Exploring the adoption of multimodal freight procurement platforms: The case of Freight Mobility as a Service (FMaaS)

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Short summary

Freight Mobility as a Service (FMaaS) is a freight procurement platform concept that seeks to improve the efficiency and sustainability of the international freight transportation system by increasing the visibility of multimodal transport options. However, it remains unclear whether shippers and carriers are willing to adopt such a platform. Existing research is limited, often focusing on a single transport mode or a specific market segment. To examine adoption behaviour for FMaaS, we conducted 36 semi-structured interviews across diverse industries and supply chains. Thematic analysis revealed hierarchical adoption factors: Long-term strategic decisions strongly influence shippers' and carriers' willingness to join multimodal freight procurement platforms, whereas tactical benefits and drawbacks are weighed when deciding whether to sign up and use them. When comparing specific platform offerings, potential users evaluate functionalities in the operational context. Overall, the study highlights multiple drivers but also significant barriers to widespread adoption of FMaaS.
Keywords: Adoption decision, Semi-structured interviews, Thematic analysis, Freight procurement platform, Multimodal transport

1 Introduction

Freight procurement platforms have been proposed as a means to boost the efficiency and sustainability of the freight transport system by reducing empty trips and improving load factors across transport modes. However, the diffusion of current platforms is concentrated on environmentally damaging modes (Fazi & Fransoo, 2025), increasing their visibility and price transparency and potentially making them more attractive (Helwing, Verfürth, & Franz, 2023).

As a platform that integrates multiple transport modes, the concept of Freight Mobility as a Service (FMaaS) (Fazi & Fransoo, 2025) aims to provide full visibility across modes. Inspired by Mobility as a Service in passenger transport (Jittrapirom et al., 2017), FMaaS offers a promising pathway towards a more efficient and sustainable freight transport system.

A key barrier to the success of a potential FMaaS platform is arguably the willingness of shippers and carriers to adopt it, understood here as registering for and using the platform for a substantial share of their operations.

Existing research on digital platform adoption in freight procurement largely focuses on isolated market segments rather than the integrated transport system. Studies typically examine maritime supply chains (Zeng, Chan, & Pawar, 2020; Nguyen & Goldwasser, 2024) or trucking-focused marketplaces (Collignon & Sternberg, 2020), while work on multimodal platforms remains limited to specific mode combinations such as rail and road (Bossong, Reinhardt, & Elbert, 2025). Consequently, there is still little understanding of how a freight procurement platform spanning multiple transport modes and supply chains would be adopted.

This paper addresses this gap by examining how and why shippers and carriers would adopt a potential multimodal FMaaS platform. Using an exploratory qualitative design (Miles, Huberman, & Saldaña, 2020), 36 semi-structured interviews were conducted with industry stakeholders and academics to identify factors influencing adoption across multiple stages.

Through thematic analysis, the paper shows that adoption decisions occur at distinct hierarchical levels. At the highest level, companies make strategic decisions that shape their fundamental willingness to adopt. At the tactical level, they evaluate potential benefits and drawbacks. At the operational level, they select specific software tools, with platform functionalities influencing this choice.

By distinguishing motivations across these hierarchical levels, the study offers a more nuanced understanding of platform adoption behaviour. Furthermore, by analysing the FMaaS concept, the paper extends existing research beyond current platform practices and provides insights for platform operators and policymakers seeking to foster a transition toward a more efficient and sustainable freight transportation system.
The remainder of this paper is organised as follows. Section 2 outlines the used methods, Section 3 presents the results, and Section 4 discusses the implications of the findings, provides recommendations for future research and concludes the paper.

2 Methodology

Research design

The adoption of shipper-carrier procurement platforms remains relatively unexplored, making it suitable for exploratory (Stebbins, 2001), qualitative (Miles et al., 2020) research. To gain rich insights into this relatively unexplored research area, interviews were chosen as the data collection method. A semi-structured interview approach enabled consistency across respondents while facilitating deeper probing. To identify factors that enable or hinder adoption, thematic analysis was applied. This approach enables us to describe the data in detail while accounting for repeated mentions by respondents (Braun & Clarke, 2006).

Data collection

The interview questions were organised into four blocks. First, companies were asked about their characteristics; second, about transport organisation and sub-contracting practices; third, about their use of platforms; and lastly, about the potential of integrating FMaaS into their operations. For this study, a convenience sampling approach was used, in which respondents were recruited through the authors' personal contacts. The sample focused on Germany and the Netherlands, countries with extensive inland waterway and rail networks, and on Full Truck Load (FTL) and Full Container Load (FCL) shipments. This geographic and economic market is particularly suitable for multimodal transport. After knowledge saturation was reached, no further respondents were contacted.
All participants were contacted via email, personal networks, or LinkedIn when email addresses were unavailable. Before the interviews, they received an informed consent form detailing the study's purpose, privacy regulations, and their rights. After the interviews were conducted, the anonymised transcripts were returned to the interviewees for validation.

Table 1: Company overview

Type	Interviews	Dutch Share
Shipper	7	57%
Carrier	4	75%
Platform	5	80%
Researcher	9	56%
Third Party	11	64%
Total	36	66%

The interviews were conducted between January 2025 and November 2025. In Table 1, an overview of the interviewed companies is provided, including the proportions of Dutch companies.

Data analysis

This study follows the six phases outlined by Braun and Clarke (2006) for conducting an inductive thematic analysis. In the first phase, the data were familiarised with. Each transcript was read thoroughly by the first author at least once before coding to gain an initial understanding of the content and context. In the second phase, systematic coding was carried out across the entire dataset. Structural coding (Saldaña, 2021) was employed to identify the question blocks. Within these categories, In Vivo coding preserved participants' own language, while process coding captured actions and dynamics over time.

Furthermore, descriptive coding was applied to more clearly reveal factors (Corbin & Strauss, 2015). Following initial coding, broader patterns were identified in phase 3 by grouping related codes into potential themes. In the fourth phase, these candidate themes were revised in two stages. First, all codes and quotes within each theme were examined to ensure internal coherence. Second, themes were evaluated against the entire dataset to confirm their validity and relevance. Once a satisfactory thematic map was established, themes were clearly defined and named in phase 5. In this paper, themes represent the factors influencing the adoption of the conceptual FMaaS platform from the perspective of shippers and carriers. The sixth phase involved synthesising the analysis into a coherent report. Fully developed themes are presented in the results section. An example of quotes with corresponding codes, candidate themes, and a final theme is provided in Figure 1.

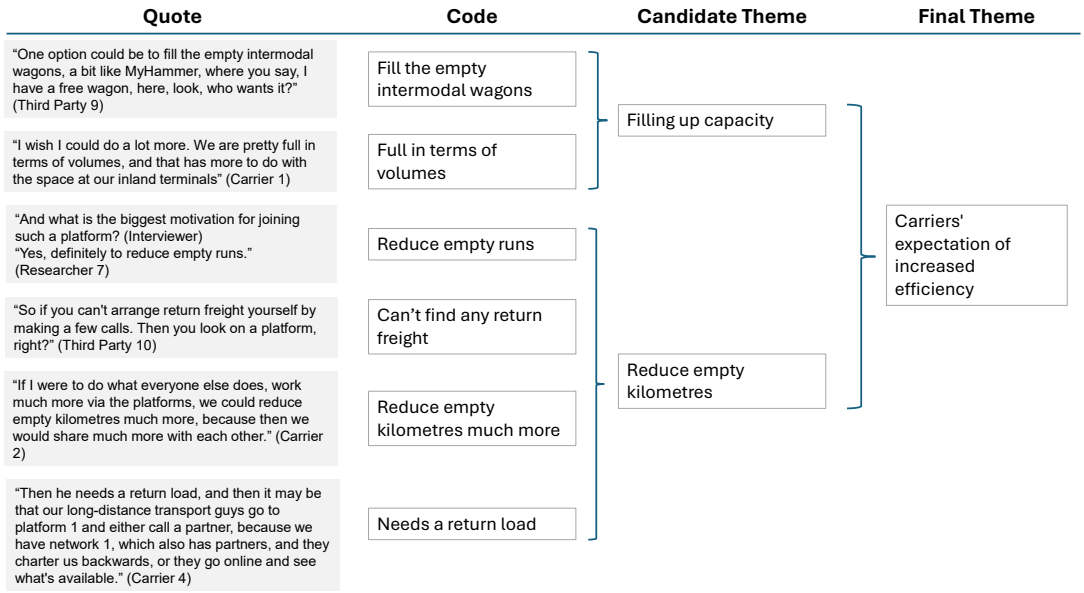


Figure 1: Exemplary coding procedure for identifying factors influencing the adoption of shippers and carriers

3 Results

The interviews revealed that factors (themes) influencing the adoption of multimodal freight procurement platforms can be distinguished into three levels. First, shippers and carriers make strategic decisions about their businesses that may make them more or less willing to use platforms. If decisions have been made in ways that make them interested in using platforms, interviews revealed that companies weigh tactical benefits against drawbacks. At the third level, companies are expected to compare software options and select the most suitable one. Here, platform functionalities are compared, considering the context in which the companies operate.

Strategic decisions of shippers

Shippers differ in the extent to which they outsource logistics, which shapes platform adoption. Fully or partially outsourced firms have little need for spot-market platforms, whereas others insource to maintain control. For one interviewed shipper, for example, carriers cannot guarantee proper cooling: "This is not how we are allowed to deliver the product." Because many either outsource too much or insource too heavily, interest in a combined tender/spot FMaaS platform is limited. Although FMaaS aims to increase the visibility of multimodality, shippers already know these options and primarily choose modes based on cost, speed, reliability, and flexibility. Rail and inland waterways are widely seen as unreliable or inflexible. Since platforms cannot change these mode characteristics, multimodality remains unattractive for many users. Shippers also prefer long-term carrier relationships; one interviewee described switching as "not desirable". Among

other benefits, stable partnerships deliver tailored processes and superior customer experience. A researcher highlights the advantages of "the same driver who knows which ramp" to approach, while a shipper emphasises the driver's role as the shipper's "calling card". While some prioritise price, most rely on established partners, reducing the attractiveness of platforms.
Contracts offer price stability, whereas spot contracts are limited to "rare" shipments, and even then, many prefer known carriers like another shipper: "We don't yet dare [...] to put this on the open market." Platforms mainly support spot activities, making this more a question of scope than a major barrier.

Strategic decisions of carriers

Most carriers own a mixed fleet comprising proprietary vehicles, regular charters, and occasional platform use. Depending on fleet size, a carrier may act like a shipper (requesting capacity) or like a carrier (offering it). This factor shapes behaviour on platforms but is neither a strong driver nor barrier for platform adoption.
Carriers also prefer stable partnerships. For one interviewed carrier, "[a] personal connection [...] [is] just worth more" than working short-term with shippers. They seek clients with the same size ("elephants like to do business with elephants") and avoid dependence on a single platform or subcontractors of different qualities ("you want to work with A-suppliers"). This reduces incentives to use open matching platforms like FMaaS.
Carriers rely on long-term contracts to secure revenue for investments. A third-party interviewee asks: "If you try to buy everything on the spot market [...], how can you properly substantiate long-term investments?" Leftover capacity goes to the spot market, which limits the volume available to spot platforms but aligns with tender-management tools. In Table 2, an overview of the strategic decisions of shippers and carriers is provided.

Table 2: Strategic decisions of shippers and carriers preceding the adoption of multimodal freight matching platforms

Strategic decisions	**Expected Impact**
Shipper-specific decisions	
Decision to outsource logistics	Barrier
Decision to use multimodal transport	Barrier
Decision to establish long-term relationships with carriers	Barrier
Choice between spot and contract markets	Mixed
Carrier-specific decisions	
Decision on vehicle ownership	Mixed
Decision to establish long-term relationships with shippers	Barrier
Choice between spot and contract markets	Mixed

Tactical factors of shippers

Shippers are attracted to freight procurement platforms mainly for lower prices enabled by transparency: One interviewee can "save about 3% on [the] total gross margin". This increased transparency helps shippers "find carriers quickly" according to an interviewed researcher by comparing "hundreds" of offers simultaneously according to a third party. A shipper received acceptance for shipment requests "within half an hour". A final tactical advantage for shippers is optimised processes enabled by streamlined communication and reduced administrative work. Instead of emailing, shippers "place the order directly" via the platform, saving significant administrative effort.

Tactical factors of carriers

From a carrier's perspective, reduced platform prices constitute a barrier. According to a third-party respondent, on platforms, "return loads are offered at ridiculously low prices". Increased competition is perceived differently. Whereas one interviewed carrier perceives this as a barrier, other carriers are less concerned, with one highlighting that "you start to see your competitors as colleagues". Carriers join platforms to reach new shippers, turning it into a "purchasing and sales

channel" according to another.
Platforms might also help multimodal operators "fill up empty wagons", and road carriers to reduce empty kilometres. Furthermore, carriers use platforms to observe market conditions; for example, an interviewed carrier uses platforms as a "barometer". Furthermore, some carriers may be concerned about being "100% dependent" on a platform, thus loosing "negotiation power" according to a researcher. Some carriers might hesitate to post jobs because, according to another researcher, it "reveals the customer", enabling competitors to identify and poach clients. Multiple carriers are more relaxed and view peers as "colleagues" or "friends". Tactical factors for both shippers and carriers are summarised in Table 3.

Table 3: Tactical factors of shippers and carriers

Tactical factors of shippers	**Impact**	**Tactical factors of carriers**	**Impact**
Reduced carrier prices	Driver	Reduced carrier prices	Barrier
Increased carrier competition	Driver	Increased carrier competition	Mixed
Optimised processes	Driver	Increased efficiency	Driver
		Increased number of clients	Driver
		Market intelligence	Driver
		Platform dependency	Barrier
		Willingness to share data	Mixed

Platform functionalities

In particular, shippers emphasise low implementation effort and simplicity as enablers of adoption, with one shipper asking themselves, while considering adoption: "How quickly will you be able to implement something?" Since many platforms appear to require low implementation effort and are easy to use, we consider this factor an adoption driver.
To enable multimodal chains, platforms must integrate carriers and terminals, which can be difficult since terminals "have no interest" initially to join a platform such as FMaaS according to a third-party interviewee. Legal responsibilities along the chain must be clear, defining whether platforms merely match, as in the case of an interviewed platform, or act as freight forwarders. Because multimodality often forces platforms into a quasi-forwarding role while platforms often emphasise being merely a matchmaker, this factor seems to be a barrier to adoption.
To improve shippers' carrier choice, platforms can validate carriers and monitor their performance using punctuality and ratings. Criminal misuse on platforms remains an issue. While platforms increasingly "kick out" offenders according to a carrier, struggles persist. Ensuring trustworthiness and safety remains a barrier to adoption.
Platforms may increase their attractiveness by offering a track-and-trace system and an IT-system integration. Tracking is useful for time-sensitive shipments, while IT integration (TMS/WMS/fleet systems) mainly benefits large shippers.

Context

Besides the functionalities, the context could also influence the FMaaS adoption of shippers and carriers. The independence of a platform may be difficult to achieve, posing a barrier to adoption, much like the network effect. For new platforms, attracting users could be difficult when the user base is small. Lastly, companies with free resources and an innovative mindset might be more inclined to adopt platforms. An overview of the influence of functionalities and the context is provided in Table 4.

Table 4: Platform Functionalities and Context

Platform-Functionalities and Context	**Impact**	**Related FMaaS Principles after Fazi and Fransoo (2025)**
Platform Functionalities		
Implementation effort and ease of use	Driver	Principle 1: A platform to seamlessly plan, execute, monitor and pay for shipments
Organising multimodal trips	Barrier	Principle 2: Multi- and synchromodality
Validating carriers and ensuring safety	Barrier	Principle 3: Open, global market platform
Value-added services	Driver	Principle 1: A platform to seamlessly plan, execute, monitor and pay for shipments
Context		
Platform independence	Barrier	Principle 5: Fair platform
Network effect	Barrier	
Company characteristics	Mixed	

4 Discussion and Conclusion

This study was the first to analyse the adoption of the freight procurement platform concept FMaaS, spanning multiple modes and supply chains. We showed that strategic decisions influence adoption made long before platform adoption becomes relevant. Prior studies that apply the TOE framework (Bossong et al., 2025; Zeng et al., 2020; Nguyen & Goldwasser, 2024) largely overlook such long-term considerations because of the chosen theoretical lens.

In contrast, tactical factors largely align with previous research on digital freight platforms. Shippers are attracted by lower prices and broad carrier access, just like Marzi, Marrucci, Vianelli, and Ciappei (2023); Helguera Sánchez and Hendra Mukti (2018) showed, while carriers value improved utilisation but fear increased competition and platform dependence. These carrier-related issues have been addressed only sparingly in prior work.

Regarding platform functionalities and the context, this study confirms prior findings on ease of use (Helguera Sánchez & Hendra Mukti, 2018; Nguyen & Goldwasser, 2024; Bossong et al., 2025) and network effects (Hentschel et al., 2018; Helguera Sánchez & Hendra Mukti, 2018; Roukouni & Zuidwijk, 2020) but emphasises that governance is especially critical for multimodal platforms. Users require clear responsibilities in the multimodal chain, safety assurance and platform neutrality. This is in line with earlier platform research (Bossong et al., 2025).

Despite providing valuable insights, the study faces limitations. Its broad conceptual scope and reliance on interviews introduce heterogeneity that depends on their platform use, complicating estimates of FMaaS adoption. Some stakeholder groups, like rail carriers and terminal operators, were underrepresented, limiting perspectives on crucial parts of multimodal chains. Future research should investigate different platform designs and industries separately, gather firsthand insights from underrepresented actors, and employ large-scale quantitative studies to test the relevance and weight of the identified factors.

Overall, the findings suggest that while FMaaS could, in principle, enhance efficiency and sustainability, significant strategic decisions of shippers and carriers, the organisation of multimodal chains, and governance-related barriers might hinder widespread adoption.

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