Strategies to secure the role of private rail sidings in the Netherlands

by

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Preface

This thesis marks the end of my studies at TU Delft. Although choosing the master programme Transport, Infrastructure and Logistics may not have been the most obvious path for me at the time, I truly enjoyed the journey. Along the way, I discovered a strong enthusiasm for mobility, and in particular, for the rail sector. While the master primarily focuses on passenger transport, it was both refreshing and enriching to explore the freight side of the industry during my thesis.

I would first like to express my gratitude to my graduation committee. The start of this project was not without its challenges, but the guidance of Lóri Tavasszy was a great help, and his ability to see the bigger picture always helped me to define my future steps. I also want to thank Arjan van Binsbergen and Niek Mouter for taking the time to provide me with their friendly feedback in their demanding schedules.

A special word of thanks goes to Alexander Warmelink and Nigel Birch, who supported me on a weekly basis and introduced me to the inner workings of the rail sector. It was a pleasure to learn from you, and inspiring to see the passion with which everyone at Royal HaskoningDHV approaches their work. I always felt very welcome.

Lastly I would like to say a thank you to my family and friends who supported me throughout my studies and especially my thesis. Their patience, understanding and encouragement really helped me to complete this chapter of my life. I'm grateful to have such a warm and strong support network around me.

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Abstract

Abstract English

Private rail sidings form the physical access gates for companies to the rail network. Without these rail freight, transport is not possible and these private sidings can be seen as an indicator of the competitiveness of rail transport. However, the number of private sidings has dropped significantly over the last decades, which limits the rail freight sector and the resilience of the rail network. A resilient rail network is important to reach societal goals such as emission reduction and less road nuisance. This research focuses on this problem by proposing concrete strategies to help the companies using rail transport and allow them to use their private sidings. Through the help of literature, data and stakeholder interviews, an Osterwalder business model canvas, SWOT analysis and TOWS matrix are constructed to identify the problems and propose strategies. Causal diagrams show the coherence of the sector and how problems, strategies and private sidings influence each other. The first result is a new way of categorising companies and their respective private sidings. This reveals the underlying problems and strengths per type of private siding. The most important problems are rising costs, unreliability of the rail network and limited usability of the private siding due to regulations and non-electrified infrastructure. To combat this, six strategies are proposed with the introduction of a second infrastructure manager to combat costs and regulations and specific infrastructure investments as the most promising strategies. Effective policies require tailored solutions based on the type of company and private siding. This can help the Dutch rail sector and increase the resilience of the transport network.

Keywords: Private siding, rail freight transport, spur line, rail siding, private siding typology, strategies for railfreight transport

Abstract Nederlands

Spooraansluitingen vormen de fysieke toegangspoorten voor bedrijven tot het spoornetwerk. Zonder deze aansluitingen is spoorgoederenvervoer niet mogelijk, en ze kunnen dan ook worden gezien als een indicator voor de concurrentiekracht van het railvervoer. Het aantal spooraansluitingen is echter de afgelopen decennia aanzienlijk afgenomen, wat de spoorsector en de veerkracht van het netwerk beperkt. Een veerkrachtig spoornetwerk is juist essentieel om maatschappelijke doelen zoals emissiereductie en het terugdringen van hinder op de weg te behalen. Dit onderzoek richt zich op dit probleem door concrete strategieën voor te stellen die bedrijven ondersteunen bij het behouden en benutten van hun spooraansluiting. Aan de hand van literatuur, data en interviews met stakeholders zijn een Osterwalder businessmodelcanvas, een SWOT-analyse en een TOWS-matrix opgesteld om de knelpunten te identificeren en strategieën te formuleren. Causale diagrammen tonen hoe problemen, strategieën en spooraansluitingen samenhangen. Een eerste resultaat is een nieuwe typologie van bedrijven en hun respectievelijke spooraansluitingen. Deze indeling maakt onderliggende problemen en sterke punten per type zichtbaar. De belangrijkste problemen zijn stijgende kosten, onbetrouwbaarheid van het spoor en beperkte bruikbaarheid van de spooraansluiting als gevolg van regelgeving en niet-geëlektrificeerde infrastructuur. Om dit tegen te gaan worden zes strategieën voorgesteld, waarbij de invoering van een tweede infrabeheerder ter bestrijding van kosten en regeldruk, en gerichte infrastructuurinvesteringen, als de meest veelbelovende naar voren komen. Effectief beleid vereist maatwerk op basis van het type bedrijf en spooraansluiting. Dit kan de Nederlandse spoorsector versterken en de veerkracht van het transportsysteem vergroten.

Trefwoorden: Spooraansluiting, spoorgoederenvervoer, stamlijn, aftakspoor, spooraansluiting typologie, strategieën voor spoorgoederenvervoer

Summary

Private sidings are the physical gates via which companies gain access to the Dutch and European rail network. They are essential for the transport of goods by rail. However, the number of private sidings has fallen from over 900 to 168 today. This reduction leads to a loss of network as less other transport nodes such as suppliers or clients are available, rising costs for the remaining companies and a reduce of resilience. Smaller companies, in particular in urban areas, are struggling to maintain their private sidings as they often transport lower volumes in a less efficient way.

On the other hand, society's desire to reduce emissions, congestion, noise and accidents could be partly achieved by using more rail to transport freight. Despite these advantages, companies are closing their private sidings. Reasons for these closures are a lack of interoperability, strict regulations and a loss of network. These problems lead to overall rising costs and increasing unreliability of rail as a mode of transport. These problems make using rail as a transport mode less attractive which results in less companies using rail transport which results in the closure of private sidings. This puts pressure not only on private sidings, but on the resilience of the whole transport network as the position of rail is weakened.

To combat this unfavourable situation, this research proposes strategies to mitigate the problems faced by companies with private sidings. To reach these strategies this research introduces a new categorisation to make a distinction between private sidings. Other contributions are the establishment of the problems and possible strategies, and the causal diagram which combines these two. The essence of this research is captured in the main research question:

What strategies can help keep private rail sidings in the Netherlands operational in the long term?

This research question is supported by sub-questions to determine the current status and use of private sidings, to find out what the interests and roles of the stakeholders are, to identify the problems and future perspectives and finally to propose strategies to meet these challenges.

The methodology consists of three steps: in the first step, the private sidings are analysed and classified into four categories based on data, literature and stakeholder interviews. The second step analyses the problems using a SWOT model and the Osterwalder business model canvas. In the third step the strategies are developed based on a TWOS matrix. All these steps are supported by interviews with stakeholders.

In total, the research has identified problems that affect some or all of the companies with private sidings. These problems are not all directly related to private sidings, but as they weaken the advantages of using rail as a modality, they negatively influence private siding usage. The problems range from political to operational problems. Their impact is analysed by type. The main problems are:

- Companies with private sidings face rising costs of rail services due to high costs of staff and locomotives.
- Limited flexibility of rail network due to fixed train paths and overcrowded marshalling yards means that companies cannot operate their private siding to their full extent.
- Companies closing their private sidings due to a loss of network as more private sidings are closed, resulting in rising costs and reduced opportunities for cooperation.
- Companies with private sidings have to adhere to stricter regulations than those of the European Union when it comes to dangerous goods, which makes it harder to use the private siding.
- Problems with low waterway levels in inland waterway transport affects the amount of freight terminals transship, and thus impact the transshipment via their private sidings.
- The decrease of companies with private sidings can become a negative reinforcing loop, as the private sidings disappear, the ones left behind are facing increasing costs. Furthermore, the network becomes more scarce, thus making it harder to find other companies who use rail transport to transport to or from.

On the basis of the interviews, literature and data an Osterwalder business model canvas, SWOT and TOWS analysis are conducted, supported by causal diagrams. This resulted in six strategies which are proposed to mitigate the problems encountered by rail-using companies. The most important are:

- The introduction of a second infrastructure manager who can reduce costs by simplify regulations, lowering individual investments and reusing more materials.
- The use of clustering of investments and military cooperation to share infrastructure and investment costs.
- The use of the TEN-t network and lobbying to force new regulations and improve European interoperability.
- The use of marshalling yard measuring points to increase marshalling capacity by 25%.

The relation between the problems and strategies can be seen in figure 1. These strategies are established through the help of TOWS matrices, which are the result of a SWOT analysis. This SWOT analysis is based on the different types of companies and private sidings. Overall, the most promising strategies are the introduction of a second infrastructure manager and adding measurement points to shared infrastructure. These strategies are the quickest to implement and will have the highest impact.

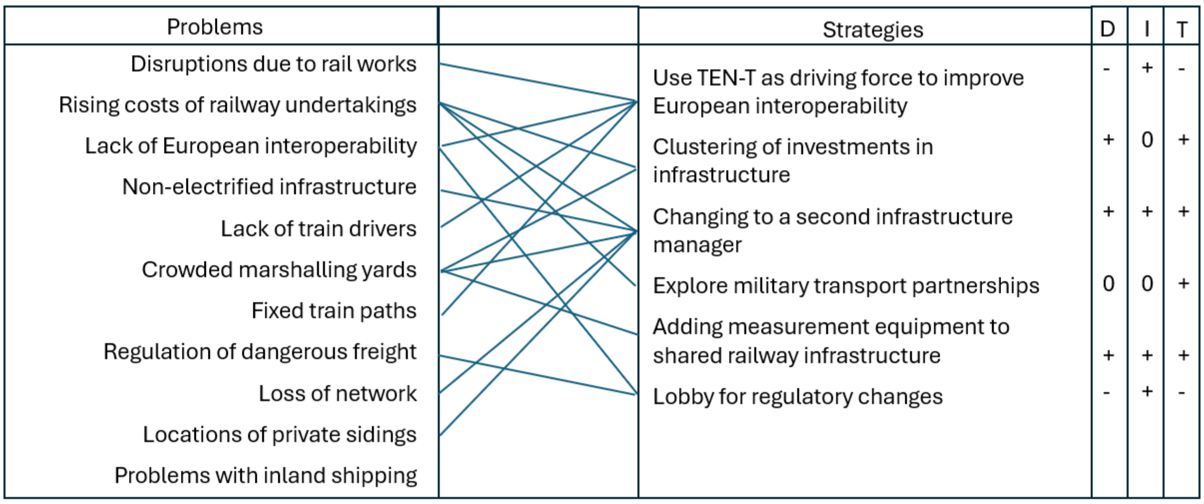

Figure 1: Problems, strategies and their impact

These strategies can alleviate some of the problems associated with private sidings, but not all of them. In particular, the smaller volume and with isolated location companies will still have difficulties in keeping their railways operational. Overall, the following conclusions can be drawn:

- Companies and their respective private sidings come in all shapes and sizes and a one-size-fits-all solution will not solve the problems. The scale and impact of the problems faced by companies and their private sidings vary greatly. Not all companies are equally affected by problems such as rising costs or unreliability of the rail network. Therefore the categorisation in this research is crucial to design strategies for different types of private sidings. This results in four different types.
- Large port (type 1) private sidings are relatively robust, although problems are beginning to emerge which may become very serious in the long term. The use of rail for inland terminals (type 2) is unexpectedly linked to the use of inland waterways, as the focus on inland waterways is the main modality. Lower water levels will mean less freight for transshipment, which results in less freight transported via the private siding. Large industry of type 3 is dependent on the use of rail. This means that when disruptions occur, they have no choice but to temporarily shut down their business processes. However, this does not mean that they stop using rail, even if this is costly. The smaller isolated type 4 companies are almost never in a position where using rail is a viable way of transporting freight if only the company and private siding itself is considered. The reason for staying with rail is often related to other reasons, such as improved logistics because the production plant is also served by rail.

- Some of the problems have realistic solutions, but most are not easy or quick to solve. One of the most promising strategies for private sidings, especially type 4, would be the introduction of a second infrastructure manager who would also take over the marshalling yards, while simplifying the regulations.
- While some regulatory changes may be sufficient for type 1 or 3 companies, type 4 companies will require an adaptive policy, which will need to be tailored to the individual characteristics of the private siding, such as location, available infrastructure and proximity to other private sidings.
- In concrete terms, the implementation of these strategies would require the Ministry of Infrastructure and Water Management to allow the second infrastructure manager more lenience to operate under simpler regulations, and ProRail should consider selling marshalling yards which are not part of the main railway lines to this infrastructure manager. Other concrete actions would be the installation of more measuring equipment on marshalling yards.
- Resilience is crucial for the rail sector, as disruptions and unreliability increasingly challenge the ability of companies and private sidings to continue operations. When private sidings disappear as a result, it weakens the overall resilience of the rail freight network, since each lost siding reduces flexibility and capacity across the system.

The limitation of this research was the qualitative nature of the research as interviews were the main research method. These interviews will not be free from bias or other personal opinions. In addition, access to reliable data was limited to public databases such as Eurostat and CBS Statline. ProRail was able to provide a useful rail map, but unfortunately it contained errors. This made the validation of the results more difficult.

Future research should focus on further exploring the strategies found in this research, researching more about the European context and how other countries deal with similar problems. Also, the role of private sidings in the resilience of the Dutch rail network or the Dutch transport network would be interesting to investigate.

Samenvatting

Spooraansluitingen zijn de fysieke toegangspoorten waarmee bedrijven toegang krijgen tot het Nederlandse en Europese spoornetwerk. Ze zijn essentieel voor het vervoer van goederen per spoor. Het aantal spooraansluitingen is echter gedaald van meer dan 900 naar 168 op dit moment. Deze afname leidt tot verlies van netwerk, stijgende kosten voor de overgebleven bedrijven en een afname van de veerkracht. Vooral kleinere bedrijven, met name in stedelijke gebieden, hebben moeite om hun spooraansluiting te behouden, aangezien zij vaak lagere volumes op een minder efficiënte manier vervoeren.

Tegelijkertijd kan de maatschappelijke wens om emissies, congestie, geluidsoverlast en ongevallen te verminderen deels worden gerealiseerd door meer goederenvervoer per spoor. Ondanks deze voordelen sluiten bedrijven hun spooraansluitingen. Redenen voor deze sluitingen zijn een gebrek aan interoperabiliteit, strikte regelgeving en het verdwijnen van netwerkverbindingen. Deze problemen leiden tot oplopende kosten en toenemende onbetrouwbaarheid van spoor als vervoersmodaliteit. Hierdoor wordt spoor minder aantrekkelijk voor bedrijven, wat resulteert in minder gebruikers van het spoor en dus nog meer sluitingen van spooraansluitingen. Dit zet niet alleen druk op de individuele spooraansluitingen, maar op de veerkracht van het gehele transportsysteem doordat de positie van spoor wordt verzwakt.

Om deze ongunstige situatie te keren, stelt dit onderzoek strategieën voor om de problemen aan te pakken waarmee bedrijven met spooraansluitingen worden geconfronteerd. Om tot deze strategieën te komen, introduceert dit onderzoek een nieuwe categorisering om onderscheid te maken tussen verschillende soorten spooraansluitingen. Andere bijdragen zijn het in kaart brengen van de problemen en mogelijke strategieën, en het causale diagram waarin deze twee worden gecombineerd. De essentie van dit onderzoek wordt samengevat in de centrale onderzoeksvraag: **Welke strategieën kunnen helpen om spooraansluitingen in Nederland op de lange termijn operationeel te houden?**

Deze onderzoeksvraag wordt ondersteund door deelvragen die gericht zijn op het bepalen van de huidige status en het gebruik van spooraansluitingen, het achterhalen van de belangen en rollen van stakeholders, het identificeren van de problemen en toekomstperspectieven, en tot slot het voorstellen van strategieën om deze uitdagingen het hoofd te bieden.

De methodologie bestaat uit drie stappen: in de eerste stap worden de spooraansluitingen geanalyseerd en gecategoriseerd in vier typen op basis van data, literatuur en interviews met stakeholders. De tweede stap analyseert de problemen aan de hand van een SWOT-model en het Osterwalder businessmodelcanvas. In de derde stap worden strategieën ontwikkeld op basis van een TOWS-matrix. Al deze stappen worden ondersteund door interviews met stakeholders.

Het onderzoek heeft in totaal problemen geïdentificeerd die van invloed zijn op sommige of alle bedrijven met spooraansluitingen. Deze variëren van politieke tot operationele aard. Hun impact wordt geanalyseerd per type aansluiting. De belangrijkste problemen zijn:

- Bedrijven met een spooraansluiting worden geconfronteerd met stijgende kosten voor spoorvervoer, onder andere door hoge personeelskosten en dure locomotieven.
- Beperkte flexibiliteit van het spoornetwerk, door vaste treinpaden en overvolle rangeerterreinen, zorgt ervoor dat bedrijven hun spooraansluiting niet optimaal kunnen benutten.
- Bedrijven sluiten hun spooraansluiting vanwege het verlies van netwerkcapaciteit; naarmate meer spooraansluitingen verdwijnen, nemen de kosten toe en worden samenwerkingsmogelijkheden beperkt.
- Bedrijven met een spooraansluiting moeten voldoen aan strengere regelgeving dan die van de Europese Unie met betrekking tot gevaarlijke stoffen, wat het gebruik van de aansluiting bemoeilijkt.
- Problemen met lage waterstanden op de binnenwateren beïnvloeden de hoeveelheid goederen die terminals kunnen overslaan, en hebben daardoor ook impact op het gebruik van spooraansluitingen voor overslag.

- De afname van het aantal bedrijven met een spooraansluiting kan leiden tot een negatieve vicieuze cirkel. Naarmate er meer spooraansluitingen verdwijnen, worden de overblijvende bedrijven geconfronteerd met stijgende kosten. Daarnaast wordt het netwerk schaarser, waardoor het moeilijker wordt om andere bedrijven te vinden die goederen per spoor willen vervoeren of ontvangen.

Op basis van interviews, literatuur en data zijn een Osterwalder businessmodelcanvas, een SWOT-analyse en een TOWS-analyse uitgevoerd, ondersteund door causale diagrammen. Dit heeft geleid tot zes voorgestelde strategieën om de problemen waarmee bedrijven met spooraansluitingen worden geconfronteerd, te verminderen. De belangrijkste hiervan is:

- De invoering van een tweede infrabeheerder die kosten kan verlagen door regelgeving te vereenvoudigen, individuele investeringen te beperken en meer materiaal her te gebruiken.
- Het clusteren van investeringen en het inzetten van militaire samenwerking om infrastructuur en investeringskosten te delen.
- Het benutten van het TEN-T-netwerk en lobbyactiviteiten om nieuwe regelgeving af te dwingen en de Europese interoperabiliteit te verbeteren.
- Het gebruik van meetpunten op rangeerterreinen om de capaciteit van rangeerprocessen met 25% te vergroten.

De relatie tussen de problemen en de voorgestelde strategieën is weergegeven in figuur 1. Over het geheel genomen blijken de meest kansrijke strategieën de invoering van een tweede infrabeheerder en het toevoegen van meetpunten aan gedeelde infrastructuur. Deze strategieën zijn het snelst te implementeren en zullen naar verwachting de grootste impact hebben.

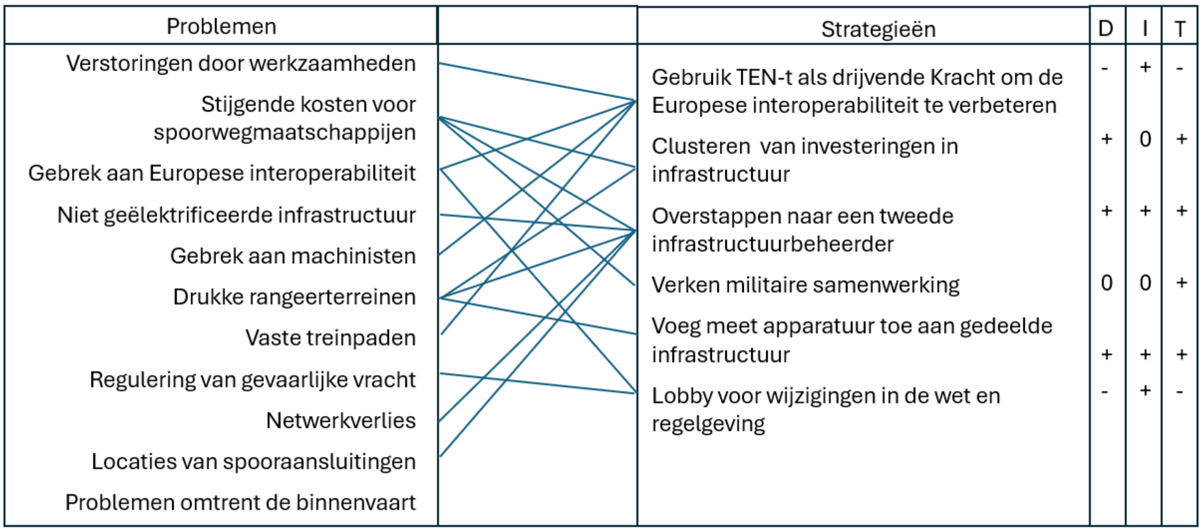

Figure 2: Problemen, strategieën en hun impact

Deze strategieën kunnen een aantal van de problemen rond spooraansluitingen verlichten, maar niet allemaal. Met name bedrijven met een laag volume en een geïsoleerde ligging (type 4) zullen nog steeds moeite hebben om hun spooraansluiting operationeel te houden. Op basis van het onderzoek kunnen de volgende conclusies worden getrokken:

- Bedrijven en hun respectievelijke spooraansluitingen zijn er in allerlei vormen en maten; een uniforme oplossing volstaat niet om de problemen op te lossen. De schaal en impact van de problemen waarmee bedrijven te maken hebben, verschillen sterk. Niet alle bedrijven worden in gelijke mate getroffen door bijvoorbeeld stijgende kosten of onbetrouwbaarheid van het spoornetwerk. Daarom is de in dit onderzoek ontwikkelde categorisering van cruciaal belang om gerichte strategieën te ontwerpen voor verschillende typen spooraansluitingen.
- Spooraansluitingen in grote havens (type 1) zijn relatief robuust, hoewel zich ook daar problemen beginnen af te tekenen die op langere termijn ernstig kunnen worden. Het gebruik van spoor bij

inland terminals (type 2) blijkt onverwacht sterk verbonden met de binnenvaart, aangezien binnenvaart daar de dominante modaliteit is. Lagere waterstanden leiden tot minder overslagvolume, wat weer leidt tot minder lading voor het spoor. Grote industriële bedrijven (type 3) zijn afhankelijk van rail. Dat betekent dat zij bij verstoringen soms hun bedrijfsprocessen tijdelijk moeten stilleggen, al blijven zij het spoor meestal gebruiken, zelfs als dat hoge kosten met zich meebrengt. Kleine, geïsoleerde type 4-bedrijven bevinden zich zelden in een positie waarin railvervoer rendabel is wanneer alleen wordt gekeken naar het bedrijf en de spooraansluiting zelf. De reden om toch bij rail te blijven is vaak gelegen in andere factoren, zoals logistieke voordelen doordat de productie-installatie via het spoor wordt beleverd.

- Voor sommige problemen bestaan realistische oplossingen, maar de meeste zijn niet eenvoudig of snel op te lossen. Een van de meest veelbelovende strategieën voor spooraansluitingen, vooral bij type 4, is de invoering van een tweede infrabeheerder die ook de rangeerterreinen beheert en de regelgeving vereenvoudigt.
- Terwijl voor type 1- of type 3-bedrijven een beperkte wijziging in regelgeving al voldoende kan zijn, vereisen type 4-bedrijven een adaptief beleid dat moet worden afgestemd op de specifieke kenmerken van de spooraansluiting, zoals ligging, beschikbare infrastructuur en nabijheid van andere aansluitingen.
- Concreet zou de uitvoering van deze strategieën vereisen dat het Ministerie van Infrastructuur en Waterstaat de tweede infrabeheerder meer ruimte geeft om te opereren onder vereenvoudigde regelgeving. Daarnaast zou ProRail moeten overwegen om rangeerterreinen die geen deel uitmaken van de hoofdspoorlijnen te verkopen aan deze infrabeheerder. Andere concrete maatregelen zijn het installeren van extra meetapparatuur op rangeerterreinen.
- Veerkracht is essentieel voor de spoorsector, omdat verstoringen en onbetrouwbaarheid het voor bedrijven en spooraansluitingen steeds moeilijker maken om operationeel te blijven. Wanneer spooraansluitingen daardoor verdwijnen, wordt de algehele veerkracht van het spoorgoederenvervoer aangetast, aangezien elke verloren aansluiting leidt tot minder flexibiliteit en capaciteit in het systeem.

Een beperking van dit onderzoek is het kwalitatieve karakter, aangezien interviews de voornaamste onderzoeksmethode vormden. Deze interviews zijn niet vrij van vooringenomenheid of persoonlijke opvattingen. Daarnaast was de toegang tot betrouwbare data beperkt tot publieke bronnen zoals Eurostat en CBS StatLine. ProRail kon wel een bruikbare spoorinfrastructuurkaart aanleveren, maar deze bevatte helaas fouten, wat de validatie van de resultaten bemoeilijkte.

Toekomstig onderzoek zou zich kunnen richten op het verder uitwerken van de in dit onderzoek voorgestelde strategieën, en op de Europese context: hoe gaan andere landen om met vergelijkbare problemen? Ook zou het interessant zijn om de rol van spooraansluitingen in de veerkracht van het Nederlandse spoornetwerk of het bredere transportsysteem nader te onderzoeken.

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Nomenclature

Abbreviations

Abbreviation	Definition
SWL	Single Wagonload
TEN-T	Trans European Transport Network
ITU	Interchangable Transport Unit
DAC	Digital Automatic Coupling
TEU	Twenty-foot Equivalent Unit
MWL	Multiple Wagonload

1 Introduction

First of all, this chapter will go into detail about the background and cause for this research. It explains why this research is necessary, what the research questions are after which it will present the rest of the research in the methodology.

1.1. Background

A private siding can be described as a piece of rail infrastructure that enables companies to use rail as a modality by providing the physical entrance and exit points of companies to the railway network. The private siding branches from the main railway line to a company nearby. Besides private sidings, also sidings exists that are used for train or track maintenance or access to rail museums. Private sidings contain all the sidings used by companies to transport freight. These entrance and exit points of the railway network used to be numerous, as the Netherlands contained over 900 private sidings around 1960 (Sporenplan, n.d.). This number has dropped, which means nowadays only 168 private sidings are left (Hofstra, 2024). The private sidings function as the entrance gates for companies to enter the railway network. This way they are an essential link in the logistical network of manufacturers, terminals and consuming companies. This trend of disappearing private sidings are most problematic for companies which are positioned in remote regions such as the north and east of the Netherlands and for companies with relatively small transport volumes. As more private sidings disappear, the structure of the railway network gets more coarse which makes that companies are less connected via the railway network. This leads to higher costs per company and a less feasible business case for the use of trains for transporting freight.

A striking example of this, are companies with private sidings who transport relatively small volumes and which are often located in a remote region. These companies are often reliant on rail transport, even though they only use small trains which consist of only a few wagons per transport (wagonload transport). These companies miss the scale advantages of other nearby rail using companies or terminals.

The rural and more remote areas where these private sidings are located, used to contain a finely meshed railway network, however as neighbouring companies stopped using their private sidings the clusters thinned out and the companies with a private siding which are left are facing rising infrastructure costs and more unreliability.

A second reason for this research can be found in the way the disappearance of the private sidings puts pressure on the future of the whole railway network. As the freight streams change from the inland to the large industrial areas around the ports and the network gets less coarse and only intensifies on the main corridors, the access to the railway network for the rest of the Netherlands is getting worse. This can lead to a mismatch between the social wish for environmentally friendly transport (European Commission, 2019) and the physical access of the railway network.

Freight transport using trains is from a social perspective one of the most environmentally friendly forms of transport. Railway transport has has external costs such as emissions, noise, accidents and congestion which are six times lower than that of road transport per tonne per transported kilometre (van Essen et al., 2011). This goes to show that when rail transport is effectively used, it is a valuable option in the variety of transport modalities which are available to companies who want to transport freight. Depending on the type of freight, this is also complemented by the characteristics of rail transport such as the ability to move large volumes over long distances.

In practice, companies with a private siding can be seen quitting and switching to other modalities. In many cases this is not due to the logistical unsuitability of rail, but because of other causes such as inflexibility, deficient regional clustering or complicated regulations. This puts pressure on the resilience of the logistical system as companies have less modalities to use at their disposal. The train can contribute to this mix of modailities by offering an alternative to congestion, low water level in the waterways, a lack of truck drivers or other disruptions to road and inland shipping transports. This resilience which rail offers is not only suited for individual companies, but can help strengthen the whole logistical network which underlines the value of the conservation and development of rail access points for companies.

1.2. Research gap

Private sidings form essential parts of freight transport per train. Every active private siding generates rail freight traffic. The amount of operational private sidings can be seen as a way of measuring competitive strength of rail in a country (Drewnowski, 2019).

Although European railway undertakings mostly provide ”terminal-to-terminal” services, the supply chain of companies also requires an integrated ”door-to-door” approach where railway undertakings provide this service (Islam, 2014). In this context, private sidings are an essential but vulnerable part of the logistics infrastructure. These private sidings facilitate a direct connection to the railway network for the company using the private siding and reduce the dependency on other last mile solutions.

A technical barrier to the operation of such private sidings is the fact that the main railway network is largely electrified, while the infrastructure of the private siding is often not electrified and can only be accessed by diesel locomotives. Although hybrid locomotives are available and can be cost effective in the long term, their purchase price is higher, which is a barrier to wider use (Islam et al., 2016). At the same time, research highlights the importance of maintaining infrastructure to facilitate single wagonload (SWL) traffic, such as marshalling yards and private sidings (Pittman et al., 2020).

However, the availability of private sidings is under pressure. In countries such as Poland the number of private sidings has decreased significantly since 1989 due to increasing legal and formal requirements (Pittman et al., 2020). Also in a broader sense, when faced with financial pressure, railway undertakings first decide to reduce unprofitable SWL services, which indirectly leads to the closure of private sidings (Guglielminetti et al., 2017). This undermines the accessibility of the rail network.

At the same time, there are countries where private sidings play a crucial role. In Turkey, for example, it is estimated that 50 to 60% of rail freight is carried on a private siding. However, high maintenance costs and administrative burdens form barriers for companies to operate a private siding (Çelebi, 2023).

Most of the literature focuses on European countries other than the Netherlands, more general topics such as modal shift from road to rail or specific topics related to private sidings such as single wagonload traffic. None of these studies focuses on the private siding itself, which connects the company to the rail network. This specific focus is important because there is a difference between a private siding in a large port and a private siding in, for example, the north of the Netherlands. Among the available literature, the study by Guglielminetti et al., 2017 provides the most thorough description of the current situation. However, this study mostly focusses on smaller private sidings which use SWL services. This essential when deciding what type of solution is needed.

These studies emphasise the importance of the role of private sidings and the fact that companies with private sidings are struggling to keep them open. But these studies do not talk about the specific problems that these private sidings companies are experiencing and how they can be solved. It would therefore be useful to delve deeper into this issue and find out what the specific problems are that private sidings face and how and to what extent these problems can be mitigated.

In order to do this, it is necessary to know more about the role of private sidings in the Dutch railway network and which institutions and companies are involved.

This research aims to fill these gaps by analysing and categorising private sidings, analysing the business models of private sidings and constructing strategies for the future based on literature, data and interviews with stakeholders.

1.3. Research questions

The background of the research described above and the research gap leads to a set of research questions which will answer and fill the research gap. The main research question is as follows:

What strategies can help keep private rail sidings in the Netherlands operational in the long term?

This research question can be answered by breaking it down into several sub-questions, namely:

1. What is the structure and operational context of private sidings within the Dutch rail freight system?
2. What types of private sidings exist in the Netherlands and how are they utilised by different categories of companies?
3. What challenges and developments affect the use and continuity of private sidings?
4. What strategies can address the challenges private sidings are faced with?

Sub-question 1 is meant to first describe the current situation in which the private sidings are used. For example, what organisations interact with them? Who owns, invests, regulates, maintains, benefits from or decides on private sidings? This provides a basis for the rest of the research. This question is answered in chapter 2.

Sub-question 2 focuses on the companies that are linked to the private sidings. This questions tries to unravel what types of private sidings exist and what the differences there are between them. It also tries to answer how the companies use the different types of private sidings. This question is answered in chapter 3.

Sub-question 3 dives deeper into what problems the private sidings and the companies around them experience. This shows how the problems are caused and how the problems relate to each other. All of this information can be found in chapter 4.

Finally sub-question 4 will use all the gathered information to establish strategies for the private sidings to help them and secure their position in the logistical network. The strategies are linked back to the problems and the impact of the strategies is shown. This information can be found in chapter 5.

After these questions are all answered, it will be possible to form an answer to the main research question.

1.4. Methodology

The general methodology is shown in figure 1.1 below and it consists of three parts. The first part is the analysis of the private sidings and their greater spur line counter parts. This is be based on data, literature and interviews, which together can be processed into a overview map and business model canvasses of the companies using the private sidings. This results in a categorisation of the private sidings which can be used to answer sub question 1.

The second part, the stories and conflicts of the different types of private sidings are determined. The scope is widened again and this is where the majority of the interviews are performed. Supported by data and literature this triangulation is formed into a SWOT analysis to understand the private sidings, a stakeholder diagram to determine who benefits from and influences what, and a system diagram to understand the role of the private sidings.

For the third part, the next step is to make a TWOS from the SWOT, which helps to formulate strategies. The strategies are presented to different stakeholders. The feedback from the stakeholders provides a final opportunity to refine the strategies. This is ultimately used to answer sub question 4.

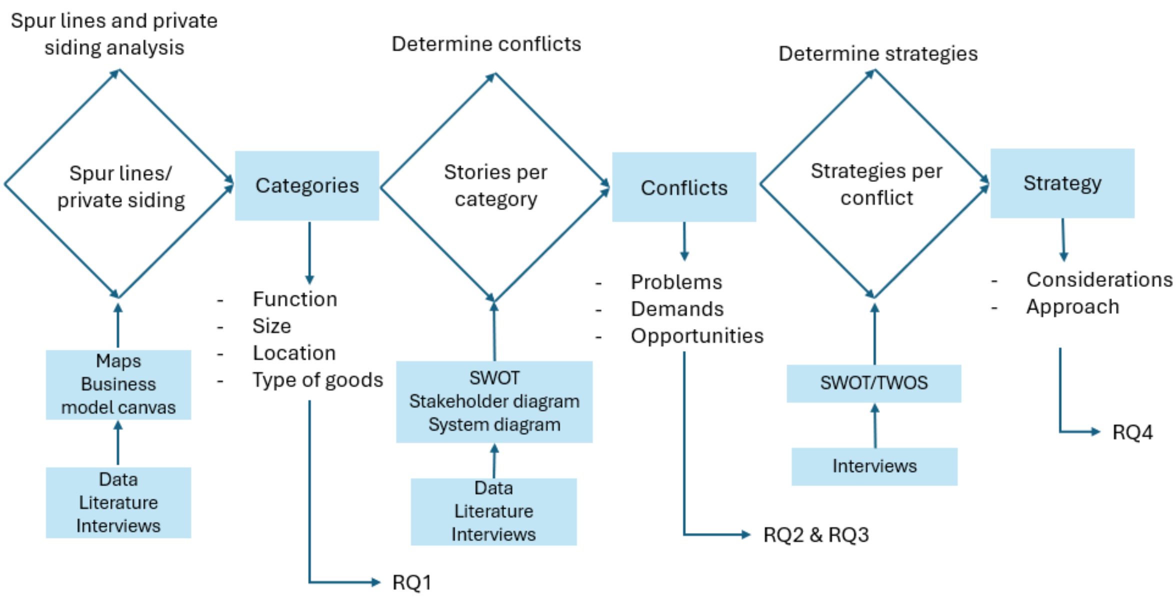


Figure 1.1: Overview of the methodology

1.4.0.1. Osterwalder business model canvas

The Osterwalder business modal canvas is a way to analyse a company and distillate what its value propositions are (Osterwalder et al., 2010). This is done by describing the customer relations, equipment and services needed to operate and its cost structure. In the context of this research, this is done to show how the private siding plays a different role in different types of companies.

1.4.0.2. Stakeholder & system diagrams

The diagrams provide an overview of a complex system by turning it in a visual. With arrows and icons the system is explained. This can be done between stakeholders as is the case in the stakeholder diagram or with goods between the layers of a company as is the case in the system diagram. In both cases the diagram is a tool to structure and analyse the system at hand and to help the reader understand what is going on.

1.4.0.3. SWOT analysis

A SWOT (Strengths, weaknesses, opportunities, threats) analysis is a way of looking at the situation of a company or part of a company (Humphrey, 2005). In this case the SWOT is used to analyse the position of a private siding in the context of a specific type of company, for example for a terminal. This shows the problems the use of a private siding induces, but also the opportunities which the company can use to improve its situation. For this research this helps to understand the stories of the different types of companies with private sidings.

1.4.0.4. TOWS analysis

A TWOS analysis is a way of making strategies from the results of the SWOT by using strengths to exploit weaknesses, overcoming weaknesses to exploit opportunities, using strengths to meet threats and overcoming weaknesses to avoid threats (Weihrich, 1982). This is illustrated visually in figure 1.1. In this research, this method is used to construct the strategies needed to answer sub question 4.

	Strengths	**Weaknesses**
Opportunities	Strengths to take advantage of opportunities	Overcoming weaknesses to take advantage of opportunities
Threats	Strengths to face threats	Overcoming weaknesses to avoid threats

Table 1.1: General TWOS matrix

2
How the rail system works

This chapter answers sub question 1 and explains how the rail system works in order to establish a basic understanding. This understanding is necessary to understand the context of the information from the interviews. This chapter will go into the details of the private siding itself, and the place of the private siding in the company and the railway system. It also talks about the different types of trains making use of the private siding, as well as the type of freight moved using a private siding. Lastly it will also explain what stakeholders are operating in the rail sector.

This information is used to answer sub question 1, which is:

What is the structure and operational context of private sidings within the Dutch rail freight system?

2.1. The role of private sidings in the rail transport system

This section explains the place of a private siding in the whole system. It will explain the different layers of the system and the system boundaries.

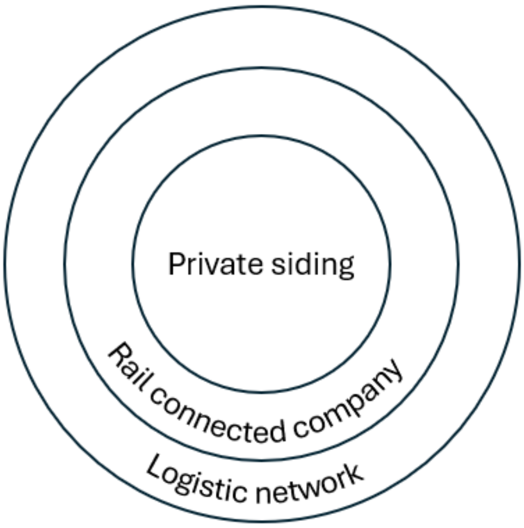


Figure 2.1: System diagram of private siding

Above, in figure 2.1, a simple system diagram can be seen of a private siding and the layers that surround a private siding. The private siding itself is part of a company which transports its goods using trains. The private siding is the access point of the company to the railway network. This company can be a production plant, but it can also be a terminal, storage facility or another company which uses rail. It could also be a workshop of a rail operator, but this research only focuses on the private sidings used for freight. The company is part of a larger logistical network of suppliers, buyers, manufacturers and terminals. The company can trade and make deals with the other companies in the system.

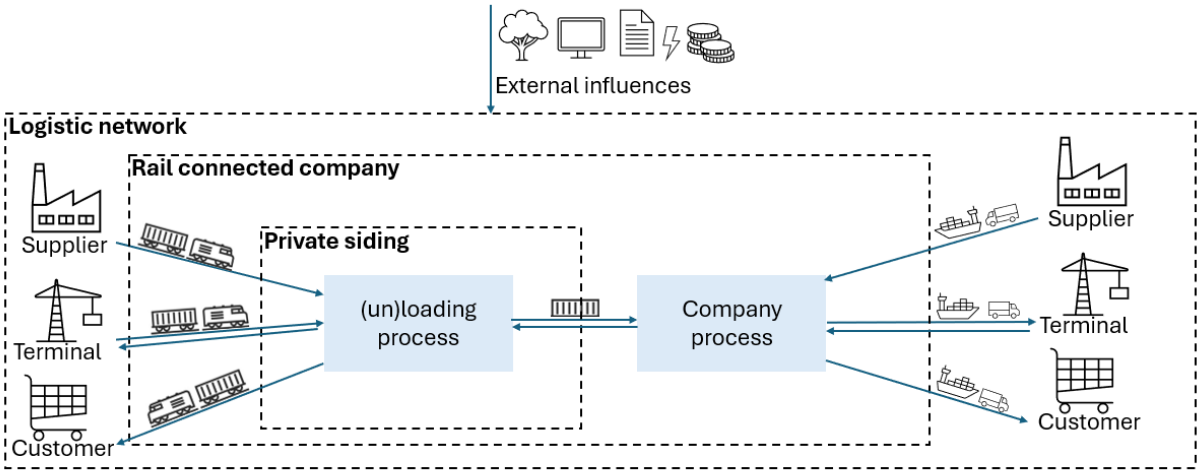


Figure 2.2: Boundary diagram of private siding and surrounding system

Figure 2.2 shows the complete system with the boundaries between the layers. In the middle, the private siding is visible which receives or exports trains with freight from either a supplier or a terminal, or to a terminal or customer. The freight unloaded or loaded at the private siding moves to or from the company process, which can be a manufacturing process, for example. As rail is often not the only modality used by a company, the company also transports freight using other modalities such as road or shipping. This is illustrated on the right of the visual.

As can be seen the private siding itself is not part of the company process. It is a way of transferring freight to another modality. The private siding itself consists of the infrastructure running from the main line to the company. Dependent on the private siding switches, lights or signs are necessary for the safety and an efficient operation.

This network is also subject to external influences such as changes to the economy, energy transition, climate adaptations and rules, digitisation and laws and regulations which are being imposed from outside. This shows how a private siding cannot only be seen as a separate system but that it is part of a larger system.

The private siding can be seen as one of the many parts of a company which is in its turn part of the larger logistical network. However, a private siding can also be seen as an endpoint of the railway network. The railway network is a large cluster of pathways and railway lines which ultimately end somewhere in a place where goods can be loaded or unloaded. So these endings of the network are the private sidings. This can be seen in figure 2.3. The figure also shows the location of a large Dutch marshalling yard called Kijfhoek. This is an important part of the Dutch railway network.

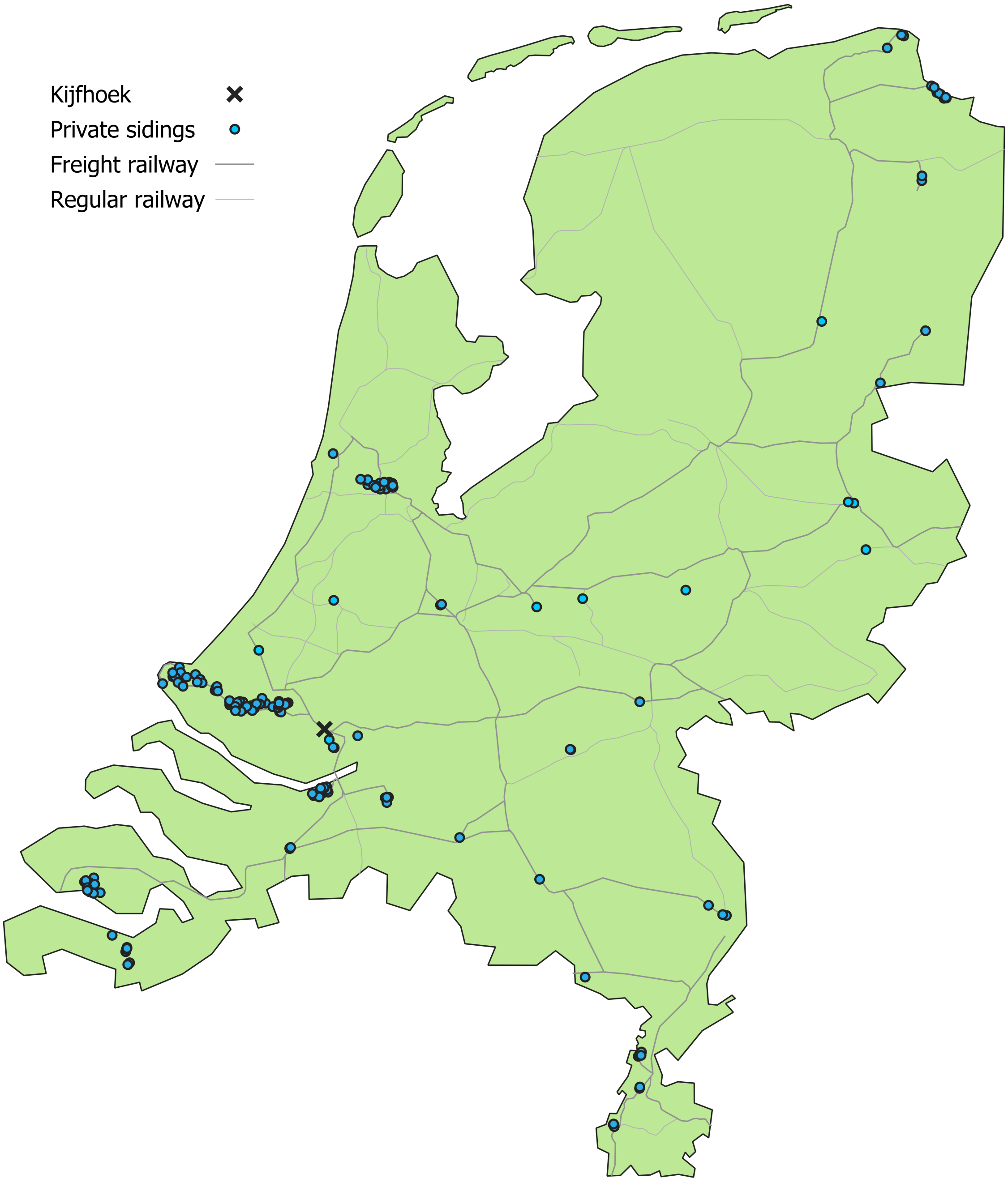


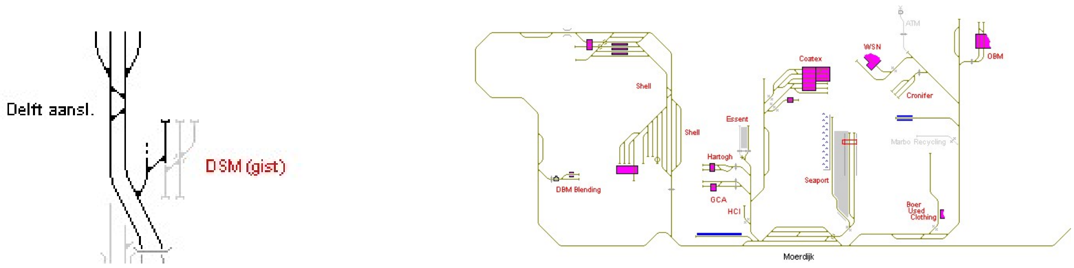
Figure 2.3: Map of all private sidings in the Netherlands

As the map shows, the private sidings are the end of the railway network for the trains. This is especially visualised in the north of the country, as the railway tracks marked in gray clearly end at the private sidings. For the goods transported by the trains on the other hand, the private sidings only a transfer point. From the private sidings onward the goods enter another transport modality, a factory to be processed or a final selling point.

Ultimately the private siding is only part of a much bigger system which also influences the private siding. For example, interviewee B.2.2.4 explained how their Dutch private siding is not necessarily beneficial on its own for the company, but as they also have factories in other places in Europe the advantage of a direct rail connection outweighs the disadvantages of having a private siding at their Dutch distribution centre.

There are two main types of private sidings. The first can be seen in figure 2.4a. This is a simple private siding on its own. The main railway line is visible on the left with a fork which branches out to the right. This part on the right is the private siding. The private siding starts at the fork with the main railway line.

On the right in figure 2.4b a larger network is visible. This is a spur line which means that it is a cluster of private sidings connected to a separate railway line. A shared emplacement is often also part of the cluster, which can be used as a marshalling yard. The marshalling yard in this figure can be found at the bottom. An overview of the spur lines in the Netherlands can be found in appendix A.2.4.



(a) A single private siding (DSM) **(b)** A spur line with multiple private sidings (Moerdijk)

Figure 2.4: Two forms of private siding. *source: Sporenplan.nl, n.d.

2.2. Connecting function of rail sidings

The goal of this section is to explain what types of rail transport are available to companies in possesion of a private siding. The different types of rail freight traffic are discussed and the role they play for a private siding.

This section gives an overview of the different types of railway transport which are visualised in figure 2.5. A train is made up of wagons. This can be a full/block train which is a complete train of around 30 to 50 wagons. These trains typically transport only one type of freight, but in large quantity. The other option is a full wagon, which is a much smaller quantity, namely only a wagon. This can be split into either single or multiple wagonload, which is just a small part of a train, or a multimodal option, such as a container which goes with a truck from the company to a terminal where it is loaded onto a train. In 2023 the share of multimodal rail transport was 46% in terms of gross weight transported (Eurostat, 2024).

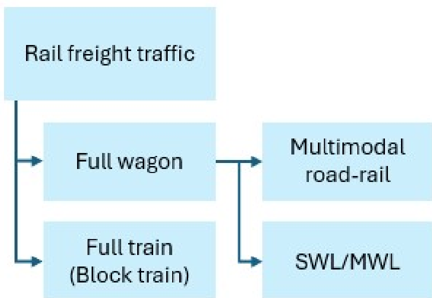


Figure 2.5: Rail transport types

These three types of rail transport are visualised in figure 2.6 with on top the blocktrain which simply drives from origin to destination, in the middle the wagonload transport which leaves the origin as a small train and can be assembled and reassembled multiple times during its journey. This process is called shunting, and happens at a marshalling yard. At the bottom of the figure, the multimodal road-rail option is shown. In multimodal road-rail, the transport via train can be combined with inland shipping, or with a terminal at one end and a private siding at the other end.

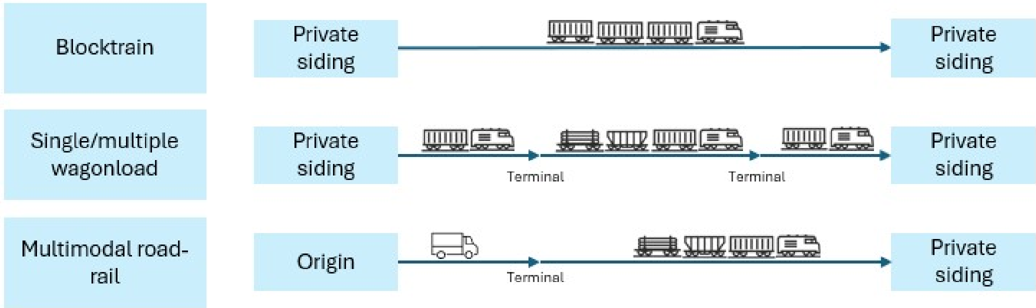


Figure 2.6: Train types

2.2.1. Block trains

Here the function of block trains is explained, as well as how they benefit a company with a private siding. Block trains are the large volume trains. This type of train is best suited to longer distances, but can also perform well on shorter distances if the volume is right (B.2.2.8). The value proposition of a block train is its ability to transport high volumes over large distances. Other advantages of the block train are its ability to carry dangerous goods. The block train is mostly used by companies such as terminals or large industrial companies who require large volumes to be transported. Another strength of the block train is its ability to drive directly to a customer without shunting operations. Overall, the block train is a relatively straightforward way of transporting goods. The private siding is a way for the railway operator to directly access the place where they need to pick up or deliver freight. So the railway operator is dependent on enough companies using their private siding.

2.2.2. Wagonload transport

Wagonload transport is the transport of a few or even one wagon at a time. It is also known as single wagonload (SWL) or multiple wagonload (MWL) and is suitable for origins and destinations with smaller volumes. Running a wagonload service often requires shunting to combine several wagonload services. Shunting costs money as more handling is required. Wagonload traffic is suitable for customers with smaller volumes, the regional spread of these customers is important, as the shorter the individual leg of the journey and the longer the combined leg, the more feasible wagonload traffic becomes. Wagonload traffic requires more extensive logistics and planning software and infrastructure, as more transshipment operations are required. Also the distance to connecting points such as a marshalling yard is important. The Netherlands only has one large marshalling yard which transports almost all wagonload transport. Overall, wagonload transport is more difficult to implement due to the extra steps necessary and the smaller transport volumes. However, with the right conditions, such as regional concentration, proximity to marshalling yards and long combined legs, it can overcome its obstacles. The private siding is a way for the railway operator to directly access the place where they need to pick up or deliver freight. So the railway operator is very dependent on enough companies owning and using their private siding.

2.3. What types of freight is being transported using trains

This section explains what freight is moved with trains and how this compares to other modalities. The full explanation can be found in appendix C. The goal of this section is to show in what the types of goods are that trains typically transports in what types of trains.

The Dutch railway market is only a few percent of the total freight sector. The sector is dominated by road transport, followed by inland waterways (Centraal Bureau voor de Statistiek, n.d.). Private sidings are used for a broad scale of freight types. Overall these can be categorised in dry bulk, wet bulk/dangerous freight, containers, general goods and waste/recycling. Dry bulk are unpackaged solid cargo such as coal, ores, minerals and grain. These are mostly transported in large quantities. Traditionally this is a large part of the transported volume in the Netherlands (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024). Sectors that needs trains to transport these goods are energy (coal), steel industry (ores), construction (stone, cement, sand) and agro industry (grain and animal feed). This freight is mostly transported with the help of private sidings at either a terminal or directly at the factory (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024).

Wet bulk can be in liquid or gaseous form, and are often classified as dangerous cargo. This cargo can be crude oil, petroleum products (petrol, diesel, kerosene), chemicals (fertilisers, methanol, naphtha) and gases (LPG, chlorine, ammonia). About 10% of the rail cargo consists of dangerous freight (Ministerie van Infrastructuur en Waterstaat, 2022). Sectors using this freight are the chemical industry and petrochemical/refining industry. These companies often have a private siding to load or unload tank wagons.

Containers are often part of intermodal transport and nowadays form the largest part of the rail freight (44%) (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024). Containers are often transshipped at rail terminals in the port of Rotterdam for example. These containers are used by a lot of sectors such as industry or consumer products. Containers are often moved using a shuttle train. These shuttle trains operate as block trains specifically for containers (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024). Private sidings play an indirect role, most of them are used by terminals to transship the containers.

Table 2.1: Transported volume per freight type by rail in the Netherlands(2022)
Estimated based on data from CBS data and KiM.
Sources:(Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024)(Centraal Bureau voor de Statistiek, 2023a)(Centraal Bureau voor de Statistiek, n.d.)(Ministerie van Infrastructuur en Waterstaat, 2022)

Freight type	Volume 2022 (mln ton)	Percentage of total
Containers	19,6	44%
Coal	approx. 9,5–9,6*	∼21–22%
Metal ores	approx. 4,7*	∼10–12%
Chemical products	3,3	∼7%
Metals	2,3	∼5%
Other goods (such as construction materials, agro, waste)	4,9	∼11%
Total	**44,5**	**100%**

*

2022 was a peak year with about 44.5 million tonnes of rail freight. In 2023 this dropped to 39.3 million tonnes. Overall containers, coal and ores are dominant when it comes to transported freight.

Table 2.2: Number and share of freight trains by train type on Dutch border crossings in 2022
Source: (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024)

Train type	Number of trains (2022)	Share of total
Container shuttles	26,900	44%
Block trains (coal)	7,750	13%
Block trains (iron ore)	2,700	4%
Block trains (liquid/dry bulk and other)	10,300	17%
Wagonload trains	10,400	17%
Unknown type	1,600	3%
Total	**61,550**	**100%**

The majority of the Dutch rail freight is passing the border, this is about 80% (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024). As can be seen in table 2.2, the majority of this freight is containers, which are moved by a container shuttle. The other block trains make up 34% of the mix and another 17% percent of the freight is moved by wagonload transport.

2.4. Rail infrastructure governance

This section explains how the different stakeholders work together, who decides on what and who benefits from private sidings. This is done by using a RACI table which shows accountability and responsibility. Furthermore a stakeholder diagram visualises the relations between the stakeholders.

Most of the Dutch rail infrastructure is owned by the Railinfratrust. The Ministry of Infrastructure and Water Management owns Railinfratrust. Part of Railinfratrust is ProRail which manages the infrastructure, this infrastructure is the main railway line ("Hoofdspoorweg Infrastructuur" or HSWI) and most of the non-HSWI such as emplacements, freight infrastructure and shunting yards. The goal of the Ministry of Infrastructure and Water Management is to reinforce and maintain the logistical network of the

Netherlands. Some of the connections to the main railway such as private sidings are owned by private companies. These companies can own and manage their own private sidings. However, some of these private sidings owners employ Strukton Rail Shortlines to do this work for them. More about this can be found in paragraph D.3.1. A visual representation can be seen below in figure 2.7. The goal of the companies with the private sidings is to be competitive and make a profit. For them the private siding is a way of transporting their goods.

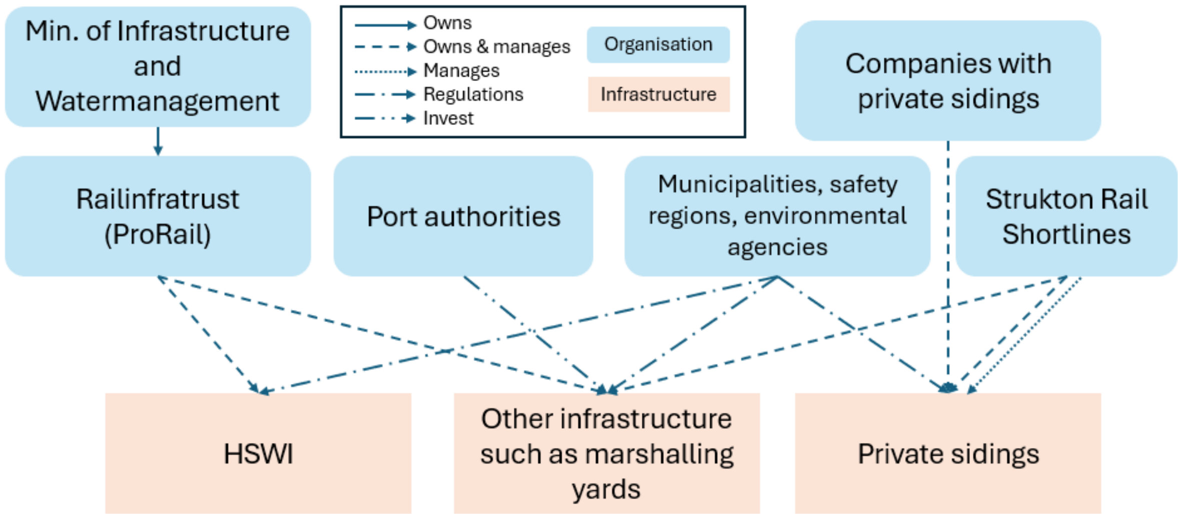


Figure 2.7: Visual of ownership and management of various infrastructure

Other stakeholders are the port authorities. They control the ports and invest in the infrastructure of the ports. When it is in the port's interest they are sometimes willing to invest in rail infrastructure if this improves the port. So they can influence the private sidings and the other infrastructure in the port by investing money. Their interest is to improve the competitive position of their ports.

ProRail plays a central role in carrying out the policy of the Ministry of Infrastructure and Watermanagement. The rail carriers are responsible of requesting space on the railway line at ProRail on behalf of the companies wanting to use rail to transport freight (B.2.2.16). As they are a rail management organisation, their goal is to maintain the Dutch rail infrastructure. Accountability and responsibility of these various stakeholders can be found below in figure 2.3. A RACI modelis a way of seeing which stakeholder is accountable (A), responsible (R) or has to be consulted (C) or informed (I) on a certain action (Smith et al., 2005). This RACI model helps to understand who decides on what topics when it comes to the private sidings and other rail infrastructure. This way it becomes clear who can act and make changes to the current situation in favour or against private sidings. This ultimately helps to understand who can act on which strategies The RACI is constructed based on the information in the policy document (Van Breukelen, 2024), and the exploratory interviews (B.1.0.4)(B.1.0.1).

Table 2.3: RACI model of the stakeholders planning and operating rail infrastructure projects.

	I&W	ProRail	Municipality	Province	Rail carrier	Private siding
Policy making	A	R	I	I	I	I
Infrastructure planning	C	A/R	C	C	I	I
Capacity distribution	I	A/R	I	I	C	I
Capacity request		C			R	A
Zoning plans	I	C	A/R	I	I	I
Request infrastructural change	I	C	C	C	I	A/R

Municipalities can also decide to invest money in companies using rail transport as a form of subsidy (B.2.2.14). Provinces have limited power over the railways but they can also use subsidies to encourage transport using rail. Their goals around rail and private sidings are varying. These goals can be to strengthen their local position, to remove trucks and other road vehicles from the road. These goals often have to stay within regulation to protect their local nature or citizens from dangerous freight, noise or other rail related nuisance.

Apart from the regular operation, there are parties who can add regulations to the railway infrastructure and the trains that drive there. These regulations have to do with dangerous goods, noise or other types of nuisance. Such parties are the safety regions and the regional environmental agency. These rules are often put on top of already existing national rules (B.3.0.7) Municipalities are in charge of constructing the zoning plans and thus they have influence on where there can and cannot be rail infrastructure, which has to fit together in the urban development plans.

2.5. ProRail policy

This section explains the policy surrounding private sidings.

The only policy with a dedicated focus on private sidings is ProRail's policy when to transfer infrastructure to companies with private sidings (Van Breukelen, 2024). The policy helps to decide when ProRail should or shouldn't transfer infrastructure to private sidings. The starting point is to transfer as much of the non-HSWI to rail users as ProRail wants to focus on the main railway lines and shared infrastructure. The guidelines are explained below:

ProRail should keep the HSWI if the infrastructure serves a public function such as: multiple companies use the infrastructure or the infrastructure is a public marshalling yard. The HSWI is also kept when the infrastructure is strategically relevant. For example, the infrastructure could become relevant in the near future when expansion of the network is needed. Another reason can be technical dependance. For example, the infrastructure at hand shares crossings or overhead lines with the main railway line. Lastly, ProRail should keep the infrastructure if it is a centrally served area (Centraal bediend gebied). A transfer of infrastructure would also mean an unwanted transfer of control of the timetable scheduling.

ProRail should transfer the HSWI when the infrastructure only serves one private company. For example, all but one companies have stopped using a spur line, then the last company will need to take ownership of the infrastructure. Another reason could be if the infrastructure has no current or future function. This will mean the infrastructure will be removed. In some cases a party will have interest in taking over the ownership of the infrastructure.

When infrastructure is transferred to a private party, the connecting switch and associated signs will remain with ProRail as ProRail wants to remain complete owner and manager of the infrastructure of the main line. The costs of maintaining these switches and signs are to be paid by the connecting party.

Changes to the infrastructure can follow two processes (B.2.2.11). New infrastructure as well as new private sidings have to follow a rather elaborate process called "Kernproces MIRT Programma's"or core process MIRT program. Smaller infrastructural changes such as the transfer of infrastructure from ProRail to a company with a private siding can be done using the "Procesbeschrijving overdracht HSWI aan derden" or process description for the transfer of main rail infrastructure (HSWI) to third parties. This process is less elaborate and can be continued faster.

Core process MIRT program This process follows four steps (preparation, exploration, planning and studies and construction). These four steps are split by decision moments (ProRail, 2024a). This whole process can take at least two years to complete. For the construction of a private siding, a sum of 1.5 million euros is not uncommon (B.2.2.11).

Process description for the transfer of main rail infrastructure (HSWI) to third parties The process for a smaller infrastructural change, such as an extension or taking over ProRail infrastructure is simpler. The process contains a policy, technical and financial check. Hereafter a consultion with IenW and the rail carriers will be done after which the construction can start.

2.6. Conclusion

On the basis of the findings, we can answer sub-question 1, which is:

What is the structure and operational context of private sidings within the Dutch rail freight system?

The private sidings form the physical entrance and exit gates of the Dutch railway network. They enable companies to access the network in order to transport their freight, this way they fulfil a crucial role in the logistical chain for industrial companies and terminals. The structure of the rail network is build in a way where ProRail maintains the main railway lines and a lot of smaller railway lines. The companies own and maintain their own private sidings. However, they can outsource this to other companies such as Strukton Rail Shortlines.

The operational context of the private sidings is strongly intertwined with the logistical network. The private siding itself is not part of the production process of the company, but functions as a point to switch modalities. From here the freight can be transported further into a company, or on to another modality such as road transport or inland shipping.

A large part of the rail transport, which originates from private sidings, consists of block trains such as container shuttles, coal, iron ore and other trains with bulk goods. Wagonload trains make up around 17% of the overall rail freight volume.

The stakeholders can be identified as the companies operating private sidings, the infrastructure managers such as ProRail and Strukton Rail Shortlines, the Ministry of Infrastructure and Water Management, rail freight operators, municipalities and provinces.

The Ministry of Infrastructure and Water Management is rarely present, its interests are represented by ProRail. The aim of ProRail is to maintain the shared railway infrastructure. This means that any infrastructure that is not used by more than one company must become the property of the company that uses it. ProRail is trying to stimulate the use of rail for freight transport, mainly by investing in the large freight networks such as the port of Rotterdam, the Kijfhoek and the Betuweroute. ProRail is responsible for the construction and maintenance of all the ministry's infrastructure. The ministry is also responsible for the zoning plans of the areas where the main lines (HSWI) are located (B.2.2.12).

Strukton Rail Shortlines tries to fill the gap between the private sidings and ProRail's main infrastructure. As a private company, it tries to reduce the costs of the infrastructure it owns in order to make money in the long term.

The interest of companies using private sidings is to use them to transport their freight as efficiently and cheaply as possible. But other reasons for using rail, such as resilience could also be a possibility. For production companies, this simply means getting freight in and out of their facilities as efficiently as possible, which can be done on a smaller (wagonload) scale or a larger (block train) scale. For terminals, it means a fast transshipment process that can handle large volumes.

The aim of the railway companies is to make a profit from the transport of goods by rail. Wagonload traffic is a problem because it is often less profitable, which has to be compensated by operating their block trains. The railway companies are responsible for transporting the freight from a private siding at the origin to a private siding at the destination. In the meantime, the railway company often uses marshalling yards to optimise its operations.

Municipalities have different interests. Some municipalities want to use rail to get trucks out of their city, some want more sustainability, while others want to support industry and employment in their city. The city decides on the development plans of companies with a private siding, which means that it has a say in where the private sidings are located. The province has a limited role when it comes to private sidings. It can use money to support projects.

Overall the main stakeholders are the companies who own and maintain the private sidings, ProRail who manages the railway lines, and the railway undertakings who are responsible for the safe transport of the freight.

3 Users of private sidings

This chapter will answer research sub question 2 and explain in detail the categories of companies and their respective private sidings. First an overview of the categories is given, then the types of companies with private sidings are explained one by one. For each type, the characteristics are presented, supported by an Osterwalder business model canvas. Each type is also accompanied by a map to give an idea of where the private sidings are located. This section will also explain the resilience, utilisation, the external influences, and the costs and benefits of the specific types.

3.1. Overview of categories

First a broad overview of the different types of companies with private sidings is presented and how this categorisation is made.

Companies with private sidings can be broadly categorised into 4 different types. The first and second round of interviews show that volume of transported goods and location are the most important factors when it comes to how well companies with private sidings operate. The location based distinction can roughly be seen as companies close to large maritime ports (type 1), inland terminals which are often located on strategic locations (type 2) and other companies in less strategic locations. These type can be divided in a company with large transport volumes (type 3) and a company with small transport volumes (type 4) These types are based on the volume of goods they carry and the region in which the company is located. These distinctions can be found in the table 3.1. The four types are listed below:

- Type 1: Companies in a large port with a private sidings
- Type 2: Inland terminals with private sidings
- Type 3: Large industrial companies with private sidings
- Type 4: Companies with private sidings which transport smaller volumes

The table below categorises which company falls into which category. Type 1 are those in major ports such as the port of Rotterdam. Type 2 are inland terminals specialised in transshipment to rail. Type 3 are large industrial companies. These are large enough to be less dependent on the proximity of other companies with private sidings. Type 4 are companies which handle smaller volumes and cannot benefit from the economies of scale of type 3. Often these type 4 companies are also more spread out throughout the country.

Table (3.1) below shows how the different companies are categorised into different types. The horizontal row describes the area in which the private siding is located. The vertical row describes the volume carried by the private siding.

Table 3.1: Types of private sidings based on their location and transported volume

	Large port	Industrial cluster	Small port/cluster	Other
Large volume	1A	3	3	3
Small volume	1B	4A	4A	4B
Terminal	1C	2	2	2

In order to identify high volume private sidings, the minimum number of trains must be around 3 to 4 per week. This is based on the "Overzicht infra 2030" map from ProRail (Hofstra, 2024). The difference between a large and a small cluster is around 2000 trains per year (Demmers and Van Es, 2025). These limits are based on the interviews. For example, interviewee B.2.2.2 indicated that around 3 to 4 trains is the point at which a private siding can start to benefit from the frequency that this number provides. The borders between the different types can be a little vague. Some of the companies have a varying usage. Some companies run very small trains but on a high frequency or the other way around.

3.2. The private sidings

This section deals with the different types one by one to explain how types differ from each other. The section goes into detail about what type of freight is transported and where the private sidings are located. This all helps to understand the context in which the companies and their private sidings are operating.

3.2.1. Type 1: Large ports

The major ports are characterised by their location, industrial cluster and access to infrastructure. Ports are often located close to the coast, with easy access to sea routes. The ports are located at a junction of transport infrastructure consisting of maritime and inland waterways, easy access to high capacity road infrastructure and rail. Another characteristic of type 1 companies with private sidings is the regional clustering of the private sidings. The companies and sidings are located close to each other and often share marshalling yards.

The private sidings in the ports handle a large volume of goods (Demmers and Van Es, 2025), which means that most private sidings can handle block trains. There are three types of companies with private sidings: Type 1A, Type 1B and Type 1C. Type 1A refers to type that are large enough to handle several block trains a week on their own. Type 1B refers to companies that are not able to operate several trains per week on their own, but the regional cluster of private sidings means that they can transport their goods by rail, as they can combine transports with wagonload traffic (B.2.2.7). Type 1C refers to the terminals located in the ports. These can be, for example, deep-sea container terminals or other bulk terminals. Ports often have transshipment facilities where goods can be loaded from road or ship onto a train (B.2.2.7). This means that all three rail modalities are present in a port. An example of this is the Rail Service Centre in the port of Rotterdam.

The type of cargo handled on private sidings of type 1 is diverse. Rail is used to transport containers, wet bulk, dry bulk and break bulk. Often, companies operating around ports choose to use rail for cargo that does not fit on trucks or for cargo that is destined for a location that cannot be reached by inland waterways (B.2.2.6).

Ports often have easy access to major transport corridors such as the Trans European Transport Network (TEN-t) routes. The most important corridors for the Netherlands are the North Sea - Mediterranean corridor, the North Sea - Baltic corridor and the Rhine - Alpine corridor (Government of the Netherlands, n.d.). Together with these corridors, the ports form the backbone of national and international freight transport, handling the vast majority of goods.

Location of private sidings

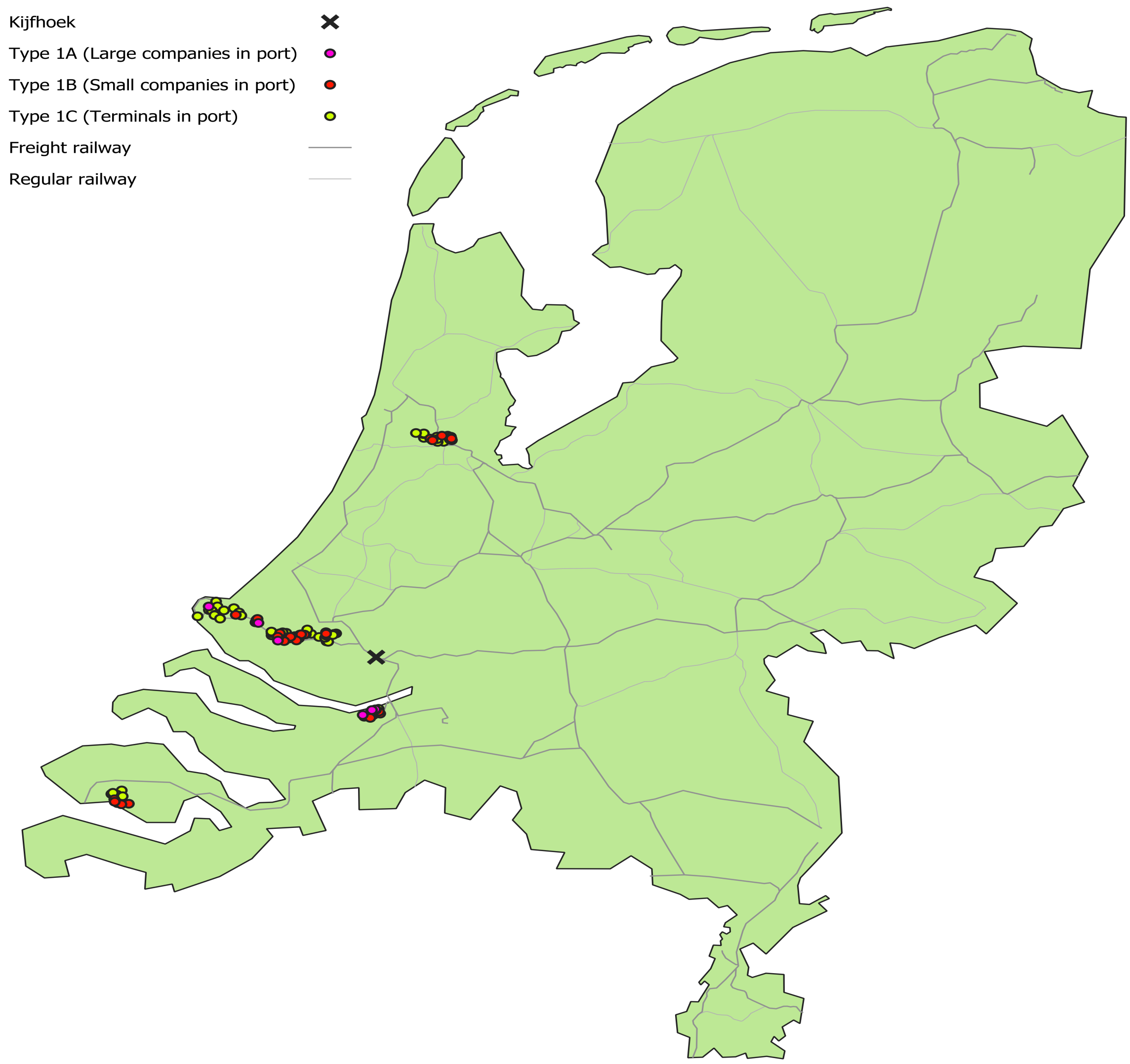


Figure 3.1: Private sidings type 1 (Large ports) in the Netherlands

The map above shows the type 1 private sidings. Here 1A is shown in pink, 1B in red and 1C in orange. The major ports are the ports of Amsterdam, Rotterdam, Moerdijk and Sloe. In the ports of Amsterdam and Rotterdam, where seaward expansion is taking place, it can be seen that the smaller private sidings (1B, red) are located in the eastern part of the ports, closer to the cities themselves. The new companies and private sidings being built in the west are larger and more of the type 1A and 1C. In total, the Netherlands has 6 type 1A sites, 32 type 1B sites and 65 type 1C sites. The boundary between 1A and 1C sites can be blurred, as many of the companies operating private sidings in the major ports are both a terminal and a production facility.

In figure C.9 in the appendix, the Osterwalder business model canvas is shown for a company of type 1B with a private siding. The company for which it was created is a chemical production facility in a large port. The diagram shows how the company creates value and what is involved in creating this value. Transport and the role of rail have their place in this business model. It is clear that the company uses multiple modalities, which makes sense because the company is also located in a port. This means that it is likely to be less reliance on rail. Part of the key infrastructure will also be the infrastructure to access the rail network. The company has a complex production process, which requires reliable transport facilities so as not to disrupt this flow. Chemicals are often classified as dangerous goods, which makes the client more dependent on rail infrastructure, as it is usually more difficult to transport dangerous goods by road. Overall, the company's focus is on the production and delivery of high quality chemical products. The mode of transport is ancillary to supporting this value proposition. The red stars in the OW figures (C.9) show the parts of the company which are directly linked to or part of the private siding. The rail operators transporting the goods are part of the private siding, as they need the private siding to deliver the goods. The private siding is made up of the physical infrastructure. In the costs it is visible that this infrastructure requires maintenance and that the private siding also is part of the total logistical costs. Overall the private siding is a part of one of the transport options the company uses.

Figure C.10 in the appendix shows the Osterwalder business model canvas of a large port terminal (type 1C). The value proposition focuses on fast and efficient handling. As the key process is focused on the transport itself, the modality used is of high importance. It is useful for the company to have rail as an option to serve its customers, as this extends the company's services. The warehousing options that these companies often have allow for more flexibility, which can help solve the unreliability of the rail system. The red stars again show which parts of the companies operation are part of or directly linked to the company itself. Again, the railway undertakings which rely on the private siding to reach the company, the infrastructure and the transshipment equipment are the physical part of the private siding. The private siding is also directly related to one of the value propositions, namely the fast and efficient transshipment between modalities. An efficient private siding can directly support this value proposition. Other important parts of the business model canvas relating to the private siding are the infrastructure costs necessary to do maintenance on the private siding and the transshipment fees which are directly earned through using the private siding. Overall, rail will be complementary to a terminal operator as one of the most important assets of a terminal is its connectivity to other hubs and transport networks. The private siding plays a crucial role in this logistical system of the company.

External influences These types of companies with private sidings are well connected to the world wide network of logistics. This means that they are influenced by disruptions in the global transport sector which can be caused by wars, climate disasters or other disruptions. Also geopolitical disruptions can directly influence these companies and thus their sidings. Also, more targeted actions such as new innovations in the rail sector or changed policy on climate rules can hurt or benefit this type of private siding.

Utilisation The level of utilisation can be seen in figure C.14. It shows that most of the private sidings in the large ports are used actively or at least incidental. This means that they are operated at least 3 to 4 times a week.

Type 1 sidings are among the most intensively used in the Netherlands. These sidings are typically owned by large-scale bulk companies or container terminals, and often handle block trains with high regularity. For example, the EMO terminal on the Maasvlakte operates its own private siding infrastructure and transports several coal and ore trains daily to industrial sites in Germany and beyond (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024).

The majority of outbound bulk flows from Dutch seaports are transported by rail in block trains directly from these sidings. Container terminals in the port, such as APMT or RSC Rotterdam, also rely heavily on private sidings to support high-frequency shuttle trains(B.2.2.8). These intermodal services account for over 26,000 border-crossing container trains per year, or 44% of all international freight trains in 2022 (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024). Utilisation is not only high in frequency (daily use), but also in volume .

Resilience Because of the scale of these companies and their multimodal transport options, they are relatively resilient. The partnership with the port authorities strengthens this even more. They have direct access to large freight corridors which makes them part of a robust logistical system. However their resilience is limited as they are vulnerable for congestion, changing rules and legislation as was explained in this letter of concern.(Provincie Zuid-Holland, 2025).

Costs and benefits The benefits of having a private siding for this type of company are relatively large. They move a lot of weight which means the costs density is low as they have a scale advantage. A common block train can transport 30 to 40 wagons or 2000 to 4000 tons of goods. A close location to strategic infrastructure and shared infrastructure costs lessen the load on the individual company.

3.2.2. Type 2: Inland terminals

The private siding terminal type is characterised by its transshipment capacity and its often strategic location in relation to major freight corridors. These terminals act as logistical hubs for cargo flows. The terminals are equipped with facilities that allow cargo to be transferred from one modality to another as efficiently as possible.

This study distinguishes between terminals belonging to large ports (type 1C) and other inland terminals (type 2), even though both types of terminals generally have access to road, rail and inland waterways. The large deep-sea terminals are of a different scale and serve a different purpose (maritime transshipment to a large corridor rather than a large corridor to a region). Therefore, these types of terminals are treated separately.

This transshipment can serve different purposes. In the case of road to rail, the road modality can act as a first or last mile modality, while the train is used for the main part of the journey. In the case of a ship-to-train modality, transshipment is likely to be only part of the journey due to infrastructure constraints. Trains do not need waterways and ships do not need rails to transport cargo.

The cargo handled on these private sidings can be quite substantial. The supply of cargo by ship will generally be larger than that of a train. This allows the terminal to operate block trains. As far as truck deliveries are concerned, since the private siding is a place where several flows of cargo meet, the terminal can use it to assemble block trains. This block train could be made up of freight destined for different destinations, so that at the end of the rail leg it could be split into wagonload traffic or use another terminal.

Terminals can handle different types of cargo. However, this is very much dependent on the infrastructure available at the point of transshipment. ITUs such as containers are very suitable for handling, but bulk cargo can also be handled if the right equipment is available.

Private siding terminals are often located near major freight corridors such as the Trans-European Transport Network. Easy access for the different modalities is essential for efficient operation. Furthermore, if the terminal is used in combination with first and last mile road transport, proximity to an industrial cluster will also be important.

Location of private sidings

Figure 3.2: Private sidings type 2 (Inland terminals) in the Netherlands

Figure 3.2 above shows the location of the inland rail terminals in the Netherlands. Inland means that the ports do not have deep-sea terminals and are smaller than those of type 1. Most of the terminals are located in the south of the Netherlands around industrial areas such as Tilburg, Eindhoven and Limburg. Not all the terminals on this map are operational, for example the terminals at Lage Weide (M10), Veendam (N14) and Valburg (ZZ1) are not used by trains. In total, there are 23 type 2 locations in the Netherlands.

Figure C.11 in the appendix shows the Osterwalder business model canvas of an inland terminal. The value proposition is similar to the 1C type. However, the focus is also on lower volume modalities such as intermodal transshipment. Again, the transport equipment used is one of the most important resources the terminal has. And rail is a complement that enables terminals to reach a wider clientele. Container handling and handling fees are one of the company's main sources of income, which emphasises the importance of an efficient handling process. Another important resource is a strategic location, often close to the TEN-T network or a large marshalling yard. With red stars the parts of the business model canvas are shown which are part of or directly relate to the private siding. Such parts are the rail operators who are dependent on the private siding to deliver their goods, the physical infrastructure of the private siding such as the rail and the transshipment equipment and the effort and costs it takes to maintain these parts. Overall the private siding is a large and important part of the terminal. The main goal of the terminal is to let freight change between modalities and the use of a private siding is an essential requirement to do so. A side note is that these terminals tend to see the inland shipping as their main priority.

External influences As the terminals are reliant on inland shipping this is the most important external influence when it comes to their private siding (B.2.2.8). When the inland shipping is hurt by low water levels one could imagine the terminal would solve this by switching to more rail transport. However the terminals have explained that as the inland shipping is their main modality, it is of paramount importance that that modality is healthy and thriving. Also disruption from the direction of road transport will hurt terminals relatively heavy. Of course terminals are also not immune to disruptions in the national and European supply chains. Furthermore, they are vulnerable to bad economic times as they are completely floating on national and international trade.

Utilisation Figure C.14 shows that the inland terminals are used actively. This means that most of the inland terminals receive and dispatch trains at least 3 to 4 times a week. These sidings are used as hinterland nodes that transport freight, often containers or bulk commodities. Unlike the dedicated industrial sidings, these facilities are usually operated by logistics service providers who manage the terminal and coordinate access for different clients.

Utilisation levels vary by location and market, but some terminals operate daily shuttle services (B.2.2.8). For example Coevorden's Graaco terminal receives regular bulk grain shipments from Eastern Europe (Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024).

Resilience Their multi modality and warehousing capabilities provide these companies with some form of resilience. They are build around efficiency which means they are used to scaling up and down when necessary. This makes them more resilient to disruptions. They also have a scale benefit as terminals generally process a lot of volume.

Costs and benefits Terminals earn their money by transshipment between modalities and temporary storing freight. This means that their rail access and thus their private siding benefits them directly in their operations. However, this infrastructure and transshipment equipment, such as cranes costs money. This means that every moment that the private siding is not being used, it will harm the terminal. The frequency of trains is high with often at least 3 to 4 times a week a full block train (B.2.2.8).

3.2.3. Type 3: Large industrial companies

Private sidings of the industrial giant type can be characterised by the size of the operations of the companies present and the specialisation of the operation.

The volume of freight transported at these sites is often quite substantial. Large companies such as Tata Steel provide enough volume to require full block trains on a daily basis. This advantage of scale makes them more flexible as they can run trains more frequently. They are also more dependent on a high volume modality such as rail or water. Road is often not a suitable substitute for the scale of these operations.

The type of cargo transported in these locations is of high volume. Also, cargo that is undesirable to transport by road can be transported by train. One type of such cargo is dangerous chemicals. This is the case at the Chemelot site, where Sabic produces many chemicals. The weight of the transport is also important. A large metal production plant in the south of the Netherlands uses block trains with 40 wagons, each weighing 62 tonnes. Replacing one train with a lorry means using 100 lorries instead.

Location of private sidings

Figure 3.3: Private sidings type 3 (large industrial companies) in the Netherlands

At the top of the figure 3.3, the large private industrial sidings are made visible. Well known companies are Tata Steel (NW2) in Beverwijk, Chemours (ZH12) in Dordrecht and Chemelot with Sabic (ZO14) in Lutterade. Most of the type 3 private sidings are located in Limburg. This makes sense, as this is where the coal was mined. This was the driving force behind the expansion of the railway network. In total, there are 14 of these type 3 sites in the Netherlands.

The figure in appendix C.12 shows the business model canvas of a type 3 company operating a private siding. It shows a large manufacturing company focusing on the production of metals. The company has rail infrastructure as a key resource, as the amount of raw material required to run such a plant is difficult to import by truck. This infrastructure is marked with a red star to show it is part of or directly linked to the private siding. Other parts which are marked with a red star are the rail operators who need the private siding to (un)load their freight and the costs required to maintain the private siding. This particular company does not have access to a large enough port, so it relies on rail for imports and exports. So, although transport is ancillary to their value proposition, they are dependent on rail and thus their private siding for their operations as other modes are not suitable for their business. For them the private siding is one of the main ways of accessing the raw materials that they need.

External influences These type of companies are influenced by new policies which are currently being developed such as nitrogen rules and other environmental rules. This can influence the way the companies use their private sidings. This also touches upon the energy transition with which these companies have to deal. Also the way the (inter)national railway network will develop is part of this. For example the TEN-t rail freight corridors.

Utilisation As figure C.14 shows, all type 3 private sidings are actively operated 3 to 4 times a week at least. Type 3 sidings are found at large industrial sites located inland, such as chemical complexes, steelworks or fertiliser plants. These sidings are usually dedicated to a single company and are deeply integrated into production and logistics operations.

Typical users of this siding type include Tata Steel in IJmuiden, Chemelot in Geleen, Dow Chemical in Terneuzen and Yara in Sluiskil. At Tata Steel, for instance, rail is used for both incoming materials such as scrap and fuels and outgoing steel coils. The site has an extensive internal rail network of over 100 kilometres, and receives approximately 125 rail wagons per week via the single wagonload system operated by DB Cargo (Tata Steel Nederland, 2023)(B.3.0.2). According to the same source, Tata Steel also dispatches around 1.2 million tonnes of outbound steel by rail annually. Similarly, Chemelot has internal siding access for multiple on-site plants and is serviced daily by shunting operations coordinated by DB Cargo Kennisinstituut voor Mobiliteitsbeleid (KiM), 2024.

Utilisation is therefore structurally high for this siding type, both in terms of volume and frequency. Many of these sidings are in daily operation, with mostly block trains for bulk flows.

Resilience Type 3 companies transport large volumes of freight using rail. Their resilience is forced as they are often relatively dependent on rail. Some of these companies can also use inland shipping. But trucks are often not seen as an alternative as they cannot efficiently transport large quantities or cannot transport dangerous goods(B.2.2.7). This forces these companies to stay with rail and keep their private siding open. This does not take away that disruptions in their logistic chain can directly disrupt their production processes. The only option for the companies is often to wait and take these blows.

Costs and benefits If the rail system works well the benefits are large. Rail offers large volume transports in a reliable and frequent manner. It is suited for dangerous goods which these industries often need. However disruptions and strict rules tend to decrease these benefits. The costs of using the rail system are the access costs, infrastructure maintenance and getting the right permits to follow the regulations. For these companies the volume of freight is also large which shows that the benefits can be large. Multiple blocktrains a week are not uncommon (B.3.0.2).

3.2.4. Type 4: Small companies

Type 4 private sidings are characterised by a smaller volume to be transported, regional isolation and in many cases this private siding was part of a larger cluster of private sidings.

This type of private siding is subdivided into type 4A private sidings, which run one train or less per week but are part of a regional cluster, and Type 4B private sidings, which are also private sidings with a lower train frequency but are also isolated. The 4A status may be a precursor to the 4B status if the private siding is located in an area with only smaller private sidings where rail transport is disappearing.

This type of private siding is often located in areas that are less connected by rail to other industrial areas connected. An example of this is the north of the Netherlands, where many private sidings have disappeared over time. This is exacerbated by the relatively long distance between the north of the Netherlands and the large industrial clusters in the south and the major ports of Rotterdam and Amsterdam. The result is an isolated area, far from the large industrial clusters and the marshalling yard 'Kijfhoek', which would be used to assemble wagonload trains.

The volume of goods transported is often not large enough to make regular block trains profitable. This could result in either irregular traffic, with the train running once a week or less, depending on when the company has collected the minimum volume for a block train. If waiting for a block train is not an option, the alternative is to switch to wagonload traffic. This is less efficient as it requires shuffling of wagons and proximity to other companies requesting wagonload traffic. It also requires the infrastructure to shunt the wagons, such as a marshalling yard. Taken together, this results in a company that is highly dependent on the network and its location within that network.

It is not uncommon for the type 4 company with a private siding to be part of a larger regional cluster of companies using private sidings. This concept originated decades ago when road transport was not as common as it is today. Even small towns would have their own private siding to serve local industry. This was driven by the need for coal (B.1.0.2), which was the primary energy source at the time. Over time, the other private sidings have disappeared and transport has shifted to other modes. The result is that fewer and fewer companies are using the same amount of infrastructure, resulting in less income for the infrastructure manager who has to maintain the same amount of infrastructure. As a result of these rising costs, ProRail has a policy of transferring marshalling yards and mainline track to the last company using it. This increases the infrastructure costs for the private siding (Van Breukelen, 2024).

Location of private sidings

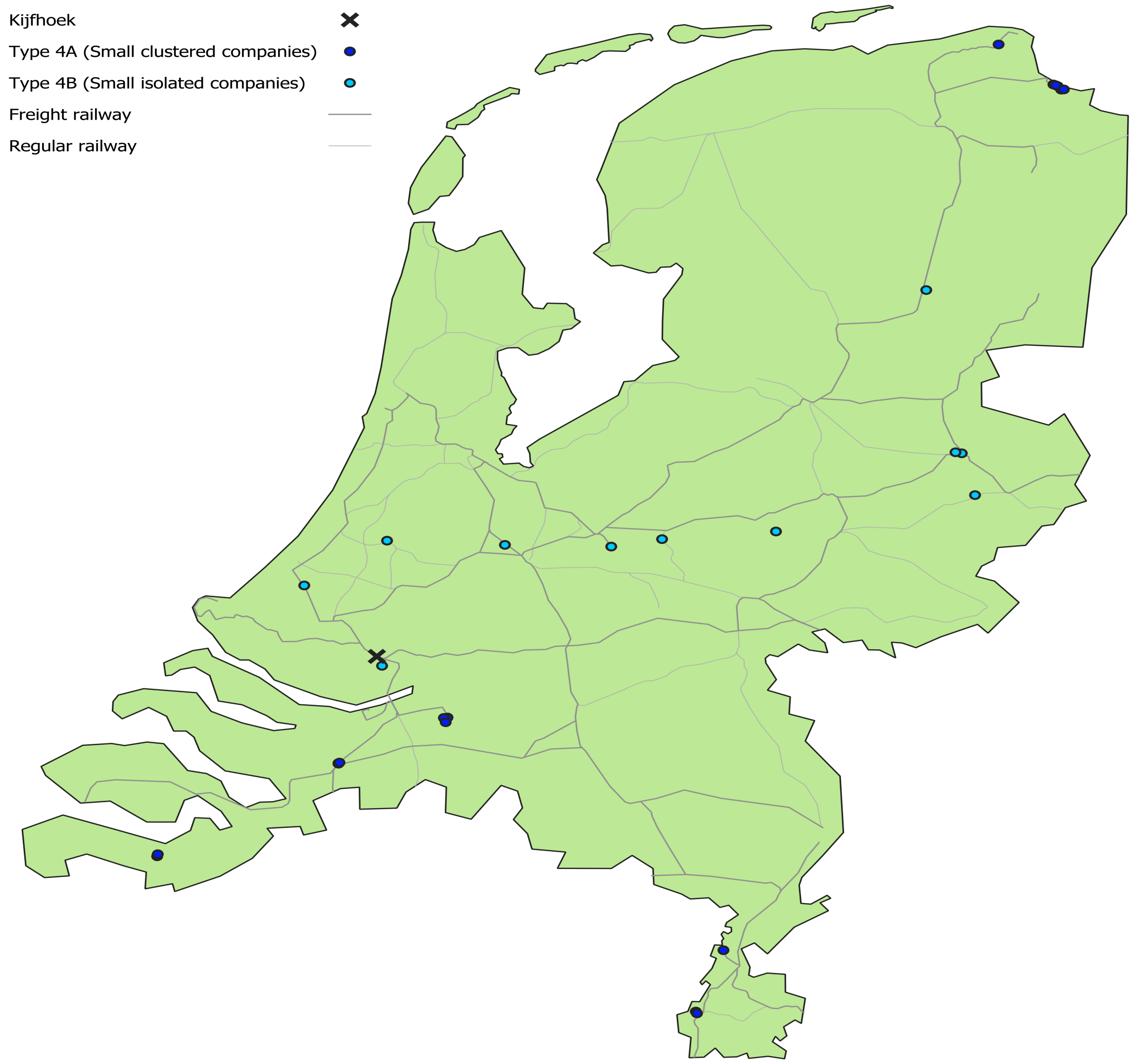


Figure 3.4: Private sidings type 4 (Small companies) in the Netherlands

Figure 3.4 above shows the locations of type 4 private sidings with private sidings that are part of a regional cluster in dark blue (4A) and the isolated private sidings in light blue (4B). As can be seen, the private sidings are scattered throughout the country with a cluster in Groningen. It is important to note that most of the private sidings in light blue are not actively in use. Many of them are still connected and could be operational, but no trains are currently running to or from them. In total, there are 29 type 4 sites in the Netherlands, of which 18 are type 4A and 11 are type 4.

The figure in appendix C.13 shows the Osterwalder business model canvas of a type 4B company using a private siding. The focus is on the production of metals. This again means that transport is a secondary issue for this company, which has to fit in with its business model and value proposition. However, other modalities are also an option for the company. The fact that the volumes required are often smaller than a block train means that the truck can be more competitive compared to rail. This particular private siding also has a well-developed barge connection, which further strengthens its independence from rail. The parts of the private siding are again marked with a red star, which are its rail operators, rail infrastructure and maintenance expenses. Overall, rail will not be as important for this company as it is not part of their value proposition and they have other modalities available to them. So the private siding is merely a way of accessing one of their transport modalities.

External influences Depending on the location, this type of company and its private siding is influenced by varying factors. These can be the earlier mentioned climate and nitrogen rules, or rules for dangerous goods. But also a changing network such as neighbours who stop using rail which harms the private sidings.

Utilisation According to figure C.14 the smaller companies with private sidings are not using them frequently. A significant part of the private sidings of this type sees no use at all. Type 4 private sidings are often simpler in layout and more limited in capacity. Their use is highly diverse: some are in regular use by bulk-handling in smaller quantities while others are only used occasionally. In some cases, sidings are technically operational but commercially inactive which results in no activity.

Utilisation levels in this category are highly variable. Some sidings may be used a few times per week or month, depending on demand. Others have become inactive. A significant number of small sidings in the Netherlands face underutilisation or closure (B.1.0.2).

Resilience These private sidings are relatively vulnerable. Their resilience is limited. This has to do with their small scale and often unfavourable location. When frequency of the trains arriving is low, one missed train can easily mean a week delay of goods.

Costs and benefits The costs per unit are relatively high. As the costs are high and the transported volume is low at these private sidings. The reason for using rail is often part of a bigger picture such as operational efficiency or sustainability.

3.3. Conclusion

Now the the second sub question will be answered for each type of private siding. The sub question is:

What types of private sidings exist in the Netherlands and how are they utilised by different categories of companies?

Since companies with private sidings differ significantly in terms of transported volume and location, they face different levels of competitiveness and challenges. Therefore, a tailored approach is needed, starting with a categorisation of the companies with private sidings. The data, literature and interviews provided an overview of the sector. Different views are possible depending on the type of private siding considered, which will be discussed in more detail below:

3.3.1. Large private sidings in ports (type 1)

Type 1 companies handle more than three quarters of the rail freight in the Netherlands. They are located in large clusters in the ports of Rotterdam, Amsterdam, Moerdijk and Sloe. Most of the private sidings in the ports move block trains daily or several times a week. Some of the companies use wagonload traffic, which can already be assembled on the marshalling yards of the port, after which it can go to Kijfhoek for further marshalling. The Netherlands has 103 private sidings of this type, of which 6 are type 1A, 32 are type 1B and 65 are type 1C.

3.3.2. Inland terminals (type 2)

Type 2 operators are inland terminals that handle large volumes of freight. Most terminals are located in strategic locations around the country, close to industrial areas or strategic freight routes. These terminals mostly use block trains, but some are also known to handle wagonload traffic. These terminals often have a direct connection to the major ports. There are 23 of these type 2 sites in the Netherlands.

3.3.3. Large industrial enterprises (type 3)

These companies move a lot of freight by rail. Much of this is dangerous goods, which makes them more dependent on rail for their transport. These companies are located all over the Netherlands, but most of them are located in the industrial areas in the south of the country. These companies use block trains to transport their goods. The frequency of the trains varies from once a week to several times a day. The Netherlands has 14 of these type 3 sites.

3.3.4. Small private sidings (type 4)

These smaller private sidings, which are not located in the major ports, are spread throughout the country. They are often part of a small cluster of other private siding companies or even completely isolated. Quite a few of these private sidings are still connected to the main railway lines, so in theory they are operational, but they are no longer in use. The companies that use them often only send wagonload traffic, and because of the regional distribution this means that small volumes have to travel long distances, which can quickly become expensive. Type 4 sidings are divided into two types: type 4A has 18 private sidings in the Netherlands, while type 4B has 11.

4
Problems

This chapter answers sub question 3 which is:

What challenges and developments affect the use and continuity of private sidings?

This sub question helps to understand how the rail-related problems experienced by companies lessen the attractiveness of rail transport and thus result in the closure of private sidings. Furthermore this chapter helps to understand how the situation of companies and their private sidings can be improved by mitigating the problems they experience. In order to do so this chapter describes the problems experienced by companies with private sidings. This can be used to construct strategies to mitigate these problems. The chapter begins with the problems which are found in the interviews, after which it will discuss the relations between problems through the help of a causal diagram and finally the problems per type of private siding.

4.1. The problems of private sidings

This section presents the different problems which companies with private sidings experience. This overview provides a basis to establish which problems impact which private sidings. In order to establish what these problems are, two rounds of interviews are conducted and literature was consulted. The interviews can be found in appendix B. The first round of interviews was used to establish a general idea of what the situation of private sidings looks like, after which the second round was used to interview different stakeholders such as companies with private sidings, infrastructure managers, railway operators, municipalities and experts. In total 34 interviews are conducted in which the statements could be checked against each other. After the interview, the statements of the interviewees were checked with the help of literature and government reports. The problems are grouped into three groups which discuss the problems and the underlaying relationship. These groups are: reduced reliability, high costs and constraints on siding usability. In addition, two other problems are discussed which do not fit in the groups. These are: loss of network and problems with inland shipping. The structuring of the problems and their relation to each other can be found in figure 4.2 below.

4.1.1. Reduced reliability

The problems which relate to the reduced reliability which companies with private sidings face are discussed here. The reduced reliability itself is a problem for companies with private sidings as they cannot be sure their shipment which will be loaded or unloaded at their private siding will arrive or leave on time. If this unreliability becomes too large, it will be tempting to switch to another modality thus decreasing the use of or closing the private siding.

The problems which lead this reduced reliability to this are:

- **Disruptions due to rail works** Infrastructure projects can hinder the operation of private sidings. As the railway network is less dense than the road network for example, disruptions in the network means significant detours, or no access at all to the private siding. In Zeeland, for example, an ERTMS test line has been opened (ProRail, 2024b)(B.2.2.1). This means that private sidings in this region will be hindered as they will not be able to use the railway infrastructure. In Germany, a railway line close to the Dutch border was shut down for 80 weeks of construction (ProRail, 2021). These constructions in Germany result in major network problems (B.2.2.8) which hinders companies that use the railway system through their private siding. As the network itself is not functioning due to the disruptions, the private sidings temporarily do not serve a function.

- **Lack of train drivers** Lack of train drivers is also a frequently mentioned problem (B.2.2.1) (B.2.2.8). This problem is mainly present when urgent transports are planned or a train driver misses its shift for some reason. As there is a shortage of train drivers, it can be hard to find a replacement in time, thus resulting in the transport to not be executed. This causes operational problems for the company and the private siding as trains will not run from or to the private siding. Trains can be left standing at the private siding for example, which hinders operations for the company.
- **Lack of European interoperability** A third issue is the lack of interoperability between the European countries (B.1.0.2) (B.2.2.5). This is described as the differences between different countries in the railway systems they use, which makes the whole railway network less efficient (Rajabalinejad and Schuitemaker, 2017). As can be seen in figure 4.2, this influences the disruptions to to rail works and the lack of train drivers. The lack of interoperability worsens the impact of the disruptions as there is poor communication between countries when rail works will be happening (B.3.0.7). Therefore companies in the Netherlands are not prepared as rail works happen suddenly in Germany, for example. The lack of interoperability influences the lack of train drivers because of the high standards which train drivers have to adhere to. To drive internationally, the train drivers have to speak all the languages of the countries fluently and have to be able to use and operate all the different safety systems the countries use (B.3.0.6). The European Union is partly trying to solve this problem through the TEN-T network and the introduction of ERTMS (B.3.0.7). These disadvantages are bad for the companies which use the private sidings, as they have to pay for the increasing costs and have to deal with unreliability and longer lead times. An indicator for this, is the fact that often more than 30% of the trains which have to cross the Dutch border, cross the border more than 30 minutes late.

4.1.2. High costs

In this section, the problems which relate to the high costs which companies with private sidings have to deal with are discussed. The high costs are a problem for private sidings as it reduces the competitiveness of rail transport and tempts the companies into switching to another modality. This could result in the closure of the private siding as it is no longer necessary when the company has switched to another modality.

The problems which lead to these higher costs are:

- **Rising costs of railway undertakings** Rising costs are also mentioned, mostly by the smaller private sidings (B.2.2.3)(B.2.2.4)(B.2.2.5)(B.2.2.8)(B.2.2.10)(B.2.2.15). These rising costs refer to the higher costs that the railway companies pass on to the private sidings. The increased costs are confirmed by the railway undertaking asking these costs (B.3.0.6)(B.2.2.15). These rising costs can be explained by the high costs of locomotives as locomotives have to be able to drive using different safety systems and use different forms of energy. Ultimately these costs are passed on to the companies which use rail transport and which operate a private siding. Especially for companies with smaller transported volumes, these costs are relatively expensive.
- **Lack of European interoperability** Again the lack of European interoperability is a problem (B.1.0.2) (B.2.2.5) and how this impacts the costs for the companies with the private sidings. As can be seen in figure 4.2 the lack of interoperability influences the rising costs of railway undertakings. This is happening because the locomotive needs to be more advanced as countries use different safety systems and the locomotives have to be able to deal with all of them. The lack of interoperability also influences the train drivers as the train drivers have to adhere to high standards. To drive internationally the train drivers have to speak all the languages of the countries fluently and have to be able to use and operate all the different safety systems the countries use (B.3.0.6). This makes means that train drivers are expensive to train and employ.
- **Non-electrified infrastructure** Non-electrified infrastructure also increases costs for the railway undertakings, as the locomotives have to deal with other power sources beside the overhead lines in non-electrified infrastructure. On these lines the railway undertaking will use diesel or hybrid locomotives. This is a frequently mentioned problem with large and small private sidings (B.2.2.16) (B.2.2.15) (B.2.2.6) (B.2.2.5). Most of the railway network in the Netherlands is electrified with

overhead lines. This makes the network more sustainable, but the private sidings themselves are often not electrified (ProRail, n.d.). This is because overhead lines can get in the way of loading equipment (B.2.2.10). Another reason is that overhead lines are expensive to build, so private sidings are often unwilling to make the investment. This creates a problem because the locomotive used on the main line is an electric locomotive, so it is not suitable for hauling the last part of the journey. This can be solved by using a hybrid locomotive, but this is more expensive (B.2.2.5) (B.2.2.16). This often results in the use of another diesel locomotive for shunting and unloading, which is less sustainable, and every extra operation increases costs and makes the process less efficient. In the northern part of the country this applies to the whole region as a part of the mainline is not electrified (B.2.2.5). Either special hybrid locomotives or both electric and diesel locomotives are needed, which also adds steps to the transport. Ultimately these costs are passed on to the companies who own use rail transport via their private sidings. This makes the use of rail less attractive.

4.1.3. Constraints on siding usability

In this section the problems which relate to the siding usability which companies with private sidings have to deal with are discussed. Some problems cause the private siding to be less effective and limit its use. As companies with these private sidings are limited in their use they are tempted to switch to another modality, thus using their siding less.

These problems are:

- **Regulation of dangerous freight & lack of flexibility of the train paths** This problem is split in two. The direct problem which hinders the siding usability, is the lack of flexibility of the train paths. This means that based on the location of their private siding, companies are sometimes forced to only use a single route. This limits their flexibility in the railway system and means that disruptions can temporary cut the company loose from the railway network and the private siding cannot be used anymore. For example, a company in the south of the Netherlands could only use a freight train path from Rotterdam via Antwerp through Belgium back to the border in Limburg, even though a much simpler route runs directly from the port of Rotterdam to Limburg. This fixed train paths decreases the resilience of the railway network for this company as one small disruption means it cannot use rail anymore. Another example is a company in the east of the Netherlands which has to have its freight run through Germany, where it has to pass several marshalling yards before it goes back to the Netherlands, where it reaches its final destination of the port of Rotterdam (B.2.2.9). This elaborate route decreases the attractiveness of using rail which could result in a company to stop using their private siding.

  These inflexible train paths are partly caused by the regulation of dangerous freight (B.3.0.7) (B.2.2.9) (B.3.0.1). The European union has regulations for dangerous freight transported by trains, which is used by many countries (EUR-Lex, 2008). However, in the Netherlands a lot of local authorities such as the safety region and local environmental agencies are also authorised to install stricter rules on top of the already existing rules (B.3.0.6). The European rail expert explains that rail transport of dangerous freight in the Netherlands has to adhere to stricter rules than in other European countries (B.3.0.7). This results in less flexibility in the rail system as some companies with private sidings are only allowed to use one freight route.

- **Crowded marshalling yards** Sufficient space in the local infrastructure is also mentioned as a problem (B.2.2.7) (B.2.2.2). This applies to the ports of Rotterdam, Amsterdam and Moerdijk (Voppen, 2024). In most cases, the shared infrastructure, such as rail yards and marshalling yards, does not always provide sufficient capacity for all the shunting operations required. The means that the minimum time to reserve a shared section of port railway infrastructure is too long. Some operations that take less than an hour require a train path reservation of three hours (B.2.2.7). This means that the infrastructure cannot be used for most of this three-hour period. This is compounded by the fact that train paths are often contracted, meaning that a particular private siding has to use a particular shared track at the same time every week. If a transport is delayed, the train path is not used, but remains reserved, preventing other companies from using the infrastructure. This problem is true for the smaller companies in these areas which use wagonload transport, but also for the larger companies as not all companies using block trains have a private siding with the capacity to assemble a block train on their own terrain. Ultimately this results in companies not being able to use their private siding to the full extent as they are not allowed often enough to drive on the rail just outside their private siding which limits the private sidings usability.

- **Non-electrified infrastructure** Most of the railway network in the Netherlands is electrified with overhead lines. This makes the network more sustainable, but the private sidings themselves are often not electrified (ProRail, n.d.). This is because overhead lines can get in the way of loading equipment (B.2.2.10). Another reason is that overhead lines are expensive to build, so private sidings are often unwilling to make the investment. This creates a problem because the locomotive used on the main line is an electric locomotive, so it is not suitable for hauling the last part of the journey. To still be able to move the wagons over the private siding, another locomotive is necessary which increases train movements. This is more expensive, costs time and is overall less efficient. This limits companies in using their private siding to their full extent.

4.1.4. Loss of network

The loss of network problem cannot be clustered in one of the overarching themes. Loss of network is actually influenced by the closure of private sidings as was described by the European rail expert (B.1.0.2). As every siding that closes is one siding less which can sustain the whole railway network. When the loss of network is happening the locations of the other sidings becomes worse as they cannot benefit from the clustering of private sidings. This increases the costs of the remaining private sidings which results in more closures of private sidings. This results in a negative reinforcing loop where the loss of network causes itself to worsen. This can be seen in figure 4.1. The full version of this causal diagram can be found in figure 4.2.

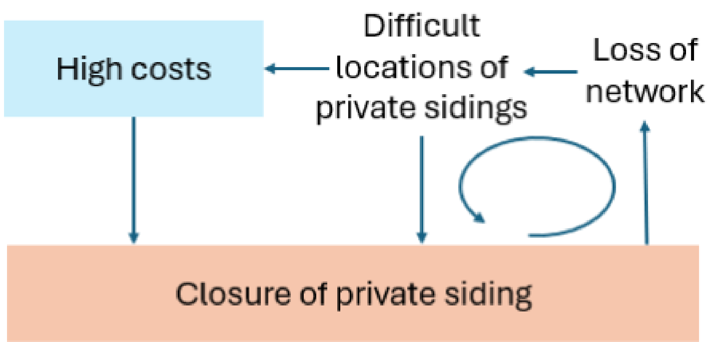


Figure 4.1: Negative reinforcing loop concerning loss of network

The rail network in the Netherlands is becoming less dense as private sidings are disappearing (Sporenplan.nl, n.d.). This loss of private sidings results in a loss of network as less destinations or origins of the rail network are existing. This makes operating a private siding more difficult for the remaining companies with private sidings as a less coarse network makes it harder to combine wagonload transports and means that the remaining private sidings are distributed further away from each other. This can be seen in figure 3.4. As explained the loss of network leads to a less optimal location for the company and private siding. The problem of these difficult locations also have to do with the location of marshalling yards. The large national Dutch marshalling yard which processes most of the wagonload transport is called Kijfhoek. Kijfhoek is the national marshalling yard located in Zwijndrecht next to the port of Rotterdam. Kijfhoek has direct access to the Betuwe line, a dedicated freight corridor to Germany. Kijfhoek is used for shunting wagonload traffic. It is therefore both a strength and a weakness for wagonload traffic. Kijfhoek is an advanced and modern marshalling yard, which makes marshalling operations more efficient. The location is very strategic for freight coming from the port of Rotterdam and Moerdijk. However, smaller private sidings that are not located in the west of the Netherlands, but that use wagonload traffic, often have to use Kijfhoek as well. This means that a transport from Delfzijl to Hamburg has to pass through Kijfhoek, which makes the journey much longer, thus less efficient and more costly (B.2.2.5).

This loss of network also causes problems to the companies with the private sidings as they have to carry more of the costs for the railway network because the costs cannot be shared with the neighbours. Less shared transport is possible and eventually when a private siding is the last siding left. The company connected to it has to pay for the infrastructure alone(Van Breukelen, 2024). These higher costs mean that operating a private siding becomes less attractive for companies.

4.1.5. Problems with inland shipping

An issue that is hard to cluster, has to do with problems with inland shipping, which can result in the closure of a private siding. One would expect that if inland shipping is suffering from low water levels this would mean companies would start using other modalities such as the train. And while this may be true for type 3 or type 1 companies and their private sidings, inland terminals with private sidings can actually suffer from this phenomenon. The terminals interviewed for this research pointed out how they see inland shipping as their main modality (B.2.2.8). The train and truck are meant as complementary modalities which support their inland shipping position. This would make the transition to less inland shipping and more train not an obvious choice as the focus is on inland shipping. So if an inland terminal would need to reduce or quit its operations because of low water levels, this would mean they would also make less use of their private siding as they miss the inland shipping freight supply to transfer to the train. That is why a terminal suffering from low water levels could also lead to less rail transport.

4.1.6. Reported but unconfirmed problems

In addition to the confirmed problems above, a number of other issues were raised during the interviews which could not be validated through multiple sources or data. These problems are presented as reported but unconfirmed problems to show stakeholders feel these subjects are problematic. While these issues may lack empirical confirmation, they reflect stakeholder perceptions that may still influence decision-making or point to challenges that deserve further investigation.

- **An imbalance in capacity allocation between passenger and freight trains** A problem which is described is the capacity of the network which is decreased by the imbalance between freight and passenger transport. An European rail expert mentions that within Europe, the Netherlands in particular are focused on passenger transport (B.1.0.2). A common problem is that freight trains have to give way several times during a journey to allow passenger trains to pass. However, the infrastructure manager explained that this situation has already improved in the Netherlands compared to how it used to be (B.3.0.5). This does not mean the problem has been mitigated completely.
- **Investment uncertainty** Investment uncertainty is also mentioned as a problem. In particular, the government's investment freeze until 2030 for the port of Rotterdam means that large projects in the port lack funding (Overheid.nl, n.d.). This argument can be seen as controversial, as in general projects should not rely on government subsidies. The port authorities also have the ability to combine investments of the private sidings and encourage the investment process.
- **Uncertainty because of the energy transition** The energy transition is both a problem and an opportunity. Mostly, it is a change that companies have to deal with. Coal has been in decline for a long time, and as part of the Sustainable Development Goals, more and more large coal users are switching to more sustainable energy sources (CBSstatline, n.d.). This means that the decline of coal can be partly compensated by the growth of biofuels and hydrogen. The interviewees expect that a large part of these fuel sources will be transported by pipeline or ship. But it is likely that some will be transported by rail (B.2.2.6).
- **Lack of level playing field** A frequently heard theme is the lack of a level playing field compared to other modalities (B.1.0.2) (B.2.2.7) (B.2.2.5). Respondents point out that road and waterway infrastructure is often paid for by the government, whereas rail infrastructure has to be paid for by the operator of a private siding. This view is shared by many in the rail sector. Respondents also point out that in order to create a more sustainable world, a modal shift should be executed to move more freight from less sustainable transport modes such as diesel trucks to more sustainable transport forms such as rail transport. But in order to facilitate this model shift there should be a level playing field so modalities can compete with each other in a fair way.

  However, research shows that when infrastructure costs and external costs are compared with taxes and levies, road pays 16.3% of the costs it generates, while rail pays only 12.9% of the costs it generates, as shown in table 4.1. Only inland navigation pays significantly less than rail and road in terms of average costs. However, rail has high marginal costs, which may explain why wagonload transport is less feasible (Ministerie van Infrastructuur en Waterstaat, 2020).

  Concerning the disappearance of a cluster, leaving the last company with an (unwanted) private connection. As was explained earlier, the costs for this infrastructure has to be paid by the last company. For road infrastructure this is technically the same (van Infrastructuur en Waterstaat, 2024). So this would not impose a competitive difference between rail and road transports.

Table 4.1: Percentage modalities pay through levies and taxes to the infrastructural and external costs they create

	Average costs	Marginal costs
Rail	12.9%	48.3%
Inland shipping	1.7%	3.2%
Road	16.3%	24.0%

4.2. Relations between problems

This section describes the relations between the problems. This helps to understand how problems influence each other and how solving one problem, can help solve multiple problems.This causal diagram contains the three overarching themes which were presented in section 4.1. These themes are visible in the blue squares. Ultimately problems can lead to the closure of private sidings as can be seen in the visual. This diagram was constructed based on the cause effect statements made in interviews, such as how a rail expert explained the relation between a lack of European interoperability and a lack of train drivers (B.3.0.7). For the clusters this has been further explained section 4.1.

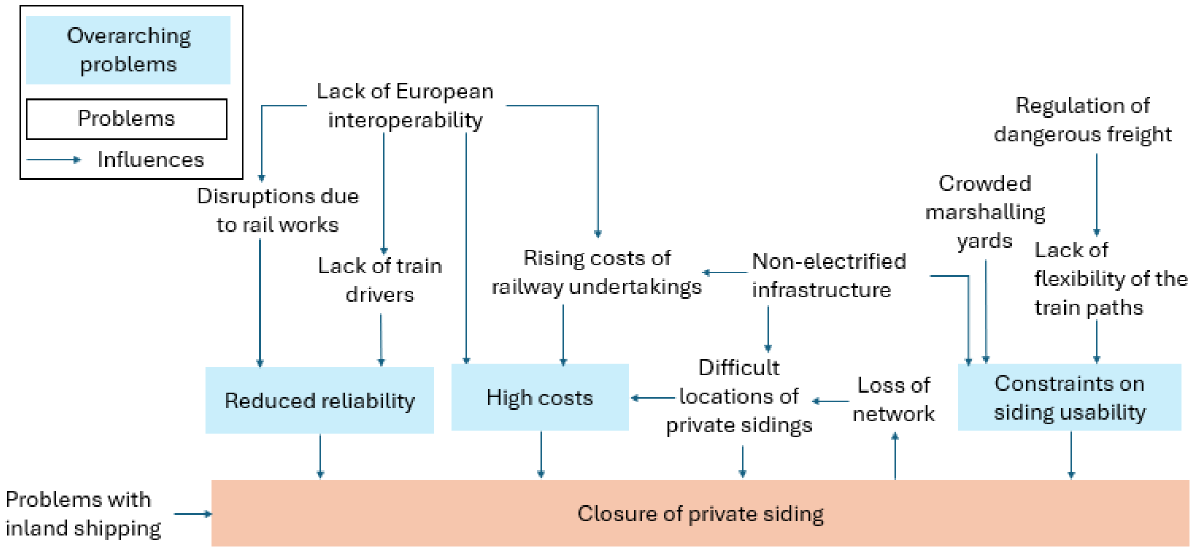


Figure 4.2: Relations between problems

The three main clusters are visible in the three themes of reduced reliability, high costs and constraints on siding usability. Lack of European interoperability is a root problem which influences multiple other problems. The same is true for the problem of non-electrified railway infrastructure. Note the negative reinforcing loop via loss of network and difficult locations of private sidings. Problems with inland shipping is a problem which is not part of any of the clusters and influences the private sidings directly on its own.

4.3. Problems per type of private siding

This section looks in more detail at how the problems presented above are associated with the different types of private sidings. This is done for all 4 types of private sidings. For each type of private siding, a SWOT is constructed to summarise the findings (Learned et al., 1965). The explanation of these SWOTs can be found in appendix D.1.1. The SWOT is made from the perspective of a company's use of rail. For example, it shows the strengths of using rail as part of a company's operations.

4.3.1. Type 1 Large ports

Strengths • Block train volume • Regional clustering • Combined port investments • Suited for dangerous freight	**Weaknesses** • Non-electrified infrastructure
Opportunities • Increasing unreliability of inland shipping • Introduction of a second infrastructure manager • Better measurement in shared infrastructure • Dependent on location, closeness to Kijfhoek and TEN-t network	**Threats** • Disruptions due to rail works • Rising costs of railway undertakings • Lack of European interoperability • Crowded marshalling yards • Regulation of dangerous freight

Figure 4.3: SWOT model of a type 1 private siding

4.3.1.1. Conclusion type 1 companies with private sidings (large ports)

The type 1 companies with private sidings possess multiple strengths such as volume, clustering, combined investments and the ability to transport dangerous freight. The opportunities to strengthen the situation even further are also numerous with the introduction of a new infrastructure manager, new measurement points in shared infrastructure and strategic locations. They can use this to deal with the non-electrified infrastructure, disruptions in the network, rising costs, lack of interoperability and the crowded marshalling yards.

Overall, type 1 private sidings have a strong position in the railway sector and in the transport sector as a whole. Their strategic location, volume and clustering help them mitigate issues.

4.3.2. Type 2 inland terminals

Strengths • Block train volume • Flexibility through warehousing facilities • Not dependent on multi-modal or wagonload transport • Suited for dangerous freight	**Weaknesses** • Non electrified railway tracks
Opportunities • Grow of container market • Dependent on location, strategic location • Introduction of a second infrastructure manager	**Threats** • Disruptions due to rail works • Lack of European interoperability • Increasing unreliability of inland shipping • Loss of railway network • Rising rail transport costs

Figure 4.4: SWOT model of a type 2 private siding

4.3.2.1. Conclusion type 2 companies with private sidings (inland terminals)

Type 2 companies and their private sidings have multiple strengths such as their volume, flexibility, dangerous freight ability and the fact they can switch between smaller and larger rail transport forms. They can benefit from a grow of the container market, strategic locations and a second infrastructure manager (Centraal Bureau voor de Statistiek, 2023b). They can use this to battle the non-electrified railway tracks, disruptions, lack of interoperability, loss of railway network and rising costs.

Overall, type 2 companies with private sidings can be successful if the two main requirements of volume and location are met. Apart from those, the stability of inland shipping is important as inland shipping often is the main modality of inland terminals.

4.3.3. Type 3 Large industrial companies

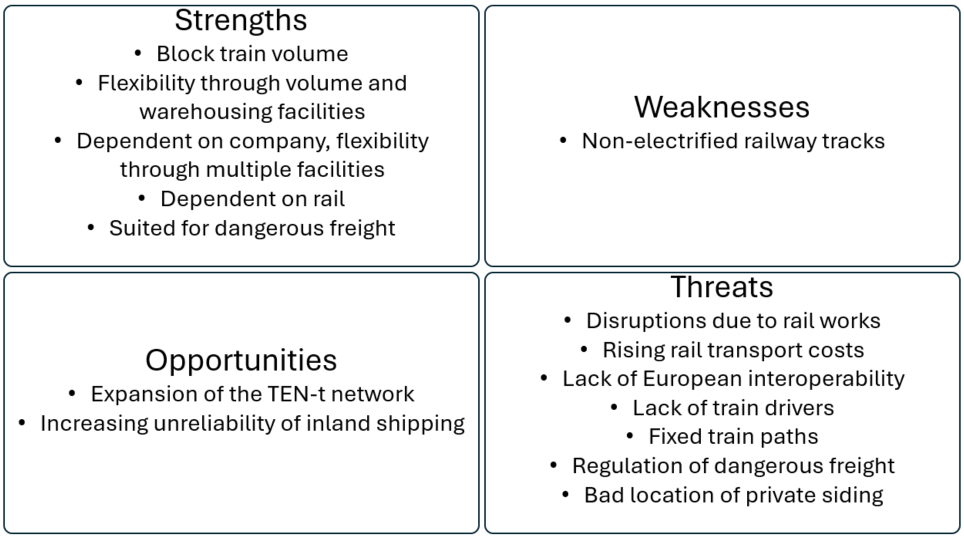


Figure 4.5: SWOT of a type 3 private siding

4.3.3.1. Conclusion type 3 private sidings (large industry)

The large industrial companies with type 3 private sidings can rely on their volume, flexibility and ability to transport dangerous goods. They also could benefit from a expansion of the TEN-t network and increasing unreliability of inland shipping. They have to deal with various weaknesses and threats such as non-electrified railway tracks, disruptions, rising costs, lack of train drivers and interoperability, fixed train paths and regulation of dangerous freight.

Overall, the type 3 private sidings are stable. The biggest problems, the fixed train paths, are something that the companies have no power over. On the other hand, the fact that the company has to use the fixed train paths indicates that the company transports dangerous goods. If a company does not have the possibility to transport these goods by inland waterway, the likelihood of switching to another modality is low. Therefore it could be seen as a strength that the companies are dependant on rail.

4.3.4. Type 4 Small companies

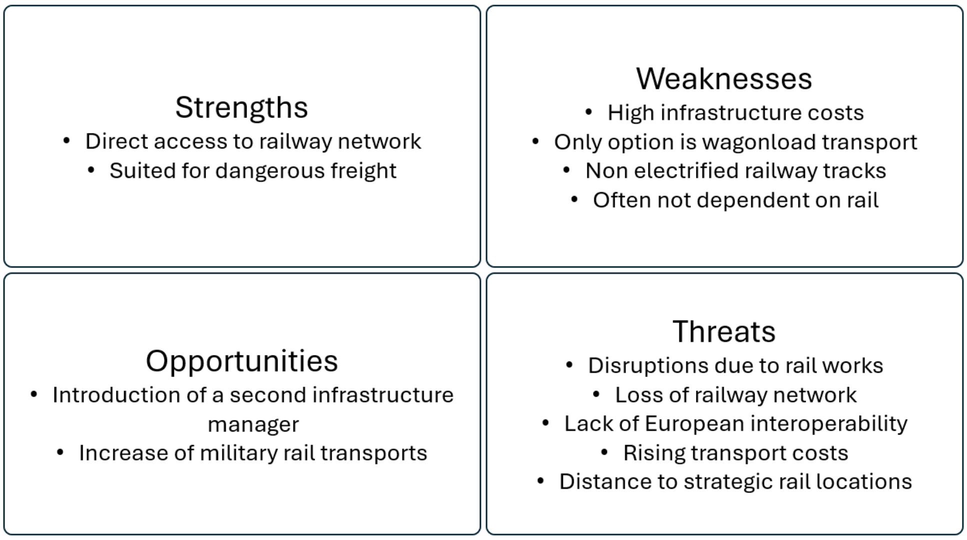


Figure 4.6: SWOT of a type 4 private siding

4.3.4.1. Conclusion type 4 companies with private sidings

This type of company can also count on a number of opportunities, the most important of which is the introduction of a second infrastructure manager. This can mean a reduction in costs, while adding more neighbouring private sidings, which means more infrastructure can be shared financially. Other opportunities could be a cooperation with the military. The strengths of these companies are their direct access to the railway network and the ability to transport dangerous goods. However the companies face a large variety of weaknesses and threats such as high costs, non electrified railway tracks, small volumes, disruptions, loss of network, lack of interoperability and a difficult location.

Overall, type 4 companies and their private sidings face a variety of problems and often lack the means to mitigate them. This has resulted in most type 4 private sidings ceasing to operate. The type 4 private sidings that are still in operation often have external factors that force the company to continue to use the rail and thus the private siding as a means of transport.

4.4. Conclusion

With this conclusion research question 3 can be answered, which is:

What challenges and developments affect the use and continuity of private sidings

4.4.0.1. Companies with private sidings in large ports (type 1)

Type 1 operators with private sidings are not in immediate danger of abandoning rail. The main factor causing them to abandon their private siding is the planned relocation of the city to the port. However, the port is also planning to move away from the city. So this phenomenon does not threaten the survival of private sidings.

Type 1 private sidings do face challenges when it comes to capacity problems in the port itself, non-electrified railway tracks and lack of interoperability. However, the clustering of private sidings together with the port authority provides a stable platform from which the companies and the port can invest in their infrastructure. This enables them to overcome many of the challenges they face. Overall, these private sidings are mostly able to mitigate the challenges.

4.4.0.2. Inland terminals (type 2)

Inland terminals face problems such as a lack of European interoperability, disruptions due to inland shipping problems, problems in the local infrastructure and loss of network. Terminals are also expressing growing demand, which can help the terminal to grow. Because of its location and the volume it handles, the terminal should be able to mitigate most of the threats it faces.

4.4.0.3. Large industrial companies(type 3)

They face a number of problems, one of the biggest being the rigid and limited train paths they can use to transport their dangerous goods. Rising costs and lack of interoperability are also a problem. As these companies are often quite dependent on rail due to their volume and dangerous goods, they are unlikely to abandon rail. Trucks are often not a viable substitute, so if the company cannot use inland waterways, it will have to continue to use rail, even if this means temporary shutting down a factory. The development of the TEN-t network may also provide opportunities for these companies. However, they will have to contend with rising rail transport costs and unreliability.

4.4.0.4. Small private sidings (type 4)

Companies operating these private sidings face a number of problems, including the rising transport costs, loss of network, difficult locations and non-electrified lines. This has led to the disappearance of many of these private sidings. Private sidings, smaller port authorities and railway companies have expressed their concerns about these types of private sidings, which rely heavily on wagonload traffic. Wagonload traffic does not seem to be feasible if the cluster of companies with the private sidings are not very dense, as is only the case in the major ports. The introduction of a second infrastructure manager can help. However, the threats to the companies with these private sidings are numerous.

5 Strategies

This chapter answers research question 4 which is:

What strategies can address the challenges private sidings are faced with?

To do so, this chapter explains the strategies that can be used to mitigate the problems experienced by companies with private sidings. It will list the strategies, their advantages and disadvantages. A diagram will then show which strategies can solve which problems and what the effects of these strategies will be. To do so the chapter will start with strategy generation with the help of the TOWS method. After this the strategies are explained in further detail and with an accompanying causal diagram the relation between the strategies and the problems is shown. The chapter ends with a figure showing the impact of the strategies in terms of directness of the influence, impact of the strategy and time to implement.

5.1. Strategy generation

The TOWS-diagrams shown below are formed with the help of the underlaying TOWS-matrices which can be found in appendix D.2. The TOWS diagrams are constructed following the method of Weihrich (Weihrich, 1982). In these matrices the combinations of the internal or endogenous factors (strengths or weaknesses) and the external or exogenous factors (opportunities or threats) are combined to see if there is a relationship. These combinations showed which factors can be used for a strategy. In more detail, the strength - threat combinations can be used to show existing resilience. The weakness - opportunity combinations can be used as a basis for solutions to address internal weaknesses. The strength - opportunity and weakness - threat combinations can be used to research where the company with the private siding is strong and where it is vulnerable.

5.1.1. Strategies for companies with a type 1 (Large port) private siding

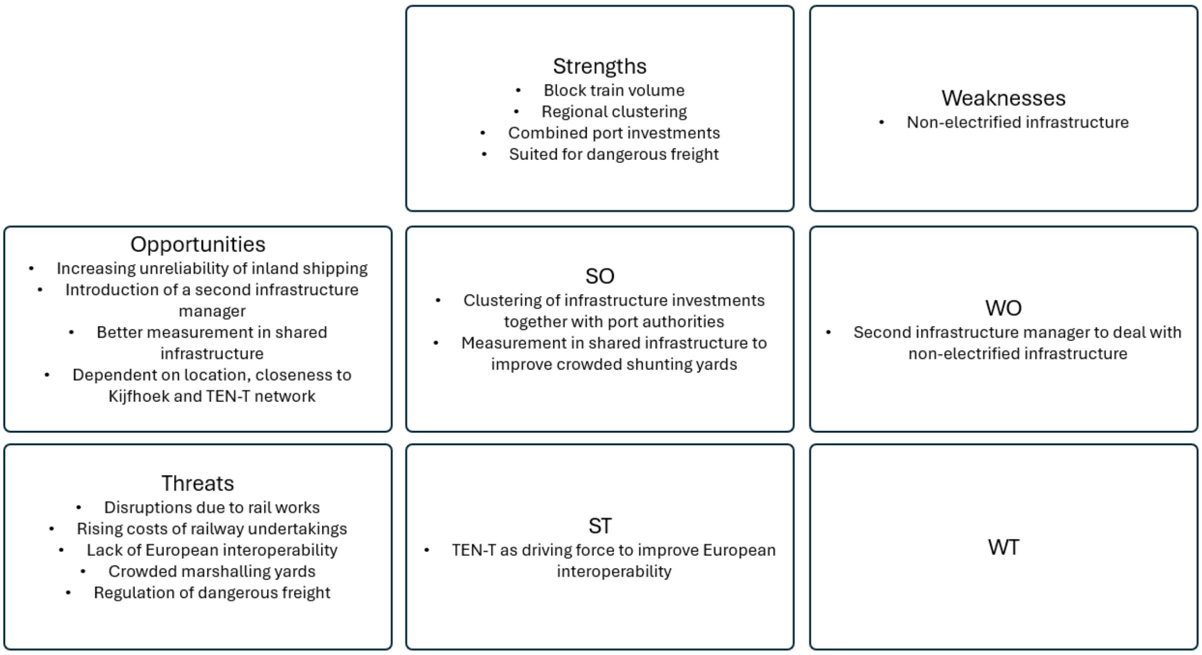


Figure 5.1: TWOS analysis of a type 1 company (large port)

Clustering of infrastructure investments together with port authorities

This strategy was developed using the SO quadrant of the TOWS matrix for type 1 companies (D.5). It combines the strength of regional clustering and block train volume with the opportunity of combined investment with partners, particularly port authorities. As indicated in the Osterwalder business model canvas (C.9), port terminals list “cooperation with port authorities” as one of their main customer channels, and rely on these authorities for shared investments in infrastructure. The shared interest of both actors in maintaining and upgrading rail access creates a strong case for collaborative funding. The interview with a port stakeholder (B.2.2.7) confirms this reasoning, as they mention that investments in sidings are often not initiated by individual companies, but rather coordinated with port authorities to benefit all private sidings. The strategy is also grounded in the business logic of type 1 large port companies, where sidings are an integral part of the value proposition (fast and efficient transshipment). This strategy is especially relevant for type 1B and 1C sidings, which benefit from proximity to shared infrastructure and already make use form intermodal transport options for which the shared marshalling yards are important.

Add measurement points in shared infrastructure to improve crowded shunting yards

This strategy was developed using the SO quadrant of the TOWS matrix for type 1 companies (D.5), combining the strength of joint port investment structures and block train volume with the opportunity to improve performance through better measurement in shared infrastructure. As explained in the problems, shared yards often suffer from inefficiencies due to the lack of real-time data, which leads to overly conservative time-slot reservations which lead to unnecessary congestion.

This issue was raised explicitly during the second interview round with a port stakeholder (B.2.2.7), who noted that limited visibility and coordination in marshalling yards causes avoidable delays in otherwise efficient block train operations. He stated that if the marshalling yards would be equipped with better measuring tools, the operation could be streamlined. Interviewee B.3.0.3 stated a possible efficiency increase of 25%.

Second infrastructure manager to deal with non-electric infrastructure

This strategy is based on the WO quadrant of the TOWS matrix for type 1 sidings (D.5). It combines the weakness of non-electrified infrastructure with the opportunity of introducing a second infrastructure manager who could take responsibility for the development of the rail infrastructure. This alternative governance model allows for more flexible operational standards and new investments.

The idea is supported by multiple interviewees. During the second interview round, stakeholder B.2.2.10 mentioned how a second infrastructure manager could decrease costs while investing in solutions for non-electric tracks.

Using TEN-t as driving force to improve European interoperability

This strategy was developed from the ST quadrant of the TOWS matrix for type 1 sidings (D.5). It combines the strength of high-volume block train operations with the threat of limited European interoperability, especially regarding cross-border transport, rolling stock standards, and infrastructure compatibility. By anchoring port rail connections more firmly within the TEN-T network, companies and authorities can position themselves to benefit from EU driven standardisation.

This reasoning is supported by expert B.3.0.7. Stakeholder B.2.2.7 mentioned that despite local improvements, international services still face avoidable disruptions due to mismatched national systems and insufficient coordination of rail works.

5.1.2. Strategies for companies with a type 2 (inland terminal) private siding

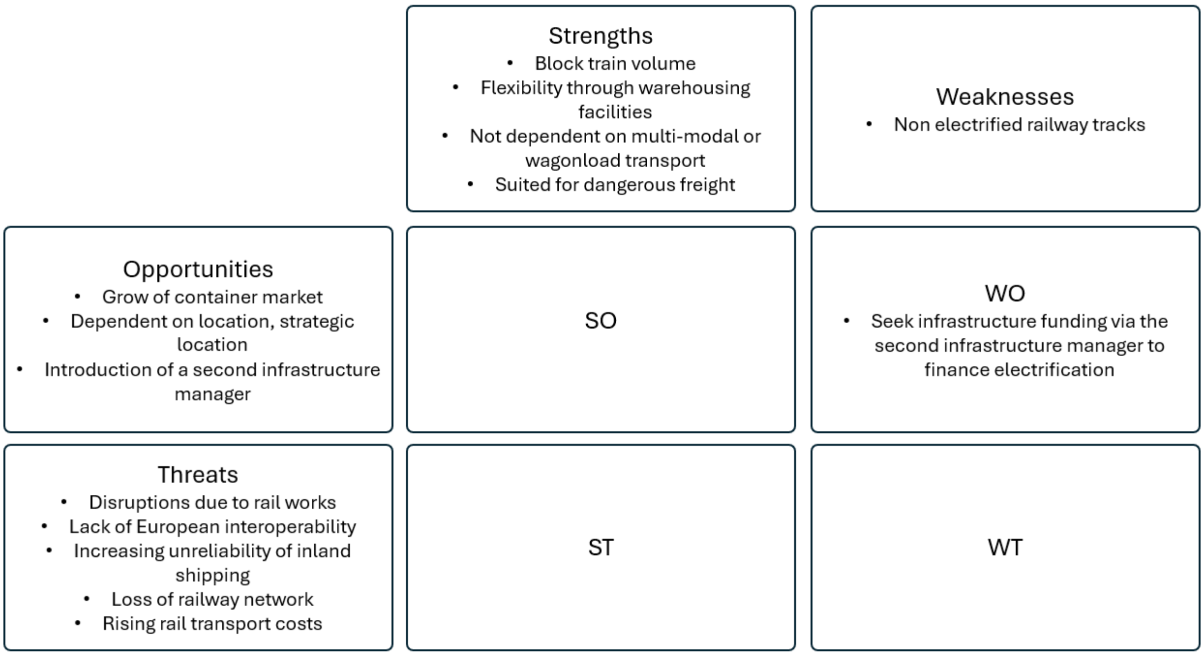


Figure 5.2: TWOS analysis of a type 2 company(inland terminal)

Seek infrastructure funding via a second infrastructure manager to finance electrification

This strategy emerges from the combination of the weakness non-electrified infrastructure and the opportunity presented by the introduction of a second infrastructure manager. The issue of non-electrification is highlighted as a technical and financial barrier for private sidings, particularly for inland terminals that aim to improve interoperability and attract modern rolling stock(B.2.2.8).

From the interviews conducted during the second round, several stakeholders, including inland terminals and railway operators, indicated that electrification is often out of reach due to cost and regulatory burdens. However, the introduction of a second infrastructure manager could offer a more flexible and financially viable governance model for investing in infrastructure upgrades such as electrification.

This is supported by the Osterwalder business model canvas for type 2 companies (C.11), where it shows that inland terminals are reliant on their infrastructure to deliver value through multimodal transshipment. Electrification would improve efficiency, strengthening their value proposition.

5.1.3. Strategies for companies with a type 3 (large industrial companies) private siding

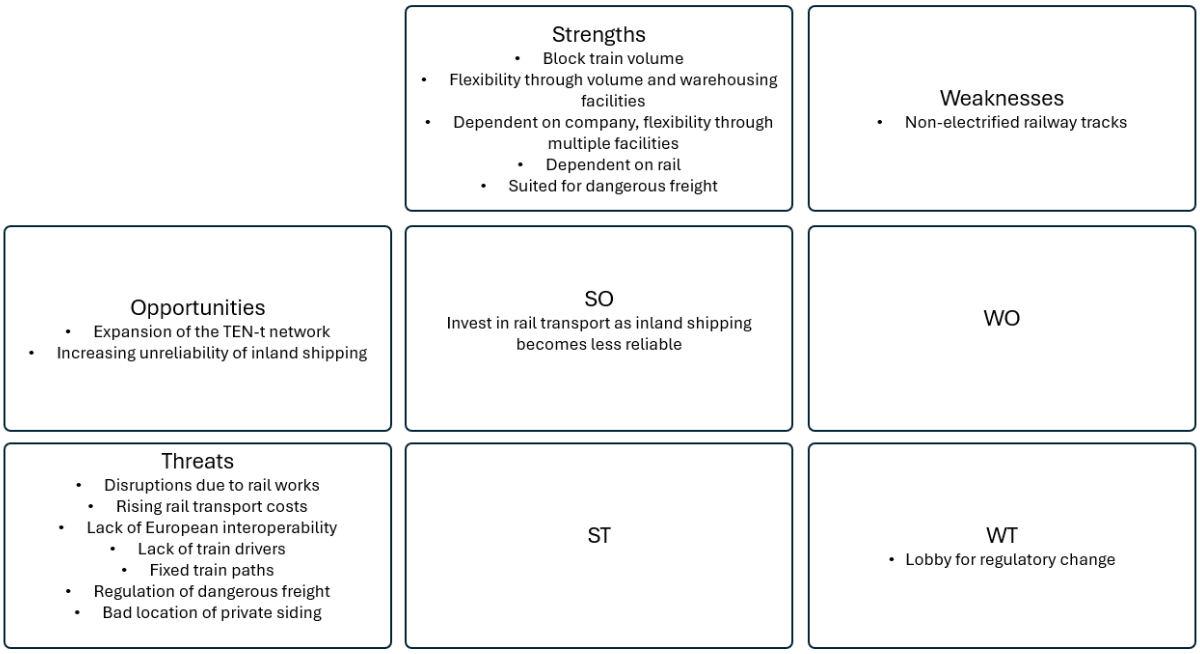


Figure 5.3: TWOS analysis of a type 3 company(large industrial companies)

Lobby for regulatory change to simplify the rules for dangerous freight

This strategy does not originate from a classic TOWS combination, but rather from a recurrent issue identified in both interviews and the business models of large inland industrial sidings (type 3). As discussed in section 4.1.3, companies that handle dangerous freight are often confronted with additional regional or local regulatory demands, beyond the European RID framework. These requirements, imposed by environmental agencies or safety regions, vary across locations and create more burdens, and discourage rail use despite its higher safety compared to road transport. This issue was explicitly raised in the by expert B.3.0.7 and private siding B.2.2.9.

Thus, the lobbying strategy is less about combining internal and external factors, and more about creating better conditions for the companies and their private sidings.

5.1.4. Strategies for companies with a type 4 (small inland industry) private siding

	Strengths • Direct access to railway network • Suited for dangerous freight	Weaknesses • High infrastructure costs • Only option is wagonload transport • Non electrified railway tracks • Often not dependent on rail
Opportunities • Introduction of a second infrastructure manager • Increase of military rail transports	SO	WO • Engage in transferring infrastructure to the second infrastructure manager to save costs • Explore military transport partnerships to share rail costs
Threats • Disruptions due to rail works • Loss of railway network • Lack of European interoperability • Rising transport costs • Distance to strategic rail locations	ST	WT • Form local siding clusters to share infrastructure and remain operational amid declining network (together with a second infrastructure manager)

Figure 5.4: TWOS analysis of a type 4 company(small inland industry)

Transfer infrastructure to the second infrastructure manager in order to save costs The strategy for type 4 private sidings emerges from both the practical cost issues these sidings face and the operational model of second infrastructure managers.

The SWOT analysis (D.4) identifies "high infrastructure costs" as a key weakness for type 4 sidings, combined with their isolated locations and limited volumes. This makes it difficult for individual sidings to afford the full burden of infrastructure ownership and maintenance. The TOWS analysis for this type shows that the second infrastructure manager can help mitigate most of the weaknesses (D.8).

Support for this strategy comes from interviews during the second round. For example, Strukton Rail Shortline (B.2.2.10) explains their preferred model of acquiring private sidings and leasing them back to companies, allowing these companies to avoid high maintenance and compliance burdens. They emphasise cost savings through reuse of materials and simpler technical standards.

Together, these sources show that transferring infrastructure to a second infrastructure manager mitigates internal weaknesses and external threats (as categorised in the WO quadrant).

Explore military partnerships to share rail costs This strategy comes from the WO quadrant of the TOWS matrix for type 4 sidings (D.8), combining the weakness of high infrastructure costs with the opportunity sharing costs with the military. As described by expert B.3.0.7 the military normally does not make much use of the rail infrastructure, but requires it to still be maintained to a high level. PArt of the military budget is also meant fro general costs such as the infrastructure (NOS, 2025).

Rather than scaling down due to poor financials, this strategy offers a way for private sidings to remain functional through sharing costs, where national security needs align with logistical infrastructure preservation.

Form local clusters to share infrastructure remain operational (possibly with the help of a second infrastructure manager) This strategy emerges from the WT quadrant of the TOWS matrix for type 4 sidings (D.8), where the weaknesses of high infrastructure costs and low rail dependency intersect with the threat of network decline and loss of railway connections. Rather than continuing to operate in isolation, small sidings can collaborate in geographic clusters to maintain access to the main network by sharing the costs for parts of the rail infrastructure or rail processes such as marshalling.

This approach is supported in the second interview round, where stakeholder B.2.2.11 talked about companies trying to pursue other companies to also switch to rail and stakeholder B.2.2.10 wanting to play an active role in this process.

This is a defensive but pragmatic strategy, aimed at avoiding closure not by boosting volume, but by sharing responsibility, cost and potentially transferring management to a second infrastructure manager capable of maintaining these lines and attracting more companies to share the load.

5.2. Strategies for private sidings

This section explains the different strategies which were found through the help of the TOWS method. This helps to understand how the strategies will work in practise and how the strategies can help the companies and their respective private sidings. This done by explaining the strategies, listing their advantages and disadvantage, and with the help of a causal diagram to understand at which problems the strategies come into play.

5.2.1. Relation between strategies and problems

Here the causal diagram is shown. The diagram is based on the earlier presented diagram (4.2). The place where the strategies attach to the problems follows from the strategies which were formulated based on the TOWS diagrams. This helps to understand where strategies can influence certain problems. The causal diagram can be seen below:

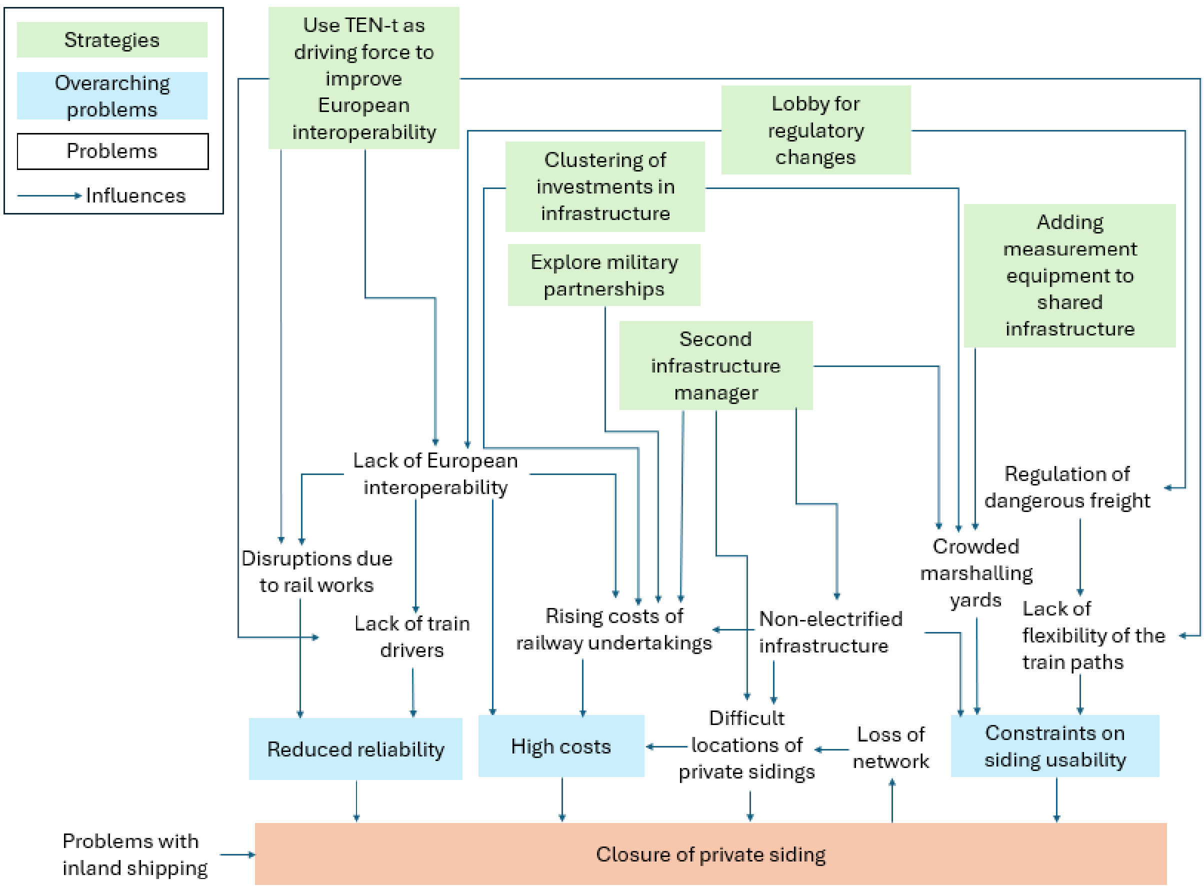


Figure 5.5: Causal diagram of strategies and problems

As can be seen the use of the introduction of a second infrastructure manager plays a central role by influencing four problems. The strategy of a partnership with the military only has the ability to mitigate one problem. The introduction of TEN-t to improve European interoperability also plays a central role and can influence multiple problems related to reduced reliability and high costs. Lobbying and the clustering of investments both influence two problems. The strategies are explained below.

5.2.2. The strategies

In this subsection the strategies are discussed in more detail. The potential advantages and disadvantages are communicated which helps with understanding how the strategies will ultimately work when being implemented.

Clustering infrastructure investment with other companies using private sidings and possible port authorities

The port authorities consulted in this study have explained how they can play a role in enabling companies to work together to pool their investments in shared infrastructure, and port authorities are also prepared to invest in some of the infrastructure changes themselves if necessary. This strategy could be interesting if investments in shared port rail infrastructure are needed, for example to build longer (740 metres) tracks, more measuring points on the tracks to improve efficiency or to build larger marshalling yards. As can be seen in figure 5.5, the strategy aims to improve the the situation at the crowded marshalling yards. As this method is based on financing, it aims to finance the improvements which are necessary to improve the crowded marshalling yards. This could be done by providing money for innovations such as more measuring points, or by providing money for building more shared railway tracks which the companies with private sidings can use. This strategy also tries to mitigate the rising costs of railway undertakings. By making the infrastructure more efficient, such as installing overhead lines, more measuring points, longer tracks, the railway undertakings will need less time for their shunting operations, this can save money as the load on railway undertakings will lessen. This strategy can also be used by companies on their own without the port authorities. This could be useful for type 4 companies who want to share costs for infrastructure or operations. For example upgrades to infrastructure, marshalling costs, or shared transports could lower individual costs for companies.

Advantages:

- Improvement in port infrastructure leading to increased capacity and efficiency
- Improvement in the resilience of the port transport network by improving the position of rail.
- If all companies with private sidings and port authorities contribute, infrastructure investment will remain lower.

Disadvantages:

- Investing in shared infrastructure also means improving the position of a potential competitor with whom you share the infrastructure.
- The complexity of shared projects due to budgets, timelines, different wishes and responsibilities can lead to delays and indecision

This strategy could be promising as was explained in the interviews (B.2.2.7), but the amount of money that companies and port authorities are willing to invest also depends on how secure the business climate and business opportunities are. Without ProRail, many of the necessary investments will be very costly and the amount of money that can be invested is limited (B.2.2.7).

Changing to a second infrastructure manager

There are several aspects to this strategy, the most important of which is to introduce a simpler set of rules and regulations for the last mile of the railway. Trying to get more companies to use private sidings, thus rebuilding clusters and sharing infrastructure costs. This company preferably buys the tracks and leases them back to the company that wants to use them. In this process, the infrastructure manager is prepared to make new investments in the infrastructure. This strategy could be useful for all four types of private sidings. To understand more about the way this company operates and wants to change the railway network, a more detailed version can be found in the appendix D.3.1. This strategy works by decreasing the impact of four problems. First, the rising costs of the railway undertakings could be reduced as the infrastructure manager aims to actively cluster companies with private sidings, thus making shared transport options such as SWL more feasible. The strategy also works by relatively improving the difficult locations of some of the private sidings, by pulling more companies to the rail it increase the rail network which means more potential origins or destination can be reached by rail. Thirdly, this strategy focusses on improving the situation with the non-electrified infrastructure. The infrastructure manager sees the investment in solutions to deal with this such as more overhead lines or hybrid locomotives as an investment in the future. Lastly, the strategy aims to impose their own simpler safety system at the crowded marshalling yards, which simplifies regulations. These investments costs money which the infrastructure manager can acquire by using second hand materials for the upkeep of the tracks, and by setting lower standards for the railway tracks it maintains. The explanation of this can be found in appendix D.3.1.

Advantages:

- Fewer rules and regulations for the tracks, thus reducing costs
- Companies don't have to pay for the upkeep and maintenance of the tracks.
- The new infrastructure manager is willing to invest
- Parking costs for wagons will be lower
- Active clustering of companies with private sidings could restore the network and reduce individual costs

Disadvantages:

- The new infrastructure manager will need to be paid, whether this will be less than the current situation remains to be seen
- The division of traffic control areas could lead to inefficiencies

Adding measurement equipment to shared rail infrastructure in the port to improve congested marshalling yards By adding measurement equipment such as cameras or axle counters, traffic control can get a better view of which train is going where. This means that more trains can operate in the same area, leading to efficiency gains. The interviewee roughly estimated this at 25% (B.3.0.3). This strategy is intended for infrastructure in ports, so it can benefit type 1 private sidings. This strategy, as can be seen in figure 5.5, is directly aimed at the crowded marshalling yards. That is the only problem for which this strategy could make a difference.

Advantages:

- Capacity gains through more efficient use of existing infrastructure
- Basis for more automation and digitalisation in the future

Disadvantages:

- Costly to install and maintain
- The system will be more prone to problems as it becomes more complex
- Tracks will be taken out of service to install the equipment

Use TEN-T as a driving force to improve European interoperability TEN-T is a way of optimising major freight corridors across Europe for trucks, trains and inland waterways. TEN-T forces European countries to follow more or less the same rules on certain routes, such as allowing 740 metre long trains (B.3.0.7). This is good for European interoperability. Another advantage of this strategy could be that it will improve European interoperability and help the implementation and European spread of digital automatic coupling. This is explained in more detail in appendix D.3.3. This strategy is aimed at multiple problems which are encountered. It focusses on the lack of European interoperability. The main goal which has to be solved is the introduction of ERTMS. This helps in standardising infrastructure and operational procedures. This helps to harmonise infrastructure and operational systems across borders. The introduction of ERTMS could also help with the lack of drivers as the drivers will encounter less requirements as they only have to be able to work with ERTMS on that corridor instead of all the different national safety systems. The introduction of TEN-T rail corridors can help reduce the regulatory and operational constraints related to fixed train paths for dangerous goods. Currently, trains carrying dangerous materials often face strict routing limitations. These restrictions are often increased by national institutions such as safety regions and environmental agencies. TEN-T corridors, however, are designed to be high-capacity, high-priority freight routes, equipped with interoperable systems (such as ERTMS), improved safety infrastructure, and consistent standards across borders. They offer more predictability and flexibility for dangerous goods transport. Additionally, because TEN-T corridors are part of the EU's strategic transport framework, this reduces local deviations and conflicting interpretations of safety rules. This streamlining helps to mitigate the need for rigid, fixed train paths and supports more efficient and scalable planning for dangerous goods transport.

Advantages:

- Better European interoperability can lead to fewer problems of unreliability as more systems are standardised
- Lower costs as wagons and locomotives can be less sophisticated
- More drivers available as driver requirements are simpler
- More capacity as there is less need to wait for new drivers and locomotives

Disadvantages:

- Only the major corridors are forced to adhere to common standards. This excludes many of the different national networks.
- The amount of pressure a company with a private siding can exert is very limited. This should be done by national governments and lobbying organisations.

Explore military transport partnerships to share infrastructure costs Military budgets are rising across Europe, and so is the importance of the military. Logistics networks are important to the military. Part of the military budgets are specifically meant for general expenses like improving infrastructure such as bridges or railways (NOS, 2025). This could mean that the costs of the infrastructure can be shared with the military. Military loading facilities in ports could be shared, and investments in railways used by the military could be shared with civil parties. The military often does not need the infrastructure all year round, leaving the railways open for civilian use. This strategy can be used mainly by private sidings of type 1, 3 and 4. As can be seen in figure 5.5, this strategy mainly focusses on reducing costs as the military takes on part of the costs required to maintain the rail network. This is especially true for those low traffic or strategically located sidings. Military logistics often require access to rail infrastructure for transporting equipment, vehicles, and supplies. However, the military typically uses these sidings only occasionally and cannot justify full ownership or stand alone investment. By establishing partnerships between infrastructure managers and defence organisations, the costs of maintaining and operating shared infrastructure can be split, making it more viable for both parties. For the operator, this reduces fixed maintenance costs. For the military, it ensures access to a rail network when needed, without having to build and maintain infrastructure themselves.

Advantages:

- Shared costs result in lower costs for companies using private sidings
- The military stabilises the network, they often make little use of the network but find it important to have it available when needed. So less network downtime.
- The military has specific requirements, such as wide tunnels for trains or the ability to carry long or heavy trains, which would also suit the civil private sidings

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Disadvantages:

- Stricter rules and regulations when it comes to safety and privacy
- The military has priority and could claim the railway line whenever they like. This leads to unreliability.
- This strategy is only applicable in very specific situations, not a widespread solution

Lobbying for regulatory change Some of the problems have to do with regulatory restrictions or lack of investment. One way of dealing with this is to lobby for regulatory changes. This is already happening through organisations such as Evofenedex and the UIRR. A frequently heard argument from these organisations is the lower social cost of using rail. The reasoning behind this is set out in Annex D.3.2. As the causal diagram (5.5) shows, the lobbying for regulatory changes aims to mitigate two problems. First of all the lack of European interoperability, which is caused by a variety of reasons such as the different safety systems, the different standards which trains have to adhere to or the different languages train drivers have to speak. By streamlining this, the European interoperability will improve. Secondly, the lobbying can also be used to influence the regulations of dangerous freight. These regulations are strict and vary between countries as national or local authorities stack additional regulations on top of the European regulations. Lobbying is a way of trying to remove these extra regulations and only adhere to the European regulations.

Advantages:

- It is a system-wide approach that can be used to address some of the fundamental problems of the rail industry
- In addition to specific regulations such as fixed train paths, this can also strengthen the rail network as a whole and improve network resilience

Disadvantages:

- It can take a long time to see results from this strategy
- This strategy is highly dependent on the current political spectrum. A change in political thinking can quickly disrupt the lobbying process
- This approach is very broad. There is a risk that the lobby you support will not help your business directly because it is too broad.

5.3. Which strategy to use for which problem

The diagram below shows which strategies can be used to mitigate a particular problem experienced by companies with private sidings. After the strategy, the table continues with three columns. The D is for directness of influence. This refers to how direct the influence of a strategy is. The I stands for impact, which refers to how large the impact will be if the strategy works. The T stands for time, which refers to how long it will take for the strategy to work. To get to these results the knowledge from the interviews, data and literature were combined. The reasoning behind this can be found in appendix D.3.4 All three columns use the following scale: +, 0, -. Where + is the most direct influence, the biggest impact or the fastest strategy to work.

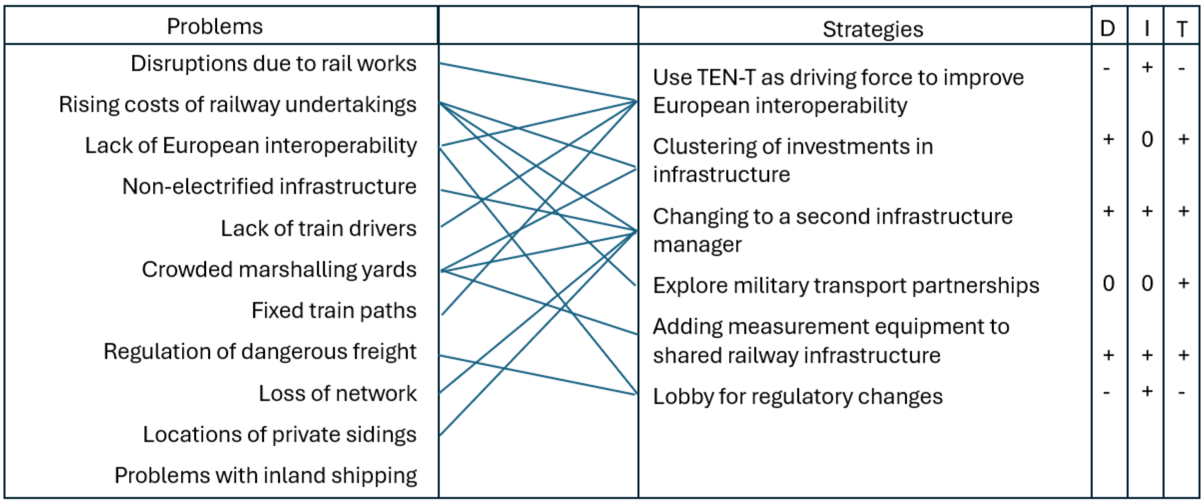

Figure 5.6: Problems, strategies and their impact

Strategies such as adding measurement equipment and changing to a second infrastructure manager are both scoring well on impactful and feasible in the short term. They directly address problems such as crowded marshalling yards and high costs. This suggests they are strong candidates for a fast implementation to support private sidings.

Strategies like using TEN-T to improve interoperability are more indirect and take longer to realise, but address deep-rooted structural issues such as lack of European interoperability. These are good to include in long-term planning and require institutional commitment, even if short-term results are limited.

The military partnerships may have a moderate or indirect effects but serve as a way that help keep infrastructure operational, especially for the vulnerable users. This strategy may be context-dependent but can be decisive in local settings.

The lobby for regulatory change strategy shows limited direct or short-term effect, but it addresses regulatory barriers. This implies it should be pursued beside other strategies to take the long term into account.

As can be seen in the figure, a strategy to deal with the inland waterway problems of low water level has not been found. As the inland terminals explained, they are very dependent on inland shipping, and it is highly questionable if a private siding strategy would allow the terminals to cope with the problem.

5.4. Main results

This section explains to what extent the problems for the different types can be mitigated by combining the information on the impact of the problems with the impact of the strategies. This also answers sub-question 4:

RQ4: What promising strategies can address the challenges faced by private sidings?

5.4.1. Type 1, Companies in large ports

This type of company, with its private siding, is relatively robust. However, they are vulnerable to a number of problems. In particular, congested marshalling yards and rising costs for railway undertakings hinder the efficient operation of this type of company. The regulation of dangerous goods, the lack of European interoperability and investment uncertainty are also problematic. The good news is that most of these problems can be mitigated to some extent through strategies, such as clustering investments, adding metering points to the infrastructure and lobbying for new regulations. This does not mean that type 1 companies are infallible, but they do have strategies that can help them mitigate their problems. The most immediate gains can be achieved through the clustering of infrastructure investments and measurement equipment in shared rail infrastructure. These strategies are not only high-impact and short-term (see figure 5.6), but also build directly on existing strengths such as block train volume and collaboration through port authorities within the port environment. Their implementation would help mitigate issues like marshalling yard congestion and rising costs. Overall it is worth considering for port authorities and rail using companies in the port area to form partnerships and combine investments in infrastructure such as more measurement points.

5.4.2. Type 2, Inland terminals

Inland terminals have a wider range of problems including non-electrified infrastructure, loss of network, lack of European interoperability and problems with inland navigation. These are serious problems which, taken together, can add up to a major problem. However, these problems can be mitigated reasonably well by strategies such as investing in new infrastructure (possibly together with a second infrastructure manager). Priority should be given to a solution of the non-electrified railway tracks. These terminals often suffer from non-electrified tracks, which makes operations more expensive, but also hinders operational efficiency, which is a key part of their value proposition.

5.4.3. Type 3, Large industry

Type 3 companies face a number of problems that hamper their operations. A major problem for them is the fixed train paths, which can be a reason for temporary closures. They are also hampered by rising costs for railway undertakings and the lack of European interoperability; they are relatively dependent on rail, which means that they will not be able to switch quickly to another modality. Priority should be placed on lobbying for regulatory change. This strategy may be longer-term and indirect, but is necessary to mitigate the regulatory burden that threaten siding continuity.

5.4.4. Type 4, Smaller regional companies

Type 4 private sidings seem to be the most vulnerable. They face several problems that could lead to closure. Such problems include rising costs, loss of network and an unfavourable location of the private siding. The focus should be on cost sharing strategies, such as transferring infrastructure to a second manager and forming local clusters. These sidings often lack financial autonomy and are located far from strategic nodes. Clustering reduces their costs and make the rail modality more viable. Overall it is worth considering for ProRail and the Ministry of Infrastructure and Water management to decrease the regulations for rail freight on private sidings and marshalling yards and furthermore allow a second infrastructure manager to acquire infrastructure such as marshalling yards from ProRail to decrease track access costs for railway operators.

5.5. Discussion

5.5.1. Data

The data used has its limitations. Most of the data comes from ProRail's infra 2030 document (Hofstra, 2024). The document itself states that there may be errors in the document. In the course of the research, several errors were found in the data. Some private sidings were owned by different companies, some numbering was incorrect and not all activity levels were correct. As a result, the figures in this document should not be taken literally. They are only intended to give an overview of the status of private sidings.

The data on the volumes carried are gathered from a number of sources, including ProRail reports, interviews and correspondence with ProRail staff. The research endeavours to express freight volumes in net weight. This is not the case in all ProRail publications. Some of the sources provided conflicting data. Where this was the case, the most reliable source was chosen.

The movement of the city into the port which is the case in the port of Amsterdam most likely makes for double counting of private sidings. However from the data it was not possible to correct for this. This number can not be higher than 7 private sidings.

5.5.2. Interviews

The people interviewed were a mix of stakeholders and experts with knowledge of the sector. Stakeholders in particular are biased as they represent a company or institution. For example, a common argument was that the government should provide more subsidies and invest more in infrastructure. This is an easy argument for a stakeholder to make. Therefore, where possible, the issues raised were checked against data and literature. This resulted in some issues not appearing in the SWOT analysis even though they were mentioned by several respondents. The arguments used are still biased.

Furthermore, one respondent refused to give permission for the use of the interview report.

5.5.3. Categorisation

The categorisation of the private sidings was made on the basis of the data, information and interviews. However, it is difficult to make a clear distinction between the different types, and types can also overlap. For example, category 1C includes 65 private sidings. Many of these large port terminals are also production facilities, which could also be categorised as 1A. This explains the small number of 1A private sidings. However, as they also specialise in the storage and transshipment of materials, they have been classified as 1C. Furthermore, some of the type 4 private sidings are large companies with high volumes, but they only need an occasional block train. Although their size is comparable to that of type 3, they are classified as type 4.

5.5.4. Validation

To validate the problems found and test the strategies a third interview round was performed. This was done with a limited number of 7 interviews. (3 companies with private sidings, 2 infrastructure managers, 1 railway undertaking, 1 expert). The limited number of interviews meant not all strategies could be completely tested with the interviewees. For example was not possible to interview a type 2 company in the last interview round. Therefore, only strategies aimed at the other three types were discussed. The strategy "Explore military transport partnerships to share infrastructure costs" was difficult to validate with the interviewees. Only the European rail expert was able to comment on this. He explained how the strategy could be used to strengthen the resilience of the network, as it could be a reliable partner.

5.5.5. Focus on the Netherlands

This research sees a strong focus on the Netherlands, even though the railway network of the Netherlands is strongly connected to the rest of Europe, and a lot of the rail freight has international origins or destinations. This means that the problems within the Netherlands are not self-contained, but are part of a bigger picture. The extent in which this research takes this into account is limited.

5.5.6. Qualitative research

This research has a qualitative character due to the limited amount of data available. This has been a limitation as the validation of information had to happen in a qualitative way. This limited the research in reaching calculated results. Even though the stakeholder interviews provided a lot of context specific insights, it cannot all be used to generalise problems for all private sidings.

5.5.7. Conclusion of the discussion

Based on the limitations this research faced the results of this research should not be applied without context specific information and further research. Even though the results possess new insights with regard to private sidings, the validation of the research had to happen mostly in a qualitative way as a lack of data and literature could not help with this aspect. Furthermore the focus on gathering more information in the interviews hindered the validation of found information through interviews.

6
Conclusion

6.1. General conclusion

In the first research question is analysed what the structure and operational context of private sidings within the Dutch rail freight system is. Spur lines and companies with private sidings in the Netherlands are in an increasingly vulnerable position. From the original 900 private sidings, only a 168 are currently left with more planned to disappear. The private siding is an indispensable part of the rail network as it enables companies to use the rail network. This rail network can support environmentally friendly transport, large volumes, dangerous goods and support the resilience of the whole transport network. To keep fulfilling this role, the private sidings should be used to their full potential, however the companies using them are experiencing problems related to rail transport, which results in the closure of private sidings.

The second research question is aimed at establishing what the different types of companies with private sidings are existing in the Netherlands. The research shows that the companies and their respective private sidings can be categorised into 4 types, where the private sidings in the large ports (type 1) transport the most volume, the private sidings of inland terminals (type 2) form a crucial part of their transshipment process, private sidings of large industrial companies (type 3) are used for large block trains with large volumes of freight, and the smaller inland private sidings (type 4) are used much less, and their companies are struggling to keep them open. This categorisation provides a basis which people or organisations can use to analyse problems or construct strategies when it comes to private sidings.

The third research question is used to further investigate what challenges and developments the companies with private sidings are facing. As the problems of the private sidings were examined, we know that type 1 and 2 companies are relatively experiencing the least problems, such as crowded marshalling yards and lack of European interoperability. The large industry of type 3 is experiencing a number of significant problems such as fixed train paths and regulations of dangerous goods. Their size and dependency on rail help them to stick to rail usage. The companies of type 4 are experiencing the most problems and have the least amount of options to mitigate these. Problems are rising costs, loss of network, difficult locations and non electrified railway lines. All of these problems make the use of rail transport less attractive which ultimately can force rail using companies to close their private siding.

The final sub-question is used to establish what strategies can be used to mitigate the challenges the companies with private sidings face. This resulted in the following insights: type 1 large port private sidings possess quite some options to use their strengths and partnerships to overcome the problems, such as cooperation through the port authorities and concrete strategies such as more measuring points in the infrastructure. Type 2 inland terminals also have access to strategic tools, particularly through cooperation with second infrastructure managers to invest in electrification. For type 3 sidings used by large industry, the strategy mostly lies in regulatory changes for transporting dangerous goods. The type 3 private siding does not have a lot of options, but is very dependant on rail. However, type 4 sidings have the most problems to solve. Their options are mostly focused on lowering individual costs, such as clustering, shared infrastructure, or transferring responsibility to external infrastructure managers. This confirms that tailored strategies are necessary per siding type, and that not all users have equal access to viable solutions.

The most remarkable outcomes of this research are the insight that most companies with type 4 private sidings do not choose to use rail transport because it is the cheapest modality for them, but because it offers irreplaceable benefits in terms of operational efficiency or the ability to transport dangerous goods. Furthermore the position of a new infrastructure manager is a radical new way of managing the private sidings and could potentially offer a lot of benefits to the companies with the private sidings. Lastly, the difficult position of the inland terminals, which are highly dependant on inland shipping and its low water levels, are a new insight. This results in contrary outcomes for companies with other types of private sidings. To be able to implement the strategies from this research the Ministry of Infrastructure and Water Management should consider to provide more leniency with regard to the regulation for dangerous goods, and allow a second infrastructure manager to operate under its own rules when it comes to maximum speed, maintenance and the traffic safety system. Furthermore companies with private sidings in ports should consider to invest in collaboration with the port authorities in more measuring equipment in the shared infrastructure. Lastly, companies with private sidings, infrastructure managers and the military should consider collaborations when it comes to investments or combining transports.

6.2. Future research

This section will explain the future strategies possible to fill the research gaps, which are still left unanswered by this research.

The time to work out the strategies was limited. Before any of these strategies could be put into practice, more research will be necessary. Everyone of these strategies could justify a whole new thesis to precisely determine the exact way how the strategy should be implemented and the impact the strategy makes on every different type of company and private siding. For example, research in a specific type of private siding combined with a case study could provide valuable information about how the problems and strategies interact with each other.

Another interesting topic for further research would be the role of private sidings in the resilience of the Dutch railway network. More data will absolutely be needed for this, but a simulation of how many private sidings could disappear or should reappear before a threshold is reached in a negative reinforcing loop such as the one found in this research would be useful in policy making.

More research to understand the role and approach of other countries and their private sidings could also be useful. How do other countries cope with similar problems, and what strategies are formed in those countries? The literature from this research could form the basis of this as some of the literature already looks at other countries such as Poland and Turkey. This topic should be explored further. Eventually this could help with determining the right strategies for the Netherlands.

The perspective and take of the Dutch national government has not been part of this research. Unfortunately, they were not available for interviews and the policy on this topic has been very limited. All information was collected via other stakeholders. However, it would be useful to better understand how private sidings would fit in the vision of the government. This could be done by interviewing government officials.

6.3. Societal reflection

This research contributes to the debate with regard to the conservation and future proofing of private sidings in the Netherlands. The private sidings form an essential connection between the railway network and the individual companies which use this network. They are essential in order to use rail as a transport modality. If policy makers want the modal share of trains to be increased due to environmental, resilience, congestion or other reason, the private sidings have to exist and be functional in order to support these goals. Concrete findings from this research are the categorisation of the four types of private sidings. This presents a way to better understand private sidings. Another concrete finding is the causal diagram which shows the relations between private sidings, its problems and possible strategies. The outcomes of this research can be used by policy makers and infrastructure managers to decide on new regulations, investment decisions or subsidy programs. For companies who operate a private siding the strategies can be used to decide on investments or collaborations. Furthermore the government can use the insights from the problems found to prioritise infrastructure investments with societal benefits, be it environmental or resilience.

6.4. Academic reflection

Scientifically, this research is positioned between infrastructure planning, logistical management and governance. By combining SWOT and TOWS analysis, Osterwalder business canvasses with input from data, literature and stakeholder and expert interviews, a new analysis has been made of the Dutch private siding situation. Thereby, this research fills a void in the existing literature about rail transport with a focus on private sidings. The chosen qualitative approach offers space for new insights, but also has its flaws. The validation of problems and strategy choices has mainly been done with logical reasoning and estimations from stakeholders. This weakens the reproducibility of the research. Also the sometimes case oriented focus offers space for new insights, but does not improve reproducibility. Further quantitative validation would be desirable for further research.

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A

Data

A.1. Market data

Table A.1: Goods transported in intermodal transport units by rail in the Netherlands (thousand tonnes)

Cargo	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Containers and swap bodies	14,760	15,304	16,390	16,284	19,494	18,473	17,963	19,300	20,329	18,142
Road vehicle (accompanied)	1	0	0	0	0	0	0	0	0	0
Semi-trailer (unaccompanied)	96	524	512	471	308	56	94	270	215	147
Unknown	0	0	0	0	0	0	0	0	0	0

Source: Eurostat

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Inland waterway	282	275	275	295	279	262	285	279	287	296	285	236	302
Road	635	686	669	681	653	707	704	708	726	754	734	726	705
Rail	25	25	28	26	28	30	33	34	37	39	38	31	33
Air	1	1	1	1	1	1	1	2	2	2	2	1	2

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Inland waterway	306	301	300	310	306	306	309	304	296	291	310	301	284
Road	705	681	690	692	701	730	745	756	767	770	785	777	729
Rail	37	36	37	38	40	40	38	38	38	36	39	41	36
Air	2	2	2	2	2	2	2	2	2	2	2	2	1

Source: CBS (Statistics Netherlands)

Table A.2: Goods transported by inland waterways in the Netherlands (thousand tonnes)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total	342314	347819	357027	349088	354177	359067	349189	347541	335760	357507	345449	327478
Dry bulk	200057	203031	210455	201416	198548	199813	194553	179681	170906	184450	181357	168581
Wet bulk	103634	105166	104293	106312	111400	112129	109505	119907	115539	122617	118541	119269
Container	38622	39621	42278	41359	44228	47125	45129	47952	49314	50439	45550	39627

Source: CBS

Table A.3: Percentages of gross weight of rail freight transported in container over time in the Netherlands

Product Category	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Agricultural, forestry, fishery products	75%	79%	45%	32%	29%	73%	77%	79%	76%	86%	92%	99%	94%	67%	75%	67%
Food and beverages	80%	85%	89%	94%	94%	97%	84%	93%	81%	96%	95%	93%	95%	91%	93%	91%
Coal and lignite	2%	2%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Coke	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%
Natural gas	-	-	-	-	-	100%	100%	100%	97%	100%	73%	75%	-	100%	0%	-
Crude oil	-	0%	0%	-	-	0%	0%	-	0%	0%	0%	0%	0%	0%	-	-
Petroleum products	27%	29%	26%	29%	18%	24%	16%	24%	18%	15%	17%	23%	3%	1%	17%	1%
Ores	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Salt, sand, gravel, and clay	25%	35%	42%	40%	35%	30%	44%	49%	57%	59%	50%	49%	23%	30%	5%	49%
Other mineral products	34%	28%	28%	60%	55%	21%	24%	25%	20%	24%	29%	32%	30%	42%	6%	21%
Chemical and fertilizer products	62%	67%	59%	57%	59%	55%	57%	59%	57%	59%	60%	67%	69%	70%	42%	52%
Pharmaceuticals, chemical specialties	0%	0%	0%	74%	76%	79%	81%	95%	96%	96%	95%	94%	89%	91%	79%	95%
Plastics and rubber	0%	0%	0%	83%	83%	80%	57%	54%	67%	81%	41%	93%	94%	97%	97%	99%
Basic metals and metal products	12%	16%	15%	14%	12%	24%	21%	21%	18%	21%	33%	32%	14%	19%	8%	21%
Machinery and electronics	16%	17%	26%	95%	96%	97%	97%	93%	94%	94%	94%	97%	97%	95%	96%	98%
Transport equipment	4%	2%	2%	28%	24%	44%	36%	65%	37%	67%	53%	59%	80%	62%	95%	80%
Textiles, leather, and related products	0%	0%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Wood, pulp, paper, and paper products	0%	0%	0%	40%	31%	21%	25%	31%	26%	28%	26%	34%	20%	44%	37%	40%
Waste and secondary raw materials	90%	78%	91%	63%	61%	78%	89%	99%	91%	80%	59%	47%	66%	66%	59%	56%
Other goods	99%	98%	92%	52%	62%	83%	80%	76%	81%	81%	79%	81%	50%	63%	98%	77%

Source: CBS

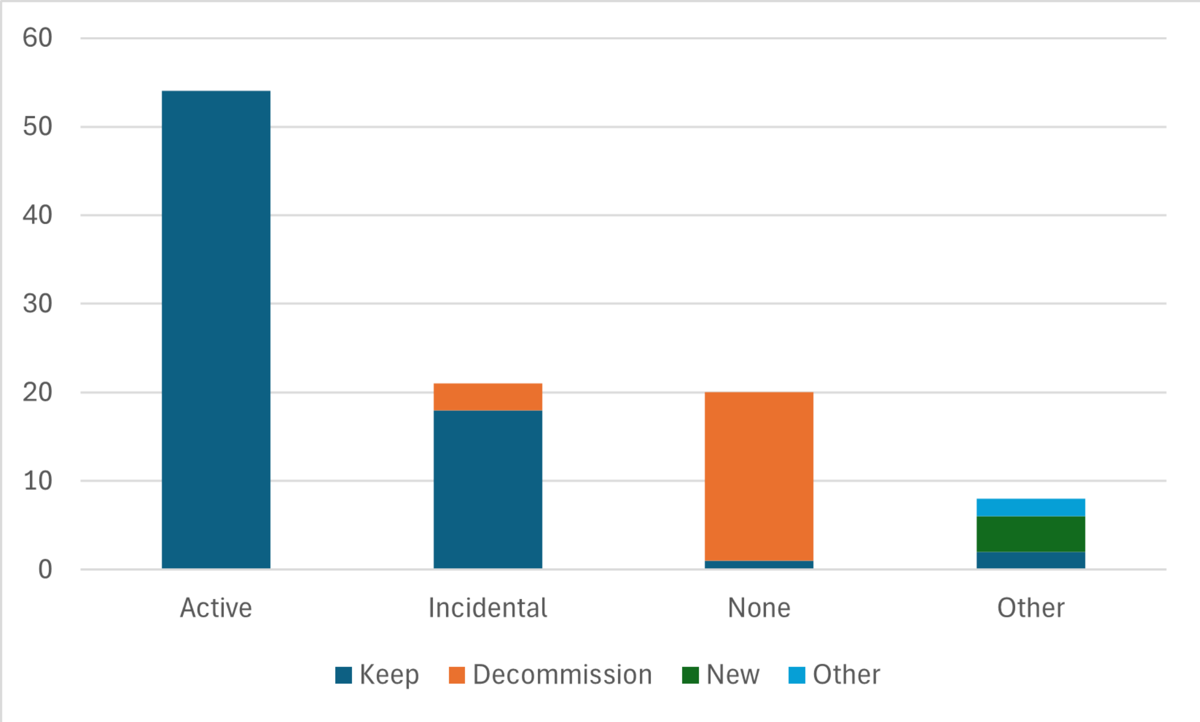


Figure A.1: Status and activity level of private sidings of type 1

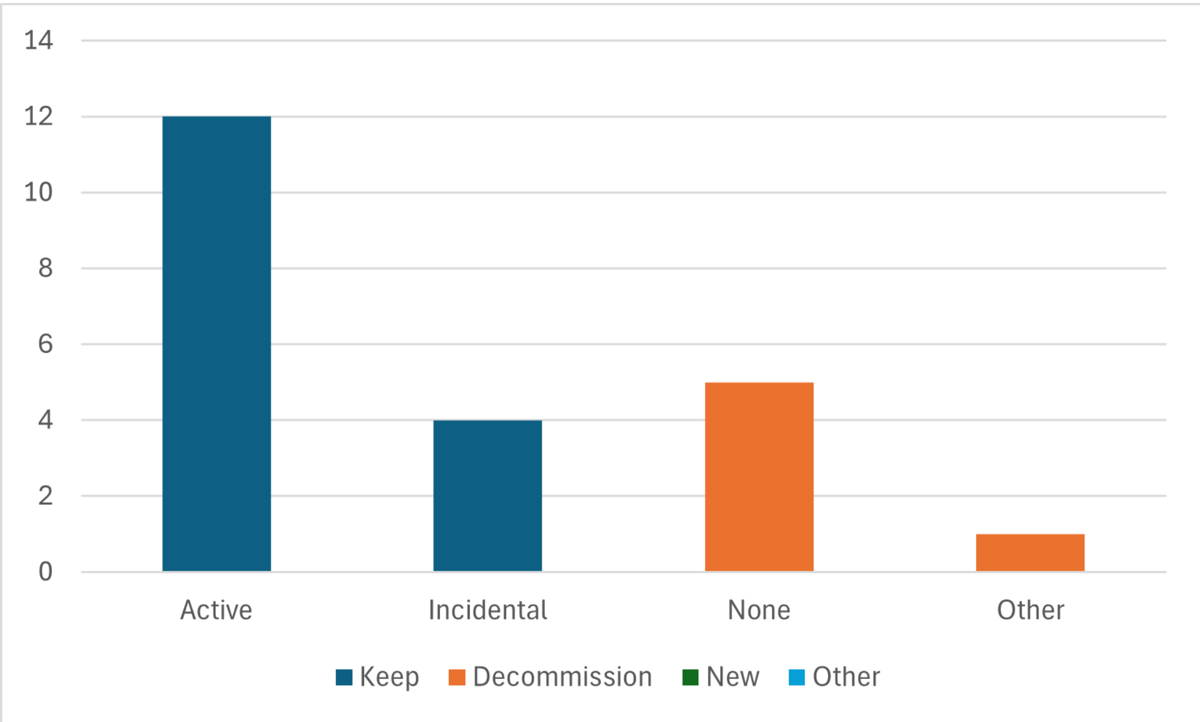


Figure A.2: Status and activity level of private sidings of type 2

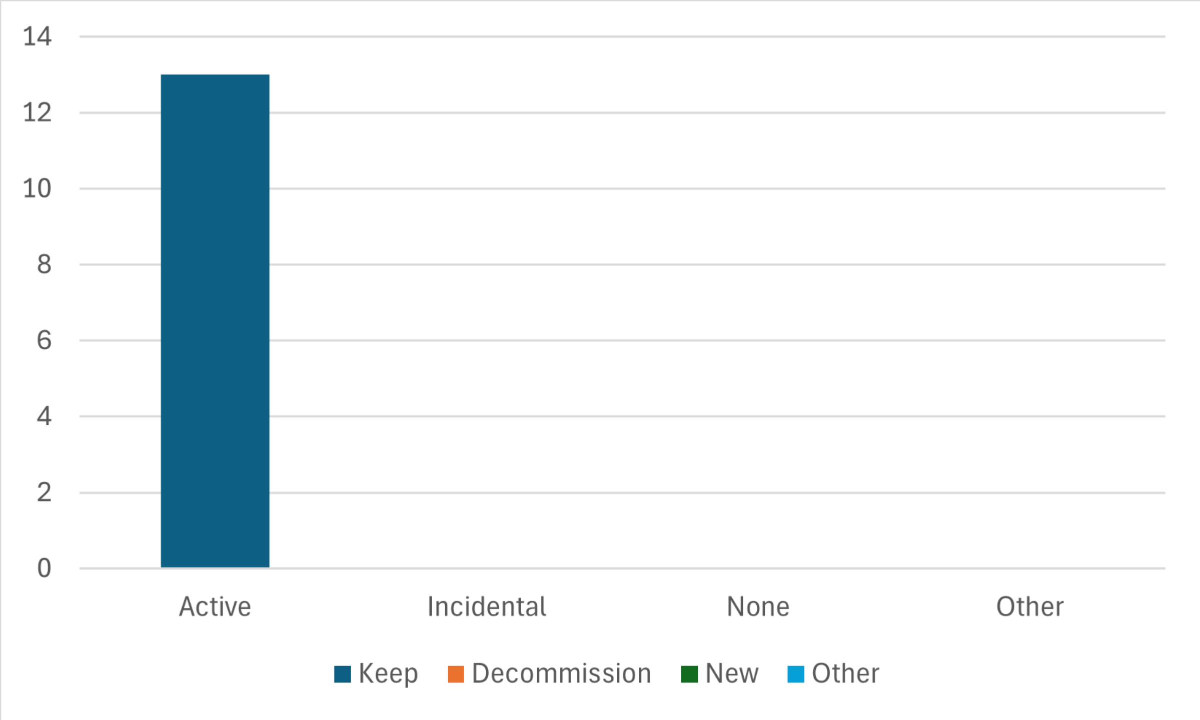


Figure A.3: Status and activity level of private sidings of type 3

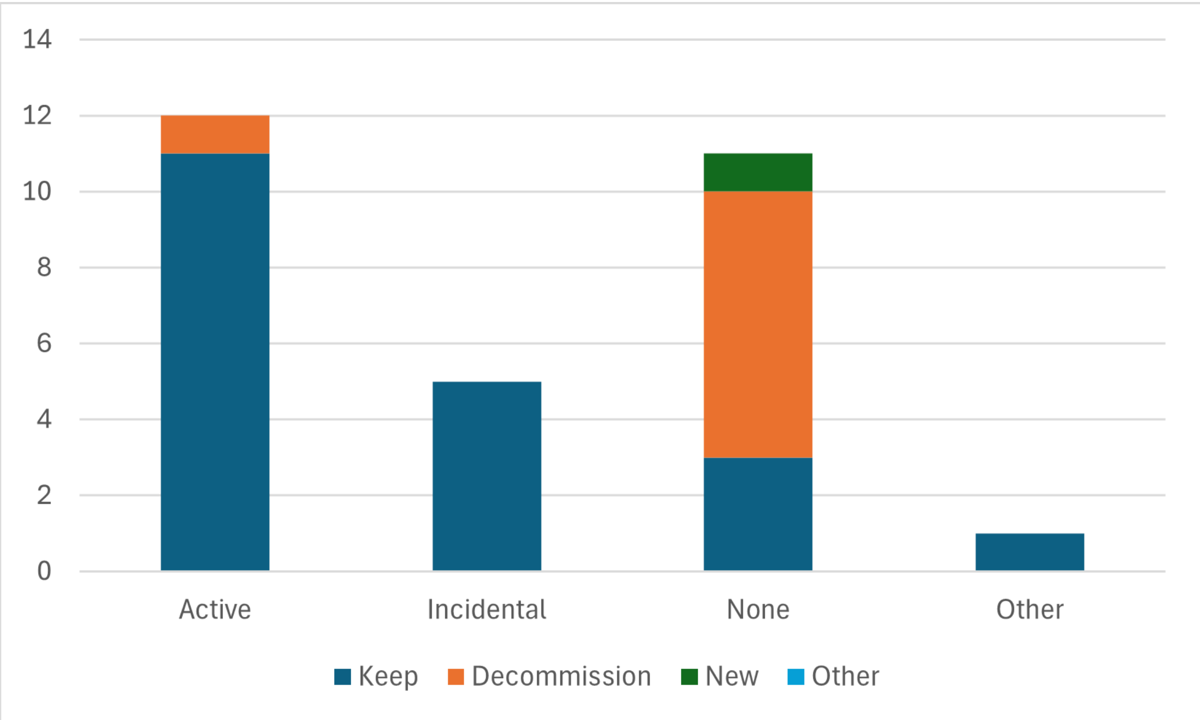


Figure A.4: Status and activity level of private sidings of type 4

A.2. Specific private siding data

This section analyses the data collected on private sidings in the Netherlands. The main source of information is the 2030 infrastructure document of the national infrastructure manager ProRail Hofstra, 2024. In total, the national ProRail network is connected to 224 private sidings. The 2030 infrastructure document classifies the private sidings into categories based on their functions. These categories are

(Infrastructure (Infrastructuur), Museum (Museum), Travellers (Reizigers), Military (Defensie), Freight (Goederen) and Rail (Spoor). As the focus of this research is on companies operating private sidings as part of logistics processes, only private freight sidings are considered. 11 Private sidings were changed by hand as the data was not accurate. These private sidings are ZZ2, ZZ3, ZZ4, ZZ45, ZZ51, ON1, M6, ZW7, ZW10,ZW16, ZO7. After filtering, 186 private sidings used for freight remained.

The private sidings were assigned a level of activity and a status. The level of activity ranges from none to daily. In order to analyse the data, the 13 different activity levels were categorised, as can be seen in the table A.8. A status is also assigned to the private sidings. This status says something about the future perspective of the private siding. For example, maintain, remove or revitalise. The 17 types of status have also been categorised, as can be seen in the table A.7.

The relationship between status and activity can be seen in the figures **??** and **??**. The first thing to notice is the relationship between no activity and the plan to remove these sidings. This is the orange block. It is also clear that almost all the private sidings marked as active are being maintained and will therefore continue to exist. The number of private sidings that are planned to be removed is slightly larger in the casual block. Out of a total of 224 private sidings, 169 are planned to be retained, 42 are planned to be removed and 8 new ones are planned A.6. Of the 168 private freight sidings, 125 will be kept, 36 will be removed and 5 will be added A.5. This means that 21.4% of the private sidings are planned to be removed before 2030.

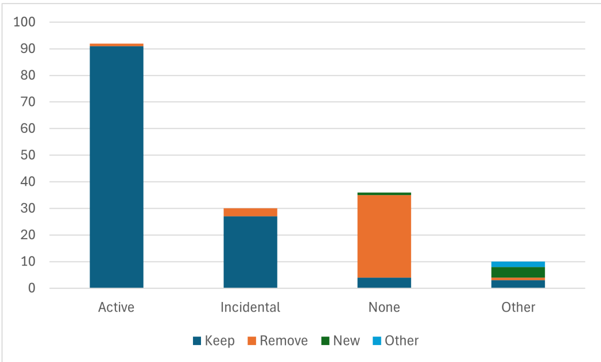


Figure A.5: Status in relation to activity of freight private sidings

Source: Hofstra, 2024

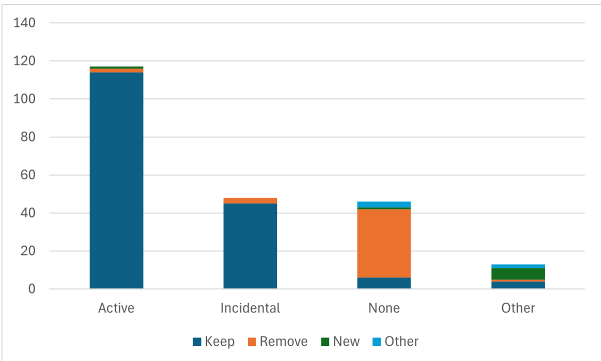


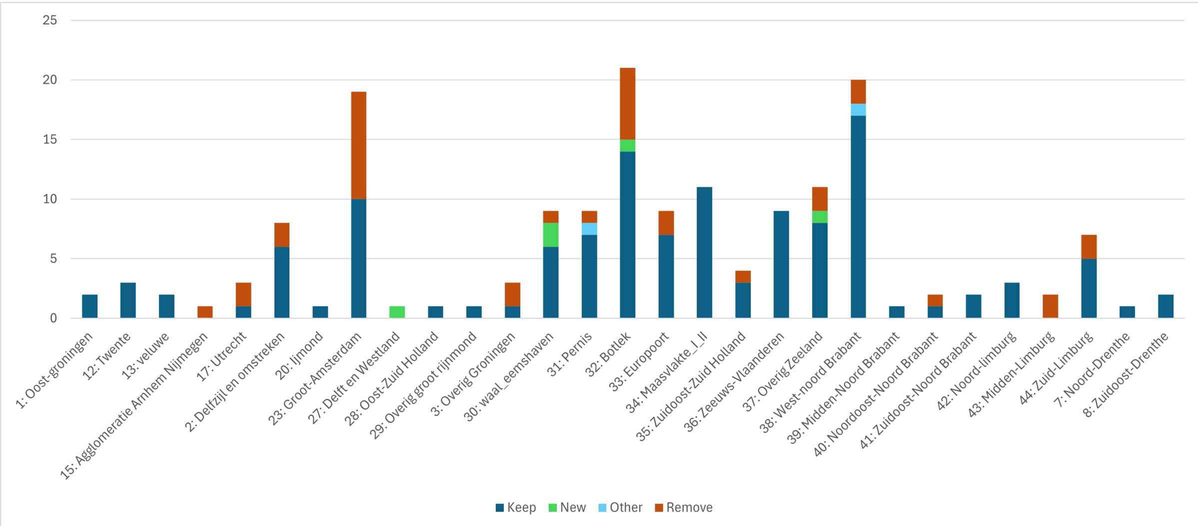
Figure A.6: Status in relation to activity of private sidings

Source: Hofstra, 2024

A.2.1. Regional differences

Below, the figures **??** and A.8 describe the use of private sidings per region. When looking at the private sidings that are disappearing, the two zones that stand out are zone 23: Amsterdam and zone 32: Botlek. Both are port zones with a lot of private sidings. Interviews B.2.2.6 and B.2.2.7 explained how the ports are constantly developing and moving away from the cities, while the cities are starting new housing projects in the ports. Another striking fact is that all the new private sidings are located in the ports, with the exception of Zone 27, which is the DSM private siding. ProRail expects this siding to be revitalised. Another logical conclusion is the high number of private sidings in the ports, these are zones 23 (port of Amsterdam), 30 to 34 (port of Rotterdam), 36 & 37 (Sloehaven and Zeeuws-Vlaanderen) and zone 38 (mostly port of Moerdijk).

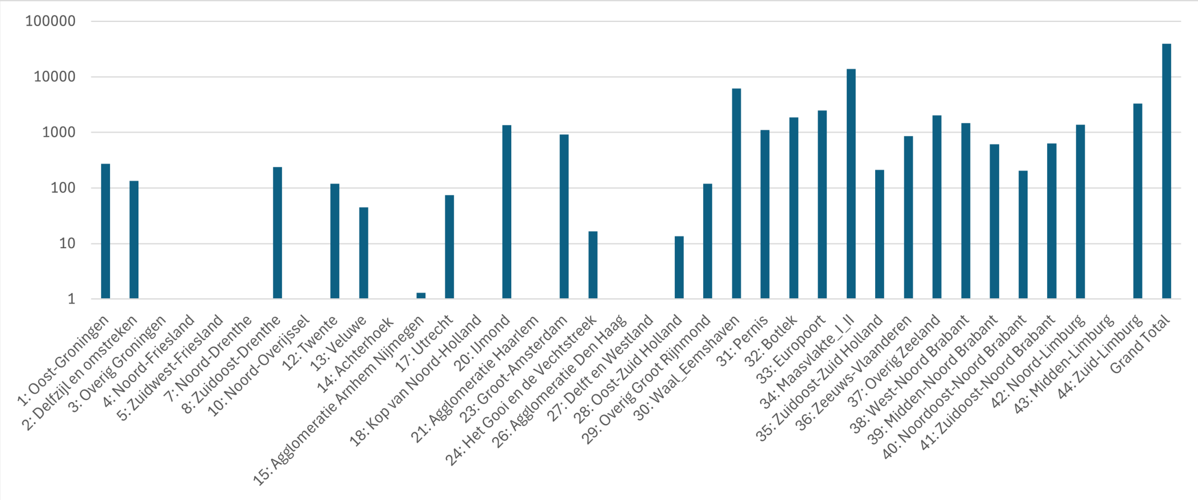
In order to have a better understanding of the freight transported per industrial cluster, the data from BasGoed was combined with the data from the ProRail annual reports (Demmers and Van Es, 2025), (ProRail, 2023), Demmers and Van Es, 2024. The BasGoed data from table A.11 has been combined with the information from table A.2.4. This second table is an overview of which spurlines share BasGoed zones. In this way the BasGoed data could be linked to certain private sidings. Apart from the spur lines, the other industrial clusters and private sidings without neighbours were mapped. This resulted in the table below: A.4. This is the most complete overview of all private sidings with the volume of goods transported in kilotons and the number of trains going to a private siding/area. The two years used are 2018. This data comes from the BasGoed viewer, which uses 2018 as the reference year. The data from 2024 are taken from the ProRail reports. ProRail distinguishes 7 main attraction and production regions Demmers and Van Es, 2025. The 7 regions are the port of Rotterdam, the port of Amsterdam, Chemelot, Moerdijk, Sloehaven, the Venlo region and Beverwijk. Together, these regions account for the majority of goods transported by train. Below these 7 regions are the smaller clusters. These are the regions from Zeeuws-Vlaanderen to Oss. The regions below Oss are all regions with only one private siding. A map of the private sidings can be seen in figure A.9. This map shows the locations of all private sidings. The clusters around the port areas are clearly visible.



Source: Hofstra, 2024

Figure A.7: Status of private sidings per zone

Figure A.8: Freight transported per zone (kt)



Source: Rijkswaterstaat Water Verkeer en Leefomgeving (WVL), n.d.A.11

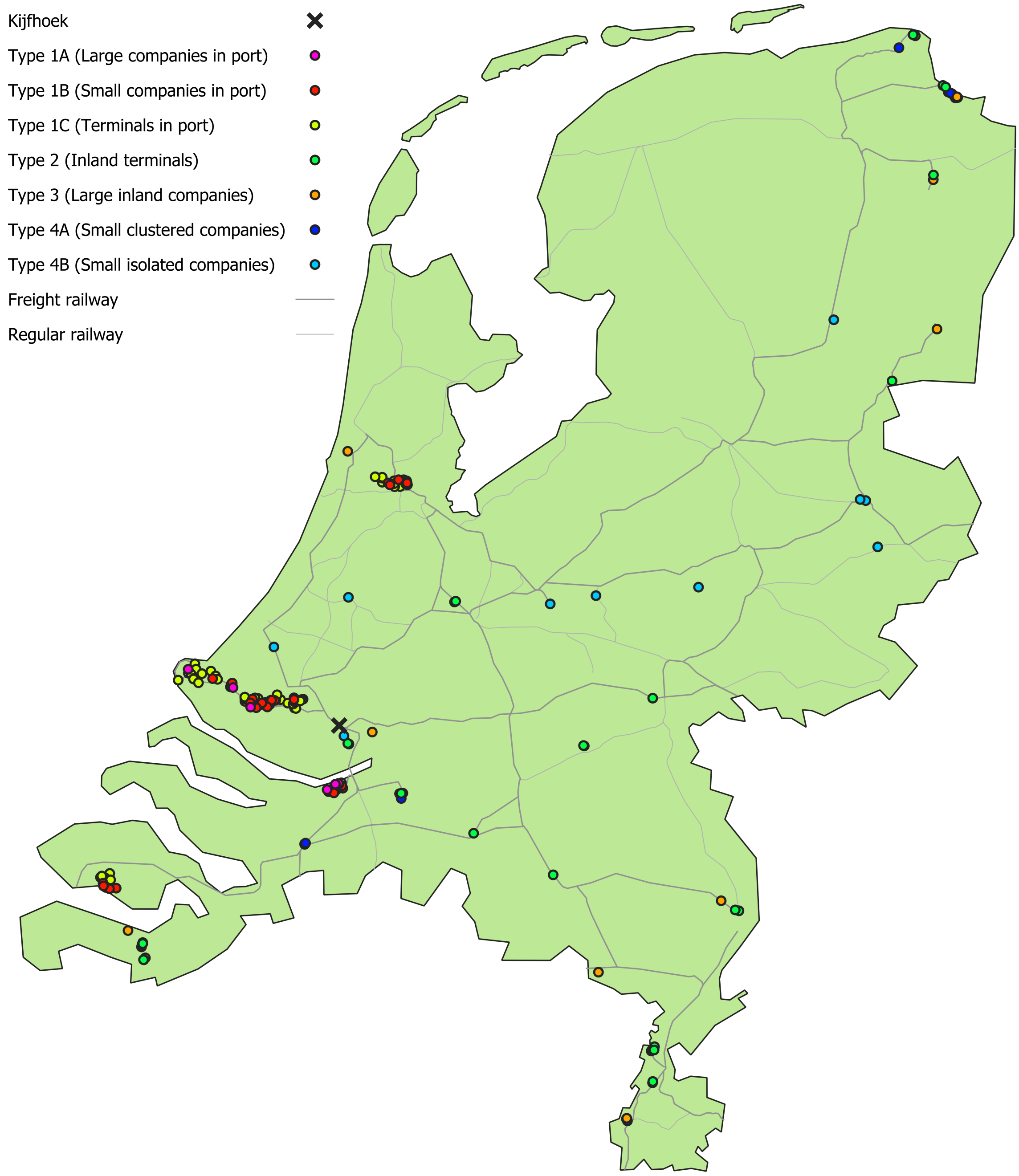


Figure A.9: Map with all private sidings in the Netherlands

Table A.4: Netto weight moved an trains ran per private siding cluster

	2018		2024	
	Netto tons moved (kt)	Trains	Netto tons moved (kt)	Trains
Havenlijn total	25529		26700	33050
Eemhaven_waalhaven	6202			5450
Botlek	1878			2350
Pernis	1101			4250
Europoort	2497			3750
Maasvlakte	13851			17250
Amsterdam Westhaven (Coenhaven)			815	1000
Amsterdam Houtrakpolder (aziëhaven)		685	1150	
Chemelot			1900	3100
Moerdijk			900	2050
Sloehaven	2018		1200	2500
Regio Venlo total			1900	3650
Blerick				
Gekkengraaf				
Beverwijk (Tata)			1600	1750
Zeeuws-Vlaanderen		1850	800	1700
Axel			200	750
Terneuzen, sas van gent, sluiskil				
Oosterhout			50	150
Roodeschool	0			
Delfzijl	133			250
Maastricht (beatrixhaven)			100	350
Dordrecht			200	50
Born			100	450
Almelo (Dollegoor en bedrijventerrein)			100	100
Veendam				150
Ut. Lage weide			0	0
Oss	91.7		400	500
Alphen a/d rijn	13.6			150
Tilburg			800	1200
Amersfoort (PON)				1030
Acht				125
Emmen+coevorden	239			150
Emmen				
Delden				100
Roosendaal			0	0
Zwijndrecht			100	50
Valburg				
VAM aansl.			0	0
t Harde				
Barneveld				0
Beekbergen				
Delft			0	0
Schiedam				
Zwijndrecht				50
Budel				225

A.2.2. Transport between industrial clusters

Rail data between Dutch industrial clusters is scarce, but it is possible to obtain some information. The most heavily used inland freight route provided by ProRail is the connection between the port of Rotterdam and Blerick near the German border. This traffic has a volume of between 1250 and 2500 trains per year. The other freight flows are between Rotterdam and Amsterdam, Rotterdam to Chemelot, Rotterdam to Lage Zwaluwe (marshalling yard near Moerdijk) and Rotterdam to Tilburg. On all these routes, there are between 500 and 1250 trains per year (Demmers and Van Es, 2025).

A.2.3. Chemelot

The document on which this data research is based consists of all private sidings connected to the ProRail main railway infrastructure (HSWI). There is one exception: the Chemelot industrial complex. ProRail considers this as a single private siding (ZO14). However, this is a private industrial site with several companies using rail transport. The main player is Sabic. But about 5 other companies also have rail access. As no data were available for these companies, Chemelot is treated as a single private siding B.1.0.3.

A.2.4. Limitations

The data has limitations. The document from which the data was taken contains errors. Some classifications were wrong. For example, a passenger railway undertaking with a private siding with a repair workshop was classified as a private siding carrying freight. This has been corrected as far as possible. The author of the document also acknowledges that the document may contain errors and that the status of private sidings are only plans or ideas in various stages of implementation. Not all of the plans that form part of this document have been finalised.

Table A.5: Future plans in relation to activity of private sidings operating freight

	Keep	Remove	New	Other
Active	91	1	0	0
Incidental	27	3	0	0
None	4	31	1	0
Other	3	1	4	2

Table A.6: Future plans in relation to activity of private sidings

	Keep	Remove	New	Other
Active	114	2	1	0
Incidental	45	3	0	0
None	6	36	1	3
Other	4	1	6	2

Table A.7: Status of private sidings

Status simple	Status	Private sidings	Private freight sidings
Keep	Behouden	126	98
Keep	Overdragen	42	27
Keep	Verplaatsen	1	0
Remove	Saneren	27	24
Remove	Wordt gesaneerd	3	1
Remove	Saneren?	1	0
Remove	Geannuleerd	1	1
Remove	Potentie?	9	9
Remove	Klemmen	1	1
New	Nieuw	3	2
New	Uitbreiden?	1	0
New	Toekomst?	2	1
New	Nieuwe aansl?	1	1
New	Reactiveren?	1	1
Other	Onderdeel project	2	0
Other	N.t.b.	1	0
Other	?	2	2
TOTAL:		Private sidings	Private freight sidings
Total keep		169	125
Total remove		42	36
Total new		8	5
Total other		5	2

Table A.8: Activity of private sidings

Activity simple	Activity	Private freight sidings
Active	Dagelijks	55
Active	4x/week	2
Active	3x/week	1
Active	Wekelijks	34
Incidental	Beperkt	0
Incidental	Incidenteel	28
Incidental	Zelden	2
None	Geen	36
Other	N.v.t.	3
Other	?	3
Other	Nieuw	2
Other	Potentie	1
Other	Toekomst	1
TOTAL:		Private freight sidings
Total active		92
Total incidental		30
Total None		36
Total other		10

Table A.9: Status of private sidings per zone

Zone	Keep	New	Other	Remove
1: Oost-groningen	2			
12: Twente	3			
13: veluwe	2			
15: Agglomeratie Arnhem Nijmegen				1
17: Utrecht	1			2
2: Delfzijl en omstreken	6			2
20: Ijmond	1			
23: Groot-Amsterdam	10			9
27: Delft en Westland		1		
28: Oost-Zuid Holland	1			
29: Overig groot rijnmond	1			
3: Overig Groningen	1			2
30: waal_eemshaven	6	2		1
31: Pernis	7		1	1
32: Botlek	14	1		6
33: Europoort	7			2
34: Maasvlakte_I_II	11			
35: Zuidoost-Zuid Holland	3			1
36: Zeeuws-Vlaanderen	9			
37: Overig Zeeland	8	1		2
38: West-noord Brabant	17		1	2
39: Midden-Noord Brabant	1			
40: Noordoost-Noord Brabant	1			1
41: Zuidoost-Noord Brabant	2			
42: Noord-limburg	3			
43: Midden-Limburg				2
44: Zuid-Limburg	5			2
7: Noord-Drenthe	1			
8: Zuidoost-Drenthe	2			

Table A.10: Overview of spur lines and grouping in BasGoed zones

Location	Name Spurline	Zone	Volume Predictability	Notes
Delfzijl	Stamlijn Havenschap	2: Delfzijl en omstreken	Good	
Roodeschool	Eemshaven	3: Overig Groningen	Good	Shared with N17 (No freight)
Almelo	Dollegoor	12: Twente	Bad	Shared with Bedrijvenpark Twente, Delden (And ON9, no freight)
Almelo	Bedrijvenpark Twente	12: Twente	Bad	Shared with Dollegoor, Delden (And ON9, no freight)
Utrecht	Industrieterrein Lage Weide	17: Utrecht	Bad	Shared with (M1-6,8,11, no freight) (M8, PON)
Haven van Amsterdam	Westelijk Havengebied	23: Groot-Amsterdam	Medium	
Haven van Amsterdam	Hemhaven	23: Groot-Amsterdam	Medium	

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Location	Name Spurline	Zone	Volume Predictability	Notes
Haven van Amsterdam	Houtrakpolder	23: Groot-Amsterdam	Medium	
Alphen aan den Rijn	Industrieterrein Rijnhaven	28: Oost-Zuid Holland	Good	
Haven van Rotterdam	Waalhaven	30: Waal-Eemshaven	Medium	Shared with Eemhaven
Haven van Rotterdam	Eemhaven	30: Waal-Eemshaven	Medium	Shared with Waalhaven
Haven van Rotterdam	Pernis	31: Pernis	Good	
Haven van Rotterdam	Botlek	32: Botlek	Good	
Haven van Rotterdam	Europoort	33: Europoort	Good	
Haven van Rotterdam	Maasvlakte	34: Maasvlakte I-II	Good	
Dordrecht	Zeehaven	35: Zuidoost-Zuid Holland	Medium	Shared with Dordrecht De Staart en Zwijndrecht
Dordrecht	Industrieterrein De Staart	35: Zuidoost-Zuid Holland	Medium	Shared with Dordrecht Zeehaven en Zwijndrecht
Zwijndrecht	Groote Lindt	35: Zuidoost-Zuid Holland	Medium	Shared with Dordrecht Zeehaven en De Staart
Axel	Axelse Vlakte	36: Zeeuws-Vlaanderen	Bad	Shared with Sas v. Gent, Sluiskil, Terneuzen
Vlissingen	Sloehaven	37: Overig Zeeland	Good	Shared with ZW9 (No freight)
Moerdijk	Industrieschap	38: West-Noord Brabant	Medium	Shared with Oosterhout en Roosendaal
Oosterhout	Industrieterrein Weststad	38: West-Noord Brabant	Medium	Shared with Roosendaal en Moerdijk
Roosendaal	Industrieterrein Eemshaven	38: West-Noord Brabant	Medium	Shared with Moerdijk en Oosterhout
Oss	Elzenburg	40: Noordoost-Noord Brabant	Good	
Venlo	Tradeport	42: Noord-Limburg	Bad	Shared with Gekkengraaf
Born	Franciscushaven	44: Zuid-Limburg	Bad	Shared with Beatrixhaven, Chemelot, (ZO18-21, no freight)
Maastricht	Beatrixhaven	44: Zuid-Limburg	Bad	Shared with Franciscushaven, Chemelot, (ZO18-21, no freight)

Table A.11: Freight transported per zone

Zone	Sum of weight (kt)
1: Oost-Groningen	271.15
2: Delfzijl en omstreken	133.55
3: Overig Groningen	0
4: Noord-Friesland	0
5: Zuidwest-Friesland	0
7: Noord-Drenthe	0
8: Zuidoost-Drenthe	239.464
10: Noord-Overijssel	0
12: Twente	119.45
13: Veluwe	45.1
14: Achterhoek	0
15: Agglomeratie Arnhem Nijmegen	1.3
17: Utrecht	74.2
18: Kop van Noord-Holland	0
20: IJmond	1340.95
21: Agglomeratie Haarlem	0
23: Groot-Amsterdam	911.4
24: Het Gooi en de Vechtstreek	16.5
26: Agglomeratie Den Haag	0
27: Delft en Westland	0
28: Oost-Zuid Holland	13.6
29: Overig Groot Rijnmond	119.814
30: Waal_Eemshaven	6203.62
31: Pernis	1101.578
32: Botlek	1877.573
33: Europoort	2496.408
34: Maasvlakte_I_II	13853.46
35: Zuidoost-Zuid Holland	212.6
36: Zeeuws-Vlaanderen	859.447
37: Overig Zeeland	2018.311
38: West-Noord Brabant	1472.599
39: Midden-Noord Brabant	609.673
40: Noordoost-Noord Brabant	202.95
41: Zuidoost-Noord Brabant	636.154
42: Noord-Limburg	1374.673
43: Midden-Limburg	0
44: Zuid-Limburg	3280.412
Grand Total	39485.94

B Interviews

Before the interviews all respondents were informed of the goal of the research, the collaboration with Royal HaskoningDHV and the fact that the research will be visible in the TU Delft repository.

Not all interviewees gave permission to put an interview report in the thesis. Therefore some of the interview reports are incorporated in an anonymous way in the main text.

B.1. First round exploratory interviews

B.1.0.1. Infrastructure manager 4

How do companies operate and maintain private sidings? Often companies choose to outsource this, Strukton rail shortlines manages most of the private sidings for companies.

Can you share data with regard to how many trains private sidings handle, how often, how much freight, etc.? The IM does not measure this as sensors to measure this are often not present. Furthermore the IM hs to guard the privacy of its clients. The best way to get a grip on these numbers is to use the BasGoed model.

What are the factors determining the success of a private siding? Volume, followed by location.

B.1.0.2. Expert 1

Feasability of SWL and how does this compare to other modalities The feasibility of SWL is questionable as SWL needs private sidings, these sidings often need to be build to the specifications of the main line. This makes it expensive.

Road transport: If you build a logistical center/terminal for road transport: all the roads to get there are build by the government. This is not the case for railway lines. Even tough social economical costs are higher when having trucks instead of SWL.

What does Intermodal rail transport look like? 3 types of intermodal: a: rola, whole truck goes on the train. Popular in alps (Austria and Switzerland) but it is less efficient (you pay for/move the whole truck and trailer). It is done because you donnot want trucks on the alps. b: tasschenwagen: whole trailer with load on the truck, popular in Germany c: classical containers which are moved between modes.

Best one is technology C. very practical, easiest to move between modes. Most neutral one. However countries in Europe push other types of technology. B is pushed in Germany and is quite feasible there.

Intermodal is nice, but not all trucks do have the capacity for replacing SWL. Some loads are too heavy for trucks. Also chemicals like fuels can be too dangerous to be transported using trucks.

What policies can countries use with regard to SWL Austria: Government pays for maintaining the sidings at companies. Austria also decreases access tax for SWL so you pay less money when operating. These two programs really help SWL. This is done this way because Austria figures it is cheaper to build and maintain the SWL system and sidings than to have more trucks in the company. One of the reasons this is cheaper is because if you destroy the SWL market, you destroy a lot of railway market. SWL builds up to a block train. So you also lose block trains

Croatia: All sidings are large enough for almost full blocktrains. (about 1250tons is large enough, full blocktrain is around 2000tons). So there is no SWL anymore in the country.

How does the expert percieve the rail freight situation in the Netherlands, what problems does he see? Netherlands sold state owned freight companies. The Netherlands do have one of the better public railway systems of Europe. But no capacity for freight trains. An example is it was not possible to transport freight from Rotterdam port to rest of Europe so for freight the Betuwelijn was build. But you cannot build a separate freight railway network in all of the Netherlands. So the infrastructure manager is quite against freight transport.

What policy would be best for the Netherlands, which roles should governments fulfill? The Netherlands have to start somewhere if they want more freight trains so try running trains in the nights for freight trains. However this will most likely lead to complaints from citizens.

What investments would help the Netherlands more, better shunting at Kijfhoek (help SWL) or 740m trains (help block trains)? Majority of sidings in Europe cannot fit 740m trains. For example port of Rotterdam is build over time terminal by terminal. The terminals from decades ago are not build for the modern long trains. So older terminals do not have the longer sidings. but you can join trains together if you want at a marshaling yard such as Kijfhoek. Also at European level, not all tracks can fit 740m trains. TENT made document that all tracks part of the TENT system have to have 740m track lengths. problem is: You only concentrate on port of Rotterdam and the freight corridors. Rest of the country is out of trains as you cannot make all sidings in the Netherlands 740m. If all the money is being put in 740m sidings in Rotterdam the rest of the country loses trains, leads to less demand, which again leads to less trains (not all money in one basket. So we should do a decentralized approach.)

What factors play the most important role in categorizing private sidings? How much goods do you deliver or does your daily operation deal with (comes down to volume), Type of goods, type of facilities a sidings has, length of tracks, is there a dedicated shunting machine? (This comes down to access).

What innovations do you see in the market which could help rail freight and SWL? Innofreight, they make a sort of lego system for freight transport, they minimize the time it takes to change mode of transport (https://www.innofreight.com/en/logistics-solutions/timber/)

DAC is not the option, it is too expensive. it is very nice and advanced technology, brings a lot of options, but as a businessman it is not worth it. normal coupler is around 50 euros, DAC coupler is around a million for one. So who will pay that? at European level a lot of people (especially Austrians) talk about this but the expert thinks it is too expensive.

B.1.0.3. Expert 2

Expert from RHDHV on Chemelot

How does the organization at Chemelot works, who manages what? Chemical site which is managed trough Circleinfra, this used to be Sitech. Circleinfra manages the common infrastructure, every company who uses rail has their own little private siding. Circleinfra is owned by the companies at Chemelot together. So all companies have a say when it comes to changes to the infrastructure.

What are the most important users Sabic by far the biggest user of the complex

How does Chemelot look at the future of their rail usage Chemelot sees the importance of rail, it is a unique asset which should stay available to the users of Chemelot Rail will stay very relevant in the future, the advantage of rail is the large volume which can be transported in an efficient manner. SWL can work, but it needs proximity to other SWL companies. A lot of infrastructure to operate SWL has disappeared in the Netherlands.

Are there more comparable industrial sites with their own railway tacks in the Netherlands? No, at least noting of this size.

B.1.0.4. Expert 3

What does the private siding situation look like? After world war II road transport was booming and as a result truck transport took over a lot of the SWL transports. Lots of small sidings disappeared. If too much private sidings disappear than the large spur lines will also disappear. SWL is inherently not feasible (unless specific smaller goods such as nuclear waste are transported) The rail freight carriers only make profit on the larger frequent transports. SWL could only be profitable if the SWL network would be a lot larger and more subsidies.

Who are the rail freight carriers? Around 20 rail freight carriers in the Netherlands, mostly only block trains. Only two SWL carriers (DB cargo and Lineas).

What private sidings or spurlines are having troubles? Roosendaal has a new spur line, opened in 2012 but has ben closed already. Sloehaven got a new railway line as part of the spurline as the port grows. Port of Amsterdam is in a big project. Pieces of the port industry (and thus part of the spur lines) are being transformed to housing projects. So this leads to some disappearance of private sidings. But they also build new railways in the east part of the port. Tilburg is planning to open a new terminal, that is connected on an old spurline.

Why do some of these projects fail? Financing can be difficult, capacity will not be a problem. New private sidings are complex and expensive. There has been a lot of initiatives, such as waste transport using rail, modular systems to quickly trans ship containers.

Creating a new spur line with a connection to the main railway network is expensive; the connecting turnout(s) and the signaling system are large cost drivers.

What does the Dutch policy concerning private sidings look like? No policy as far as he knows, the subject feels like nobody really cares. At least not from the national government, sometimes a municipality has a plan for a private siding. Some lobby groups exist. These have a limited effectivity.

Which governments can influence private siding projects? National government is the owner of ProRail, so it can influence through ProRail, Provinces do not really have influence, sometimes they want to subsidize a project. Municipalities can subsidize, but depending on the project they have to agree with a change in the zoning plans or provide permits to companies.

B.2. Secound round in-depth interviews

B.2.1. Interview questions

Q1: What are the barriers and bottlenecks when operating private sidings This question is focused on determining what the problems are, private sidings and other parties surrounding private sidings have to deal with. Depending on the interviewee the questions was altered a bit. For companies with a private siding the questions is asked as: What are problems and bottlenecks surrounding you daily operation of the private siding. This is followed with the question what the problems are with regard to increasing freight on or revitalizing a private siding.

Q2: How do you see the future of rail freight transport and private sidings? This question is asked to find out more regarding the future plans of the interviewee with a private siding, and to see how they think the problems surrounding private sidings will unfold in the future.

Q3: What trends and innovations do you see in the sector with regard to private sidings? This question is asked to see if there are relevant trends or innovations which will impact the rail freight positively or negatively. Follow-up questions can be asked to determine the impact of the trend and the time it takes before the trend will become noticeable.

Q4: If it was up to you, how would you shape the future of rail freight transport This questions is asked to find out what interviewees actually want to happen to the private sidings and rail freight transport. It is also a way of verifying the problems interviewees see which are to be solved in this future vision. Follow-up questions can what concrete changes need to be made, how the cooperation between parties such as infrastructure managers, private sidings, governments and rail freight carriers should change.

Q5: What are the most important factors when making a distinction between private sidings? This question is asked to determine the factors on which private sidings can be categorized. It also says something about the problems private sidings encounter.

Table B.1: Overview of issues mentioned by the interviewees

	Q1	Q2	Q3	Q4	Q5
PS1	Driver shortage leading to unreliable service, legislation with regard to their company terrain. ERTMS tests, rising costs.	Freight will decrease	Battery locomotives		
PS2	Unreliable service, space on main line, lack of local shunting options	Rail freight will increase as companies will make more use of hubs and terminals		More local shunting options	Volume and thus costs
PS3	Unreliable service, suppliers quitting rail, expensive	Rail share will not grow	Low water in inland shipping could lead to an increase in rail freight		
PS4	Long lead times, unreliable transport, increasing prices	Modal share of rail will drop	Not much	More efficient railway system thus lowering lead times	
PS5	Infrastructural disadvantage, high costs, connection to Germany has fallen away, regional spread of private sidings	Very negatively	A new Friesenbrücke bridge could be an opportunity	Solve the infrastructural disadvantage, more focus on rail freight	
PS6	Investment uncertainties, lack of interoperability, diesel locomotive	Change from coal to biofuels	Sensors on the private sidings	One large European rail network, more stability surrounding difficult topics	
PS7	Rigid train paths, lack of investments, lack of space on the shared port rail tracks	Rail will continue to be used, it is indispensable for the port	Battery powered locomotives	Less rigid train paths, more flexibility with regard to the occupation of the port rail infrastructure	Volume, block trains or SWL
PS8	Unreliability because of lack of drivers and track maintenance. Fixed train paths	Looks alright, cautious for environmental law and legislation	Small efficiency gains with a better unloading process	Flexible train paths	
PS9	Lack of drivers, unreliable, loss of infrastructure, legislation and costs	Promising, market is large enough	740m if it is wide spread	More attention in politics for rail freight	

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	Q1	Q2	Q3	Q4	Q5
PS10	Loss of neighbouring private siding, fixed train path, lack of drivers	Increasing rail volume		Use of hybrid locomotive, more train paths available	
IM1	Too expensive for companies, lots of laws and legislation, unreliable service	Worried about the decrease in freight transport. Not worried about electric trucks	Roll-on-roll-off systems	Bring the price down with more focus from ProRail on rail freight.	Does not matter to them as long as the infrastructure fits the four demands
IM2	Too expensive due to handling, not enough volume	SWL will decrease, energy transition will decrease coal and increase biofuels transported by block trains		More subsidy from the government for infrastructure projects	Volume, location, value density of freight
IM3	740m tracks, unguarded crossings, limiting rules surrounding rail freight	Small private sidings will completely disappear, only block trains will move rail freight	740m trains	No private sidings, all investments go to large industrial clusters, only block trains. Less rules	Volume
Mun1	Passenger trains, no 740m trains, limited operating times, limited freight types	An increase in freight trains		An increase in freight in the municipality without it disturbing the city	
Mun2	Money to invest in infrastructure, balance between green and rail, limited use of the general railway sidings			Multiple companies using rail, as much as possible on their own terrain when it comes to loading and shunting	
RC1	Access of siding, high costs, location	The train is suffering from unfair competition when compared to trucks, this harms rail freight	TEN-T, industry growth, 740m trains	More transshipment terminals and fewer fees for trains	Volume and access

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	Q1	Q2	Q3	Q4	Q5
RC2	Not enough volume, location not close to Kijfhoek (SWL), not being able to adapt to changes in frequency, ease of access	Concerning block trains, a change surrounding the energy transition. From coal to energy-carrying liquid bulk. Concerning SWL, a slow decrease	DAC, more sensors in the infrastructure	More attention from politics for rail freight. Optimizing the infrastructure and Kijfhoek leads to a more efficient network	Volume, location, access

B.2.2. Interview reports

The interviews conducted were with employees of infrastructure managers, rail carriers, municipalities and companies using private sidings. Therefore the interviews are not to be taken as the official position of a company, but can merely be used as an informational insight into the operations of the companies.

B.2.2.1. Private siding 1

This company did not have the time for a online interview. However they answered the questions in writing. The company is a production company in a large port. The port is located in Zeeland.

The most important issues surround their private siding and rail usage are a a lack of machinist, less flexibility and legislation with regard to the amount of wagons they can park on their private siding. Also tests for implementing ERTMS are disturbing the rail operation.

Trends and innovations could be battery locomotives.

As they are a bit distant from the rest of the Netherlands there are not many alternative lines when their main lines has a disturbance. But overall the connection is adequate.

They easiest way of making the private siding perform better is by transporting more freight more frequent. However, due to a shortage of drivers and not a lot of freight being moved to their part of the Netherlands it is understandable that rail carriers choose to operate less in their area.

Concerning the future, it can be expected that rail freight will drop in the near future due to the ERTMS porject which will be tested on the main line. Companies will switch to trucks as an alternative. Less train drivers will also lead to less trains, maybe automatization can play a part and solve this problem.

B.2.2.2. Private siding 2

Terminal in a large port. All of their transports are planned. No need for flexible schedules. Their transported volumes are very stable. They have warehousing facilities. So if needed they can store freight for a while to counter fluctuations. The focus of their operation is on waterborne activities. So train and truck should strengthen their position on the waterways. Concerning trains they only transport containers. Some of this is block train and some of it uses SWL. The SWL trains are put together on the industrial complex together with their direct neighbors. As they are a terminal, they do not have to pay for the transports, so their customers pay for the SWL deliveries. Around 10% of their freight is moved by train. The rest is transported using inland shipping or trucks. Almost all of their incoming freight is delivered by short sea shipping. Their rail share compared to trucks has increased significantly. Freight is moving from truck to rail.

Most of their freight goes from ship to train. They also fulfill some first/last mile functions for regional companies by truck, but most of their freight is not for regional destinations.

Their biggest problem is the available space on the main railway lines. They have to travel to Kijfhoek to enter the Betuwelijn. This is mainly due to a lack of shunting sidings at their industrial site. Another problem is the reliability of rail freight. Especially transports to Italy and Germany is unreliable.

Regarding the future, they expect companies to start thinking more in terms of hubs and terminals instead of direct A to B transport. They have a saying: "1 train is no train." This means that scaling up is difficult when you are starting, but when you operate three trains a week, a fourth train is easy. Volume is everything.

Sustainability looks important, but in the end it all comes down to costs. That is what matters to companies.

B.2.2.3. Private siding 3

Production company which regularly transports freight using block trains. Most of their transports are done using inland shipping. They used to receive 3 block trains a week from Germany. Nowadays suppliers are quitting rail to transport freight. So their block trains are only incidental. This leads to problems as the rail freight carrier can be rigid when it comes to incidental transports. They often refuse service. When rail is used the freight often arrives too late, there is no consequence for the freight carrier. When the private siding is too late with their freight they have to pay fines. The rail freight carrier cut back on their locomotives and removed the locomotive which operates the private siding. That complicates the process. All of the distribution which comes from the private siding is now happening using trucks. They used to use rail for this, but the rail freight carrier cannot make it feasible.

One time the lock used for inland shipping had problems. They would rather have the freight arrive by train as one train is easier to handle than 30 trucks. However this could not be arranged, resulting in 30 trucks arriving at the company.

The company emphasizes they are not dependent on rail, however this could change if low water hindering inland shipping will be more frequent in the future.

For the future, the private siding does not expect to increase their rail activities. This is not because they do not want to use it, but because suppliers stop using rail.

B.2.2.4. Private siding 4

Company uses only SWL transports to supply their dutch warehouse. The wagons from their European factories gather in Kijfhoek and are transported to their location. About 40% of the volume to their distribution center is done using trains. All of their European factories have a private siding. This gives them an advantage as they can load and unload directly on the wagons that will transport the freight the whole journey. Another advantage is the wagons are parked on their terrain for 24 hours. This gives them a lot of freedom and flexibility to unload the wagons.

The wagons gathered at Kijfhoek and three times a week thy are being moved to their distribution center. The amount of wagons varies, it can be as low as one or two wagons.

Disadvantages are the increase in price, last year DB cargo increased their prices which is difficult for the private siding to deal with. The advantage of the direct train connection to their factories is the only thing keeping them from quitting SWL in the Netherlands.

Another problem they encounter is the shortage of drivers. If a driver is sick, a substitute often cannot be found, resulting in the train not moving and the company receiving just two trains that week. As a company you need to be able to deal with these fluctuations in your storage. This is enhanced as a truck from Poland takes only two days to get to the Netherlands, a train can easily take five days.

The company also uses intermodal transport in Europe. They put trailers on the train for transports between Poland and Germany. This is more sustainable, but also is slightly cheaper than driving them over the road.

For the future, the Private siding is not positive with regard to SWL in the Netherlands. The prices have increased significantly so it can be expected that the rail freight share will decrease. To counter this, the rail freight should be made more efficient to shorten the lead times of the train. However, the company does not see this happening in the near future.

B.2.2.5. Private siding 5

Railmanager of a northern port authority. The northern destinations that are capable receiving cargo-trains/wagons can be narrowed down to Eemshaven, Delfzijl and Nedmag in Veendam. The two ports only receive wagonload transports. Nedmag is the only company which makes use of block trains. Most of the freight is chemical cargo such as ammonia and hydrogen peroxide. The only freight stream still increasing is military transports.(these are trains to/from Eemshaven) All of the SWL is clustered in Onnen. Out of Onnen Delfzijl used to receive 5 trains a week 5 years ago. Last year it was 3 times a week and since last december it is 2 times a week. Situation in the north of the Netherlands is very difficult. The railway lines located northern from Onnen are not electrified. Therefor a change in locs (from E-loc tot D-loc) are needed which increase costs. (it also ‘cuts’ the direct delivery line which increase due to downtime cost plus ‘parking/shunting’ cost. The change to this special locomotive increased costs by 70% The results in a unfair playing field where rail in the northern provinces cannot compete with southern rail. So the biggest problem is an infrastructural disadvantage compared to the rest of the Netherlands. Another issue is a broken bridge at the border with Germany which disables usage of the most northern ‘railborder Weener/Nieuweschans’. Therefore the only freight route is through southern provinces. All of the shunting now has to happen in Kijfhoek. One of the main freight routes is from The northern ports to Hamburg, this used to go directly using the bridge. As the bridge is broken this has to pass Kijfhoek first. Another problem is the decrease of private sidings, this increases the costs for the remaining private sidings. The balance between freight and passenger trains is also a problem. The freight trains often have to wait and give way to passenger trains. This is especially true when it comes down to the new ERTMS system. For the railway undertakings operating passenger trains this train conversion will be paid by the province. The freight carriers have to pay this conversion themselves thus raising their prices. When railinfrastructure disappears it will not come back. The railterminal in Veendam is not operating rail anymore. It is mainly used as a storage location and accessible by road. Overall the future of rail transport in the north is very negative To deal with this a level playing field is necessary, this mostly comes down to electrifying the main railway lines. If the Friesenbrücke to Germany is repaired this could potentially increase usage of the railway freight by realizing a direct connection to the northern German ports and the TEN-T network. Innovations are not going to solve the problems, first more volume has to be created. However, there is also resistance against new ideas. A plan to combine freight and passenger transport failed earlier on.

B.2.2.6. Private siding 6

Interview with the port authority of a large port. Most of the freight transported is coal and liquid bulk. Liquid bulk in the form of biofuels is a major opportunity. They perceive rail as a complementary modality to inland shipping. Inland shipping cannot reach all destinations and can be unreliable due to low water. This can be mitigated using rail.

One of the problems regarding the private sidings is the requirement of diesel locomotives to reach some of the private sidings. This makes the process more difficult. Another issue is the lack of interoperability on the borders of the countries. Every country sees their national network as one network. For companies the whole of Europe is a network. Less disruption at borders would make rail freight more efficient.

An innovation they are acting on is putting more sensors and smart cameras on the tracks to gain more real time information about the trains. Biggest trend and opportunity is the energy transition. The hydrogen network will mostly consist of pipe transport, however part of it will use rail, especially during the transition.

With regard to when private sidings are disappearing. Private sidings stop operating when volumes become too small. That is not something which happens regularly. Overall only the private sidings close to the city are closing to make way for housing.

The port also processes SWL, this is shunted at the shunting yards of the port. So the distance the single wagons have to travel is very limited. Enhancements to the port shunting yards can make this process more efficient.

Another trend is that the city is moving to the port area. So the old part of the port is slowly giving way to housing, while the port is moving to the sea. This also leads to the closure of private sidings, however this is part of a bigger plan.

For the future it would be nice to have more stability regarding the energy transition policy. There are too many uncertainties(Nitrogen problem, electricity congestion, energy transition) to make large investments.

B.2.2.7. Private siding 7

Interview with a large port authority

Some of the investments are made from own funds, sometimes the ministry of Infrastructure and Water management also provides money. The port authority does not own any infrastructure. Everything is owned by the private sidings, a third infrastructure manager or ProRail. ProRail owns and maintains the main railway line, the shunting yards and the branch lines (the section of track from the yard towards the companies). From this section of track, a track siding is created to the company, facilitated by a switch (which is also owned and managed by ProRail). The siding from the switch onwards is owned sometimes by ProRail, sometimes by private companies and sometimes by a third infrastructure manager (Strukton Short Lines). The port authority collaborates with ProRail and the Ministry of Infrastructure and Water Management on document such as strategic plans, business plans and logistic vision report for the freight transport by rail in the port. One of the agreements foreseen after the construction of the new port area includes the construction, by the port authority, of a railway bundle of 16 tracks, to be built in phases depending on forecasts that necessitate greater infrastructure availability. The private sidings can be paid in different ways, the most straight forward is the company using it pays for it and owns it.

The Port Authority also uses simulation tools to check whether there are bottlenecks in the infrastructure. The volumes are based on the long-term scenario, a forecast of the amount of tons and the kind of goods expected to reach the port in the coming years / decennia. A bottleneck is a limiting factor that makes impossible to facilitate all trains of reaching the hinterland. That can be caused by a lack of marshaling yards in the port which can facilitate 740m trains or some existing structural bottlenecks (such as spots that cause reduction of trains' speed). Other issues are the layout of rail facilities private sidings have. It is easy if the company can house a whole train. But some companies can only fit a third of a train at a time. This means more shunting operations are necessary. This relates to the fact that companies want to do as much themselves as possible. That is the cheapest and most efficient. However more legislation for train drivers make this harder. When opening a new siding, companies often think about the infrastructure. However, companies also have to have safety certificates and they need to be registered with ProRail to receive updates. There is a lot more going on than only infrastructure.

Overall rail is not a very popular modality: it's often seen by customers and rail operators as expensive and unreliable. However it is indispensable in a port and for some kind of goods than can't be efficiently transported by other modalities. Companies cannot reach all destinations with inland waterways alone, and trucks are not always able to handle the volumes and/or some specific kind of dangerous goods.

Of all available modalities the railways are the least flexible. The contracts for rail traction and wagons are established on an annual basis, and they offer little opportunity to cancel trains on short notice without incurring a penalty. A truck on the other hand can be ordered or canceled at any moment. Companies choose to use rail for different reasons such as large volumes, sustainability or because rail is the only modality which can reach a certain destination. You do not choose rail because it's cheaper if compared to other modalities. The ministry of Infrastructure and Waterways did not develop a strategy regarding to freight transport by rail yet: this is slowly causing a loss of popularity for rail transport, as significant investments in infrastructure or digitalization are being postponed to the future despite their urgency. On the contrary, passenger transport seems to receive much more attention from the ministry compared to freight transport. All of the subsidies have stopped until at least 2030. ProRail has to listen to the ministry so they are in a difficult situation, they do what they can, but their power is limited. This is different in other countries where governments subsidize rail more to avoid higher societal costs. The port has a mix of mostly block trains, but also SWL transports. SWL is transported to Kijfhoek where the wagons are mixed to all reach their final destination. SWL is very expensive for the rail carriers and their clients. The port also offers a unique transportation solution in the form of a dedicated route, outside the public connection, where containers can travel without queue while maintaining their customs status. Once arrived at the terminal, they are loaded onto vessels. An innovation which could make a difference for the efficiency of rail transport is the introduction of battery locomotives. This innovation avoids time losses caused by changing locomotive types, ensuring seamless transportation to the final destination. In an ideal world the train paths would be more flexible, so you could change train paths during the year. It also should be more easier to assign a local transporter a time slot that is necessary and sufficient to perform the railway maneuver and leave the area, ensuring access to the same zone for the next user in the shortest possible time.

B.2.2.8. Private siding 9

This private siding is a container terminal in the south of the Netherlands. The company owns multiple terminals and hubs. They have two types of operations. The first option is when the terminal operates as a complete logistic provider. This means that containers from all over the world arrive at the deepsea terminals at Rotterdam. They operate a daily train connection to their terminal to transport the containers. They also do this using barges. From their terminal they serve a regional purpose, most of their destinations are within 25 km of the terminal. So they use trucks to get the containers to the final destinations. This process also works the other way around. The transport of the freight itself is done by a rail carrier. The other option is for them to only do the transshipment and none of the planning. This is the case with trains from Germany where a company used to transport everything with trucks. Now that company uses rail to transport the cargo to the terminal, from there it uses trucks.

The terminals only uses block trains. It has a daily train from and to the port of Rotterdam. In Rotterdam the train visits another deepsea terminal every day. The company also operates block trains to China, Poland and Germany. The main modality they use is barge, followed by trains, which is followed by trucks. Barge is cheaper than trains. This is strengthened as the size of barges has increased significantly the last years. While 740m trains is still a scarcity. The size barges that the terminal can receive has grown from type 2 to type 5 barges. Barges are also more reliable than trains.

One of the problems they encounter is the fact that their terminal has not been electrified. So the wagons are parked on an emplacement close to their terminal. To drive the wagons into the terminal with their own hybrid locomotive, they have to be a fully licensed rail carrier. This comes with a lot of rules an extra costs.

The company used to have another rail terminal. It was located on a piece of rail which was not electrified. So the sustainability advantages were not present as diesel locomotives were necessary for most of the journey. This was not sustainable and more expensive.

Considering electric or other sustainable fuel trucks. They think it can make an impact, but it is far away. Will take at least 15 years to develop. And it will matter most on shorter distances. For them rail is used as a scale advantage. Electric trucks are not going to change that.

On politic level freight and especially rail freight does not get enough attention. Freight is a large economic driver of the economy. The government has invested a lot of money in asphalt and not enough in water or rail.

Overall they are positive about using rail to transport freight. They see a lot of potential to grow their rail share. The market is large enough. Unfortunately a lot of the infrastructure has disappeared the last decades. So a lot of companies have lost their private sidings. The infrastructure in combination with a shortage of train drivers is an inhibiting factor of growing rail. However, road pricing could change this.

B.2.2.9. Private siding 10

The company specialises in the production of chemicals. Some of the raw materials are transported to their production site in the east of the Netherlands. They are relatively isolated with no other private sidings nearby. They receive 1 train per week, which is usually 4 to 6 wagons. Their private siding can accommodate a maximum of 8 to 10 wagons. A neighbour used to have a larger chemical train, but this connection has been discontinued. The company receives its raw materials from companies in the area of Rotterdam or Moerdijk or foreign like Antwerp, Koln and Ludwigshafen. The wagons first go to Kijfhoek, Oberhausen and are shunted in Osnabrück. The wagons are then transported back to the production site in the Netherlands. This route has to be used because the wagons contain dangerous goods, so the train paths they can take are limited.

One of the problems they face is the shortage of locomotive drivers, which results in less flexibility if a train is late or cannot come for some reason. A new train is often not available at short notice. Some of the raw materials can be transported by truck, but the company prefers to use trains because they are safer and better suited to the handling process at the site. This is also one of the main reasons for using trains as a transport mode. As mentioned before, the complicated route through Germany also hinders the flexibility of their rail transport.

They are looking to expand their operations, which would lead to an increase in rail transport. As their storage space is limited and the private siding cannot handle trains longer than 100 metres, they are investigating the possibility of receiving a second train per week. Their private siding is not electrified, which has not really hindered their operations, but they are considering switching to an electric or hybrid locomotive for sustainability reasons.

B.2.2.10. Infrastructure manager 1

This infrastructure manager manages private sidings on the instruction of companies using these private sidings. As companies often do not have rail as part of their core business, but simply use it as a transportation method, they are glad to not have to deal with their rail infrastructure. The IM manages 150 private sidings in the Netherlands. This infrastructure manager can work in different ways. The most common is through a ”Rent maintenance renewal” contract. This is 95% of their contracts. The IM becomes the economical owner of the infrastructure and the company using it rents access from the IM. The other option is that the company stays the owner and the IM only does the management of the private siding. The IM is also active in Belgium where it manages around 30 private sidings.

In reality the services of the Im comes down to visiting each private siding a couple of times a year and inspecting the siding, measuring the wear and repairing where necessary.

This IM is a private owned company, which means everything is a business case unlike ProRail. The relations they build with companies this way is very good for their relation management. In the future this will pay itself back. ProRail has a complicated set of requirements which all of their infrastructure has to comply with. However this is a single set of requirements for the high speed line, the regular infrastructure and the spurlines. Even though spur lines see a completely different type of operation. For example the maximum speed is often not higher than 40km/h on spur lines. The IM has an own set of requirements specially made for freight infrastructure. Which means they need less expensive infrastructure. Furthermore, ProRail replace all infrastructure after 25 years, even though most of the infrastructure still has life in it. The IM buys this and uses it to build new infrastructure and replace worn out private sidings. This reduces costs. The four main demands for the IM to buy and exploit rail is a maximum speed of 40 km/h, the infrastructure is part of no central controlled area (”Niet centraal bediend gebied”) Which means trains on the infrastructure do not have to listen to the rail traffic control, less safety laws and only freight trains make use of the infrastructure. The IM want to acquire everything that fits these demand, regardless of size of the private siding.

The IM sees a chance of making rail profitable. Trucks suffer from congestion and a lack of drivers. On the other side, trains are less reliable and often more expensive. Companies balance these facts and choose what is best for them. The IM wants to tip the balance to the rail side.

So overall the IM plans to take over more private sidings, spurlines and whole emplacements if possible. They want to decrease the costs for freight transport in the Netherlands this way. ProRail is glad to only have to focus on the main infrastructure(HSWI). The IM also tries to connect companies close to each other and to a private siding to share the costs for the infrastructure. This way they try to make rail profitable.

For the future the IM is worried about the overall decrease of rail freight. This is mostly due to risen costs. However, if the government will introduce road pricing (”Rekening rijden”) for trucks a change to rail will inevitably happen.

Innovations which could help rail are roll on roll off systems. This would allow companies to use trucks for the first/last mile but use trains for the main leg.

In an ideal scenario, the main thing is the costs decrease. ProRail should see rail freight of equal importance as passenger rail. So freight trains should not have to move out of the way if passenger trains. This dis balance is a problem.

Concerning the trend of electric trucks, the IM is not worried about this. trucks have to deal with congestion, detours, shortage of truck drivers and with the electric grid congestion.

B.2.2.11. Infrastructure manager 2

Interview with a private siding account manager from the national infrastructure manager.

Private sidings deal with infrastructure managers through account managers. One account manager deals with all of the 170 private sidings in the Netherlands. Some of these private sidings are not in use, some of them process multiple trains a day. A lot of variety.

The national infrastructure manager is from origin a manager of infrastructure and not a seller of using rail. So, for a long time there was no focus on getting companies to use rail as a freight transport method. That is slowly changing.

Upgrading, revitalizing or opening a private siding follow different processes. A new siding has to follow the ”Kernproces”. This is a long process. Simpler operations such as revitalizing or upgrading follow a simpler process.

They IM receives about 10 requests each year to open a new private siding. Companies often underestimate the costs and time it takes to open these sidings. A general rule of thumb: It can easily take 2 years and 1.5 million euros to open a private siding. The complete costs are for the company wanting to open the siding. Around half of the companies (So 5 a year) successfully go through the process and open a private siding.

Most of these are new initiatives in the large ports in the energy transition. Right now, biofuels are upcoming, also transporting captured CO2 using rail is in development.

New smaller private sidings are not happening, it is too expensive. SWL is a complicated product. It takes a lot of handling to shunt the wagons. Thus, it becomes too expensive for most companies.

Not all new private sidings are successful, Valburg is an example of this. The province of Gelderland wanted to open a new terminal along the dedicated rail freight line Betuweroute. They invested thousands of euros for studies but in the end, there wasn’t a company willing to operate the terminal.

If companies stop using rail, they do not return to the rail, they will be lost forever. In the end block trains are more feasible, however small companies cannot handle the volumes required for this due to limitations to the length of the tracks (740m) and their storage facilities. Sometimes companies can support each other, for example, companies using the sidings of a neighboring company to load their freight. Or by already locally bundling their SWL wagons before they go to shunting yard Kijfhoek. This reduces the costs. As the most important issue for companies, the infrastructure manager says: in the end, everything comes down to costs. It has to be feasible.

For the future, the IM sees an increase due to the energy transition. More bulk will be transported because of hydrogen and other biofuels. These are dangerous goods, so transport using rail will be likely. This is also suited as it is often transported in large quantities. Furthermore, the container market will keep growing, thus also growing the amount of containers which rail can handle. Another grow market could be waste transported using rail. Amsterdam has a large waste management facility which imports waste using rail. Coal and SWL will continue to decrease. In the end it is likely that trucks will take over the entire SWL market. It cannot be made feasible.

Concerning the sustainability. Rail freight is inherently more sustainable than other modalities. The IM does not see trucks as a real competition regarding sustainability. He notes: Trains are also developing, examples of this are electric locomotives. The gap between rail and trucks is too big. One train substitute 55 trucks. So, trucks will not become a sustainable alternative.

In an ideal world, tomorrow the government would decide to provide subsidies for al the infrastructural investments. So, companies using rail would only have to pay for access to the railway lines.

Concerning the factors to categorize the sidings. Volume and location are the most important, the value density of the freight also matters. High value freight means that the cost component of the transport is smaller, which means that the transport prices matter less.

B.2.2.12. Infrastructure manager 3

The stance on smaller private sidings can be described by one of the first sentences: ”That someone is still working on this, the smaller sidings have completely died”. The Netherlands used to have a widespread and fine network of private sidings to transport coal. This network has largely disappeared.

The most important factor to remove private sidings is costs. A smaller component is the safety as the level crossings on these sidings are often not guarded crossings. Another small component is the disruptions freight trains can cause when entering the main railway line. The impact of this differs per private siding.

The policy regarding removing of infrastructure is as follows: The infrastructure is paid from public resources, if there is only a single user the tracks will be transferred to the private siding owner. If no one is using it, it will be removed. Every change to infrastructure will be consulted with the stakeholders. Then the decision goes to the “Tafel van Vergroting”. This consultative body will approach the stakeholders and collect reactions.

The account manager of the private sidings regularly handles requests for new private sidings, most of these requests quickly fail as companies often underestimate the costs connected to a private siding.

The rail freight is fairly stable on the main freight corridors. Most important connection Rotterdam-Germany (about 80% of the total rail freight) The most important obstacles are logistical limitations, rules about noise, safety and length limitations. However, if the demand would be available, the freight moved over the main corridors could triple with the current infrastructure.

Too many sidings cannot handle 740m trains yet. The Kijfhoek upgrade was extremely expensive and aimed at a market that is clearly declining on a European level (SWL), with the same money the port of Rotterdam could have completely been changed to 740m tracks.

More sidings are not necessary, focus on the existing sidings and enhance the main freight flows. Sidings are getting more concentrated and bigger. So less private sidings, but more volume per siding. That is a good development. In the end the trend in Europe is to stop using SWL and operate only block trains from and to large industrial clusters.

Terminals could be a solution to the first/last mile problem if smaller private sidings disappear. The most important factor to classify private sidings is transported volume, thus the amount of full trains being operated.

B.2.2.13. Municipality 1

The municipality wants to grow as a city and believes that better rail connections and more attractive stations are needed for this, and that a solution is needed for the rail barrier in the city. The municipality has an inland port with trimodal options. A limited number of companies in the port is using the water. Of these only one is a rail user in the industrial area. The municipality is working on a port vision to gain control over the strategic development of the port as a more water-related employment location in the future. Any investments in improving or expanding the tracks to the port depend on the results of this vision. The plan is to adopt this vision around the summer holidays of 2025. Developments around the terminal of the Osse Overslag Centrale (OOC) will determine whether a limited expansion of the sidings at the terminal is necessary in anticipation of this. And whether previously available subsidies will be used for this. The sidings at this terminal only receive block trains.

Problems with the current terminal are: the sidings cannot handle 740m trains, no freight trains run at night and the municipality does not accept hazardous substances or smelly substances.

In addition, the freight trains must cross the main route of the passenger trains. The municipality would like to see the freight and passenger trains separated better at the Oss yard. And that the freight trains remain in the port as much as possible and use the tracks and sidings through the city for shunting or storage as briefly as possible.

B.2.2.14. Municipality 2

Rail transport stopped 20 years ago. Municipality has plans to encourage rail freight, main aim is to get wheels off the road (and out of the city center). Most concrete impetus for this is to require plots next to water or rail to also use these modalities. Some of the bottlenecks are the balance between green and rail, the desire not to transport too many goods during the day and the balance between passengers and freight transport. Typical of this is the desire to clean up 1 or 2 of the rail tracks for the sake of green space, despite the push for rail as a modality. The starting point is that the companies/users of the track should be the initiator of the project. Possibly Strukton could play a role here. The municipality wants to facilitate discussions and cooperation but cannot provide funds for this. Obstacles for businesses seem to be ProRail's high set-up costs, the lack of a container terminal and the lack of businesses with volume appropriate for block trains. Policy comes from the municipal policy for the city and its surroundings. Industry associations and province have a say in this. ProRail has little to no say. In terms of future vision, the municipality envisages an industrial estate where all plots adjacent to water and rail make use of this. All loading and unloading takes place on private property, the sidings are not used for this. If a terminal is opened, this has to happen on private land. Due to infrastructural constraints to the roads around the industrial estate, the rail terminal can only serve the spur line. All in all, the municipality has a limited role, facilitating collaborations and discussions. Subsidization is not an option; the municipality guards the balance with regard to green spaces, other traffic participants and, to a limited extent, passenger transport through Utrecht CS

B.2.2.15. Rail freight carrier 1

The rail freight carrier emphasizes the high fixed costs of having and maintaining locomotives and paying the drivers. You want to be able to have the material running 24/7, every lost hour costs a lot of money. So bundling of wagons is ideal, especially on small geographical area. This could be done by building a terminal for transshipments.

A problem for the rail carrier is the absence of electrified tracks, if private sidings do not have this, the carrier will need a diesel locomotive for the last/first mile. The carrier also emphasizes that the further away a client is the more difficult it is to serve this client, especially if it concerns smaller volumes and a geographical isolated client. Ultimately this leads to refusing clients as it becomes too expensive.

Concerning the future, one of the big problems the carrier sees is the de-industrialization of Europe which has been going on since the 1970. Less industry is less volume is less rail freight. However, there is more and more realization that Europe needs its industry. Also the quality of the infrastructure has gotten worse over the years. A chance could be the TEN-T network. This can really increase the efficiency of freight trains, this mostly goes for block trains. Another chance is the green deal in Europa. Trucks are more polluting and a problem for mobility (congestion and safety). This means that regarding societal impact, it is better to transport by train.

Trends and innovations are the rise of 740m trains. DAC is not a feasible innovation, costs 300000 to 500000 euro per wagon. This cannot be paid by the rail carriers.

In an ideal scenario there would be more transshipment terminals so trains do not have to transport the smaller volume regional freight. Also the fees for using the infrastructure are too high, this should be lowered, the same goes for the fees of parking trains on marshaling yards. In the Netherlands there are a lot of noise complaints from citizens. Local governments should do a better job of explaining the benefits of rail freight versus trucks to the citizens this is necessary or take precautions to keep the noise down.

The most important factor of success for a private siding is its transported volume

B.2.2.16. Rail freight carrier 2

The rail freight carrier has big issues regarding the feasibility of their wagonload transports. It needs support from the Group to keep running. This has been the case since the 2008 financial crisis. Germany is keen to keep SWL intact as a lot of companies in Germany are dependent on SWL. The German government has researched the subject and knows SWL leads to an overall smaller societal impact compared to other modalities. However, the rail freight carrier also sees that SWL is inherently unprofitable. Eventually almost all SWL from and to the Netherlands goes through Kijfhoek to be shunted. However, the longer the trip on your own to Kijfhoek, the more difficult it becomes to keep the price down. Overall SWL in the Netherlands is quite constant. However, it is not increasing, the whole rail freight market is decreasing a bit, thus SWL is also decreasing, the latest numbers show the decrease of the German economy also leads to a large decrease of SWL. For the future, SWL will keep existing, as long as it exists in Germany, it is unsure if SWL will exist in the Netherlands, this also depends on the high infrastructure costs. The key will be to make Kijfhoek as efficient as possible.

Concerning the type of freight, the big change is the decrease of coal which leads to less block trains. This can partly be compensated by an increase of biofuels. Also, other greener energy transports such as ammonia and LNG will increase the rail freight.

Regarding the distinction between private sidings, make a distinction between large port terminals and inland terminals. They are very different types of cargo streams. Within the ports is also a variety of private sidings, not only block trains but also small companies that use SWL. These can often shunt in the port itself making it quite efficient. The most important factor to keep sidings running is volume. If the volume of a private siding is decreasing, the first solution is to decrease the frequency of the trains. So, from four to three trains for example. However, that also comes with a downside. A company has to be able to make changes to their company processes to deal with less frequency of trains.

The carrier also sees that they have become more expensive while becoming less reliable the past few years. They see that this leads to freight switching from rail to road transport. Thus, losing modal share.

The rail freight carrier sees that ProRail focuses on efficiency of their own organization, they close infrastructure when it is not being used enough. The rail freight carrier tries to lobby to keep infrastructure open, needed for efficient operation. in the end this is up to the ministry of Infrastructure and Water management.

If private sidings disappear the activity on the private siding rarely returns. This also goes for the disappearance of infrastructure. This is a one-way process.

The rail carrier does not really fear competition from trucks when it comes to sustainability. They claim that the train has a large head start compared to trucks. Train is almost completely electrified. Even if trucks become electric, trains will require less energy as steel-on-steel contact is more efficient and the train has a volume advantage. The trains also do not require heavy metals for batteries. The carrier believes they will keep their sustainability advantage, however they note that it all comes down to politics. If politics sees electric trucks as solution and subsidizes this, then electric trucks can play a big role.

Specific policy to increase SWL and rail freight are the following policies: making 740m rail more widespread , optimizing Kijfhoek to make the shunting process more efficient and create more safe crossings in the ports to solve capacity bottlenecks.

The rail carrier believes DAC will become a reality, however, it can take a long time to become widespread. Another innovation which could help optimize the project is the use of more sensors on the freight infrastructure. By automatically reading the wagons, the process can become more efficient.

Most important aspect of a private siding is its transport volume it sess, also the location of the siding is very important depending on the situation. Another important aspect is the ease of access.

With regards to the costs of the 'Last mile'. The most important factors are the people needed to execute the operation. So is one person enough to safely execute all operations or are multiple drivers necessary. This depends on the amount of unguarded crossings, is there a side track nearby which can be used and the distance from the shunting yard.

B.3. Third round interviews

B.3.0.1. Private siding 10

The previously identified issues regarding freight paths/routes through Germany are correct. It's also important to mention that the many stops the train has to make and the congestion in Germany contribute to the problem. The non-electrified private siding is not an operational issue. The company wants to introduce the hybrid or electric locomotive as a sustainability improvement.

The TEN-T network does not immediately offer benefits for the company. The legislative proposal surrounding dangerous freight transport per train that was discussed in politics last week could potentially make a bigger difference, be it positive or negative

Clustering companies in order to share infrastructure costs likely won't make a major difference, as they are only a small portion of the total costs. Costs are just one of the factors in their decision-making. They base their choice for rail on three pillars: cost, safety, and handling. However, they are certainly open to it if other companies want to cluster their railway infrastructure.

They are already using intermodal transport—trailers on trains—mainly for outbound products. The materials leave the company by truck, are loaded onto a train nearby, and then travel by train to Italy and other destinations.

For now, the company doesn't expect major changes to the rail situation. The biggest issue is the unreliability of the rail system due to a shortage of train drivers, fixed freight paths, and congestion/track closures in Germany. As a company, they feel they are not in a position to change these problems at the moment. It's mostly a matter of waiting to see how the situation develops.

B.3.0.2. Private siding 11

The shortage of train drivers is not a major issue for the company. In Belgium, this can sometimes be a problem, but in the Netherlands and Germany, trains are not being halted due to a lack of drivers. However, they do experience issues with reliability due to extensive track works and poor coordination between those works. In their opinion, this could be significantly improved. They do not transport coal by rail. All coal and ores are delivered to the factory by sea ship. They transport steel by rail, around 600 to 700 wagons per week. There are also 160 wagons arriving weekly with raw materials, mainly lime. They also want to start receiving scrap metal by rail. They already process scrap, but aim to grow in this area. As a company, they are in transition toward producing greener steel. Transport plays a role in that, so now sustainability is also a factor in transport decisions, not just cost. Their rail volume increases each year because rail is the greenest way to transport their goods. This is part of the company's internal energy transition. They do not transport hazardous materials, so restrictions related to such substances are less relevant. However, there are concerns about freight paths. The PHS (Public Transport High-Frequency Program) development means that in some places, there is no space left for freight trains on the rail network. In the annual timetable, you can still arrange a few things, but there is very little room for flexibility. Other parties often casually propose peak-hour exclusions. But if this also happens in Germany, the trains won't be able to run at all. During peak times, trains would have to be parked somewhere, which is an unworkable scenario. As a result, more and more freight trains are being pushed into night slots, and this will eventually lead to a shortage of drivers—because they are less willing to drive at night. Also, many terminals along the route are closed at night. The costs for rail usage have risen tremendously. They understand that the Netherlands shouldn't be used as a parking lot for wagons from all over Europe, but the current situation is very difficult. They make extensive use of single-wagonload transport, so they need shunting yards—and the costs for using those have skyrocketed. Using a shunting track costs €500 per day. Compared to other transport modes, that is incredibly high. They used to run trains through Rotterdam to Germany, but rising shunting costs have stopped that. This shift has moved 80 wagons per week from rail to truck. It's extremely unbalanced that the greenest mode of transport is being disproportionately burdened. There is no level playing field, making rail freight increasingly difficult. Their customer base consists of many small-volume clients. Many steel receivers/customers traditionally have a rail connection with a small hall where they can receive 3 or 4 wagons. The company assembles single-wagonload trains themselves that are then split across Europe. That train now goes directly to Germany to avoid high costs in the Netherlands. 80% of their transported volume is single-wagonload traffic. If subsidies for rail connections for single-wagonload traffic in Germany and Austria were to be cut, this could indirectly affect them as customers' rail infrastructure would disappear. They are strong advocates for door-to-door rail transport. For both environmental and road congestion reasons. They don't really see the benefits of the TEN-T (rail freight) corridor. This could be due to the fact that their trains are often split again quite quickly. Due to all the ongoing construction in Germany, the network is not functioning optimally either. 740-meter trains are not interesting for them. Personal opinion: The benefits do not outweigh the costs. New signals and new yards would be required for 740m trains, and it only gives you 40 meters of extra train length. Couldn't that money be used much more efficiently? He can't imagine that the few extra containers per train justify the investment. It may also be because they already reach 2800 tons at 400 meters, so they don't easily reach 740m anyway. He does believe that automatic couplings could be a real opportunity for rail freight. But currently, they are far too expensive. It doesn't make sense that a coupling is four times more expensive than the wagon itself. If you critically assess what's really needed in such a coupling, it should be possible to make it cheaper. Then it could definitely make a difference for single-wagonload transport. Their rail volume is as large as their inland waterway volume, mainly on waterways with somewhat manageable water levels. They aim to make these modalities complementary. So, for large goods flows to a particular area, they use both. This provides more redundancy. But this only works if you can transport really large volumes. They do experience problems with water levels on longer routes like the Danube. They had switched to rail for that route, but rail turned out to be much more expensive, so they went back to inland shipping. They don't really suffer from much unreliability, 95% of their trains run on time. So, they don't see the need to increase storage capacity to cope with rail disruptions. They prefer to keep their volumes as close to the customer as possible. They already pre-position stock near the customer to enable quick delivery. Their steel must be stored under controlled conditions. There are various warehouses across Europe where steel can be stored directly from the train. When the customer needs it, it's delivered by truck. Addition: ERTMS could also be an opportunity for rail freight, as it increases uniformity. However, it must be implemented efficiently and in an interoperable way.

B.3.0.3. Private siding 6

Regarding the additional monitoring points on the railway: The project is called ”Last mile spoor” and is being carried out in collaboration with ProRail. It focuses on equipping port rail infrastructure with sensors combined with smart cameras. This results in a substantially higher utilization rate. A rough estimate suggests it could provide up to 25

Tata does not receive coal, but rather lime as a raw material by train; all other materials arrive by sea ship. Steel is transported outbound by rail. In the future, they plan to start transporting scrap metal by rail as well.

The port still handles a coal flow, but it is expected to decline due to the energy transition. New flows are expected to replace it, such as biofuels, possibly biomass, and eventually hydrogen by rail in the longer term.

Regarding the proposal for a second infrastructure manager: He supports having a different infrastructure regulation standard for port areas compared to the standard of the main rail network. However, when it comes to traffic control, fragmentation is undesirable. In fact, it should ideally be coordinated at the European level. So, no new boundaries between traffic control areas should be created.

Regarding hazardous goods: Currently, local authorities (such as environmental agencies or safety regions) are allowed to impose additional local requirements on marshalling yards. This needs to be harmonized. There are already sufficient national safety standards in place.

Regarding the combination of the civil and military sectors: Military transports do not yet take place in their port, but he can definitely imagine that such a combination could work well.

B.3.0.4. Infrastructure manager 1

Type 1: The strategy: The infrastructure manager helps to simplify complex law and legislation surrounding the infrastructure. That's certainly possible. Prorail has a very high standard which is used for all trains. For the freight trains on the spur lines, it doesn't make sense to use these standards. The new/second infrastructure manager can use easier demands for the infrastructure. This is something with which ProRail itself also struggles. They have played with the idea of introducing a sort of HSWI light. (This would look like a copy of what the new infrastructure manager now uses)

Type 2: Strategy: The infrastructure manager helps with new investments in the infrastructure such as electrification and hybrid/electric locomotives. They have already been doing this in Moerdijk. They are building a docking station for an electric locomotive which solves the non electrified tracks problem.

Type 3: Strategy: No special strategy apart from managing the private sidings. The infrastructure manager adds, that they see that one of the main concerns for large rail users are the climate requirements. For example companies have trouble realizing new projects because of the nitrogen emissions these projects cause. However, some of these projects are specifically designed to reduce emissions such as the Porthos projects. In such cases the infrastructure manager tries to lower emissions for the private sidings so the company can use this "Emission space" elsewhere in the company The infrastructure manager does this by reusing materials such as secondhand sleepers or using materials which are better for the environment (Bamboo instead of concrete).

Type 4: Strategy: The infrastructure manager helps to reactivate private sidings and encourage more companies to use rail in order to create private siding clusters. This helps with sharing the fixed infrastructure costs. This is a real goal of the infrastructure manager. The infrastructure manager wants to take its responsibility as a business and contribute to the modal shift. Their goal is to move as many trucks as possible from the road to rail. However, ProRail has to contribute by improving the national railways. Rail has to become more reliable as a whole to really support this plan. The infrastructure manager believes that when they make clusters of companies using rail they can make rail competitive again, even for smaller rail users. The infrastructure manager is willing to invest in these clusters in order to carry the first costs.

B.3.0.5. Infrastructure manager 2

Municipalities often do not want to grant permits for night work due to noise disturbance. As a result, work has to be done during the day, which causes issues for both passengers and industry. This is a growing problem.

There are also many ageing railway bridges. When maintenance is required on these, there is often a lack of coordination with road bridge maintenance as both cannot be closed at the same time in the same area. ProRail and Rijkswaterstaat need to coordinate this together, this is gradually getting better.

ProRail often tries to cluster maintenance works within the same area to limit disruption, but the downside is that this creates many interdependencies between projects. If just one of those projects fails to get a permit, the whole operation is at risk. The coordination of works has already improved significantly compared to the past. In the past, ProRail would proceed as it pleased. Now there is more consultation with market through draft plans and discussions, and that stakeholder involvement helps the process run more smoothly.

Regarding the busy shunting yards in the ports: For safety reasons, ProRail only allows one train in a certain area at a time. This is less efficient, and they are trying to find solutions. One idea is to install more sensors on the tracks to better monitor train movements. That could allow for shorter time slots, which might be a solution.

the closure of railway sidings can lead to more closure of private sidings. There are ongoing efforts to consolidate neighbouring users where possible. The lack of flexibility in freight paths is also a recognized issue.

Regarding a second infrastructure manager: ProRail is shifting its position and is increasingly open to the idea. For example, at the railway line in Zwijndrecht, there is a long branch line that serves only Van Leeuwen. This is expensive to maintain for just a few trains. In such cases, it may be desirable for the infrastructure to be transferred to a second infrastructure manager. ProRail can no longer afford to say that everything belongs to the state and must remain under state control. This is an ongoing internal discussion.

ProRail essentially has only two sources of revenue: parking fees and track access charges. In the past, running trains was expensive and parking was cheap. Now the situation is reversed: running trains is cheaper, but parking has become much more expensive. This again led to many complaints, so the Ministry of Transport now provides a subsidy for parking on stabling tracks. However, that subsidy will end next year because the funding has run out (see ”Tijdelijke subsidieregeling opstellen en rangeren spoorgoedernvervoer 2023-2025”).

Regarding the transport of hazardous materials by rail: ProRail is in the middle of a discussion about the safety of the transport of dangerous goods. They try to inform the public as much as possible about how safe it actually is, but people are easily frightened by the term hazardous goods. The Netherlands tends to layer additional national rules on top of the already strict European regulations, which creates a kind of false sense of safety. In the end, members of parliament are often easily swayed by arguments against hazardous materials transport, even though rail transport is significantly safer than road transport (Tiekstra, 2025).

There is also resistance because there are stricter construction regulations near railway lines where hazardous materials are transported. Investing more in intermodal solutions is seen as a good idea. The government should invest in access points for intermodal transport. That would help attract market players to use rail. The auction facility in Bleiswijk was one such initiative. But then they had to squeeze a container train between local and intercity trains, and there simply wasn’t enough room.

The same happened with Heineken in Zoeterwoude, which wanted to transport beer by train, but again there was no room on the tracks. In the Netherlands, the focus is clearly on passenger trains.

Regarding strategy around civil and military cooperation: Certain terminal operators in ports that are suitable for handling military equipment are now gaining an advantage. Military freight isn’t moved every day, so if those facilities are already in place, they can also benefit the civilian sector when they are not being used for military purposes. Now that there’s more attention on defense, it should be done smartly, and civilian parties should also benefit.

Lastly, many rail-related initiatives nowadays often stall due to local authorities (municipalities, safety regions, environmental agencies) who have gained more influence and can now block or delay initiatives more easily.

B.3.0.6. Rail carrier 2

The shortage of train drivers is not necessarily the main reason for lower reliability. Reliability issues are also caused by poorly maintained infrastructure, construction works (particularly in Germany), and poor coordination between the Netherlands and Germany regarding those works.

A very important factor in the high costs of rail freight transport is the lack of European interoperability. With a truck, you can just drive through all of Europe. With a train, each country has its own regulations, power supply, and safety systems. As a result, locomotives become very expensive because they need to be equipped to handle all those systems, which drives up costs. This is partly a technical issue, but capacity allocation is also difficult due to the fragmentation between countries. You need to secure a freight path across Europe. The European Commission and the Parliament support more cooperation in terms of capacity allocation, but the European Council (meaning the individual member states) holds it back. They want to retain national control. This is currently a hot topic. Time will tell whether the EU will be allowed to create a Europe-wide capacity allocation system, or if it will continue to be managed at the national level.

The development of the TEN-T network has helped, but countries in Europe often exert pressure to maintain the freedom to apply their own rules, which makes the corridors less efficient. However, TEN-T is driving initiatives like the 740-meter trains. In the long run, we need a European system with more coordination. There should also be more oversight to prevent countries from developing their own versions of ERTMS.

The bundling of trains is indeed decreasing because more connections are disappearing. It's a kind of downward spiral. The few remaining connections then become increasingly difficult to keep in service. The companies that do remain are often those most dependent on rail, and they are the ones hit the hardest. ProRail also has to critically examine what they spend their money on. One consideration is to remove switches or tracks. As a railway undertaking, they are concerned about that option. They don't see it as a positive development that ProRail is forcing tracks to be transferred to private sidings, as that makes rail even less attractive for those users.

The pricing of the railway undertaking is made up of several components: Infrastructure charges, which they pay for track use (road transport pays almost nothing, and inland shipping pays nothing at all for infrastructure). Train drivers are expensive. Training and regulations are extensive, and they have to compete with cheaper truck drivers. Train drivers must also speak different languages and follow different rules in each country. Reducing costs would require modernizing the rail network, so one system, one set of regulations, one method of capacity allocation. That would create a truly European system where borders no longer matter. This would significantly reduce costs for both drivers and locomotives.

The rail sector is under intense scrutiny. There's a lot of focus on hazardous materials transported by rail, even though it's the safest mode. This leads to even more regulation. Train drivers, for example, must specify the exact location and content of each wagon in the train, which is disproportionate compared to road transport. Additionally, there are high fuel and electricity costs, including excise duties, which are difficult to change. Wagons also cost money and are subject to extensive regulation. Each country has its own approval process for wagons.

There is already a significant amount of intermodal container transport. But more should be possible with trailers on trains, similar to the Swiss "Rollende Landstrasse". In Bleiswijk and the Westland, this has been explored further. ProRail did not support the Bleiswijk project because it required additional trains on an already busy passenger corridor. However, there was real potential there. More can be done by combining the strengths of trucks and rail. Especially if you can organize it so that the driver does not need to stay with the trailer, it also offers a solution to the driver shortage.

Regarding dual-use civil and military cooperation: For military transport, it is important to have enough space on the railway to accommodate wide tanks, which is also useful for transporting civilian automotive cargo. Infrastructure upgrades for military use can also benefit the civilian transport sector. The 740-meter trains could be advantageous for both sectors. There are plans to add a new rail curve in the Eemshaven for military purposes, which would also benefit the civilian sector.

The interviewee doesn't believe Strukton's costs will necessarily be lower. In the end, costs always show up somewhere else in the chain. Only if Strukton were to take over entire yards, such as the entire Port Railway Line, would it really make a difference. Taking over just a few connections here and there won't move the needle.

B.3.0.7. Expert 1

Non-electrified infrastructure is not always a critical problem. To mitigate this, you can use electrical locomotives such as the Stadler euro locomotives. These are hybrid and can be used to solve the problem. These hybrid or electric locomotives are more expensive So in order to determine it a sidings wants to use them the should do a cost benefit analysis to determine whether it is worth it. Also, vectron locomotive from Siemens is a last mile locomotive. It is electrified but also has a small diesel engine for the last mile. Also more expensive

The train driver shortage is a European problem, not only Netherlands. Main driver for this problem is the fact that the occupation is not attractive to young generation. The wages of train drivers are pretty high, but there is still a shortage. A lot of barriers for train drivers, you need train drivers for every country you drive in. you need to speak almost as good as a native in that country. Another issue for the train drivers is that they need to know all the technical details of all the systems such as the safety system, the signs and speak the language of every country they cross almost fluently. A new innovation is a translating system like google translate for railway undertakings. It looks quite promosing. It is called: (translate4rail)

High costs of train operation are a global issue, not only specific for railway or Netherlands. All transport companies have rising costs. Coordination problems between railway works are happening in all countries, lack of coordination between countries. This is also a European problem. Infrastructure managers provide information to railway undertakings when rail construction is going to happen, these messages to the railway undertakings are often changed at the last minute.

Rules for maintaining the sidings are the same as for the regular infrastructure. No specific rules for sidings, they have to follow the normal rules (HSWI) The maintenance of the sidings should be on a less demanding scale to make it more feasible.

Busy shunting areas are indeed problematic Lack of operability should be: lack of interoperability.

For intermodal transport: there has to be a restriction for the road transport to only drive the time they are allowed to drive, otherwise they don't use railways. Officially truck drivers can only drive 8 hours. but in reality, polish drivers drive 20 hours a day. The fine for this is very low so it is worth it to them to drive more hours than they are allowed. If the truck drivers would be controlled more often with heavier fines, intermodal transport would have a lot more future as it would be more attractive to put trailers on the train.

The military strategy is dependent on the way of thinking of the military. they have lot of internal and external safety rules which the rail sector has to account for. But this strategy provides stability of the network, because when you build sidings together with the military, closing the sidings will be a lot less likely as it is double used.

For every strategy the end result is if it is profitable. Money is everything, so no matter what the advantages are in terms of environment, flexibility etc. In the end it has to be profitable.

C

The rail market

C.1. Freight transport in the Netherlands

The total volume of goods transported in the Netherlands is fluctuating with a drop in 2023 (Centraal Bureau voor de Statistiek, n.d.). Looking at the freight transported in Europe, the amount of goods transported is stable (Eurostat, n.d.). This is also supported by the European Commission, which speaks of a volatile freight market, that is mostly stable but slowly losing modal share to road transport (European Commission, 2019). A closer look at bulk goods, which are more favorable for rail transport, shows a slight decline. This is particularly the case for coal, crude oil and natural gas. One of the few growing bulk segments is agriculture and forestry products (Eurostat, n.d.). Another important fact is that the volume of freight to be transported in the EU will increase by 3 to 4 times in 2050 due to the change in transported goods from bulk to less efficient forms of freight (Islam et al., 2016). The changes needed to support these volumes are not yet in place in Europe. There are several barriers to increasing the share of freight. The main barriers are interoperability between countries, balance between passenger and freight needs, lack of infrastructure to allow longer trains and lastly lack of competition (Vassallo and Fagan, 2006).

C.2. Modalities

The first part of understanding the rail market and private sidings is to understand the modalities with which rail competes and cooperates. Broadly speaking, there are six relevant types of modality. The first is unimodal road transport. This is simply trucks going from a to b. Secondly, we have unimodal rail. This is mostly used for block trains from a to b. The third option is unimodal inland shipping. These were the unimodal options, the fourth type is multimodal road-rail and the fifth is multimodal road-inland shipping. The sixth category is other options. Another major modality is maritime transport, i.e. the transport of goods by sea and oceans. This type of freight is not included in the scope as it is a completely different type of shipping, mainly connecting Europe with the other continents. Pipeline transport is also mentioned as a modality, but this modality is also not part of this research.

This section aims to provide a theoretical overview of the potential use cases per modality.
Unimodal road. This modality is used to transport goods directly from origin to destination. The relatively small size of the transport means that it is very flexible in terms of last-minute orders, transport sizes and destinations. It is relatively fast, especially over shorter distances, where it can be most competitive (European Court of Auditors, 2023). Potential use cases include freight that is transported to a variety of locations, such as food distributed to supermarkets. Markets with varying demands are also suitable for this type of transport. An example would be a seasonal market such as agriculture.
Unimodal rail. This modality also transports directly from a to b. However, unimodal rail is more suitable for larger volumes of freight, such as coal or bulk liquids. It can move large volumes of freight over long distances. It works best for planned and continuous transport (European Court of Auditors, 2023). The rail sector mainly uses block trains, which are long freight trains made up of the same type of wagons. Shorter variations are also possible, as described below in the section on modalities. Another advantage

of train modalities is that they are more environmentally friendly than other modalities (Klein et al., 2021)
Unimodal inland navigation. This modality is somewhat similar to unimodal block trains as it is also specialised in large volumes over longer distances (European Court of Auditors, 2023). However, it is less flexible as it can only operate on rivers. It can also be used for bulk goods in both liquid and solid form.
Multimodal road-rail. This type of transport combines road and rail. Road is often used as a first/last mile alternative, with the longest part of the journey being carried out by rail. Goods are transhipped at terminals. This takes time and can be more expensive, but it combines the flexibility of road with the capacity advantages of rail.
Multimodal road-inland transport. This also shows similarities in use cases to multimodal road-rail. Several types of vessels can be used, but the most useful for multimodal inland waterway transport are barges carrying containers (European Commission et al., 2015). This means that this modality is less suitable for the transport of bulk goods.

C.2.1. Rail modalities explained

As mentioned earlier, there are different modalities for rail freight types. See figure 2.2 for a visual overview. The first type is the block train (or full train), which is a unimodal type, i.e. large trains carrying large volumes from origin to destination. These are often from ports where the goods arrive to the hinterland. These trains often carry only one type of freight. The other type is full wagonload, which means that at least one full wagon is carried. This can be categorised as single wagonload, multiple wagonload or multimodal road-rail. The Wagonload/Multi Wagonload option is suitable for smaller volumes coming from small sidings and going to a terminal where they are combined with other Wagonloads. Wagonload traffic is particularly vulnerable to the disappearance of private sidings (Guglielminetti et al., 2015). This is worrying as SWL is cited as one of the more competitive ways for rail to compete with road freight. However, this is highly dependent on transport characteristics such as volume, distance and country of origin/destination (Bruckmann, Dober, Galonske, et al., 2016; Bruckmann, Dober, Mancera, et al., 2016). Multimodal road-rail is similar to SWL/MWL, but it uses trucks for the first or last mile of the journey, making it multimodal. This is explained in the section below, which goes into more detail on road modalities. See figure 2.3 for a visual explanation of the journey of the rail modalities.

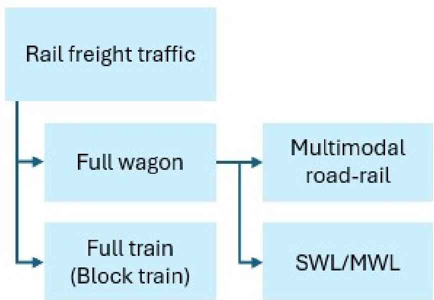


Figure C.1: Rail transport types

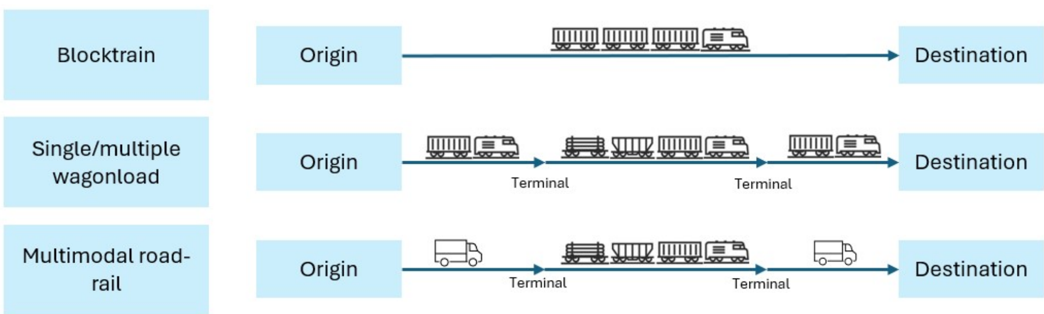


Figure C.2: Train types

C.2.2. Road modalities explained

There are different forms of road modalities. Unimodal road refers to a single truck carrying freight from origin to destination. Multimodal road options combine this with inland waterways or rail to cover the generally longest part of the journey. This can be done in a number of ways. The freight from the lorry can be loaded onto another modality. This is usually done in the form of an interchangeable transport unit (ITU). An ITU is often a container, but can also take other forms. Another form of ITU is accompanied (road vehicle with driver) or unaccompanied (semi-trailer) transport. This means that the freight and the lorry on which the freight is carried are loaded together on a train for the next leg of the journey. See figure C.3 to get an idea of this. An overview of these modalities is given in figure 2.5.

Figure C.3: Accompanied road-rail combined transport

Source: European Commission et al., 2015

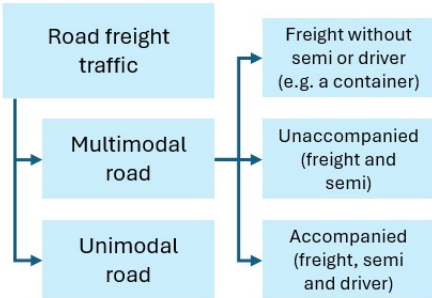


Figure C.4: Road transport types

C.2.3. Which modalities use private sidings?

The main modality using private sidings is the unimodal rail option. So unimodal rail can use the private sidings either by going directly from the private siding at the origin to the private siding at the destination. This would imply that the private siding is large enough to accommodate block trains, as no shunting is involved with this train. The alternative is an SWL/MWL loaded on a private siding and first going to a marshalling yard to be combined with other wagons. This process can be reversed at the destination. If this type of transport is used, the private siding could be smaller as fewer wagons are loaded at the private siding.

Of course, multimodal road-rail can also use private sidings, but as the road modality is often used as a first/last mile solution, the use of private sidings will only happen if the train is the solution for either the first or the last mile. For example, lorries take the freight to a rail terminal where it is loaded onto a train, which then takes it directly to a private siding. This process could also work in reverse, with trucks as the last mile transport option. The three options discussed above can be seen in figure C.5.

Theoretically it might be possible to use trains for the first/last mile and road for the middle mile, but this has not been described in the literature and the advantages of this combination are very limited. Therefore, this combination will not be part of this research.

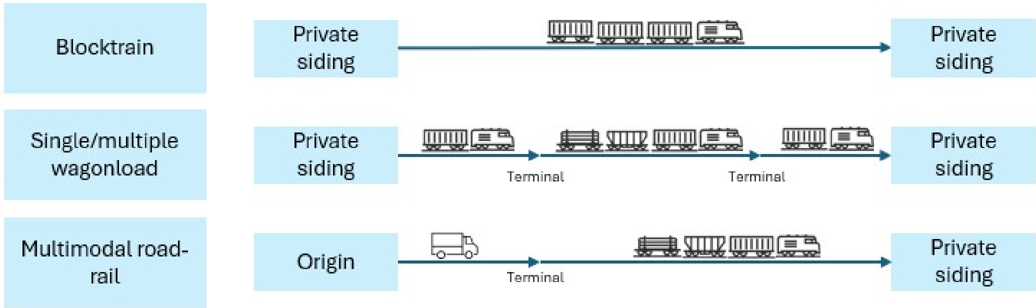


Figure C.5: Private sidings and the different modalities using them

C.3. Competition between modalities

The competition between modalities is important to know in order to ultimately understand the strengths and opportunities of the different modalities. Looking at the Netherlands in figure C.6, it is clear that road dominates the freight market. This is followed by inland waterways, after which rail only has a few percent of the market. Air transport is even smaller than rail. Sea and pipeline transport are not included in this graph as they are outside the scope of this study.

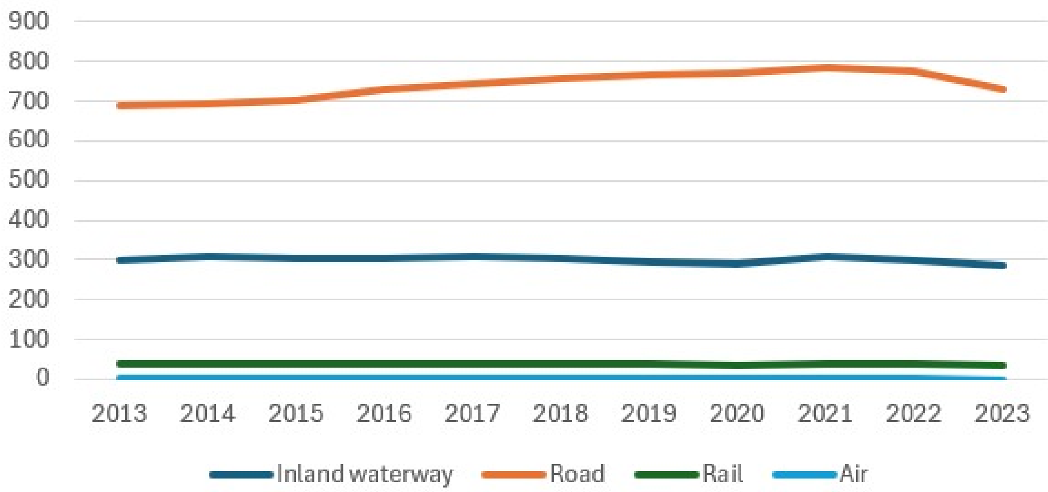


Figure C.6: Freight flows from, to and in the Netherlands per modality in million tonnes

Source: CBS(Statistics Netherlands)

Looking more closely at the distribution of goods carried in table C.1, we can see the difference in distribution by type of freight. As already mentioned, road dominates most of the categories, but the green cells show where rail also has a strong market share: coal and lignite, ores, plastics and rubber, basic metals and metal products and finally transport equipment.

Inland navigation is also strong in bulk commodities such as coke, petroleum products and ores. This makes sense as inland waterways also specialise in bulk transport. Road transport mainly dominates the categories where inland waterways and rail are weaker. These categories are: agriculture, food and beverages, crude oil, other mineral products, pharmaceuticals, machinery.

Multimodal road-rail Eurostat data are used to get an idea of the share of unimodal and multimodal freight transport. See appendix A for the data used. Table A.1 shows the gross weight of goods transported by rail in interchangeable transport units (ITU) in the Netherlands. This is also the data on which the European Commission based its calculations to determine the multimodal freight flows European Commission et al., 2015. Looking at their calculations, it is clear that they consider all container transport to be multimodal because of the use of ITUs. This is a rather large assumption for which no justification has been found. However, accepting their assumption, the share between multimodal and unimodal

Table C.1: Percentages of gross weight of freight transport per freight type in the Netherlands by transport mode, 2022

Freight type	Inland waterway	Road	Rail
Agricultural, forestry, and fishery products	11%	84%	5%
Food and beverages	24%	74%	2%
Coal and lignite	74%	1%	25%
Coke	97%	2%	0%
Crude oil	15%	85%	0%
Petroleum products	95%	2%	4%
Ores	83%	0%	17%
Salt, sand, gravel, and clay	81%	17%	2%
Other mineral products	8%	90%	2%
Chemical and fertilizer products	69%	25%	6%
Pharmaceuticals, chemical specialties	10%	84%	7%
Plastics and rubber	27%	47%	26%
Basic metals and metal products	32%	54%	14%
Machinery and electronics	18%	78%	4%
Transport equipment	20%	58%	22%
Textiles, leather, and related products	34%	61%	5%
Wood, pulp, paper, wood, and paper products	29%	63%	7%
Waste and secondary raw materials	36%	60%	5%
Other goods	7%	87%	6%

Source: CBS (Statistics Netherlands)

rail can be seen in table C.7. The total gross weight transported by all modalities together is 1050 million tonnes in 2023. This means that the gross weight transported by multimodal road-rail transport in the Netherlands in 2023 was 46% of total rail freight and 1.6% of the total freight share of all goods transported in the Netherlands.

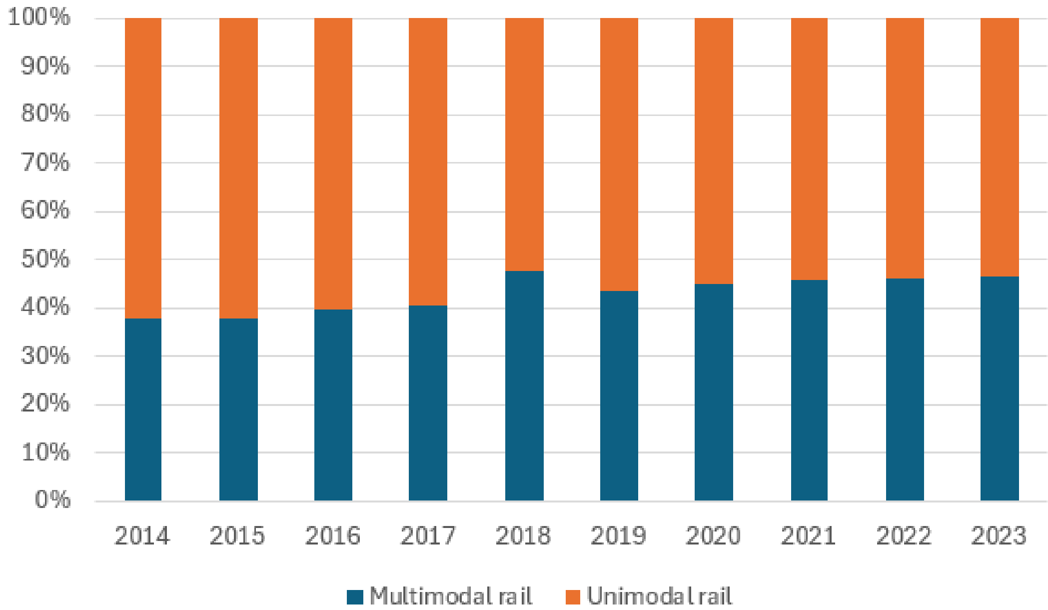


Figure C.7: Model share between multi and unimodal rail

Multimodal road-inland waterway

The total volume of goods transported by inland waterways in the NL in 2023 will be 327 million tonnes (see table A.2). Looking at the table C.8, it can be seen that the modal share of multimodal inland waterways in 2023 is 11%. This means that the total modal share of multimodal inland waterways is 3.0%. For unimodal inland waterways, the share is 24.1%.

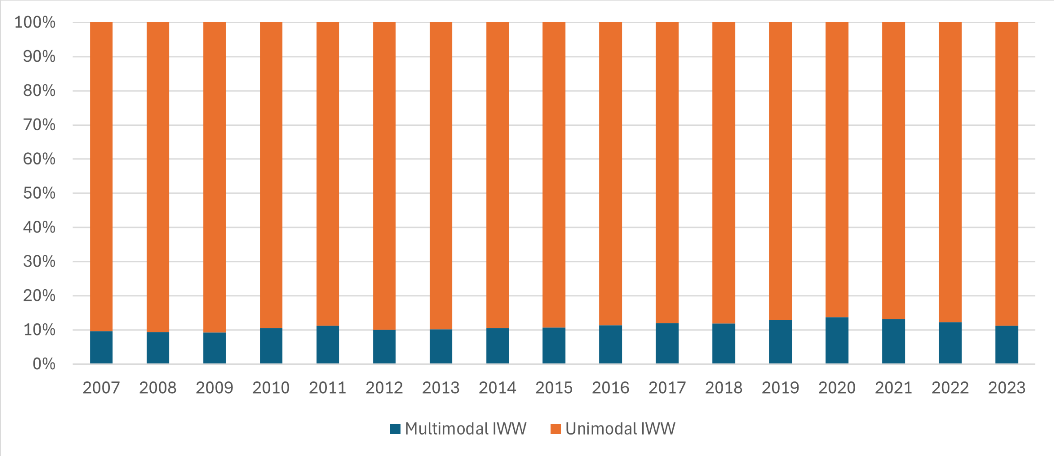


Figure C.8: Model share between multi and unimodal inland waterway

Other modalities The other modalities mainly consist of freight transported by air. In the Netherlands this amounts to about 2 million tonnes per year, which represents 0.2% of the total freight in gross weight in the Netherlands.

Conclusion Summed up the complete modal share can be seen in table C.2 below.

Table C.2: Gross weight percentages of freight transport per modality in the Netherlands

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Unimodal road	66.4%	66.8%	67.8%	68.1%	68.7%	69.5%	70.1%	69.1%	69.3%	69.4%
Unimodal rail	2.3%	2.4%	2.2%	2.1%	1.8%	1.9%	1.8%	1.9%	2.0%	1.8%
Unimodal IWW	26.6%	26.1%	25.2%	24.8%	24.4%	23.4%	22.8%	23.7%	23.6%	24.0%
Multimodal road-rail	1.4%	1.4%	1.5%	1.4%	1.6%	1.5%	1.5%	1.6%	1.7%	1.6%
Multimodal IWW-road	3.2%	3.1%	3.2%	3.4%	3.3%	3.5%	3.7%	3.6%	3.3%	3.0%
Other	0.2%	0.2%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%

Combining the knowledge from the table A.3 with the table C.1. Some conclusions can be drawn as to which sectors are most important for multimodal rail transport. As already mentioned, the biggest sectors for rail are: coal and lignite, ores, plastics and rubber, basic metals and metal products and transport equipment. If we now look at how much of these sectors are transported in ITUs, we see that coal and lignite and ores are not transported in containers, which makes sense as they are bulk goods. Basic metals and metal products are increasingly transported in containers, but their share is still only about 20% of total rail freight. Plastics, rubber and transport equipment is a different story. Their share has increased rapidly over the years to 99% and 80% respectively. This means that these important rail sectors are mostly transported in containers. This makes it unlikely that these multimodal road-rail transport operations use private sidings as explained in section C.2.3.

Private sidings are mainly used by block trains and SWLs. This would lead to the conclusion that it is mainly bulk goods that use private sidings. However, this is more about how you define a private siding. As Demmers and Van Es, 2024 shows, most bulk freight comes from the ports. These ”private sidings” are large loading terminals which are very different from the (smaller) inland private sidings. More research on this precise distinction is needed and will require data from sources other than the open source databases such as CBS and Eurostat.

C.4. Osterwalder business model canvas

This section provides the visuals of the Osterwalder business model canvasses which are talked about in chapter 3. The OW business model canvasses are put together based on qualitative input from stakeholder interviews, desk research and expert interviews. Every building block has been filled in by combining insights from relevant stakeholders and desk research. Even though it is a conceptual model, it reflects the triangulated interpretation of specific types of private sidings. The model aims to be an exploratory tool to identify roles, dependencies and cost structures (Osterwalder et al., 2010). The stars in the canvasses illustrate which parts of the company are directly connected to the private siding.

Key Partners	Key Activities / Key Resources	Value Propositions	Customer Relationships / Channels	Customer Segments
- Raw material suppliers - Logistic partners (shipping companies, port authorities, rail operators*) - R&D partners - Technology and equipment providers - Energy supplier	**Key Activities** - Chemical production - R&D of chemicals - Distribution of products - Waste management **Key Resources** - Production facility - Infrastructure to import/export goods* - Personnel - Research capacity	- Production of high-quality chemical products - Research and development leading to new innovative materials	**Customer Relationships** - Long-term contracts - Collaboration with research institutions **Channels** - Direct sales through account managers - Distributors	- Manufacturers in the automotive, construction, electronics and healthcare segments

Cost Structure	Revenue Streams
- Raw material costs - Personnel costs - R&D costs - Equipment maintenance* - Operation and logistic costs* - Energy costs	- Sales of chemicals and materials - R&D collaboration and licensing - Waste recycling and by-product sale

Figure C.9: Osterwalder business model canvas of type 1B company (small volume in large port) using a private siding

Key Partners	Key Activities / Key Resources	Value Propositions	Customer Relationships / Channels	Customer Segments
- Shipping companies and carriers - Rail transport companies* - Road transport companies - Port authorities - Customs & government agencies - IT and logistic software provider	**Key Activities** - Cargo transshipment - Logistic planning - Cargo storage **Key Resources** - Transshipment equipment* - Infrastructure - Warehouse - IT systems - Strategic location	- Fast and efficient transshipment between modalities* - Flexible temporary storage of cargo	**Customer Relationships** - Long term contracts with fixed customers - Flexible service to resolve supply chain issues **Channels** - Sales through account managers - Partnerships in a logistic network - Industry events	- Companies in the import/export business - Companies requiring raw material for production

Cost Structure	Revenue Streams
- Infrastructure costs* - Energy and fuel expenses - Personnel cost - IT systems expenses	- Transshipment fees* - Storage fees

Figure C.10: Osterwalder business model canvas of a type 1C company (large port terminal) using private sidings

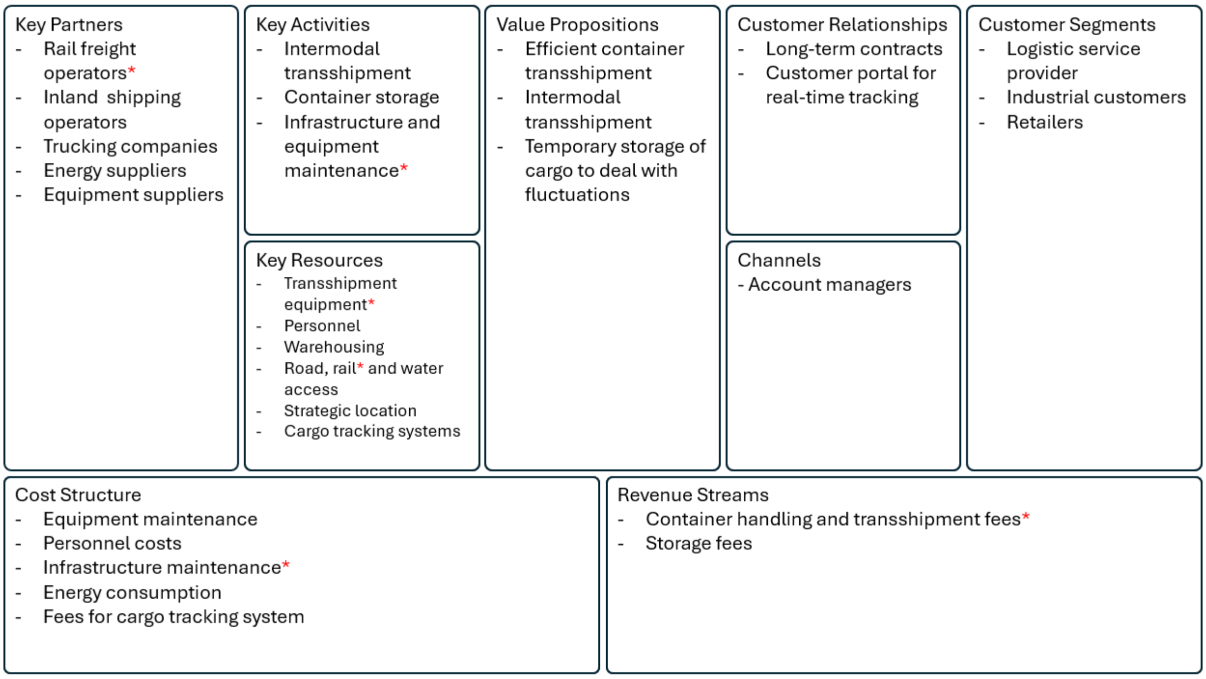


Figure C.11: Osterwalder business model canvas of a type 2 company (inland terminal) using a private siding

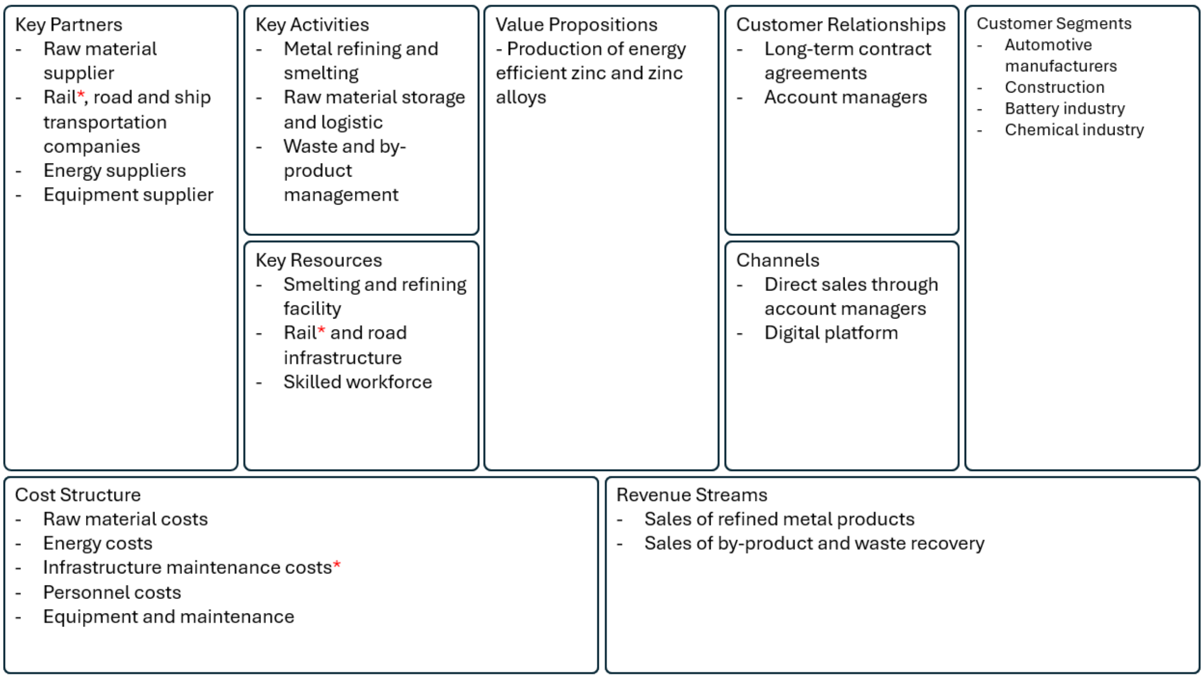


Figure C.12: Osterwalder business model canvas of a type 3 company (large inland industry) using a private siding

Key Partners
- Raw material suppliers
- Road transport companies
- Rail transport companies*
- Inland shipping companies
- Energy supplier
- Machinery provider

Key Activities
- Manufacturing & metal processing
- Material storage
- Unloading and loading of materials
- Quality control and maintenance

Key Resources
- Production facility
- Road, rail* and waterway infrastructure
- Skilled workforce

Value Propositions
- High quality metal processing and production

Customer Relationships
- Long-term supply contracts
- Just-in-time delivery service
- Personalized production

Channels
- Account managers
- Network events
- Company website

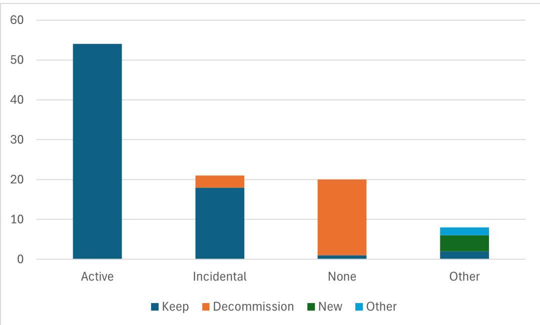
Customer Segments
- Construction and infrastructure companies
- Wholesale and distributers

Cost Structure
- Raw material costs
- Energy costs
- Logistic and transportation expenses*
- Machinery maintenance and upgrades
- Regulatory compliance and environmental costs
- Labor costs

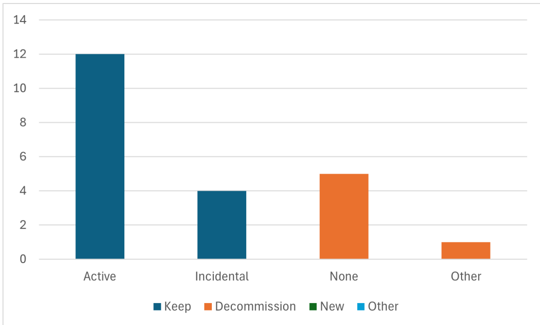
Revenue Streams
- Sales of metal products
- Scrap metal resale

Figure C.13: Osterwalder business modal canvas of a type 4B company (small volume, isolated location) using a private siding

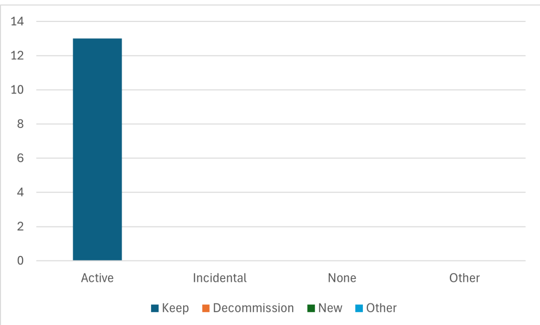
C.5. Private siding utilisation



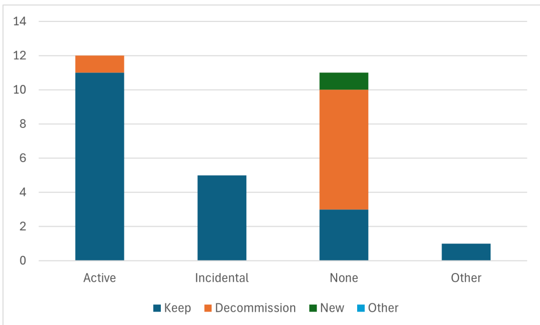
(a) Type 1 – Large ports



(b) Type 2 – Inland terminals



(c) Type 3 – Large industrial companies



(d) Type 4 – Smaller industrial companies

Figure C.14: Status and activity of different types of companies and their private sidings

D

Problems and strategies

D.1. Problems

For each type of private siding a SWOT has been constructed (Learned et al., 1965). The information is based on a combination of insights for stakeholder and expert interviews, desk research and data. In the SWOT factors have been classified as strength or weakness when they are internal (endogenous) factors. For example volume size of the company or frequency of private siding operation. The opportunities and threats are the exogenous factors which are a result from outside influences such as developments in the railway market or law and regulations.

D.1.1. SWOT

D.1.1.1. Type 1 large ports

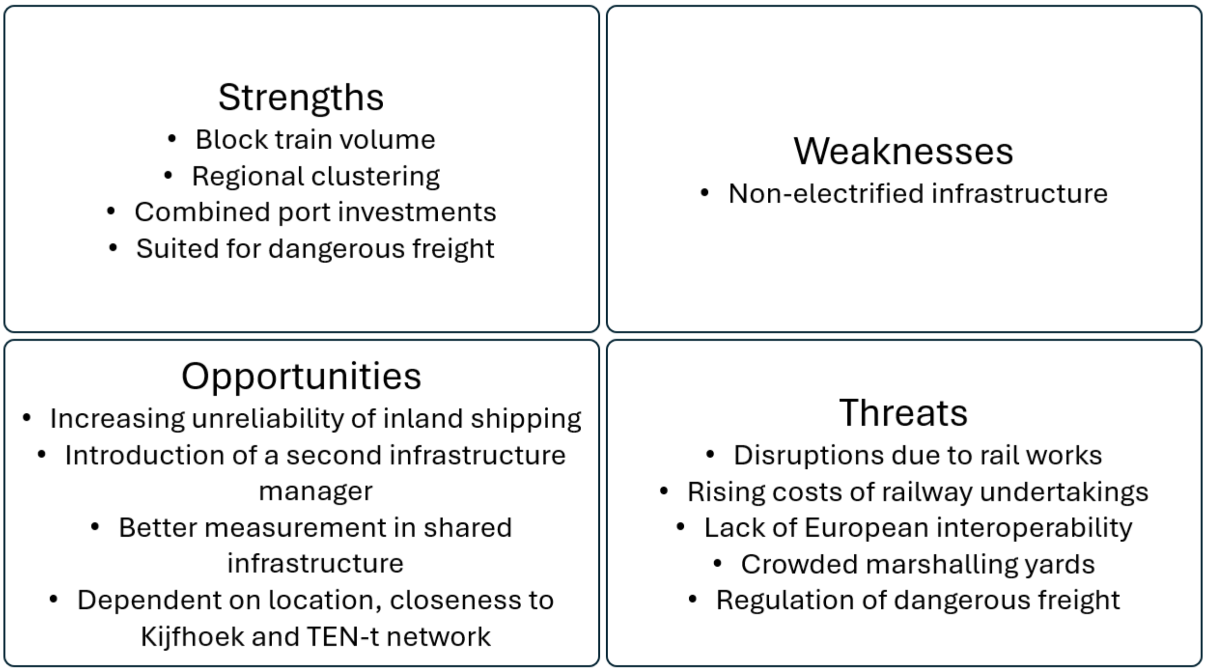


Figure D.1: SWOT model of a type 1 private siding

The above figure D.1 shows the SWOT model for a type 1 private siding. As explained earlier, one of the main strengths is volume. Volume, regional clustering, offers a way of dealing with threats such as unreliable rail service. The clustering of private sidings can also help the smaller private sidings with this problem, while the combined port investment is a way of dealing with uncertain government subsidies. This means that the main threats are capacity problems due to overcrowded marshalling yards and difficult legislation such as track occupation. Non-electrified railway lines are a weakness, but this can be dealt with by investing in infrastructure, which is one of the strengths of combined port investment. Type 1 private sidings can expect more opportunities in the form of a second infrastructure manager, investment in efficiency through better measurement by port authorities and strategic locations.

D.1.1.2. Type 2 large ports

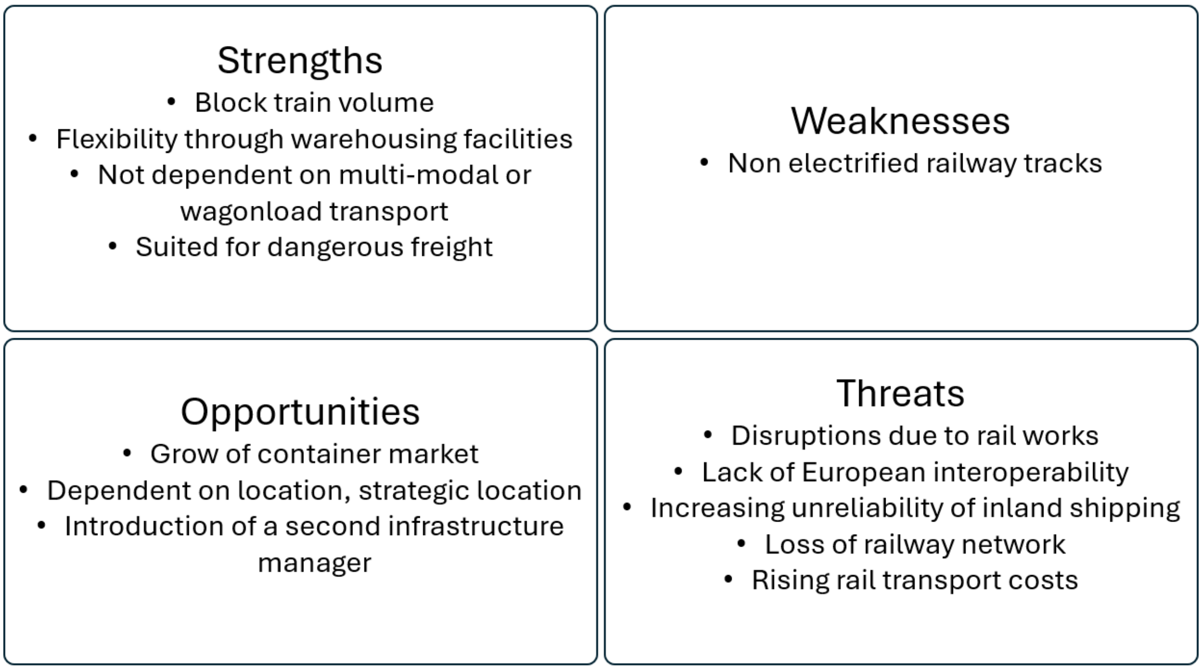


Figure D.2: SWOT model of a type 2 private siding

The above figure D.2 shows the SWOT model of an inland terminal. Volume is one of the main strengths of a terminal. It is even stronger when combined with storage facilities. The fact that some terminals operate block trains as well as intermodal and wagonload traffic strengthens the rail position of a terminal. This allows the terminal to serve a wide range of customers, from small to large.

The terminals interviewed mentioned that their focus is on inland navigation as the main modality and that the other modalities have to support the shipping component of the operation. This shows that if rail is not profitable enough, it will not be used. This is also why the increasing unreliability of inland navigation due to low water levels is a threat. The modalities are used in a complementary way, so a decline in inland waterway transport could also mean a decline in rail activity. Again the non-electrified railway tracks at the private siding are a weakness as this complicates the transshipment process. Opportunities are the grow of the container market, a second infrastructure manager and a strategic location in some cases. A final major threat to the terminal is the loss of the rail network. With the consolidation of private sidings in the major ports, the smaller private sidings that some terminals serve could disappear.

D.1.1.3. Type 3 Large industrial companies

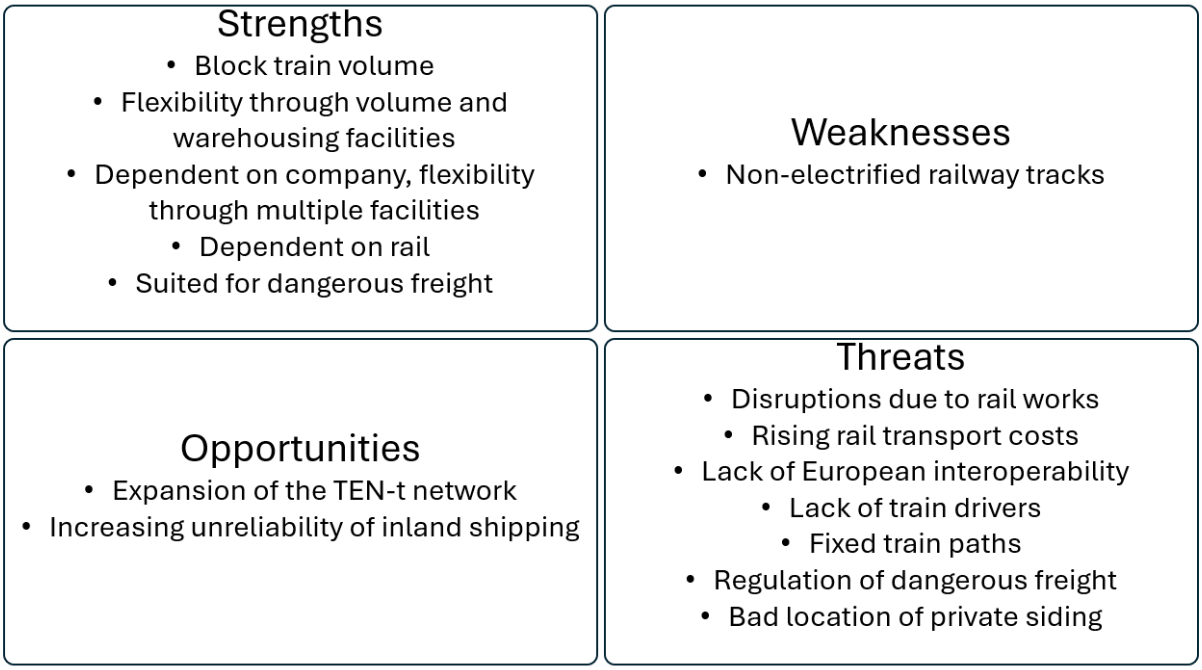


Figure D.3: SWOT of a type 3 private siding

Figure D.3 shows the SWOT of a type 3 private siding. It is similar in some ways to a type 1 private siding in that it also has volume as a strength, but this is enhanced by storage facilities and other production facilities nearby. Dependence on rail is listed as a strength because, from the perspective of this SWOT, it means that the company will try harder to continue using rail as other modalities are not suitable for its operations. It is not uncommon for companies of this size to be part of the heavy industry and therefore to transport dangerous goods. Rail is also very suitable for this. These dangerous goods also make for more complex laws and regulations which is a threat. This can also lead to fixed train routes, making the rail system less flexible for this type of company. In order to handle the large volumes, the companies often need substantial infrastructure on their own land, which results in high infrastructure costs. Type 3 private sidings face many of the same opportunities and threats as type 1 and 2 private sidings. The TEN-T network and the introduction can make transport more efficient, but the company will still have to deal with unreliable rail services caused by a lack of train drivers and construction work, and the rising cost of rail transport will also have an impact.

D.1.1.4. Type 4 Small companies

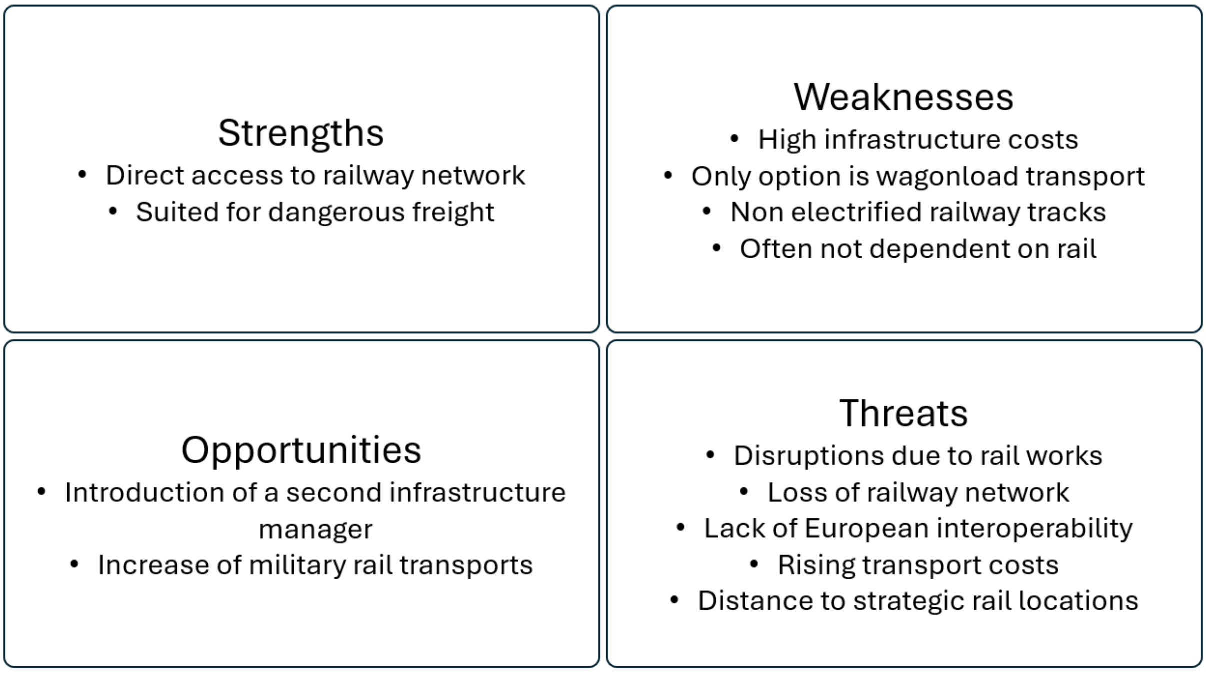


Figure D.4: SWOT of a type 4 private siding

Figure D.4 above shows the SWOT of a type 4 private siding. An important strength of rail for these private sidings is the ability to transport dangerous goods. Other strengths include direct access to the rail network. If the other origin or destination also has a private siding, this means that the freight can go directly from A to B without transhipment. The freight can remain on the same wagon for the whole journey. Type 4 has a number of weaknesses, some of which have already been mentioned, such as the non electrified railway tracks, the smaller volume requiring wagonload transport and high infrastructure costs. The cost of the rail carrier, the unreliability of the railways. are a threat. Another weakness, which is a major difference from the other types, is the fact that most type 4 private sidings do not have the volume to run block trains. This means that they have to run wagonload services, which are inherently less viable. The map of type 4 private sidings shows that type 4 private sidings are scattered throughout the Netherlands and many are not close to strategic locations such as Kijfhoek or access to the TEN-t network. Some of the opportunities are the same as for the other types of private sidings, such as the introduction of a second infrastructure manager. Another opportunity could be to increase military transport by rail. If companies could share infrastructure, such as a common marshalling yard, this could reduce costs. Private military sidings are also located in the north and east of the country, which can help with regional clustering. The extension of the TEN-T network could also help. Although most of the expansion will benefit the large clusters, such as the major ports. The main threat is the loss of the railway network and the loss of neighbouring private sidings, which will lead to increased costs for the private sidings as they have to take over the infrastructure from ProRail

D.2. TOWS matrix

For each type of private siding, a TWOS analysis was conducted. For every combination of internal and external factors, a meaningful relationship was marked (value = 1) based on triangulation of interview insights, literature, and expert judgment. This assessment was qualitatively informed but structured and presented in tabular form.

Strength / Opportunities	Block train volume	Regional clustering	Combined port investments	Suited for dangerous freight
Increasing unreliability of inland shipping	1	0	0	0
Introduction of a second infrastructure manager	0	1	1	0
Better measurement in shared infrastructure	1	1	1	0
Closeness to Kijfhoek and TEN-T network	1	1	0	1

(a) Strength - opportunity matrix

Weaknesses / Opportunities	Non-electrified infrastructure
Increasing unreliability of inland shipping	0
Introduction of a second infrastructure manager	1
Better measurement in shared infrastructure	0
Closeness to Kijfhoek and TEN-T network	0

(b) Weakness - opportunity matrix

Strentgh / Threaths	Block train volume	Regional clustering	Combined port investments	Suited for dangerous freight
Disruptions due to rail works	0	0	0	0
Rising costs of railway undertakings	1	1	1	1
Lack of European interoperability	0	0	0	0
Crowded marshalling yards	0	0	1	0
Regulation of dangerous freight	0	0	0	0

(c) Strength - threat matrix

Weaknesses / Threaths	Non-electrified infrastructure
Disruptions due to rail works	0
Rising costs of railway undertakings	1
Lack of European interoperability	0
Crowded marshalling yards	1
Regulation of dangerous freight	0

(d) Weakness - threat matrix

Figure D.5: TOWS matrices for a company with a type 1 private siding

Strentgh / Opportunities	Block train volume	Flexibility through warehousing facilities	Not dependent on multi-modal or wagonload transport	Suited for dangerous freight
Grow of container market	1	0	0	0
Dependent on location, strategic location	0	0	0	1
Introduction of a second infrastructure manager	0	0	0	0

(a) Strength - opportunity matrix

Weaknesses / Opportunities	Non electrified railway tracks
Grow of container market	0
Dependent on location, strategic location	0
Introduction of a second infrastructure manager	0

(b) Weakness - opportunity matrix

Strentgh / Threats	Block train volume	Flexibility through warehousing facilities	Not dependent on multi-modal or wagonload transport	Suited for dangerous freight
Disruptions due to rail works	0	1	1	0
Lack of European interoperability	0	0	1	0
Increasing unreliability of inland shipping	0	1	0	0
Loss of railway network	0	0	0	1
Rising rail transport costs	1	0	0	1

(c) Strength - threat matrix

Weaknesses / Threaths	Non electrified railway tracks
Disruptions due to rail works	0
Lack of European interoperability	0
Increasing unreliability of inland shipping	0
Loss of railway network	1
Rising rail transport costs	1

(d) Weakness - threat matrix

Figure D.6: TOWS matrices for a company with a type 2 private siding

Strength / Opportunities	Block train volume	Flexibility through volume and warehousing facilities	Dependent on company, flexibility through multiple facilities	Dependent on rail	Suited for dangerous freight
Expansion of the TEN-t network	1	0	0	0	0
Increasing unreliability of inland shipping	0	0	0	0	0

(a) Strength - opportunity matrix

Weaknesses / Opportunities	Non-electrified railway tracks
Expansion of the TEN-t network	0
Increasing unreliability of inland shipping	0

(b) Weakness - opportunity matrix

Strength / Threats	Block train volume	Flexibility through volume and warehousing facilities	Dependent on company, flexibility through multiple facilities	Dependent on rail	Suited for dangerous freight
Disruptions due to rail works	0	1	1	0	0
Rising rail transport costs	1	0	0	1	0
Lack of European interoperability	0	0	0	0	0
Lack of train drivers	0	0	1	0	0
Fixed train paths	0	0	0	0	0
Regulation of dangerous freight	0	0	0	1	0
Bad location of private siding	1	0	0	1	1

(c) Strength - threat matrix

Weaknesses / Threaths	Non-electrified railway tracks
Disruptions due to rail works	0
Rising rail transport costs	1
Lack of European interoperability	0
Lack of train drivers	0
Fixed train paths	0
Regulation of dangerous freight	0
Bad location of private siding	1

(d) Weakness - threat matrix

Figure D.7: TOWS matrices for a company with a type 3 private siding

Strentgh / Opportunities	Direct access to railway network	Suited for dangerous freight
Introduction of a second infrastructure manager	1	0
Increase of military rail transports	0	0

(a) Strength - opportunity matrix

Weaknesses / Opportunities	High infrastructure costs	Only option is wagonload transport	Non electrified railway tracks	Often not dependent on rail
Introduction of a second infrastructure manager	1	1	1	1
Increase of military rail transports	1	0	0	0

(b) Weakness - opportunity matrix

Strentgh / Thre ats	Direct access to railway network	Suited for dangerous freight
Disruptions due to rail works	0	0
Loss of railway network	1	1
Lack of European interoperability	0	0
Rising transport costs	0	1
Distance to strategic rail locations	1	0

(c) Strength - threat matrix

Weaknesses / Threaths	High infrastructure costs	Only option is wagonload transport	Non electrified railway tracks	Often not dependent on rail
Disruptions due to rail works	0	0	1	0
Loss of railway network	0	1	0	1
Lack of European interoperability	0	0	0	0
Rising transport costs	1	1	1	0
Distance to strategic rail locations	0	1	1	0

(d) Weakness - threat matrix

Figure D.8: TOWS matrices for a company with a type 4 private siding

D.2.1. Validation of impact diagram

This section describes how the problems which companies with private sidings encounter impact them. The information is based on the interviews and desk research.

Disruptions due to rail works For all private sidings the disruptions due to rail works is classified as manageable. These

Rising costs of railway undertakings Lack of European interoperability Non-electrified infrastructure Lack of train drivers Crowded marshalling yards Fixed train paths Regulation of dangerous freight Loss of network Locations of private sidings Problems with inland shipping

D.3. Strategies

D.3.1. Strukton Rail Shortline

Strukton Rail Shortline manages private sidings for other companies. You can read more about this in the interview B.2.2.10. The way they handle the infrastructure is very different from the conventional way ProRail does it. It could reduce costs and make operations more efficient. Strukton Rail Shortline is also actively approaching companies to use rail as a modality. This could be an opportunity for many smaller private sidings.

Figure D.9 shows the business model canvas of Strukton Rail Shortline (Strukton). Strukton Rail Shortline is part of the contractor firm Strukton which does a lot of work on railway infrastructure. Strukton rail shortline manages private sidings for companies who do not want to do the maintenance of their rail infrastructure themselves. Strukton can simply do the maintenance in exchange for a fee for the companies, but their preferred method is that Strukton buys the rail infrastructure and leases it back to the company. Strukton is doing this already for 150 private sidings in the Netherlands. Strukton tries to reuse as much materials as possible. For example they buy old sleepers (the wooden/concrete part which keeps the rails together) from ProRail which are still usable in order to keep costs and emissions down. They have also implemented a simpler version of the set of rules and regulations which they use for the private sidings. This lowers the infrastructure standards necessary and thus lowers the costs. Strukton also actively tries to pull companies to the rail and to start using a private siding. This way they try to create clusters of companies using private sidings in order to keep the costs down even further. The contractor also strives to acquire more emplacements such as marshalling yards. They want to apply the same strategy as before to this infrastructure as well in order to lower the parking fees which are relatively high at ProRail emplacements.

The business model canvas shows how the actions described above are put together in the diagram. Altogether Strukton strives to lower the prices by lowering the standards, clustering companies and reusing more materials.

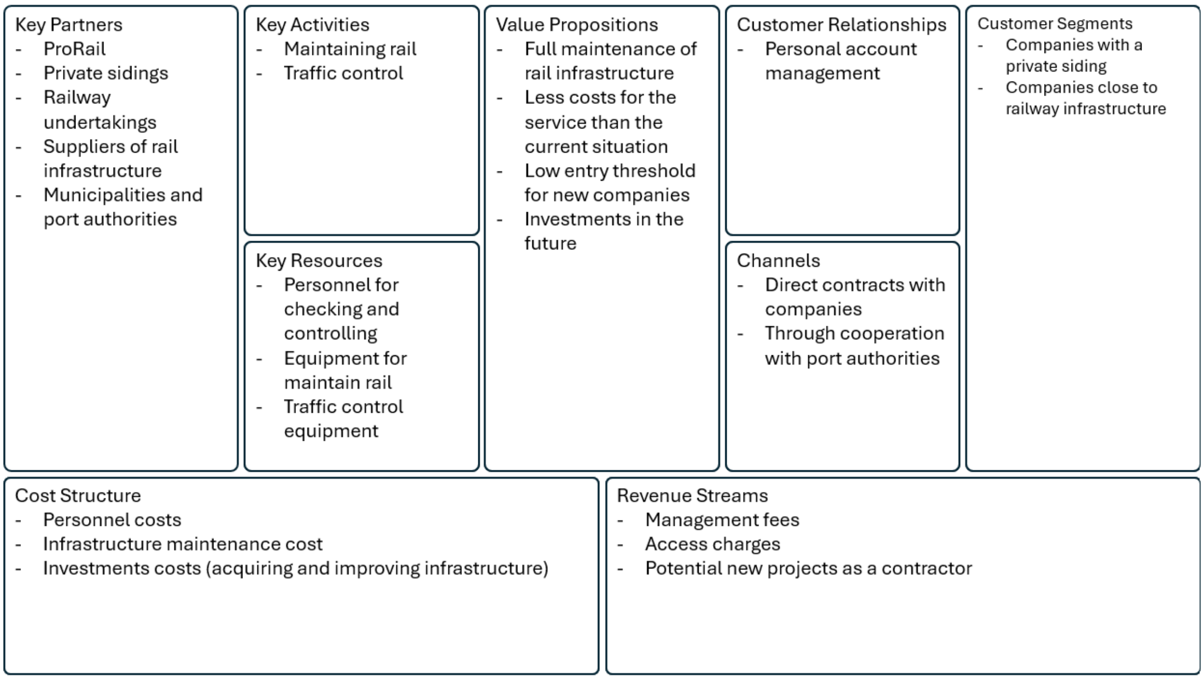


Figure D.9: Osterwalder business model canvas of Strukton Rail Shortline

D.3.2. Lower societal costs of trains.

A frequently cited advantage of rail is its sustainability. Other common themes are its lower societal costs, as trains cause fewer accidents than trucks and less congestion (van Essen et al., 2011). The societal cost of road freight is 6 times higher than that of rail freight. This is mainly due to accidents, air pollution and climate change. Although the external cost advantages of trains compared to fuel trucks are clear. The impact of the introduction of electric trucks could change this. Most of the respondents said that they do not expect electric trucks to change the modal split very much, as rail is so far ahead in electrification and network congestion is becoming more of a problem. This vision is most strongly shared by the railway companies and the port authorities. The private sidings are more nuanced. The current lifecycle emissions of rail transport are around 30 grams of CO_2 equivalent per tonne-kilometre. For diesel trucks, the figure is 119 grams of CO_2 equivalent per tonne-kilometre. Electric trucks produced in 2030 are expected to reduce their emissions to 38 grams of CO_2 equivalent per tkm (Klein et al., 2021). This is likely to change the way people and companies look at the sustainability of rail transport. Even if rail retains some advantage over trucks, companies will see trucks as less of an environmental problem because the perspective of lorries will change. This idea is reinforced by the way private sidings talk about sustainability. For example, private sidings 4 mentioned how they use intermodal trailers for rail transport because it is more sustainable. Finally, intermodal transport also turned out to be slightly cheaper than truck transport alone for this company. Other interviewees stated that sustainability is a nice advantage, but the amount companies are willing to pay for less environmental impact is very limited.

D.3.3. Digital Automatic Coupling.

DAC is seen as a way of improving the efficiency of marshalling operations (Buteel et al., 2024). This could potentially help wagonload traffic. The consensus is that a full implementation of DAC will take a very long time. Some respondents claim that DAC will never be feasible because the cost per wagon is simply too high, while others believe that the price of DAC will fall over time. Overall, DAC is unlikely to have a positive impact on the viability of wagonload transport in the coming years.

D.3.4. Validation of the problem strategies diagram

Then impact, directness, and time horizon of the strategies are primarily grounded in logical reasoning and domain knowledge developed throughout the research. The classification is informed by insights from the interviews, understanding of the rail freight system, and the functional nature of the identified issues.

The placement of each problem is not based on strict empirical measurement, but reflects a qualitative estimation of: the expected change the strategy can make (impact), the extent to which it can influence the problems at the private sidings (directness) and whether the consequences of the strategy will happen in the short or long term (time). The explanation per strategy can be found below:

Use TEN-T as a driving force to improve European interoperability The directness of the influence scores a ”-”. This is because the implementation of TEN-T is one of the many parts that influence European interoperability. On the other hand, the potential impact scores high. This is because if European interoperability is eventually improved, this will have a major impact on many other problems, as has been shown in the problem relationship diagram (5.5). The time it will take for this strategy to work scores low because the change in the European rail market is a long term issue (B.1.0.2).

Clustering infrastructure investment This strategy scores high on immediacy. This is because the clustering of infrastructure is something on which companies have a direct influence. They can actively promote this strategy by approaching their neighbours. The impact is medium because some companies clustering together will not immediately restore the whole network. For this to work, many more companies with private sidings need to push for this strategy. Time is also rated +. This is because this strategy can be implemented relatively quickly compared to the other strategies.

Changing to a second infrastructure manager This strategy scores high on all factors. Companies with private sidings can go directly to the infrastructure manager and ask him to maintain and own the private siding(B.2.2.10). The time to implement this process is also limited. The potential benefits of having an infrastructure manager who also controls the marshalling yards, thereby reducing costs and simplifying regulations, are great (B.3.0.5).

Explore military transport partnerships This strategy has a medium impact, as it is also largely dependent on the military and not just the company with the private siding. The impact is also medium, it can help improve the rail network, but will not change it at its core. The time to do this can be quite short, because there is a lot of focus on the military these days (B.3.0.7). And logistics is important for the military.

Integrating measurement equipment into shared railway infrastructure This strategy scores high on all factors. The impact of a private siding is large because the private siding is part of a cluster that can decide to make these improvements itself. The impact is also large as it can improve marshalling yard capacity by 25% (B.3.0.3). The time required for installation is also limited.

Lobby for regulatory changes This strategy scores low on impact. A company with a private siding has very limited influence on the railway lobby. The best it can do is to join one of the existing initiatives. The potential impact is large, as new regulations or a greater focus on freight transport can solve many of the problems. It will probably take a long time for this to happen.