence was specifically counted. Generic commodity labels, including FAK entries, were not interpreted as evidence of pharmaceutical technology diffusion unless they appeared with other documentary indicators such as temperature requirements, reefer or controlled-equipment fields, monitoring expectations, proof requirements, or deviation-related language.

Logistics Practices as R&D Distribution Infrastructure

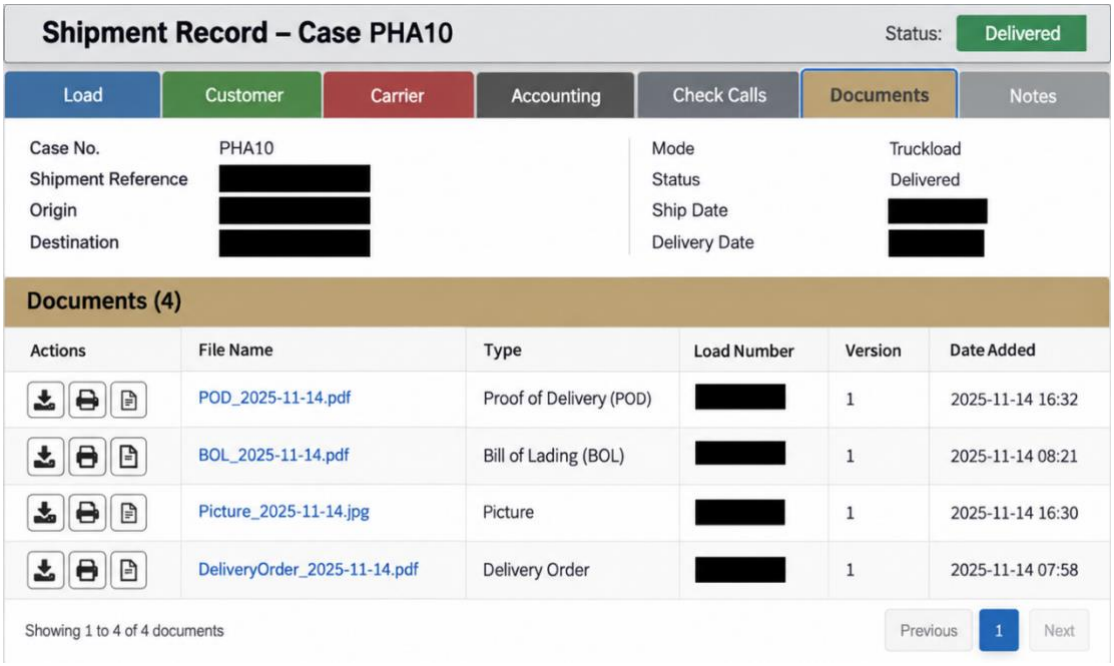
Pharmaceutical Documentation as Practice-Based Distribution Infrastructure

The first finding is that pharmaceutical logistics becomes infrastructure through ordinary documentary practices. Shipment files, load records, document tabs, check-call entries, proofs of delivery, temperature or equipment fields, and retained records made each pharmaceutical shipment recognizable as an object of coordinated work.

These documents did more than report what happened after the fact. They helped produce the shipment as something that could be assigned, monitored, verified, corrected, and closed.

This finding supports the study's argument that infrastructure should not be understood only as physical transport capacity. In the pharma records, infrastructure appeared as a practical documentary arrangement: the load file made the shipment visible; the notes carried handling instructions; the proof documents supported closure; and the retained records made the movement reconstructable. This is the point where logistics becomes relevant to technology diffusion. A pharmaceutical product may already exist and may already be ready for use, but its continued movement toward users still depends on organized documentary work.

Figure 5.1. Verified Documentary Excerpt from Retained Shipment-File Records.



Note: Redacted excerpt from Organizational record PHA10. The remaining entries identify proof-of-delivery, bill-of-lading, picture, and delivery-order records retained within the shipment file. The figure supports documentary retention and later

reconstruction; it does not establish the accuracy of each retained record, performance of every shipment requirement, successful delivery, or product condition.

This excerpt adds depth to the first finding because it shows the concrete documentary materials through which a shipment becomes reconstructable. In ethnomethodological terms, the record does not merely describe completed work; it helps make the shipment accountable as an organized object. The retained proof files are therefore treated as part of the documentary infrastructure that allows later review, closure, and verification.

Within the document tab, the proof-of-delivery, bill-of-lading, picture, and delivery order entries appear as separate records associated with the same shipment file. Their arrangement preserves selected documentary traces of the movement for later retrieval and reconstruction. The document shows proof retention as a logistics practice through which the shipment remains reviewable after the immediate act of coordination. In relation to the research question, this supports the interpretation that pharmaceutical distribution infrastructure is constituted partly through records that keep movement accountable over time. The entries establish that documents were retained. They do not establish the accuracy of every entry, performance of every requirement, successful delivery, or product condition.

This finding supports the study’s argument that infrastructure should not be understood only as physical transport capacity. In PHA8-PHA10, infrastructure appeared as a practical documentary arrangement: the load file made the shipment visible, the load notes carried handling instructions accessible to representatives each shift, the proof of documents supported closure, and the retained records made the movement reconstructable.

This is the point where logistics becomes relevant to technology diffusion. A pharmaceutical product may already exist and may already be ready for use but its continue movement toward users still depends on organized documentary work.

Differentiated Pharmaceutical Handling and Documented Product-Condition Requirements

The second finding is that pharmaceutical shipments were differentiated through the conditions attached to their movement. The relevant triggers included temperature range, reefer or controlled equipment, appointment timing, monitoring requirement, document requirement, proof retention, and deviation or excursion response.

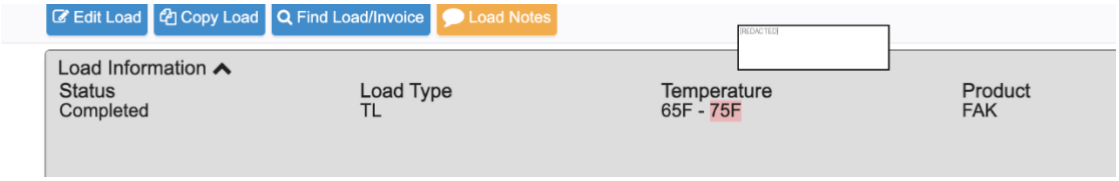
This finding demonstrates indexicality in a practical way. A completed pharmaceutical shipment did not mean only that a product arrived at a consignee. It meant that the product moved under the conditions made relevant by the documents. In the illustrative pharma records, the meaning of proper handling depended on the temperature instruction, equipment field, proof requirement, and monitoring expectation attached to that shipment. In this sense, differentiation supported the technology diffusion principle of documented product-condition requirements.

The documentary trail also shows how product-condition requirements were made visible before the shipment was treated as complete. In Case PHA2, the load information screen identified a 65F-75F temperature range and a reefer-equipment requirement, while the product field still used the generic FAK label. This combination is analytically important because the shipment was not interpreted from the commodity label alone; it was read through converging documentary indicators that made temperature control operationally relevant.

The visible entries identify 65F-75F and a reefer-equipment requirement as separate fields within the same load-information screen. Read together, the fields

document a shipment-specific handling arrangement and make the stated product-condition requirement available for operational reference. This supports the finding that differentiated pharmaceutical handling was organized through recorded conditions rather than inferred from a generic commodity label alone. The record does not establish actual temperature throughout transit, equipment performance, continuous monitoring, or achieved product-condition preservation.

Figure 5.2. Redacted Screenshot from PHA2 Showing Temperature Range and Related Load-Information Fields.



Note: Redacted excerpt from Organizational record PHA2. The visible fields identify the stated 65F–75F range and reefer-equipment requirement within the load-information screen. The figure supports a documented product-condition requirement and differentiated handling; it does not establish actual transit temperature, equipment performance, continuous monitoring, or product condition.

The excerpt supports the study's interpretation of indexicality: the meaning of proper handling depended on the documented conditions attached to the shipment. Read with Rogers' diffusion perspective, the screenshot also relates to observability because the required product condition was made visible in the logistics record, allowing the shipment to be monitored as it moved through the distribution stage.

Here, observability is limited to documentary visibility. The figure shows that a handling requirement was made visible in the logistics record. It does not show the

results of pharmaceutical innovation to adopters or establish that the recorded requirement was achieved during movement.

Compliance and Accountability as Documentary Order

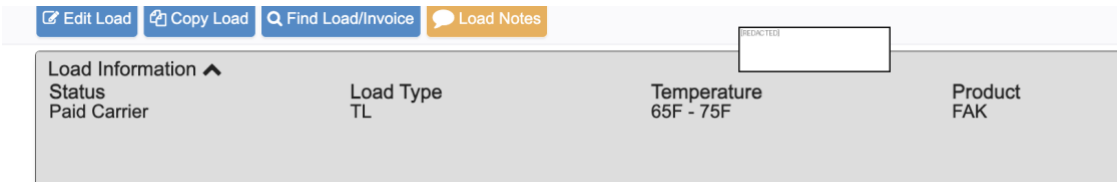
The third finding is that compliance and accountability were embedded in the ordinary workflow of pharmaceutical logistics. Required document uploads, shipment status events, appointment records, equipment and temperature fields, proof documents, cross-border records, and deviation procedures made logistics actions observable and reportable. Accountability in this analysis does not mean blame. It means that the record made it possible to reconstruct what the shipment was, what requirements applied, what was done, what proof remained, and how the shipment was closed.

This finding extends the literature reviewed in the manuscript by giving a practice-level explanation of operational infrastructure. Existing literature identifies infrastructure, coordination, and institutional support as important for diffusion, but the pharma records show how those broad ideas appear in everyday work. Compliance was not simply a separate legal requirement added after movement. It was part of the movement itself, because the shipment could remain acceptable only when its conditions, documents, proofs, and deviations were made visible in the record.

The same logic appears in Case PHA7, which is treated as a boundary case rather than as automatic evidence from the commodity label. The load screen still shows a generic product entry, but it also contains the temperature range and logistics fields that made the case analyzable within the pharmaceutical/temperature-sensitive set. The value of this case is not that every FAK record is pharmaceutical; rather, it shows why the analysis required convergence across multiple document fields.

Figure 6 should therefore be read as a documentary boundary example within the authorized pharmaceutical-related corpus. The visible generic product field does not independently disclose the pharmaceutical relationship established through the complete case context, while the visible product, temperature, and load-information fields remain organized within the same shipment record. Their arrangement shows how handling-related information was preserved for operational reference and later review. The figure supports the finding that accountability depended on the convergence and organization of documentary fields rather than on a single label. Its evidentiary scope is narrower than that of the complete PHA7 case file, and does not establish maintained temperature, performance of every requirement, a compliance outcome, or product quality.

Figure 5.3. Redacted Screenshot from PHA7 Showing a Boundary Case Where a Generic Product Label is Read with Temperature-Related Indicators.



Note: Redacted excerpt from organizational record PHA7, an authorized pharmaceutical-related case. The remaining product, temperature, and load-information fields show how handling-related information is organized within the shipment record. The displayed generic field does not independently disclose the pharmaceutical relationship established through the complete case context. The figure does not establish performance of the recorded requirements, maintained temperature, a compliance outcome, or product quality.

This figure responds directly to the concern that the results need to show the reality behind the interpretation. The PHA7 demonstrates why the study used cautious inclusion logic: the generic label alone was insufficient, but the accompanying temperature and load-information fields made the record relevant when read with other documents. This supports accountability in the ethnomethodological sense because the record makes the grounds for inclusion visible and reviewable.

Digital Coordination as Continuing Organization

The fourth finding is that digital coordination sustained pharmaceutical technology diffusion by making the shipment shareable across roles and time. Digital records connected customer information, carrier information, equipment fields, load notes, status updates, document tabs, proofs, check calls, and closure details. Through this shared record, the shipment existed not only as physical freight in transit but also as a readable organizational object.

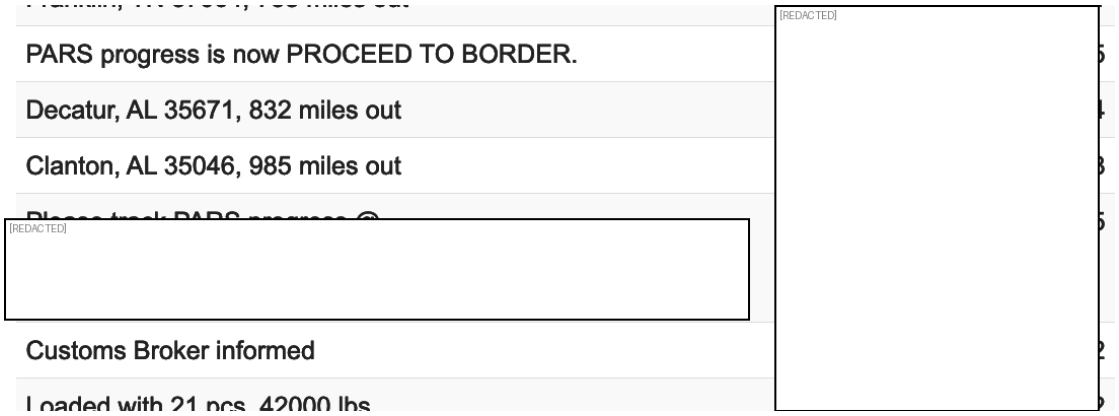
This finding supports the manuscript's use of Communication as Constitutive of Organization Theory in a limited and practical way. The organization was constituted through the records and communications that made the shipment understandable to dispatchers, carriers, customers, quality-related personnel, and other actors. Digital visibility therefore became one of the technology diffusion principles because it helped sustain coordination after the product had already entered distribution.

Digital coordination was also visible in the way shipment notes preserved movement status, PARS progress, and broker-related updates. In Case PHA6, the notes recorded progress toward the border and kept location and status updates within the same continuing record. The point was not that the notes were perfect or complete,

but that they created a shared place where different actors could read the shipment's current state.

The visible entries arranged as a chronological sequence of check calls, reported locations, PARS-related progress, and a customs-broker note within the continuing operational record. The organization documents digital coordination by preserving later updates alongside earlier ones, rather than as isolated messages. The record therefore made reported movement and border-related information available across roles and time, supporting the finding that the organization continued through communication recorded in the shipment file. The entries do not establish uninterrupted tracking, the accuracy of every status or location, completed customs clearance, prevention of delay or successful delivery.

Figure 5.4. Redacted Screenshot from PHA6 Showing Tracking, PARS Progress, and Check-Call Notes.



Note: Redacted excerpt from Organizational record PHA6. The remaining entries show a chronological sequence of check calls, reported locations, PARS-related progress, and customs-broker coordination within the continuing shipment record. The figure supports digital persistence and continuing organizational visibility; it does not

establish uninterrupted tracking, the accuracy of every status, completed customs clearance, prevention of delay, or successful delivery.

This evidence strengthens the CCO interpretation because the organization of the shipment was sustained through communication records. The digital notes made the shipment readable across roles and time, allowing dispatch, carrier coordination, and border-related updates to remain connected. In this limited sense, the shipment existed not only as freight in movement but also as a communicatively constituted record.

Deviation Responsiveness and Post-Adoption Diffusion Risk

The fifth finding is that deviation responsiveness protected pharmaceutical product value when routine movement was interrupted. Under the pharma-only scope, the most relevant concerns were temperature excursions, documentation gaps, handling deviations, quarantine or hold decisions, quality assurance (QA)-related disposition, proof gaps, and product-condition concerns. These were not interpreted as evidence of a broad failure of commercialization. They were treated as documentary indicators that pharmaceutical diffusion remains vulnerable even after a product has entered practical distribution.

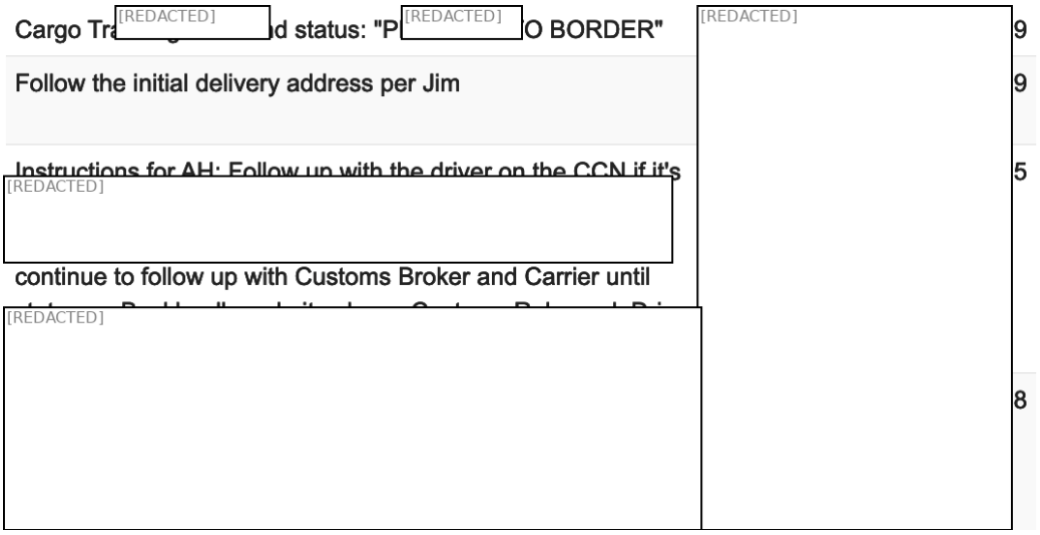
For this reason, the earlier Valley of Death framing is softened. The records did not provide enough basis to claim that logistics explains the full Valley of Death between development and market use. A more defensible interpretation is that the pharma records revealed a narrower post-adoption diffusion vulnerability. Pharmaceutical products may still physically arrive but fail to remain usable, acceptable, or properly documented if logistics systems do not preserve documented

product-condition requirements, compliance, monitoring, proof, and deviation response.

Case PHA1 provides the clearest boundary example for deviation responsiveness. The notes show that the shipment could not simply proceed to the border while customs-related information remained unresolved. The entry did not prove a broad commercialization failure, but it showed a narrower post-adoption risk: even after the product is already moving, documentary mismatch or release uncertainty can interrupt the conditions that allow the shipment to remain acceptable and usable.

The visible operational notes place the reported border status, CCN follow-up, and continued coordination with the customs broker and carrier within the shipment's continuing record. Their chronological placement documents how a customs-related concern generated further communication and follow-up work. This supports the interpretation that deviation responsiveness consisted of making an emerging concern visible and actionable within the same documentary sequence used to coordinate movement. The record did not establish the complete cause of the concern, successful correction, completed customs clearance, prevented delay, or product-condition outcome.

Figure 5.5. Redacted Screenshot from PHA1 Showing ACI/PARS-Related Customs Coordination and Border-Release Risk.



Note: Redacted excerpt from Organizational record PHA1, an authorized pharmaceutical-related case. The remaining operational notes show a reported border status, CCN follow-up, and continued customs-broker and carrier coordination within the shipment record. The figure supports further coordination generated by a reported concern; it does not establish the complete cause, successful correction, completed customs clearance, prevented delay, or product-condition outcome.

PHA1 was retained as a boundary case because it shows both the usefulness and the limits of the documentary evidence. It supports the finding on deviation responsiveness, but only within the visible record: the analysis can say that the organization documented and coordinated a customs-release problem; it cannot claim access to all informal decisions behind the case. This keeps the interpretation aligned with ethnomethodology, where claims are limited to what members' records make observable.

Technology Diffusion Principles Enacted in Logistics Work

The fourth objective of the study was to analyze how the organization and execution of logistics support practices reflect technology diffusion principles relevant to pharmaceutical distribution. The analysis identified seven technology diffusion principles grounded in the pharma-related documentary evidence:

1. Documented product-condition requirements
2. Differentiated pharmaceutical handling
3. Compliance-embedded coordination
4. Traceability and proof retention
5. Digital visibility across the order lifecycle
6. Deviation responsiveness and;
7. Continuing organization beyond adoption.

These principles explain how pharmaceutical logistics sustains diffusion by keeping products usable, traceable, compliant, and acceptable while they move toward intended users. They were discussed as technology diffusion principles rather than as a separate management-principles framework.

The seven principles were derived from the preceding documentary findings. Documented product-condition requirements were grounded in the temperature and equipment fields shown in Figure 5, while differentiated pharmaceutical handling followed from the shipment-specific arrangements illustrated in Figures 5 and 6. Compliance-embedded coordination was supported by the integration of required records, proof obligations, and cross-border information within ordinary shipment work.

Traceability and proof retention were anchored in the retained records shown in Figure 4, and digital visibility across the order lifecycle was supported by the chronological entries shown in Figure 7. Deviation responsiveness was grounded in the additional coordination recorded in Figure 8.

Continuing organization beyond adoption draws these findings together by showing that handling instructions, status information, proofs, and emerging concerns remained subject of documentary work after the products entered distribution. The records establish the organization of these practices, not their uniform performance or effectiveness.

From an ethnomethodological perspective, the fields, notes, document tabs, and proof records supplied observable resources through which participants made pharmaceutical-related movements recognizable and accountable.

From a CCO perspective, these records also helped constitute the shipment as an organizational object by assigning requirements, preserving reported statuses, retaining proofs, and making selected concerns available for further action. These interpretations remain limited to what the documentary record makes visible and do not reconstruct every informal communication or physical event surrounding the shipment.

Taken together, the principles describe how pharmaceutical-related distribution was made classifiable, documentable, visible, and reviewable through ground-freight logistics practices. The documentary findings show that shipment requirements, proof records, status information, and emerging concerns became ongoing objects of operational attention after pharmaceutical products entered distribution.

In relation to the research question, these practices support the interpretation of ground-freight logistics as part of the organizational infrastructure through which technology diffusion is sustained at the post-development distribution stage. This conclusion concerns the documented organization of pharmaceutical-related distribution and does not extend to physical product-condition outcomes, successful corrective outcomes, adopter behavior, or market-diffusion rates.

Extending Rogers' Diffusion of Innovation Theory

Read alongside Rogers' Diffusion of Innovation Theory, the findings suggest that diffusion should not be understood as stopping once adoption occurs or once a product becomes available to users. In the pharmaceutical logistics context, diffusion continued as an organizing process sustained by documentation, monitoring, temperature or condition control, proof retention, and deviation response. The study therefore extends the diffusion discussion by showing that post-adoption movement also requires documentary and operational work that keeps the product usable, traceable, and acceptable during distribution.

This extension is modest but important. The study does not claim to replace Rogers' theory. Rather, it adds a logistics-based view of what happens after adoption becomes possible. In the pharma-related records, diffusion was not simply the spread of an innovation across users. It was a continuing accomplishment in which logistics documents and systems helped maintain the conditions under which the product could keep moving toward practical use.

This interpretation is a limited extension, not a test or validation, of Rogers' theory. It directs attention from the initial adoption decision toward the documentary and communicative work through which distribution continues. The relationship to observability also requires qualification.

Rogers' concept concerns the visibility of an innovation's results to others, whereas the records examined here show documentary visibility of shipment requirements, reported statuses, proofs, and selected discrepancies.

The findings extend the concept of observability to documentary visibility within logistics records, while retaining Rogers' original adoption-oriented meaning as distinct.

Alternative Interpretations Considered

Two alternative interpretations were considered. The first is that the documented practices simply reflect ordinary pharmaceutical compliance rather than technology diffusion infrastructure. This interpretation is partly valid because many observed practices are compliance-related. However, the technology diffusion interpretation remains plausible because the same documents show how compliance enabled pharmaceutical products to remain movable, reviewable, and acceptable during distribution. In this context, compliance was not separate from diffusion. It was one of the conditions that made continuing diffusion possible.

The second alternative is that documentation protects the logistics company from liability rather than supporting technology diffusion. This interpretation is also partly valid because documentation can reduce organizational risk. However, the same practices that protect the organization—classification, proof retention, temperature monitoring, deviation documentation, and closure records—also protect the usability and acceptability of the pharmaceutical products being moved. The analysis therefore treats these functions as overlapping rather than mutually exclusive.

Tracking and status visibility may also be interpreted as contractual monitoring or surveillance rather than coordination alone. The records support audit, verification, customer-service, billing, liability and control functions as well as operational

coordination. They do not determine a single organizational meaning for visibility. Similarly, a recorded instruction is not equivalent to performance, and a recorded status is not equivalent to physical reality.

Temperature and equipment entries establish that requirements were documented, while status and response notes establish that information entered the record.

Boundary cases were therefore handled conservatively. PHA1 was used to show how a documentary mismatch or customs-release uncertainty could become a reviewable disruption, while PHA7 was used to show why a generic FAK label could not be treated as sufficient evidence by itself. In both cases, the interpretation depended on converging documentary indicators rather than on the researcher's assumption that the shipment was automatically pharmaceutical. This strengthens the credibility of the results because the analysis acknowledges records that required caution instead of forcing every case into the same level of evidence.

Chapter VI

RESEARCH SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary of Findings

This chapter summarizes the findings, conclusion, and recommendations of the study based on the revised pharma-only scope. The study examined how situated work practices in pharmaceutical ground freight logistics constitute the technology diffusion phase of R&D support infrastructure and what technology diffusion principles can be identified from the organization and execution of these practices.

The analysis was based on naturally occurring organizational documents, including pharmaceutical shipment-handling procedures, documentation and order lifecycle procedures, deviation management procedures, digital load-management records, system screenshots, load confirmations, proof documents, and related operational records from fourteen pharma-related shipment cases. These records were interpreted as documentary evidence of how pharmaceutical logistics work is made visible, accountable, and coordinated in ordinary organizational practice.

The first finding showed that pharmaceutical logistics becomes distribution infrastructure through documentation. Shipment files, load records, document tabs, check calls, equipment fields, notes, proofs, and retained records made each shipment recognizable as a coordinated object of work. The second finding showed that differentiation occurs through pharma-specific handling triggers such as temperature range, equipment type, appointment timing, monitoring expectation, proof requirement, and deviation response. The third finding showed that compliance and accountability are embedded in the documentary workflow through required records, uploaded proofs, status events, and retention practices. The fourth finding showed

that digital coordination makes the shipment visible across roles and time. The fifth finding showed that deviation responsiveness protects product value by turning excursions, documentation gaps, and other disruptions into reviewable and correctable events.

Taken together, these findings produced seven technology diffusion principles: documented product-condition requirements, differentiated pharmaceutical handling, compliance-embedded coordination, traceability and proof retention, digital visibility across the order lifecycle, deviation responsiveness, and continuing organization beyond adoption.

Conclusion

This study was guided by the research question: How do the situated work practices of ground freight logistics operations, in the distribution of pharmaceutical products, constitute the technology diffusion phase of R&D support infrastructure, and what technology diffusion principles can be identified in the organization and execution of these support practices? Based on the evidence presented in Chapter V, the study answered this question by demonstrating that pharmaceutical ground freight logistics constitutes technology diffusion infrastructure through documentary classification, temperature and product-condition control, system-based coordination, compliance integration, proof retention, and deviation responsiveness.

The study concludes that pharmaceutical logistics supports technology diffusion not by inventing products, but by preserving the documentary and operational conditions under which developed pharmaceutical products can continue moving toward intended users. The shipment file, system record, proof documents,

temperature or equipment fields, and deviation procedures all contribute to this process because they make the movement visible, traceable, and accountable.

The study further concludes that the appropriate output of the analysis is a set of technology diffusion principles. These principles explain how pharmaceutical distribution work sustains diffusion after adoption or market entry. In relation to Rogers' Diffusion of Innovation Theory, the study contributes a modest extension: diffusion does not stop at adoption. In the pharmaceutical logistics context, diffusion continues as an organizing process sustained by documentation, monitoring, compliance, coordination, proof retention, and deviation response.

These conclusions are based on one organization and on document-based analysis only. They are offered for theoretical plausibility and transferability rather than statistical generalization. The study cannot claim full access to informal reasoning, undocumented decisions, or the complete life cycle of the pharmaceutical products. Its claim is limited to what the records made visible: how logistics documents and systems organized the movement of pharmaceutical products during technology diffusion.

The findings concern documented organization practices through which pharmaceutical-related distribution was rendered classifiable, documentable, visible, and reviewable. Ground freight logistics is therefore interpreted as an organizational condition relevant to continuing diffusion, not as proof of diffusion outcomes.

The recommendations are directed primarily to R&D management and technology diffusion practice, rather than to the improvement of one logistics company. They translate the findings into implications for how pharmaceutical technology

diffusion should be planned, documented, monitored, and sustained after adoption or market entry.

1. For R&D Management and Technology Diffusion Practice

Research and development management practice should treat pharmaceutical distribution as part of the technology diffusion process, not merely as an activity that begins after innovation work is finished. When pharmaceutical products move from development, approval, or release toward intended users, diffusion planning should include the documentary, product-condition, compliance, monitoring, and deviation-response requirements needed to keep the product usable and accountable during movement.

A practical implication for the discipline is that technology diffusion models and R&D management tools should include a post-adoption logistics readiness component. This component may identify the product's required temperature range, equipment type, monitoring expectations, proof documents, deviation contacts, QA disposition rules, and closure evidence before distribution begins. In this way, logistics becomes part of diffusion planning rather than a late operational afterthought.

2. For R&D Management Education and Training

The R&D management programs may use this study to show that technology diffusion is not limited to adoption, marketing, or user acceptance. A focused module on post-adoption pharmaceutical diffusion may include logistics documentation, documented product-condition requirements, compliance coordination, proof retention, and deviation response as examples of how innovation value is sustained during distribution.

3. For Future Research on Post-Adoption Technology Diffusion

Future researchers may extend this study by examining additional pharmaceutical logistics organizations or by comparing document-based findings with interviews and workplace observation, subject to ethical approval and confidentiality safeguards. Later studies may also examine how documentation quality, temperature or equipment classification, proof completion, and deviation responsiveness relate to diffusion outcomes. These directions would move beyond the present study's documentary scope while retaining its focus on technology diffusion as a continuing organizing process.

Final Statement

This study has shown that pharmaceutical logistics offers a useful site for understanding technology diffusion as a continuing organizing process. By attending to ordinary documentary practices such as load records, SOPs, deviation procedures, proof-of-delivery files, handling notes, temperature or equipment fields, and digital shipment records, researchers can see how diffusion is sustained after adoption. The study therefore invites innovation scholars and practitioners to look beyond the point of adoption and examine the everyday organizational records through which the movement of developed pharmaceutical products is made accountable, traceable, and possible.

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APPENDICES

APPENDIX A

Certificate of Exemption from Review

UP OPEN UNIVERSITY
Faculty of Management and Development Studies
Research Ethics Committee

16 March 2026

KEZIA MAINE F. LAPICEROS
Graduate Student, Master of Research and Development Management
Faculty of Management and Development Studies
University of the Philippines Open University

RE: Ground Freight Logistics as R&D Distribution Infrastructure: Organizational Practices Supporting Technology Commercialization

FMDS REC No. 2026-005-GS-FMDS

Subject: Certificate of Exemption from Review

Dear ***Ms. Lapiceros:***

This is to acknowledge submission of the following documents dated 06 March 2026:

- 2026-Lapiceros_Diagrammatic Workflow v01.jpg (version 1, 06 March 2026)
- 2026-Lapiceros_Form 1(B) CV v01.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Form 4(E2) Non-Health Related Assessment Form v01.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Form 6(A) Application Form v01.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Form 6(A) Application Form v02.pdf (version 2, 06 March 2026)
- 2026-Lapiceros_Form 6(D) Study Protocol Assessment Form v01.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Form 6(F) ICF Checklist v01.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Full Protocol v01.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Letter Request v01.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Research Ethics Training Certificate.pdf (version 1, 06 March 2026)
- 2026-Lapiceros_Thesis Approval Sheet.pdf (version 1, 06 March 2026)

After a preliminary review of the above documents, the Faculty of Management and Development Studies Research Ethics Committee deemed it appropriate that the above proposal be **EXEMPTED FROM REVIEW**.

Additional Recommendations:

1. Commendable ethical considerations, especially in data handling and management of company documents. However, the paragraph on ethical considerations for study participants is irrelevant.
2. In page 24, paragraph 2, “required signatures” was mentioned. And in some parts, “digital logs.” While the study will not collect any personal or identifiable information, please make sure that no such information will be included in your analysis.
3. A potential conflict of interest may arise as the study proponent is an employee of the company being examined, particularly if the analysis yields findings that may reflect unfavorably on the organization.

UP OPEN UNIVERSITY
Faculty of Management and Development Studies
Research Ethics Committee

This means that the study may be implemented without undergoing an expedited or full review. Neither will the proponents be required to submit further documents to the committee as long as there is no amendment nor alteration in the protocol that will change the nature of the study nor the level of risk involved.

Very truly yours,

ROSE NONETTE C. CAPADOSA, Ph.D.
Chair

APPENDIX B

Company Authorization Letter

ecotruck
Logistics

9123 Mississippi Ave, Denver CO 80247
admin@ecotruckllc.com | 916-623-4337



CONFIDENTIAL

Re: Authorization for Access to Organizational Documents for Academic Research

TO WHOM IT MAY CONCERN

This letter formally authorizes **Kezia Maine F. Lapiceros**, in the capacity of Operations Manager of Ecotruck LLC, to access and utilize the following categories of internal organizational documents for the purpose of an academic research study conducted in partial fulfillment of the requirements for the degree of Master in Research and Development Management (MRDM) at the University of the Philippines Open University (UPOU):

1. Standard Operating Procedures (SOP) and internal protocols
2. Regulatory and compliance documentation (certificates, checklists, permits)
3. Digital system records and automated tracking logs
4. Company reports related to distribution performance and compliance

The research study is titled: **"GROUND FREIGHT LOGISTICS AS R&D DISTRIBUTION INFRASTRUCTURE: ORGANIZATIONAL PRACTICES SUPPORTING TECHNOLOGY COMMERCIALIZATION"**

The documents listed above are to be used solely for academic and analytical purposes. The employee acknowledges and agrees to the following conditions governing the use of these materials:

- No proprietary shipment specifications, client identities, carrier identifiers, product names, or commercially sensitive information shall be disclosed in the published thesis or any derivative academic output.
- All analysis shall be restricted to structural and thematic documentary patterns only. No personally identifiable information pertaining to company personnel shall be extracted, retained, or reported.
- Digital records and system screenshots shall be reviewed solely for organizational practice patterns and shall not be reproduced in full within the thesis document.
- The organization's identity shall remain confidential in all written outputs of the research.
- All documents accessed remain the intellectual property of [Company Name] and shall be handled in accordance with the organization's data confidentiality commitments.

This authorization does not constitute endorsement of the research findings. The organization acknowledges that findings may reflect operational vulnerabilities or areas for improvement, and that these findings will be presented in aggregate thematic form consistent with the ethnomethodological design of the study.

This letter is issued in good faith to support the academic integrity of the research and to facilitate transparent disclosure of data access as required by UPOU's Institutional Research Ethics Committee (IREC).

Respectfully,

Anzaur Biboletov
Chief Operations Officer
Ecotruck LLC
Date: January 20, 2026

APPENDIX C

Declaration of Tools and Artificial Intelligence (AI) Use in Research

In the interest of complete methodological transparency and adherence to the principles of academic integrity, this appendix discloses the full suite of digital tools and applications used to support the completion of this thesis. These tools were employed to augment specific, clearly bounded stages of the research process — from literature identification and manuscript writing to grammar and style editing. The researcher maintained full intellectual ownership of all analytical work, theoretical development, and final conclusions presented in this study. No tool was used to generate raw data, perform thematic analysis, conduct coding, or produce interpretive findings.

The disclosure below specifies, for each tool: its exact function in this study, the stage of the research process in which it was used, the boundaries placed on its use, and the nature of the researcher's intellectual contribution at each stage.

I. Writing and Grammar Assistance

1. Grammarly

Digital Tool	Grammarly (www.grammarly.com)
Version/Access	Premium/Business Plan — Web-based, browser extension, and desktop application; accessed throughout the writing period, 2025–2026.
URL	https://www.grammarly.com
Purpose	Used throughout the manuscript preparation and revision stages to assist with grammar correction, punctuation, spelling, sentence clarity, and writing consistency. Grammarly was applied to successive drafts of all chapters to catch surface-level errors prior to adviser review and to reduce run-on constructions and stylistic inconsistencies in the academic prose. It was also used during the revision stage following adviser feedback to ensure that rewritten paragraphs were grammatically sound before re-submission.
Limitations and Researcher's Role	Grammarly was used exclusively as a proofreading and editing tool. It was not used to generate content, formulate arguments, conduct analysis, or produce original passages. All suggestions were individually reviewed and accepted or rejected by the researcher based on whether the intended meaning, disciplinary register, and analytical accuracy of the passage were preserved.

	In several instances, Grammarly suggestions were rejected where they would have altered the ethnomethodological vocabulary or the precision of methodological descriptions.

II. Literature Discovery and Research Assistance

1. Consensus

Digital Tool	Consensus (consensus.app)
Version/Access	Pro tier — Web-based AI research tool; accessed during literature review phase, 2025.
URL	https://consensus.app
Purpose	Used during the literature review stage to assist with the identification of peer-reviewed sources relevant to the study's thematic areas: technology diffusion, logistics infrastructure, innovation ecosystems, and organizational practices in distribution. Consensus was queried using keyword and concept-based prompts to surface academic papers and identify commonly cited works in the research domains covered by Chapter II. It provided structured summaries of findings from individual papers, which assisted in determining which sources merited full reading and formal citation.

Limitations and Researcher's Role	Consensus was used solely as a literature discovery and navigation tool. It was not used to synthesize, write, or interpret content for the thesis. All sources identified through Consensus were independently retrieved, fully read, and critically evaluated by the researcher before any citation was included in the manuscript. The researcher did not rely on Consensus-generated summaries as substitutes for primary source reading. Consensus does not have access to all academic databases, and its suggestions were cross-checked against Google Scholar, JSTOR, and institutional library resources to ensure completeness and accuracy.

2. Perplexity AI

Digital Tool	Perplexity AI (www.perplexity.ai)
Version/Access	Perplexity Pro — Web-based AI research assistant with source attribution; accessed during literature review and manuscript review phases, 2025–2026.
URL	https://www.perplexity.ai

Purpose	Used as a source-based research assistant during the literature review and post-draft review stages of the study. Since the platform still largely considers Large Language Model (LLM) to summarize, this was not used during the research process. The researcher, instead focused on the following and confined its usage to: a. verify whether specific claims or theoretical positions had published academic support; b. identify additional or more recent studies relevant to the study's research gaps; c. cross-check the currency of cited literature; d. locate specific publication details (volume, issue, DOI) needed for accurate APA 7th edition referencing. It was also used during the manuscript revision stage to assist in identifying gaps flagged during adviser and committee review by querying relevant literature that could be incorporated into revisions.
Researcher's Role	Perplexity AI was used strictly as a source-verification and literature-discovery tool, not as a content-generation assistant. No passage, argument, or analytical conclusion in the thesis was generated by or attributed to Perplexity AI. All sources surfaced through Perplexity were independently verified by the researcher through direct access to the original publication before citation. Perplexity AI's retrieved sources were treated as leads for further

	review, not as authoritative confirmations. The researcher exercised full editorial and intellectual judgment in determining which sources were relevant, credible, and appropriate for inclusion in the thesis.

III. Visual Diagramming and Figure Construction

1. Coggle

Digital Tool	Coggle (coggle.it)
Version/Access	Free tier — Web-based collaborative mind mapping and diagramming tool; accessed during the figure preparation and appendix construction stage, 2026.
URL	https://coggle.it
Purpose	Used to construct the five mind maps included as figures in the main chapters and as appendix materials (Appendix F1–F5) of this thesis. These mind maps visually represent the documentary corpus, shipment categories, analytical framework, and key findings corresponding to the main research question and each of the three study objectives.

	Coggle was used solely as a drawing and layout tool to render researcher-specified content in a visually organized format suitable for thesis submission.
Researcher's Role	Coggle was used exclusively as a visual construction and layout tool. It does not perform analysis, generate interpretations, suggest content, or produce any form of text beyond what the researcher manually inputs. No AI-assisted content generation, text completion, or analytical function was used at any point. All node labels, branch structures, hierarchical relationships, and thematic groupings were determined by the researcher prior to construction and entered manually into the tool. Coggle was not used to write any part of the manuscript, conduct coding, or perform data analysis.