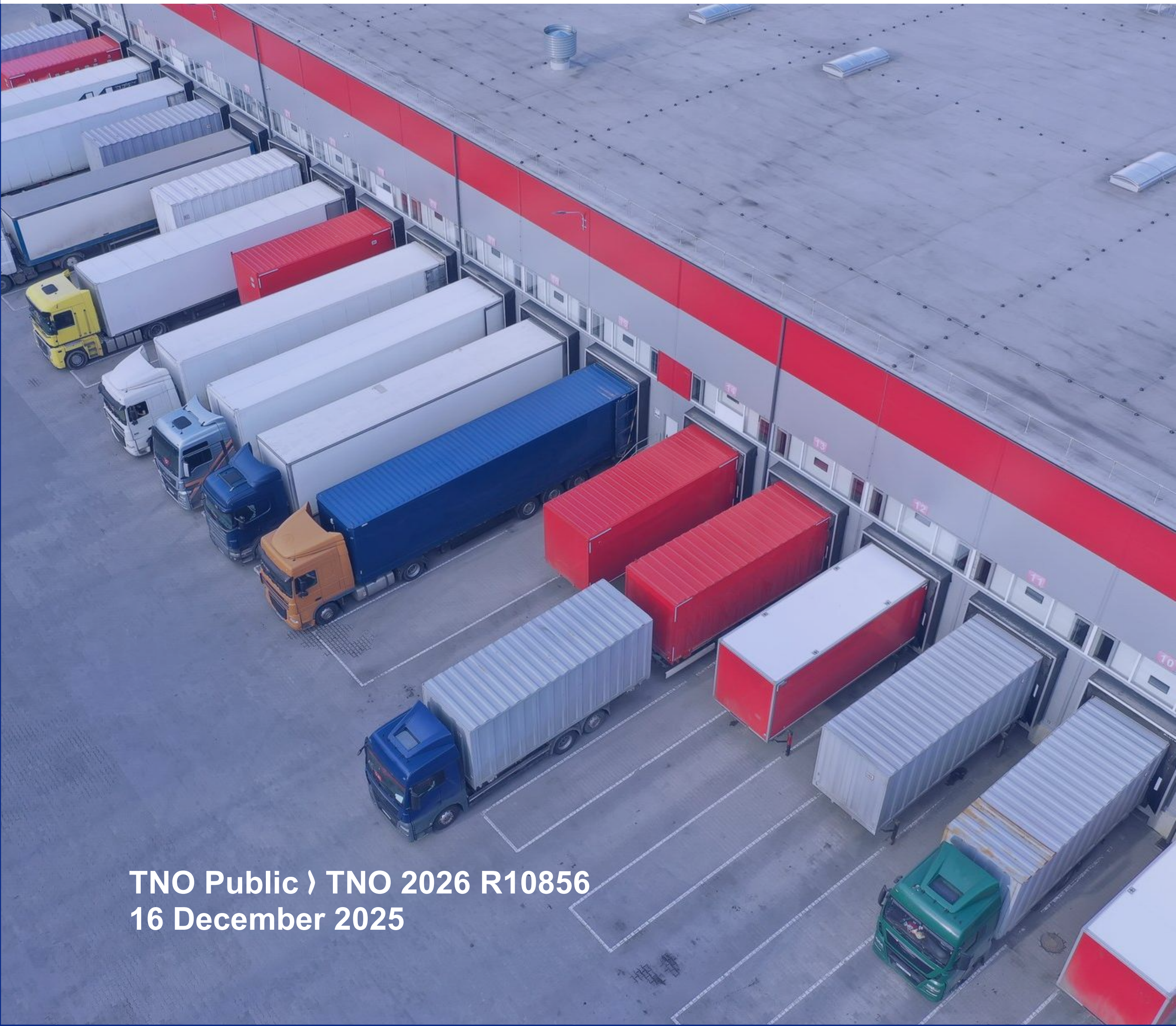
Deliverable 1: Collaborative Business Modelling - ERP Future Proof Smart Logistics

Results year 1



TNO Public ⟩ TNO 2026 R10856
16 December 2025

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TNO 2026 R10856 – 16 December 2025

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Classification report	TNO Public
Title	TNO Public
Report text	TNO Public
Number of pages	31 (excl. front and back cover)
Number of appendices	0
Project name	FULLERP - Future proof smart logistics
Project number	060.62092

Contents

1 Introduction

Logistics Service Providers (LSPs), companies offering transport and logistic services between carrier, shipper and receiver (Karam et al., 2021; Zenezini et al., 2019), often operate vehicles with empty containers, representing an estimated 12% (Europe) to 22% (nationally) of total mileage (Karam et al., 2021). As empty milage is one of the biggest logistical problems, reducing these empty trips has become essential – not only to improve cost efficiency in a market characterized by tight margins, but also to lower CO_2 emissions caused by non-productive transport movements (Matusiewicz & Książkiewicz, 2023). {Citation}

While individual LSPs have optimized their planning processes extensively, the potential for further efficiency gains within a single company is now limited. To achieve additional improvements, the sector is exploring Horizontal Transport Collaboration (HTC) – a “bundling transport of competitors, i.e., companies operating on the same level of the supply chain, who have similar or complementary transportation needs” (Vanovermeire et al., 2014). Research has shown that such collaboration can, in theory, improve economic performance, sustainability, operational efficiency, and strategic resilience (e.g., Durán-Micco et al., 2025; Grote et al., 2023; Zenezini et al., 2019). In practice, however, successful examples remain scarce, largely because collaboration among competitors introduces challenges such as trust deficits and unequal benefit distribution (Ahmadi et al., 2024; Durán-Micco et al., 2025; Karam et al., 2021).

To address these challenges, TNO – the Netherlands Organization for Applied Scientific Research – in the Exploratory Research Program ‘Future Proof Smart Logistics’ is developing a Collaborative Fleet Management System (CFMS) consisting of a decentralized planning algorithm supported by a data space. A data space is a common digital infrastructure and governance framework to help support the sharing and exchange of data for economic and societal impact, whilst simultaneously keeping individuals and companies owning the data in control (Commission, 2020). Data spaces adhere to secure and trustworthy data sharing principles, which guarantee control over the access and use of data shared by the data provider (Möller et al., 2024). The decentralized planning algorithm uses Multi-Party Computation (MPC) to match deliveries to pickups in a blind manner in several steps. In the first step, the parties collaboratively calculate a cost matrix in secret-shared form. Then, a modified, MPC-friendly version of the Hungarian algorithm is applied which assigns deliveries to pickups. Lastly, the delivery pickup pairs are assigned to companies in an efficient way (Leder et al., 2025). This decentralized approach removes the need for a central coordinating party and includes mechanisms for fair yield distribution among participants. These features help to reduce some of the main barriers to HTC.

Nonetheless, technological solutions alone are insufficient. Trust and governance issues continue to hinder collaboration (Vargas et al., 2020; Vargas et al., 2018). One example is Boxreload, an initiative where at its peak more than 40 transport companies coordinated their planning. The initiative eventually collapsed because there were no clear agreements on how to handle undesirable situations. Companies began sharing only their ‘leftover trips’ instead of their full schedules, resulting in increasingly inefficient shared planning and a gradual loss of interest from participants.

Collaborative business models are suggested to be an effective approach to overcome such trust issues, governance barriers and technology and information sharing barriers in HTCs (Vargas et al., 2020; Vargas et al., 2018). Therefore, this research focuses on developing a collaborative business model – a structured framework that defines how collaborating LSPs share value, allocate costs and responsibilities, and agree on governance arrangements – for the creation of the decentralized planning system.

Although collaborative business models have been proposed as a promising approach to strengthen trust and fairness in HTCs, their practical application remains limited (Vargas et al., 2020; Vargas et al., 2018). Therefore, this project aims to develop and test such a model in a use case involving six LSPs – Transportbedrijf G. van der Heijden & Zonen BV, Vepco, Kamps Transport, HebraGTO, H.N. Post & Zonen and Kooy Transport – that will implement TNO's CFMS. In specific, our part of the project will deliver:

- A scalable collaborative business model that can serve as a reference for other groups of LSPs using the same system.
- A practical modelling process that guides new groups of LSPs in designing their own collaboration model.

In addition, a well-functioning value network around the decentralized planning system must be established. This network comprises the broader set of organizations involved in developing, operating, and commercializing the system, such as transport management system providers, logistics consultancies, and a knowledge center. To support this, we will also design a roadmap collaborative business model for the wider ecosystem as the system evolves from development to exploitation.

These objectives lead to two central research questions:

- How can a collaborative business model be designed for a group of LSPs using a decentralized planning system?
- What is the roadmap for a collaborative business model for the value network that supports this system?

The following chapters outline how we approached these questions. We start with a review of the relevant literature, examining research on business models for collaboration, logistics, and data spaces, as well as literature on coopetition, which offers useful perspectives on governing collaboration among competitors – an important aspect of this case. We then present illustrative examples based on archival sources (such as news articles and reports) and a series of interviews with the involved stakeholders. From these materials, we derive key lessons learned, which inform the development of an initial blueprint for the collaborative business modelling process for both the HTC and the value network. Finally, we describe how this blueprint was applied in the use case, summarizing the outcomes of the first workshop conducted with the five participating parties and outlining the next steps for further validation.

2 Literature Review

2.1 Logistics and Horizontal Transport Collaboration

The Netherlands counts almost 17,000 transport companies which are license holders according to NIWO. Those transport companies mostly comprise of small and medium-sized enterprises, that collectively form the backbone of the national logistics sector (*De NIWO is de vergunningverlener voor het Nederlandse wegtransport*, n.d.). These companies play a vital role in keeping goods flowing across Europe, yet the market remains highly fragmented. Most carriers traditionally plan and optimize their operations independently. As a result, individual efficiency improvements have largely been exhausted (Muñoz-Villamizar et al., 2019).

A promising response is Horizontal Transport Collaboration (HTC). This is a business model in which transport companies operating at the same level of the supply chain jointly plan and execute transport activities. By sharing information, capacity, and resources, competitors can consolidate freight, improve vehicle utilization, and reduce empty mileage (Karam et al., 2021; Vanovermeire et al., 2014).

Shared planning through HTC offers multiple value drivers that are pushing companies toward more collaborative business models (e.g., Durán-Micco et al., 2025; Grote et al., 2023; Zenezini et al., 2019):

- **Economic efficiency**: Lower transport costs through higher truck fill rates, fewer trips, and reduced driver hours, while enabling additional revenue streams via shared capacity.
- **Sustainability**: Fewer trucks on the road, lower fuel consumption, and reduced CO_2 emissions contribute to corporate sustainability targets and lower environmental impact.
- **Operational performance**: Improved service reliability, shorter lead times, and higher flexibility in responding to fluctuating demand.
- **Strategic resilience** : Access to new markets, shared innovation, and a stronger, more resilient logistics ecosystem.

Despite the clear potential, successful implementation of HTC remains rare. Studies and pilot projects highlight several recurring barriers many of which are rooted in human behaviour, perceptions of risk, and organizational dynamics rather than technical limitations alone (Ahmadi et al., 2024; Durán-Micco et al., 2025; Karam et al., 2021):

- **Trust deficits**: A lack of trust between competitors, as well as in data-sharing methods and coordination mechanisms, often undermines collaboration.
- **Core business collaboration risks**: Sharing transport capacity involves cooperation on companies’ core business activities, increasing perceived strategic risk.
- **Unequal benefit distribution**: Gains are not always distributed fairly, leading to disputes over cost and profit allocation.
- **Hidden coordination costs**: Additional planning, handling, or warehousing costs can offset expected savings if not carefully managed.

- **Technological limitations**: Fragmented IT systems and the absence of robust collaborative planning algorithms hinder efficient data exchange and decision-making.

In summary, while the business case for shared transport planning is compelling from both economic and sustainability perspectives, realizing its full potential depends on overcoming organizational, technological, and trust-related barriers. Developing viable HTC business models will be crucial to achieving scalable collaboration in the transport sector. This leads to the next section on collaborative business models.

2.2 Collaborative Business Models

A business model describes how an organization creates and captures value (Baden-Fuller & Mangematin, 2013; Teece, 2010; Zott et al., 2011). It operationalizes strategy by translating strategic objectives into a concrete business logic that defines the activities, resources, and capabilities required to generate and appropriate value (Casadesus-Masanell & Ricart, 2010).

Increasingly, value creation is not confined to a single firm but emerges through collaborative business models (CBMs), which involve interdependent actors working together to co-create and share value. These models extend beyond traditional dyadic partnerships to encompass multi-stakeholder networks, where firms, NGOs, public institutions, and communities align complementary resources and capabilities (Roome & Louche, 2016). Collaboration enables access to knowledge, technologies, and markets that would be difficult to achieve independently, forwarding innovation and resilience in complex environments (DiVito et al., 2021).

However, collaborative business models introduce new challenges. Unlike unilateral models, they require mechanisms for joint value creation and appropriation, often under conditions of resource asymmetry and divergent strategic priorities (Colaner et al., 2018; Oskam et al., 2021). Governance structures, trust-building, and shared norms become critical to mitigate tensions and ensure equitable distribution of benefits (Ansell & Gash, 2008). Furthermore, collaboration is dynamic: actors may enter or exit networks, and roles may evolve as innovation progresses, requiring adaptive coordination and continuous negotiation of interests.

These complexities are amplified in competitive settings, such as HTC, where competitors collaborate. The next section explores this concept in detail.

2.3 Coopetition in Logistics

HTC is a form of coopetition where multiple LSPs, normally competing for trips, start collaborating by sharing data and optimizing routes. Coopetition, defined as a relationship simultaneously containing elements of both cooperation and competition (Bengtsson & Kock, 2000), has emerged as a crucial form of collaboration in today's business environment.

Coopetition is often a strategic necessity for businesses seeking competitive advantages that are unattainable alone (Velu, 2018). This necessity is driven by increasingly complex and uncertain business environments, globalization, and the pressure to innovate quickly (Devece et al., 2019; Dorn et al., 2016; Stadtler & Van Wassenhove, 2016). SMEs, in particular, are regularly forced into coopetition due to resource constraints (Devece et al., 2019; Schlee & Gutmann, 2025).

The overarching goal of coopetition is to create value (a bigger pie) and then compete to capture that value (divide the pie) (Ritala et al., 2014). Common objectives include:

- **Market expansion**: Access new markets and turn zero-sum games into positive-sum games.
- **Access to resources and capabilities**: Leverage complementarities and achieve economies of scale.
- **Improve innovation capability**: Share costs and risks of product development, reduce lead times.
- **Strategic positioning**: Strengthen competitive position through defensive or offensive strategies.

However, coopetition is inherently paradoxical and difficult to manage due to contradictory logics, risk of opportunism, and the need for continuous balancing of competitive and cooperative forces (Bengtsson & Kock, 2000; Budler, 2024; Slawinski et al., 2025). Mechanisms proposed in the literature include:

- **Structural governance**: Formal contracts, separation of competitive and cooperative domains, internal approval processes.
- **Relational strategies**: Treat tension as an opportunity, foster awareness of dual logics.
- **Strategic frameworks**: Coopetition-Based Business Model and Scenario Frameworks to structure resource sharing and value capture (Ritala et al., 2014; Velu, 2018).

Trust emerges as the most critical success factor in coopetition (Schlee & Gutmann, 2025). It mitigates opportunism, facilitates knowledge sharing, and underpins relational governance (Dorn et al., 2016). Yet, antecedents and dynamics of trust in multi-actor coopetition remain underexplored, particularly in complex settings like HTC.

2.4 Data Spaces as Enablers of Collaboration

To overcome technological and trust barriers in HTC, data spaces provide a secure and interoperable framework for data sharing. According to the Data Spaces Support Centre, a data space is an interoperable framework based on common governance principles, standards, and enabling services that supports trusted data transactions between participants (Data Spaces Support Centre, 2025).

Unlike traditional data ecosystems dominated by single commercial entities (e.g., Google, Amazon), data spaces emphasize data sovereignty, interoperability, transparency, and trust (Beverungen et al., 2022). Participants retain control over how their data is shared and used, with formal agreements governing access and usage (Jarke et al., 2019).

Examples such as Catena-x (automotive) and SCSN (manufacturing) demonstrate how data spaces enable competitors to exchange data for economic, societal, and environmental performance. In the context of HTC, data spaces can facilitate decentralized planning algorithms without requiring a central coordinating party, thereby reducing trust-related barriers and enabling fair benefit distribution.

3 Past examples

Collaboration in the transport sector is not a new phenomenon. Past initiatives offer valuable insights and lessons that can inform future partnerships. In this section, we examine two cases: Next Level Logistics and Boxreload. For each case, we provide an overview of the context, the stakeholders involved, and the outcomes achieved. This analysis draws on multiple interviews and two interactive workshops conducted with the relevant stakeholders.

3.1 Next Level Logistics

The case of inland terminals OCT and BTT forms part of the Next Level Logistics project. Both companies operate in North Brabant, the Netherlands, and provide barge, stacking, and trucking services for container transport to and from the ports of Rotterdam and Antwerp. The project focuses on optimizing the use of trucks from OCT and BTT within a shared fleet to enhance profitability, service levels, and reliability. This initiative exemplifies horizontal collaboration within the container sector.

OCT and BTT (along with other partners) have already collaborated successfully on barge capacity utilization along the West Brabant Corridor. By pooling barge capacity, they improved utilization rates, thereby increasing the profitability of barge services. A key driver of this success is the shared objective among inland terminals to strengthen the competitiveness of barge transport compared to road transport. Additionally, the terminals do not compete directly, as each operates within a limited geographic area around its own terminal. This prior and ongoing collaboration positively influences the proposed partnership under the Next Level Logistics project.

3.1.1 Logistic challenges

The stakeholders involved faced several challenges. Some act as drivers for collaboration, while others create barriers:

- Disruptions in supply chains and in ports
- Disruptions in supply chains and ports affect service reliability. Additionally, transport costs are influenced by congestion caused by these disruptions.
- Operational efficiency
- Efficiency is critical for profitability. Stakeholders continuously strive to optimize the use of equipment, fuel, and personnel.
- Integration of multiple IT-systems
- Integrating multiple IT systems remains a challenge due to the diversity of platforms and data standards in the logistics sector..
- Shortages of truck drivers
- A shortage of truck drivers impacts the entire sector. With an aging workforce and limited inflow of new drivers, the need for efficient driver utilization is increasing.
- Seasonal peaks in transport demand

- Seasonal fluctuations require transport companies to be flexible and adopt more dynamic planning approaches.
- Regulations
- Compliance with evolving sustainability regulations adds complexity to operations.

3.1.2 Involved stakeholders

In this case two stakeholders are involved: OCT and BTT.

OCT transports containers between deep-sea terminals in Rotterdam and Antwerp and its inland terminal in Oosterhout, using both inland waterways and road transport. Approximately 80% of containers are moved by barge and 20% by truck. Containers from Antwerp are transported exclusively by truck due to unreliable time windows at the terminals. In addition to transport, OCT offers warehousing and post-transport services for large multinational clients. The company operates across various market segments, primarily serving major retail customers.

BTT is a family-owned business specializing in container logistics. It operates several inland terminals in the Netherlands and one in Poland. BTT provides services including inland shipping, rail, and road transport, with a strong preference for inland shipping. Its customer base consists mainly of large shipping companies and multinationals requiring container transport.

Shared Characteristics
Both OCT and BTT offer transport services using barges and trucks. Due to the regional nature of inland terminals, their operations are concentrated within a radius of approximately 40 kilometers around each terminal. These terminals also serve as storage facilities for their customers.

Digitalization
BTT is more advanced in terms of digitalization compared to OCT. Both companies use the same barge planning software (*Modality*) to manage barge capacity for their combined fleet. Orders in *Modality* are also utilized for truck planning, which is still performed manually in Excel. Currently, both parties are implementing fleet management software (*Data2Track*) for their trucks.

3.1.3 Planning process

This collaboration is about the combined use of both truck fleets of OCT and BTT. Therefore, the overall planning is mapped below. The planning process follows the following steps:

1. **Order input**
   Customer service enters orders into Modality planning software. Some clients use a direct API connection to Modality.
2. **Barge planning**
   Both companies prioritize barge transport. Available barge capacity is maximized first; containers that cannot be shipped by barge (due to time window constraints) are assigned to trucks.
3. **Truck planning**

Truck schedules are organized in three shifts: morning, afternoon, and evening. Orders are manually entered into Excel and matched with available trucks. If capacity is insufficient, charter trucks are deployed.

4. **Daily adjustments**
   Planners make real-time changes to accommodate client needs or disruptions such as congestion at road or barge terminals.
5. **Client communication**
   Continuous communication ensures clients are informed of changes and can share urgent requirements.
6. **Monitoring and evaluation**
   Regular reviews track KPIs such as empty kilometers, reliability, and maximizing barge share.

3.1.4 Collaborative system

The collaboration between OCT and BTT involves the exchange of assets (such as trailers) and transport orders. This exchange is governed by bilateral agreements built on mutual trust. Due to the regional role of the inland terminals and the shared focus on barge transport, both parties are committed to sharing orders for the overall benefit of the system.
To enable this collaboration several things are done:

- **Tariff Agreements**: Clear agreements are established on rates per kilometer driven.
- **System Integration**: Integration of planning tools, such as Modality, is essential for sharing operational information.
- **Technology Alignment**: Both companies use the same barge planning tool (Modality), although they operate different versions with varying functionalities.

A collaboration for road transport was proposed in this project. The overall goal of this collaboration is to use transport capacities more efficiently through exchanging orders and chassis' by which costs can be reduced and reliability of transport services improved. Specific agreements on how collaboration should take place operationally are still part of discussion. What is required for this collaboration to work is transparent communication to clients about this initiative. The clients should know which transport companies are involved and it should be possible to oppose this collaboration. Second, the planning software of both transport companies has to be integrated in an automated way to streamline the planning process. Third, agreements on reliability when transporting orders for another transport company and driving with chassis' from another company have to be made. Lastly, if data is shared this should be done in a trustful way where commercial sensitive information of others cannot be seen.

3.2 Boxreload

This case examines a collaborative initiative among several Dutch container road carriers aimed at reducing empty mileage and improving planning reliability along the Rotterdam/Antwerp - hinterland corridors. The Boxreload project focused on exchanging transport orders through the PARIS software platform, developed by Hutchison. PARIS matched orders to minimize empty trips by combining two legs with empty mileage into a single backhaul. This approach also required container re-use and close cooperation with container carriers.

The Future Proof Smart Logistics use case builds on this earlier collaboration, involving some of the same parties. At its peak, the initiative included around 40 transport companies. However, the collaboration eventually ended due to trust-related issues.
The core objectives of Boxreload were:

- Reducing empty kilometers through the exchange of trips with empty containers.
- Improving efficiency in transport capacity utilization.
- Lowering emissions and increasing profitability through optimized planning.

3.2.1 Logistics challenges

The underlying logistics challenges for this collaboration were identified through interviews and a joint workshop:

- Trust & fairness
- Concerns about equitable distribution of matches and preventing “poaching” of each other’s customers. Stakeholders expressed the need for a formal code of conduct and a governance committee.
- System integration & autonomy
- Challenges related to integrating with external platforms (e.g., Avantida), clarifying the roles of different planning systems, and maintaining each carrier’s operational control.
- Commercial sensitivities
- Issues around pricing transparency and protecting client relationships among participating transport companies.

3.2.2 Involved stakeholders

Several parties participated in the Boxreload initiative. The following companies are also involved in the **Future Proof Smart Logistics** use case:

- **Transportbedrijf G. van der Heijden & Zonen BV (Ridderkerk)**
  A family-owned firm specializing in container transport with a strong sustainability focus (HVO and electric vehicles). The company chairs the container transport alliance within TLN, the Dutch transport branch organization.
- **HebraGTO (Rotterdam)**
  Operates over 100 trucks and offers multimodal transport (road, rail, barge). Services include ADR (including Class 1), reefer containers with gensets, and specialized handling.
- **H.N. Post & Zonen (Pijnacker)**
  Active in container transport at the Port of Rotterdam, with zero-emission trucks. Provides warehousing and customs clearance capabilities.
- **Kooy Transport (Heerenveen)**
  Specialist in road container transport (20–40 ft), ADR-certified, and equipped with sideloaders for flexible loading and unloading.
- **Vepco (Moerdijk)**
  Strategic hub between Rotterdam and Antwerp offering storage, depots, FYCO gas measurement and ventilation services, terminal tractors, and container road transport.
- **Kamps Transport (Bleiswijk)**
  Provides container transport (20/40/45 ft, ISO tanks), Eco-Combi (LZV), reefer containers with gensets, and gas measurement services.

3.2.3 Planning process

The order-matching process in the Boxreload initiative followed these steps:

1. **Order Intake & Data Feed**
   Orders and container releases were entered into each carrier's TMS, with an automated real-time feed of all eligible trips (laden or empty, including pre-paired out-and-back trips) sent to the shared matching layer (*PARIS/Boxreload*).
2. **Availability & Constraints Check**
   Validation of carrier and customer time windows (avoiding overly tight scheduling), container type and size, and shipping line restrictions. During the pilot, import-led prioritization was noted.
3. **Slotting & Reuse Options**
   When container reuse was required or advantageous, requests were processed via Avantida, with line approvals often enabled through paid reuse arrangements.
4. **Match Proposal & Acceptance**
   Daily suggestion sets were pushed to planners approximately 4–5 times per day. Accepted matches were locked to prevent re-planning unless a significantly better match emerged.
5. **Execution & Monitoring**
   Carriers dispatched drivers and chassis according to the optimized plan. Shunting within port cities was excluded from the scope.
6. **Closure & Settlement**
   A bilateral, kilometer-based backload tariff was applied for exchanged trips between carriers. No joint tariffs were set toward shippers.
7. **Reporting & Review**
   Monthly reports provided transparency on matches, kilometers saved, missed opportunities due to restrictions, and contributions per participant.

3.2.4 Collaborative system

The collaborative system in Boxreload was designed with strict rules and safeguards to ensure trust, fairness, and operational efficiency. Data sharing was limited to city and time-window visibility for matching purposes, with exact addresses disclosed only after a match was confirmed. Sensitive customer information remained protected throughout the process.

Participation was voluntary but came with obligations. Carriers were required to submit all trips that could potentially be performed by another party, and only licensed operators – holding NIWO, AVC/CMR, and VIHB certifications where applicable –were allowed to join. Minimum participation thresholds were also enforced to prevent free-riding.

Matching followed a clear priority order: shipping line compatibility, container size and type (including 20/40/45 ft and high cube variations), time windows with assumed ±1 hour on-site, and origin-destination alignment. System-level planning gains were considered, allowing wider radii if they reduced empty kilometers. Import flows were initially prioritized during the pilot phase.

Commercial arrangements were carefully structured. A fixed kilometer-based tariff applied only to backloads exchanged between carriers, with no collective pricing agreements toward shippers to avoid competition law concerns. Governance was supported by a code of conduct and an oversight committee to ensure equitable matching. Monthly reports provided transparency on matches, kilometers saved, and proportional contributions, while defining showstoppers such as one-sided import benefits or failure to share minimum rides. This initiative initially underestimated governance and therefore there were no concrete formal agreements made. This eventually led to the collapse of the collaboration because of lagging trust among the involved stakeholders.

Technology played a key role in enabling collaboration. The PARIS optimization engine served as the core matching platform, integrated with carriers' TMS systems and Avantida workflows for container reuse.

4 Lessons learned

A review of both the academic literature (section 2) and practical experiences from recent collaboration initiatives in the Dutch logistics sector (section 3) reveals a nuanced picture of what drives success, and what causes failure, in horizontal transport collaboration (HTC).

1. **The importance of shared goals and trust**

Successful collaborations are grounded in a clear, common objective and a foundation of trust. In the Next Level Logistics case, the shared ambition to maximize barge utilization and the existing working relationship between OCT and BTT facilitated smooth cooperation. Literature confirms that trust both in partners and in the systems used is a critical enabler, while its absence is a frequent cause of failure.

2. **Neutrality, transparency and governance**

A neutral, transparent platform for planning and data exchange is essential. The Boxreload initiative demonstrated that data-masked, planner-in-the-loop systems can build trust and accountability, especially when combined with regular, transparent reporting on performance and participation. Clear governance structures such as codes of conduct, participation criteria, and oversight committees help ensure fairness, resolve disputes, and maintain partner engagement.

3. **Fair distribution of value and responsibilities**

CBMs must address the challenge of fair value distribution. Both literature and practice show that perceived inequities such as cherry-picking of orders or unequal sharing of benefits undermine collaboration. Explicit agreements on how value, costs, and responsibilities are shared, as well as mechanisms to monitor and enforce these agreements, are vital.

4. **Scalability and flexibility**

While small-scale collaborations can be effective, scalability is often limited by operational overlap and competitive tensions. The Next Level Logistics case highlighted that limited geographic overlap can constrain growth, while Boxreload showed that flexibility in participation and planning is necessary to accommodate real-world complexities and changing partner dynamics.

5. **Technological integration and adaptability**

Technological barriers, such as fragmented IT systems and lack of robust integration, remain significant. Effective CBMs require interoperable systems that support secure, controlled data sharing and allow for both automated and manual planning interventions. Data spaces and decentralized planning algorithms, as discussed in the literature, can help lower these barriers but must be complemented by strong governance and trust-building measures.

6. **Managing commercial sensitivities**

Commercial sensitivities such as concerns over pricing transparency and client protection must be carefully managed. The Boxreload experience underscores the need for clear commercial guardrails and assurances that collaboration will not compromise competitive positions.

7. Continuous evaluation and adaptation
Finally, CBMs must be designed as living frameworks that can adapt to changing circumstances, such as partner entry and exit, market shifts, and evolving regulations. Continuous evaluation, learning, and adaptation are necessary to sustain collaboration over time.

5 Blueprint Collaborative Business Modelling

Based on the lessons learned from the literature and the illustrative examples as well as prior experience with collaborative business modelling in other projects, we developed an initial process for collaborative business modelling (CBM). This process was designed for both the horizontal transport collaboration (HTC) between logistics service providers (LSPs) and the broader value network surrounding them. Its purpose is to support the development and commercialization of the decentralized planning algorithm system.

We refer to this process as the CBM blueprint. It has been reviewed and validated by experts in both collaborative business modelling and logistics and will be applied to the use case within the ERP project Future Proof Smart Logistics.

During the design phase, we found that the overall steps in the CBM process remain largely the same, whether applied to the HTC or to the value network. Therefore, we describe the steps only once below. However, it appears that the specific tools used to carry out each step and to guide participants through the process differ between the two contexts. Moreover, the timing and frequency of the steps throughout the innovation's development process seem to vary for each application. As these issues need further exploration and validation, they are not reported in this deliverable – they will be further developed in 2026.

A **collaborative business model** describes the *shared rules and agreements* that enable independent organizations to work together while remaining competitors.
It defines:

- Who collaborates and in what roles
- What is shared and what is not (e.g. trips and data, but not customers or pricing)
- How value is created and shared
- How behaviour is governed (e.g. fairness rules, codes of conduct, conflict resolution)

It is not the technical system, algorithm, or dataspace itself, nor a single joint company. Instead, it provides the organizational and economic logic that makes collaboration viable, desirable and feasible in practice.
Example: in horizontal transport collaboration, the collaborative business model determines how competing transport companies exchange trips, allocate benefits, protect customer relationships, and govern fair participation.

5.1 CBM Blueprint steps

The collaborative business modelling process evolves from committing the right partners to implementing the model in five steps, see Figure 1 below. In step 1, the right partners are engaged in the business modelling process. This is followed by step 2 where a picture is drawn of the context, the ambitions of the partners and the system or user requirements for the step. Then in step 3 the actual design of the collaborative business model starts by defining and validating its content, structure and governance. Before this can be implemented often barriers have to be overcome and drivers leveraged, this is done in step 4. The final step is implementing the business model from pilot to demo to actual exploitation. Below each step is explained in detail. In this description the steps appear linear, but in practice this process will never be as sequential as described. Therefore, we also describe the back loops from later steps to the particular steps, describing the situation when it is necessary to reiterate to an earlier step.

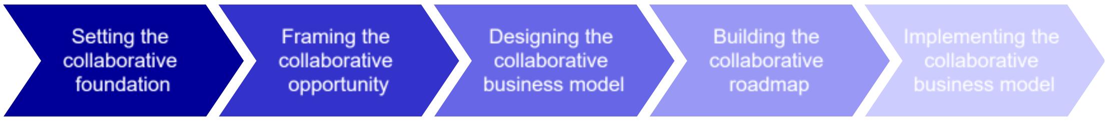

Figure 1 Overview of the CBM Blueprint steps

Step 1: Setting the collaborative foundation

Objective	Build a committed core group to initiate CBM design and assess whether there is enough shared potential to proceed
Inputs	List of potential partners, initial idea, facilitator brief (incl. mandate, budget)
Activities	Identify and assess potential partners > Value potential analysis > Convince them to participate > Sign letter of intent
Duration	~ 2 to 3 months
Methods & techniques	Individual meetings with partners; kick-off meeting with all
Tools	*To be added*
Roles & responsibilities	Facilitator (lead); partners (meet, review & sign)
Outputs	Partner overview; Value potential analysis; signed letter of intent
Backloop	From step 2 to 5 when misalignment between partners, new partners emerge or trust weakens
Evaluation criteria	Number of committed partners (i.e. signed letter of intent)
Hand-over to next step	Exploration can start once commitment is formalized
Pitfalls	*To be added based on learnings of process with use case*

Step 2: Framing the collaborative opportunity

Objective	Build shared understanding of the context, ambitions and solution requirements
Activities	Analyze environment (inc. drivers and barriers) > Define ambitions > Gather user requirements
Duration	3-4 weeks
Methods & techniques	Desk research; interviews; workshop
Tools	*To be added*
Roles & responsibilities	Facilitator (research, meetings, workshop); partners (input)
Outputs	Context report; overview of user requirements; ambition statement
Evaluation criteria	Completeness and accuracy of context description, ambitions and user requirements
Backloop	From step 3 to 5 when contextual info, user requirements are unclear or missing; or when ambition loses support
Hand-over to next step	Design can start when context, ambition and solution requirements are documented and validated by all partners.
Pitfalls	*To be added based on learnings of process with use case*

Step 3: Designing the collaborative business model

Objective	Develop a collaborative business model that is viable, desirable and feasible
Activities	Co-design content, structure and governance - explaining how value is created and shared
Duration	~ 2-3 months
Methods & techniques	2 workshops; individual interviews
Tools	*To be added*
Roles & responsibilities	Facilitator (lead, synthesize); partners (co-design)
Outputs	Draft collaborative business model (visual & narrative)
Evaluation criteria	Evaluation score for viability, desirability, feasibility
Backloop	From step 4 and 5 when design flaws appear during roadmapping or implementation
Hand-over to next step	Adaptation can start when CBM is validated for desirability, feasibility and viability
Pitfalls	*To be added based on learnings of process with use case*

Step 4: Building the collaborative roadmap

Objective	Identify drivers, barriers and actions to move from design to implementation
Activities	Re-assess drivers and barriers > map impact on CBM > create implementation roadmap
Duration	~ 3-4 weeks (longer if actions are needed to overcome barriers)
Methods & techniques	Desk research; interviews; 1 workshop
Tools	*To be added*
Roles & responsibilities	Facilitator (lead, syntesize); partners (input)
Outputs	Implementation plan
Evaluation criteria	Implementation readiness score for each partner
Backloop	From step 5 when implementation reveals new drivers and barriers (internally or externally)
Hand-over to next step	Implementation can started when there are no unresolved critical barriers
Pitfalls	*To be added based on learnings of process with use case*

Step 5: Implementing the collaborative business model

Objective	Operationalize and validate the collaborative business model; establish mechanisms for learning, scaling and adaptation
Activities	Pilot > Formalize > Operate > Learn > Exit
Duration	Pilot 3–6 m, institutionalization 3–12 m, scaling ongoing
Methods & techniques	*To be added*
Tools	*To be added*
Roles & responsibilities	Partners (implementation); facilitator (coordinate, monitor and document)
Outputs	Operational CBM, signed governance documents; monitoring asystem; scaling plan
Evaluation criteria	% of implementation plan executed; monitoring done
Hand-over to next step	Iterate to step 1-4 based on piloting; or learning
Pitfalls	*To be added based on learnings of process with use case*

6 Application of CBM to ERP Use Case

From the illustrative case of Boxreload, six partners – Transportbedrijf G. van der Heijden & Zonen BV, Vepco, Kamps Transport, HebraGTO, H.N. Post & Zonen and Kooy Transport – have expressed interest to the ERP Future Proof Smart Logistics team in the CFMS currently being developed by TNO. Although the Boxreload system collapsed for several reasons, these partners still see value in such a concept. Faced with shrinking margins, they are actively seeking ways to improve planning efficiency, reduce costs, and safeguard the continuity of their businesses.

Together with these five partners, TNO will develop the technical foundation of the CFMS. This includes creating a dataspace for storing and sharing essential data among partners, designing algorithms to calculate potential matches for shared trips, and building a user interface to facilitate interaction with the system. Since the main reasons for Boxreload's failure were not technical, it is equally important to establish a robust collaborative business model supported by governance agreements. This will ensure a viable, long-term horizontal collaboration among the partners. To achieve this, we will guide them through the process outlined in our collaborative business model blueprint from the previous section.

In 2025, we initiated this process. During the first workshop in June 2025, we set the ambition for the collaboration and identified user requirements by exploring the pains and gains associated with shared order planning (both part of phase 2). From this workshop, it became clear that the partners first wanted an initial indication of the potential value – specifically, the potential reduction in mileage – that collaboration could deliver. TNO conducted this analysis and will share the results in a workshop in January 2026. In the meantime, we conducted several interviews with participants to refine the user requirements and gain deeper insight into why the original Boxreload collaboration collapsed, so we could address these issues either technically in the CFMS or through the CBM process. Based on this, we also filled in our governance template to visualize what type of governance agreements would make sense in the initial phase of collaboration.

In parallel, we applied the DAMIAN tool – a visualization tool that demonstrates how data can be leveraged to create valuable insights for end-users – together with the developers working on the dataspace and planning algorithm at TNO. This exercise helped us map out how, in an ideal scenario, the CFMS will generate, analyze, and apply data. Unlike the other results, which relate to the HTC, this outcome pertains to the value network aspect of our work.

Below is a summary of the outcomes, organized according to the steps of the CBM Blueprint. They are not completely presented in chronological order because we learned that ambition setting and a deep dive into contextual factors should follow an initial value analysis to secure partner commitment.

6.1 Outputs achieved in 2025

6.1.1 Setting the collaborative foundation

6.1.1.1 Partner overview

In Table 1 (and section 3.2.2), you can find more information about the LSPs that are willing to collaborate on developing the CFMS. A sixth company initially joined the initiative, Overbeek, but they were acquired by another company (Koolwijk). As the owner of Overbeek is pursuing his own initiative regarding shared planning, stepped out this collaboration. This shows how important it is to be able to handle the dynamics of entrance and exit in the collaboration.

Table 1 Partner overview ERP

Name	**Place**	**Number of trucks**	**Year of establishment**	**Company size**
Transportbedrijf G. van der Heijden & Zonen BV	Ridderkerk	35/45 trucks	1927	51-200 employees
Vepco	Klundert		2009	51-200 employees
Kamps Transport	Bleiswijk	45 trucks	1957	51-200 employees
HebraGTO	Rotterdam	75/80 trucks	2014 (merger)	51-200 employees
H.N. Post & Zonen	Pijnacker	60/70 trucks	1964	51-200 employees
Kooy Transport	Heerenveen		1938	

6.1.1.2 Value potential analysis

TNO conducted a comprehensive value potential analysis to assess the expected benefits of collaborative planning among five logistics service providers. This analysis was a crucial step in the collaborative business modelling process, as it provided an initial indication of the potential reduction in mileage and associated efficiency gains that could be achieved through horizontal transport collaboration.

The value potential analysis was performed in response to the partners' request for concrete evidence of the added value of collaboration, specifically regarding the reduction of empty mileage.

For full details, the results of the value potential analysis are available in the following presentation: 20251218 FPSL Vervolgsessie potentieschatting.pptx

6.1.2 Framing the collaborative opportunity

6.1.2.1 Ambition statement

The main ambition of the six transport companies is to *“use transport capacity more efficiently so that more benefits can be made on company profitability and sustainability”.* Surprisingly, the LSPs were very uniform in the gains (or benefits) that they hoped to achieve with this collaborative endeavour. This process might have been easy because they are companies and are struggling with the same issues, while in other types of collaborations the logics of the companies and therefor their interests are more divers.

6.1.2.2 Context report

The participating logistics service providers jointly identified a range of anticipated benefits (“gains”) and challenges (“pains”) associated with the adoption of TNO’s CFMS (Table 2).

Table 2 Anticipated benefits and challenges

Gains	**Pains**
More efficient use of (transport) capacity	Trust
Sustainability	Required integrations with external systems
Better coordination with (export) customers regarding loading times	Role of the planning system and preservation of autonomy
Improved profitability	Fair distribution of trips
Better service and delivery reliability	Commercial interests
Flexibility during demand peaks	Customer perception
Use of each other’s networks	Tariff agreements
Learning from one another	Operational alignment between parties

6.1.2.3 User requirements

The user requirements for collaborative planning in container transport were developed through close consultation with participating transport companies. These requirements form the foundation for the first demonstrator of the collaborative planning system and are designed to ensure that the collaboration delivers tangible benefits in efficiency, sustainability, and profitability, while addressing the operational and governance needs of all stakeholders.

The requirements in Table 3 are structured around key themes: collaboration scope, participation conditions, fairness and governance, system information flows, and technical matching criteria. They reflect the shared ambition to minimize empty mileage, optimize resource use, and foster trust and transparency among all partners.

Table 3 summary of user requirements

Category	**Requirement**
Collaboration scope	- Target group: container transporters, supported by facilitators (TNO, TLN) - Activities: data exchange, trip matching, cost/revenue allocation - Goal: minimize empty mileage, improve sustainability and margins
Participation conditions	- Voluntary, but all potentially exchangeable trips must be submitted (no cherry-picking) - Includes all trip types (empty/full, roundtrips, all customers) - Eligibility: NIWO license, AVC/CMR insurance, VIHB registration, minimum participation level (to be specified)
Trust and fairness	- Honest distribution of matches - Customer knowledge from collaboration not used for acquisition - Import trip provider is default executor unless agreed otherwise - Trip contributor retains customer relationship and communication - Executing party only communicates via driver - Fixed backload tariff per km (export trip basis)
Governance	- Code of conduct and governance committee required - No joint pricing toward shippers - Fairness in match allocation is monitored and corrected by the participating partners themselves, based on shared rules and transparent reporting, rather than enforced by a central authority. - Rejection of matches must be justified
System input	- Daily planning shared (origin/destination, planned time, time window for future versions) - All trips from each transporter included - Data must be formatted to system requirements
System output	- Daily: suggested matches with expected savings - Both parties must accept/reject matches - Monthly: transparent reports on matches, savings, missed potential, participant contributions - Individual trip data only shared with involved parties; aggregate data anonymized for all
Matching criteria	- Shipping line: only OOCL and COSCO interchangeable (initially) - Container types: 20ft/40ft/45ft, only dry boxes (no reefers/tankcontainers) - Standard 1 hour for loading/unloading - Flexible matching radius if system-wide benefit - Matching at city level - Shunting within port cities excluded

6.1.2.4 Data flow in collaborative planning

To support the development and implementation of collaborative planning in container transport, we utilized the DAMIAN tool to systematically map the phases of data flow from initial data generation to analysis and final application (Figure 2). This visual mapping clarifies how data moves through the collaborative planning system, highlighting steps, responsibilities, and outputs at each stage – see also: Whiteboard ERP FPSL DAMIAN.

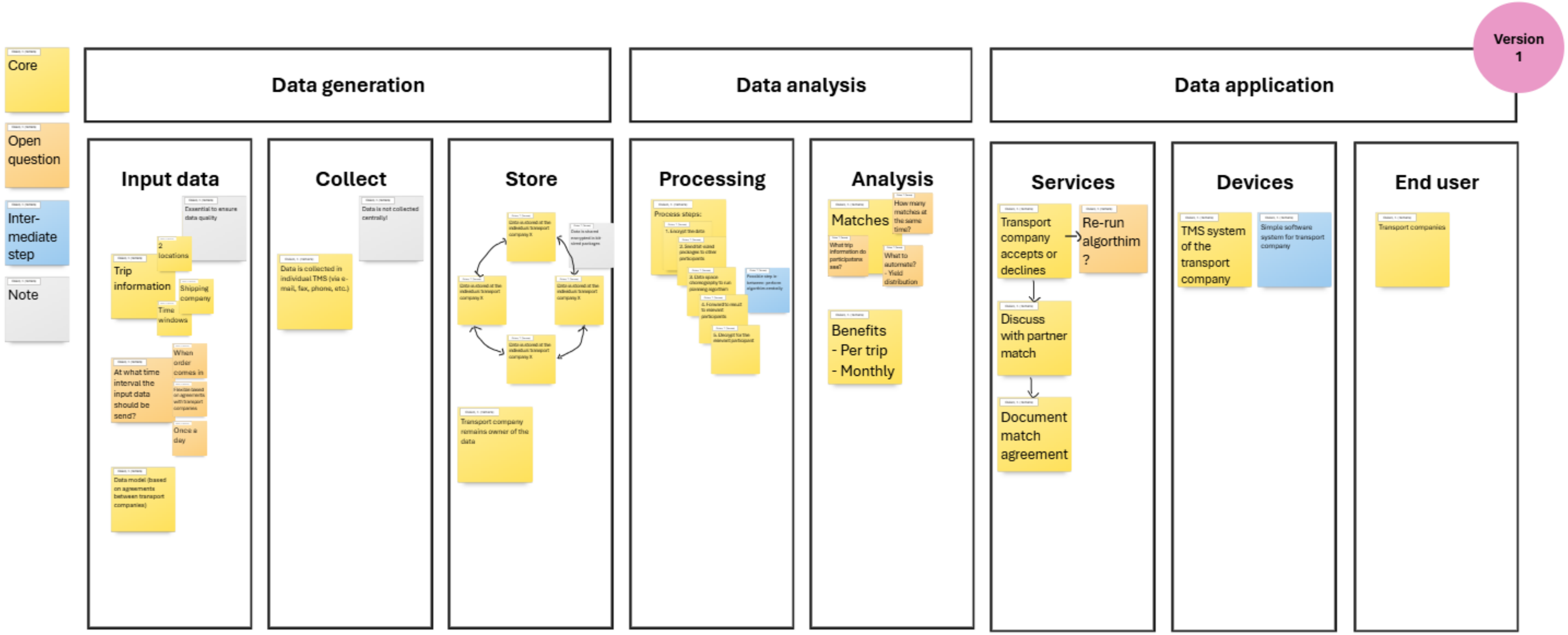

Figure 2 DAMIAN

6.1.3 Designing the collaborative business model

6.1.3.1 Governance model

Effective collaboration in a multi-party, data-driven environment requires a robust governance model that goes beyond data issues alone. Governance also covers roles, decision-making, cost and benefit sharing, behavioural rules, and conflict resolution. The collaborative planning dataspace is the shared digital environment that enables secure and controlled exchange of planning data; governance ensures that its use remains fair, transparent, and workable in practice.

This governance model addresses key aspects such as data ownership, access rights, roles and responsibilities, investment and cost-sharing, decision-making procedures, conflict resolution, and legal and contractual arrangements. The model is designed to foster trust, ensure compliance with relevant regulations, and provide a scalable foundation for future growth and adaptation.

The governance structure includes defined roles for data service providers, data consumers, software providers, and a governance board, each with specific responsibilities and contributions. Mechanisms for data sharing, frequency of updates, access control, and output distribution are clearly outlined. In addition, the model covers financial arrangements, risk allocation, evaluation criteria, and procedures for onboarding new participants or scaling the collaboration.

For a detailed overview of the governance options, roles, and mechanisms, please refer to: Governance ERP FPSL_ENG.xlsx.

7 Next steps and focus areas for 2026

As anticipated, the progress made in 2025 does not yet allow us to fully answer the central research question introduced at the start of this project. Therefore, our efforts will continue into 2026, with a focus on the following activities:

1. **Refinement and validation of the CBM Blueprint**
   We will further develop the Collaborative Business Model Blueprint through targeted expert interviews and validation within the use case. This process will involve ongoing engagement with the participating LSPs, beginning with a minimal viable set of governance agreements and a letter of intent to secure commitment. The initial focus will be on designing a minimal viable collaborative business model, starting small to build momentum while ensuring scalability for future growth.

2. **Root cause analysis of Boxreload 1.0 and translation into CBM design requirements**
   Stakeholder interviews have highlighted diverse reasons for the failure of Boxreload 1.0. In 2026, we will systematically validate these findings and translate them into concrete design requirements for the CBM process, ensuring that critical issues are addressed in the new model.

3. **User requirements validation via questionnaire for the demonstrator**
   As TNO's technical team develops the demonstrator in 2026, we will design a questionnaire to validate user requirements and assess which aspects of the CBM can be effectively tested within the gamified simulation of the CFMS.

4. **Value network mapping for stakeholder engagement and valorization**
   Building on insights from 2025, we recognize the importance of considering the broader value network beyond the immediate HTC partners. In 2026, we will initiate value network mapping to identify and engage key stakeholders, exploring their perspectives, challenges, and opportunities for collaboration.

Additionally, the work completed in 2025 and the planned activities for 2026, particularly the translation of literature and case study insights into CBM design requirements will form the foundation for a conference paper submission to the New Business Model Conference in June 2026.

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