MAGPiE

SMART GREEN PORTS

D6.5

Report on hinterland hub design for proper road spreading and connection to the last mile

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D6.5 REPORT ON HINTERLAND HUB DESIGN FOR PROPER ROAD SPREADING AND CONNECTION TO THE LAST MILE

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1. Table des matières

1. Executive Summary

MAGPIE project is an international collaboration working on demonstrating technical, operational, and procedural energy supply and digital solutions in a living lab environment to stimulate green, smart and integrated multimodal transport and ensure roll-out through the European Green Port of the Future Master Plan and dissemination and exploitation activities. The consortium, coordinated by the Port of Rotterdam, consists of 3 other ports (DeltaPort, Sines and HAROPA), 9 research institutes and universities, 32 private companies, and 4 other organisations. The project is divided in 10 main work packages which include energy supply chains, digital tools, 10 demonstrators for maritime, inland water, road, and rail transport, non-technological innovations and the development of a Masterplan for European Green ports.

In the ever-evolving landscape of maritime logistics, the Port of Rotterdam embarks on a transformative journey towards a digitally mature and seamlessly integrated port infrastructure. Funded by the visionary MAGPIE initiative, this collaborative effort brings together the expertise of Transport and Logistics Netherlands (TLN), Portbase, and the Port of Rotterdam, aiming to harness the full potential of digitalization in hinterland transport.

As we delve into this report, it is crucial to highlight the pivotal role played by MAGPIE in catalysing innovation and progress within the maritime industry. This project, fuelled by MAGPIE's commitment to advancing technological solutions, is a testament to the collective vision for a future-ready port.

Our focus in this reporting lies on WP6, demo 10 ''Spreading Road Traffic'' the initial milestone achieved – the validation of bottlenecks and needs of market parties concerning digital tools and the understanding of current and anticipated congestion. This crucial first deliverable sets the foundation for a targeted and strategic approach, ensuring that subsequent phases of the project align seamlessly with the identified challenges and opportunities. To spread road traffic, a network of bundling hubs will be developed. Several pilots will be initiated in this project to demonstrate the impact digital tools and bundling hubs on congestion to spread road traffic (demo 10). By spreading the traffic more evenly, less start and stop movements are made, thereby improving the environmental performance.

Join us as we navigate through the complexity of this collaborative venture, shedding light on the insights gained, the objectives set forth, and the promising advancements that lay ahead in our pursuit of a digitally optimized and future-proof Rotterdam port.

2. Introduction

In modern logistics, distributing cargo effectively is crucial for keeping global supply chains running smoothly. As urbanization accelerates and consumer expectations evolve, optimizing truck cargo distribution emerges as a critical challenge, necessitating innovative solutions to alleviate congestion and enhance operational efficiency.

This report investigates the strategic importance of off-peak truck container distribution, emphasizing the necessity for proper road spreading and seamless terminal to warehouse connectivity. While the conventional approach might have been to establish a hinterland hub system, our focus has pivoted towards leveraging off-peak hours (everything outside 18:00 – 06:00) to alleviate congestion and enhance trucking efficiency.

In light of growing urban populations and increasing freight volumes, the adoption of forward-thinking strategies becomes imperative to overcome logistical hurdles foster sustainable transport practices. By exploring the dynamic interplay between off-peak distribution, road network optimization, and terminal to warehouse connectivity, this report aims to provide stakeholders with actionable insights to redefine cargo distribution paradigms.

2.1 Project focus

Through empirical analysis and theoretical frameworks, this report delves into the complexities of off-peak truck container distribution, uncovering opportunities to enhance operational agility and competitive advantage. While the establishment of a hinterland hub system remains a theoretical possibility, our findings underscore the transformative potential if driving more during off-peak hours would optimize truck cargo distribution. Through the disruption of conventional wisdom and the embrace of digitalization and collaboration, the insights provided here aim to drive discussions on truck cargo distribution and potentially willingness of the transport market in the Netherlands to change their distribution towards more off-peak driving for efficiency but maybe also sustainable purposes.

We mainly focus on Dutch transport companies who operate in the Netherlands and drive to the Maasvlakte on a daily basis. This doesn't mean that the actual transport is only regional, these truckers could potentially drive long-distances as well. But we focus on the Maasvlakte area, where the terminals are located and the Haven Industrieel Complex (HIC) area plus 'groot Rotterdam' which is the most important area's outside Rotterdam/HIC. This area would give us a good understanding of the distribution from the Maasvlakte which operates 24/7 and the hinterland which mostly only caters weekdays (Monday – Friday) between 7:00 – 16:00.

Our project's primary focus is in the first place not centred on establishing a hub; rather, it concentrates on promoting the utilization of road transport and persuading market participants to consider driving more during off-peak periods. When we speak of off-peak, it is meant that that period starts as from 6pm till 6am. Thereby we will consider on-peak as from 6am till 6pm. We agreed on this in order to have a clear definition of off-peak driving. While our colleagues, who weren't directly involved in MAGPIE (but some of them are in Demo 9), are actively engaged in developing various hubs, the attention within the Environmental Management department has also turned towards exploring reefer hubs for road transport, among other initiatives. We work closely together with them as we believe that (reefer)hubs in general could potentially also promote off-peak driving, because

drivers could overlap the difference in opening hours between the Maasvlakte and the hinterland when using a hub.

The essence of the regional/reefer hub concept entails transporting containers from the deep-sea terminal to the reefer hub during late evening or nighttime hours and subsequently delivering them upon demand during the day to the importer's warehouse. Additionally, transportation between the hub and the empty depot on the Maasvlakte can be facilitated during nighttime hours. This approach aims to alleviate road and terminal congestion while ensuring the actual transport more efficiency. To establish this connection alongside our efforts to promote off-peak road transport, we await the successful outcomes of the hub projects initiated by our colleagues. Once we have more insights into their progress, we can enhance the integration process. We anticipate providing further details regarding the hubs by the end of Q2, coinciding with the completion of the road transport spreading project. For additional details, please refer to Appendix 1, where you will find comprehensive information about the hubs and their development.

2.2 Problem Indication

2.2.1 Background

Container trucks play a crucial role in the transportation of goods, facilitating supply chains and economic activities globally. However, the current pattern of container truck movements often leads to traffic congestion, increased fuel consumption, environmental pollution, and compromised road safety during peak hours. This issue is exacerbated by the influx of container volumes from larger deep-sea vessels, which puts additional strain on hinterland infrastructure. The pressure on road networks intensifies as more trucks are required to transport goods from ports to distribution centres and beyond. Addressing these challenges requires effective strategies to encourage off-peak driving among container truck operators, as well as investments in multimodal transportation systems to alleviate congestion and reduce environmental impact. By implementing measures such as congestion pricing, flexible delivery schedules, and incentives for off-peak deliveries, stakeholders can optimize the use of existing infrastructure and improve the overall efficiency of container truck operations while minimizing their negative externalities.

2.2.2 Problem Statement

"Too much truck transport during peak hours leads to congestion, environmental degradation, and safety concerns".

The inefficient utilization of off-peak hours by container trucks for transportation activities leads to a range of negative consequences, including congestion, environmental degradation, and safety concerns during peak traffic times. Despite the potential benefits of off-peak driving, such as reduced congestion, lower fuel consumption, and improved air quality, container truck operators often face barriers and disincentives that hinder their ability to adopt off-peak strategies. This suboptimal use of off-peak hours contributes to the following problem:

- **Excessive congestion and traffic disruptions** during peak hours, leading to increased travel times, fuel consumption, and operational costs.
- **Environmental degradation** due to higher emissions of greenhouse gases and air pollutants during peak periods.
- **Safety risks** for both truck operators and other road users, resulting from increased traffic volumes and the potential for accidents.

2.3 Key Challenges

To address the problem of suboptimal off-peak utilization, it is essential to overcome the following key challenges:

1. **Congestion Management:** Container trucks contribute significantly to congestion during peak traffic hours, affecting overall traffic flow, increasing travel times, and impeding the movement of goods.
2. **Environmental Impact:** The concentration of container truck movements during peak hours leads to increased emissions of greenhouse gases, air pollutants, and particulate matter, contributing to climate change, air pollution, and public health concerns.
3. **Road Safety:** High traffic volumes during peak hours increase the risk of accidents and road safety hazards, posing threats to both truck operators and other road users.
4. **Operational Efficiency:** Current operational practices often prioritize time-sensitive deliveries, leading to a reluctance among truck operators to shift towards off-peak driving schedules.
5. **Regulatory and Policy Frameworks:** Existing regulations and policies may not adequately incentivize or support off-peak driving initiatives for container trucks, limiting the effectiveness of potential solutions.
6. **24/7 vs. 9-5 Operations:** The opening hours of warehouses, customs agencies, and other relevant facilities often follow traditional 9-5 schedules, which can limit the flexibility of container truck operators to shift their operations to off-peak hours.

By addressing these challenges, it is possible to improve the efficiency, sustainability, and safety of container truck transportation while reducing the negative impacts of peak traffic congestion.

2.3.1 Goal

The primary objective is to explore leveraging transport for off-peak driving and to create a toolkit for incentivizing and advocating off-peak driving practices among container trucks. Additionally, assist other interested parties in adopting off-peak strategies within their own organizations.

Sub-Goals:
To achieve the primary objective, the following sub-goals have been identified:

1. **Increase the adoption (and also awareness amongst commercial stakeholders) of off-peak driving practices** among container truck operators.
2. **Develop effective incentives and disincentives** to encourage off-peak driving.
3. **Create a toolkit** of best practices and resources for promoting off-peak driving.
4. **Collaborate with stakeholders** to implement off-peak driving strategies.
5. **Measure and evaluate** the effectiveness of off-peak driving initiatives.

These sub-goals directly support the primary objective by focusing on promoting off-peak driving practices, developing incentives, creating a toolkit, fostering collaboration, and measuring outcomes. They address the feedback provided by ensuring that the sub-goals are aligned with the primary objective and focus on leveraging off-peak hours rather than simply reducing the impact of peak-hour traffic.

2.4 Objectives

Based on the goal(s), the following objectives are outlined for the off-peak distribution project:

1. **Reduced Road Congestion**
   - Develop strategies to encourage and facilitate off-peak distribution, aiming to alleviate road congestion during peak traffic hours.
   - Implement initiatives that leverage the reduced traffic at night to enhance the efficiency of cargo truck movements and minimize delays in the transportation of goods.

2. **Reduced Operating Costs**
   - Identify and analyse the operational expenses associated with daytime distribution, including factors such as parking restrictions and loading/unloading limitations.
   - Develop guidelines and recommendations within the toolkit aimed at reducing operating costs for delivery businesses through the adoption of off-peak distribution practices.

3. **Improved Road Safety**
   - Evaluate the potential impact of off-peak distribution on road safety, considering factors such as reduced traffic volume and decreased interaction with pedestrians and cyclists.
   - Integrate safety protocols and best practices into the toolkit to promote safer and more efficient delivery procedures during off-peak hours.

4. **Reduced Environmental Influence**
   - Assess the environmental implications of daytime distribution, including air pollution and greenhouse gas emissions associated with increased traffic.
   - Develop environmentally sustainable strategies and guidelines within the toolkit to minimize the environmental impact of distribution activities through the promotion of off-peak driving practices.

5. **Toolkit Development and Distribution**
   - Collaborate with market players, including truck hauliers, freight forwarders, carriers, terminals, and empty depots, to gather insights and data for toolkit development.
   - Create a toolkit that provides practical guidance, resources, and best practices for implementing off-peak distribution initiatives.
   - Ensure widespread distribution and adoption of the toolkit within the industry to establish a standard for night distribution and promote the adoption of off-peak distribution practices across various market sectors.

By addressing these objectives, the project aims to encourage and facilitate off-peak distribution as a more common practice within the transportation and logistics industry, contributing to reduced congestion, lower operating costs, improved road safety, and minimized environmental impact.

We want to avoid the implication of off-peak distribution becoming a new "peak" during night times. Instead, it focuses on encouraging and facilitating off-peak distribution as a more common, but not necessarily exclusive, practice. This allows for a more balanced approach that addresses the challenges of peak-hour traffic while avoiding the potential pitfalls of creating new peak periods.

2.4.1 Project team:

The project is led by two project managers, each with extensive experience in logistics and transportation management. Together, we oversee the project's strategic direction, stakeholder engagement, and the development of the off-peak distribution toolkit. Our collaborative approach and dedication to innovation are pivotal in driving the project's success, with the goal of establishing off-peak distribution as a standard industry practice. Additionally, a data scientist has joined our team to handle all data-related tasks. Collaborating closely with a dedicated data team, the data scientist ensures smooth operations and occasionally seeks their expertise for insights. In addition, with each pilot, we collaborate closely with market stakeholders to ensure they are fully engaged in the process. By working together, we gain invaluable insights into market trends and data. Through this collaborative approach, we strive to provide the most effective assistance possible to our partners.

3. Demo 10: Spreading Road Traffic

Within this demonstration, the participating ports will demonstrate road spreading measures to better utilise the capacity of existing infrastructure. Limited opening times (both port and hinterland destination), an alternating supply of cargo vessels, traffic congestion/ roadworks, etc. affect the use rate of infrastructure. Instead of further investing in new infrastructure, we aim to develop a sustainable alternative for all stakeholders in the hinterland connection chain. Port of Rotterdam will - with active involvement of relevant stakeholder groups - develop digital tools and technology that provides data insight and predictability for both transport companies and supply chain partners, based on which parties can shift their volumes from peak to off-peak hours. The potential of road traffic spreading on short-haul (first/last mile) and long haul (main leg) operation will be demonstrated. Also, the requirements for port infrastructure, operation and handling to enable road traffic spreading will be defined. Considering multimodal transport chains via ports and other hubs intermodal coordination and transhipment is a key aspect.

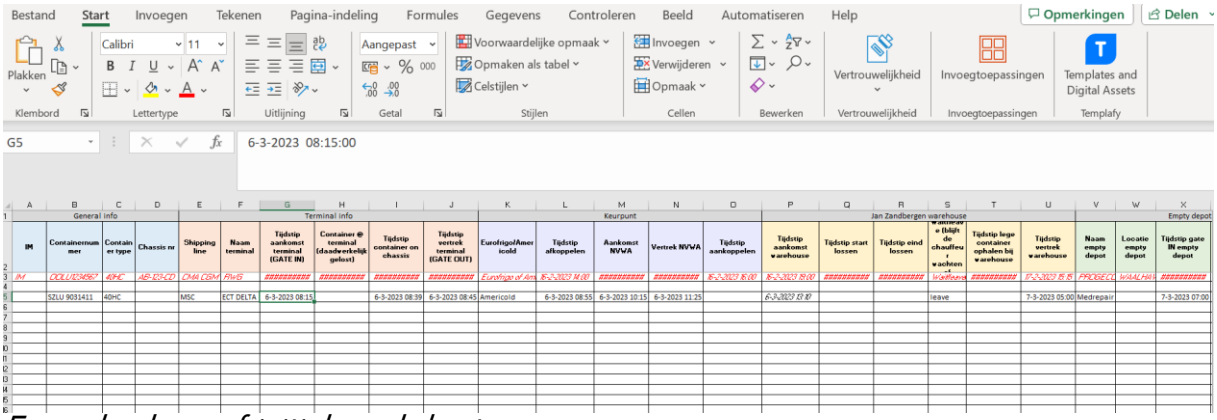
The spreading road project is divided into 2 sub-projects. One of the two projects is called "Port Alert" and deals with developing an app and desktop for carriers, transport companies and terminals to gain better insight into disruptions within the port. The other project is called: "**Off-peak Distribution**". We will focus on this report in the deliverable called: *"Report on hinterland hub design for proper road spreading and connection to the last mile".*

3.1 Off-peak distribution approach

The completion of the initial two pilots marks a significant milestone in our project. The first pilot involved collaborating with a meat importer/transporter based in the eastern region of the Netherlands. We initiated this phase by utilizing an Excel timesheet, which necessitated extensive manual input from the customer, resulting in considerable time consumption. Despite the manual effort, we acquired valuable specific data from over 300 trips. The customer's enthusiastic response underscores the project's potential, with them expressing a commitment to its continuation and potential expansion. The insights gathered, particularly regarding night distribution, have informed rate adjustments and operational enhancements.

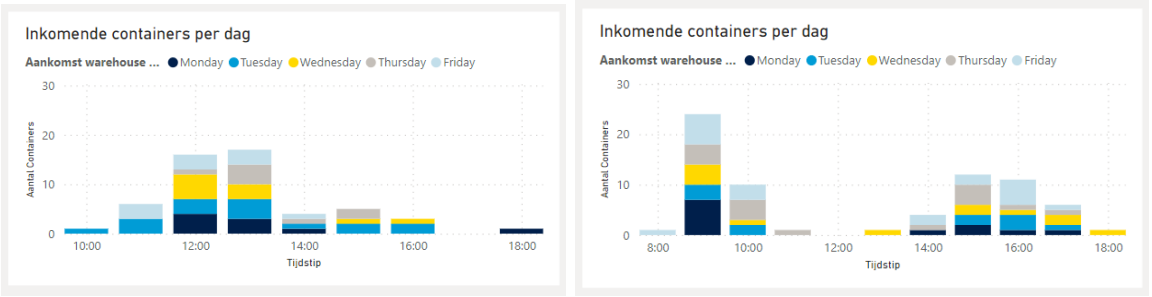
Process steps we have taken:

- Pilot party (meat importer) found us as he heard about the project and wanted to participate.
- We invited them to our office for an initial conversation and introduction to the project.
- They were convinced and wanted to participate, however they needed to inform their third parties (freight forwarder & transport company) as well. As they would also have to provide input.
- We from our side also needed to do the pre-work on creating the Excel columns on which information would have to be filled in to make a good analysis. And we also needed to allocate resources to make the analysis (translate Excel to insights) and create a dashboard for visualisation of the insights.
- We created the excel sheet with prefilled columns and 'fixed fields' to make it as error-prone as possible.



Example above of initial excel sheet.

- We asked the pilot party to fill the Excel sheet for 6 weeks in which they would do their 'regular' peak distribution.
- We would consider this as the 0-measurement.
- And after, to fill it in for another 6 weeks but then including them driving during off-peak hours so we could compare them.
- We took into consideration that the information that needed to be filled in by the pilot party would cater our needs (KPI's we needed to measure) but would also provide information which was more useful for them (win-win situation).
- An interesting insight we saw is that the delivery time to their warehouse was significantly different:



In above graphs you can see on the left that the containers would normally arrive at a peak during lunch hour at their warehouse because pick up of the container from the terminal would take place in the morning during 6:00-7:00, followed by an inspection (which is obligated for all meat imports) which costs approximately 2,5 hours on average so between 8:00-10:00 and the driving distance to their warehouse could run up to 2 hours. But during the off-peak pilot it is more spread with a morning start, regular 'break' during lunch followed by a delivery over the afternoon. Which gives the employees at the warehouse a less 'heavy peak' workload in the morning. And 2 containers could be delivered on 1 day instead of 1 during the afternoon. The insight here is that if the transport company picks up the container during off-peak hours between 04:00 – 06:00 from the terminal, they could be the 'first ones' for inspection and take off around 07:00 – 08:00, to arrive at the warehouse around 9:00 –10:00 which you can clearly see in the graph. By doing this the transport company could also do an extra round trip and take an empty container back to the terminal/empty depot after finishing at the warehouse and pick up another container, go for the last inspection round which ends at 13:00 and bring it to the warehouse in the afternoon around 15:00 – 16:00.

Openings hours of the different locations is crucial in above graph:

- Terminals 24/7
- Inspection location Monday to Friday 7:00 15:00 (last inspection possible around 13:00)
- Empty depot (differs per location but mostly around 7:00 – 15:00)
- Warehouse 07:30 – 18:30 (for loading/unloading)

After rounding up above pilot, another pilot party presented itself and we successfully concluded our second pilot project, which centred around an importer/transporter specializing in the importation of fresh goods, notably fruits and vegetables. This company is situated in the esteemed agricultural region known as 'the Westland' in South-Holland. This pilot party was already driving a lot off-peak so it was not our goal to potentially convince them with the data to increase their off-peak driving but more to provide them with insights and learn from their way of working so we could use this knowledge for the overall transport market.

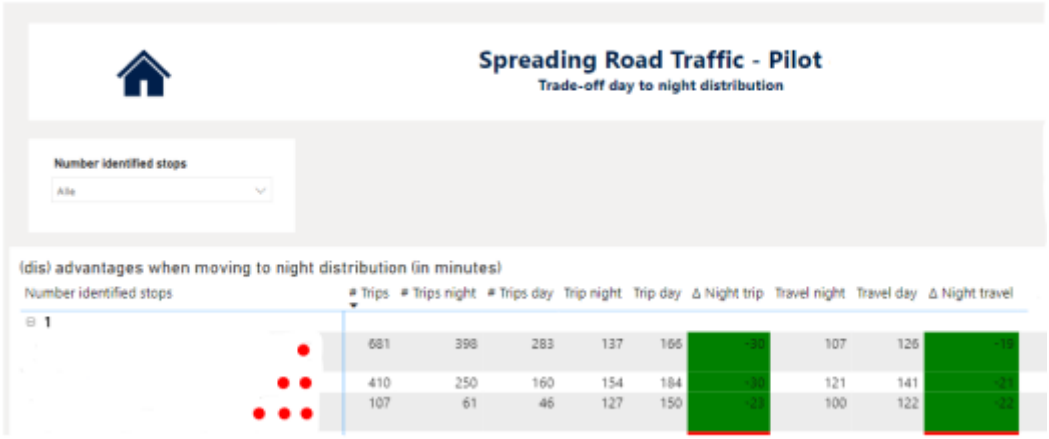
Drawing from the insights gained in our previous pilot, where manual data entry into Excel proved arduous and time-consuming, we embraced a novel strategy. Recognizing the inefficiency inherent in manual data entry, we embarked on a quest for a more streamlined method of data collection. Our solution was innovative: we leveraged board computer data from the trucks utilized by transport companies. These board computers interface seamlessly with the tachograph, capturing invaluable trip data such as timestamps and truck coordinates. This rich dataset served as the basis for our analytical process.

Our data team carefully converts raw data into a polished format using custom scripts, seamlessly adding it to our PowerBI dashboard. This dashboard empowers us to comprehensively dissect and analyse truck trips. Moreover, we extend this functionality to our clients, granting them access to the PowerBI dashboard. This access enables them to compare trips, evaluate peak and off-peak driving times, and glean valuable insights into their operations. In this second pilot, we meticulously analysed the data and presented it through PowerBI. We have now received over 3,000 trips spanning a 1.5-year period (2022 – 2023), a significant increase compared to the 132 trips in our previous pilot. Given that this data comprises board computer data, the additional pilot parties were able to provide it efficiently by running a query directly from their system. This method proves less time-consuming, more accurate, and less prone to errors.

We are currently in the process of translating this data into the PowerBI dashboard to align with the key performance indicators (KPIs) we intend to measure. The graph below illustrates the average transit time a truck spends at one of the container terminals in Rotterdam and moving to the second pilot party's warehouse. The disparity between day and night does stand out. As you can see that by analysing differences across terminals and there is a discrepancy in average transit time between night and day.

To conduct this analysis, we enlisted the expertise of another data scientist on our team, specializing in geo-fence data. He possesses the proficiency to translate this data into a PowerBI dashboard format alike to the data we received from the first pilot party (where we received the manual data.

Everything you see above is the trade-off night distribution from the second pilot party (the fruit importer). Dots were put in front of each line as these represent different terminals at the Maasvlakte where the pilot party drove from or towards. Names are not included because it needs to be anonymized.



- One dot: the difference in minutes for a trip during off-peak instead of peak hours is 30 minutes faster. The difference in minutes for a night travel during off-peak instead of during peak hours is 19 minutes faster. These averages were measured over 681 trips that have been done to this 'first terminal'.
- Two dots: the difference in minutes for a trip during off-peak instead of peak hours is 30 minutes faster. The difference in minutes for a night travel during off-peak instead of during peak hours is 21 minutes faster. These averages were measured over 410 trips that have been done to this 'second terminal'.
- Three dots: the difference in minutes for a trip during off-peak instead of peak hours is 23 minutes faster. The difference in minutes for a night travel during off-peak instead of during peak hours is 22 minutes faster. These averages were measured over 107 trips that have been done to this 'third terminal'.

Night trip = a trip has a starting point and an end point and the whole trip was measured. For example, start trip, terminal 1 pickup container, driving to warehouse unloading, driving back to terminal 1 to discharge container, end of trip.

Night travel = travel time means actually driving. So, with board computer data we can distinguish if a driver is actually driving, is resting, stands in a traffic jam, or has a break. This does not reflect all board computers, some are more detailed than others. But the pilot party itself wanted to know how many minutes his fleet was 'actually driving' so we collected this that and incorporated it into the above graph.

We have expanded our reach by engaging the board computer supplier of our initial customer, which has led to the acquisition of additional clients. We are currently in discussions with them to share data, a process that is ongoing. In tandem, our collaboration with Port Alert, another deliverable (6.5) the *Barometer*, involves requesting board computer data from various task force members and carriers.

Description of the barometer (deliverable 6.5): The Barometer within the Port Alert app is an essential tool for both drivers and planners. It provides valuable insights into the turnaround times at terminals and the congestion on the last few kilometres to terminals. The barometer uses data obtained through the Fleet Management System (FMS) from various carriers. By sharing this data, carriers receive a detailed overview of traffic congestion and operational efficiency within the Port of Rotterdam.

Purpose of the barometer: The purpose of the Barometer is to provide carriers with up-to-date and accurate information about the operational conditions in the port. By offering insights into the Truck Turn Around Time and congestion on access routes, planners can make better-informed decisions. This helps to reduce waiting times, increase efficiency, and optimize the flow within the port. Consequently, the port becomes safer, as there will be less influx when a planner or driver knows that a certain area is congested. This may also reduce the number of rear-end collisions. Additionally, the Barometer enables drivers to better prepare for their trips, allowing them to optimize their routes and arrival times. The ultimate goal is to achieve a smoother and more predictable logistics chain within the port, saving both time and costs for all parties involved.

We have forged partnerships with many of these entities to encourage data sharing, leveraging the similar format required by Port Alert. Recently, we have received this data and tasked our data scientists and analysts with its analysis and integration into the dashboard. Our findings indicate that driving during off-peak hours is more efficient than during the day, as illustrated in the appended dashboards. We aim to enrich these insights by incorporating data from additional partners, marking just the initial phase of our endeavour.

We are excited to reveal that we currently have 10 pilots underway. Two have been successfully completed as previously described, with four in progress and the remainder slated for completion in Q2 of 2024. Working closely with our data science team, we've scheduled a full sprint in the third-to-last weeks of March dedicated to data collection and scripting for integration into the PowerBI dashboard.

4. Implementation Phases and Progress Report

4.1 Findings so far

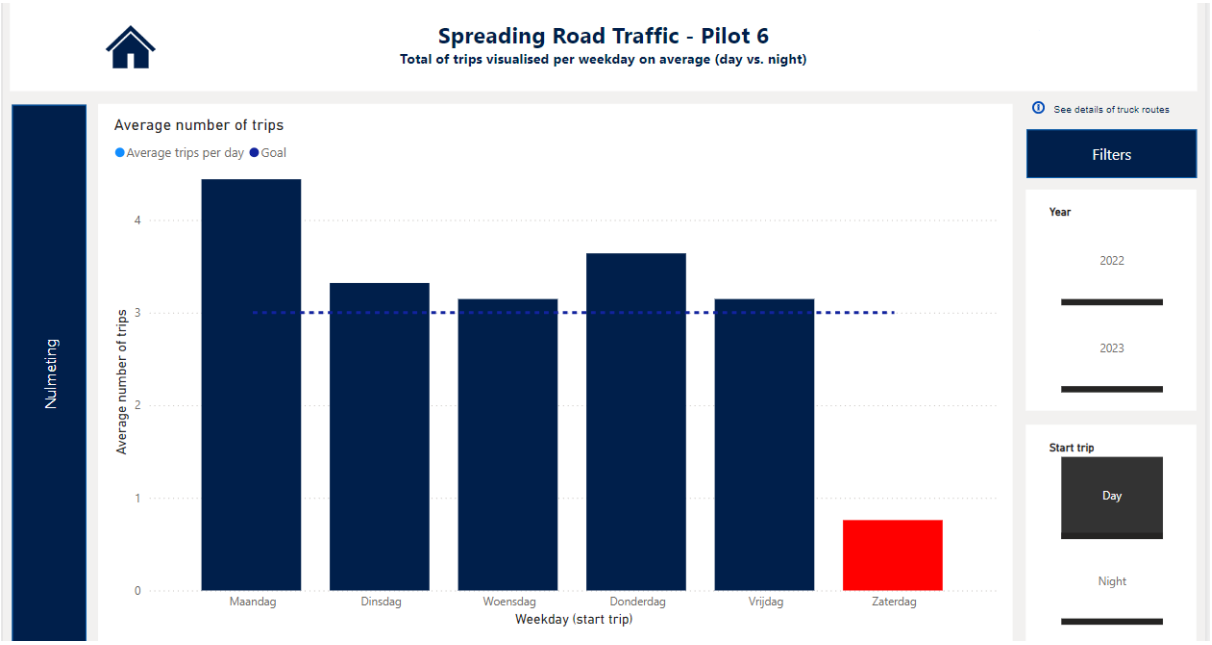
Based on our comprehensive analysis with the PowerBI dashboard with the data collected from our pilot projects, several significant findings have emerged. For the first pilot parties we made an PowerBI dashboard with basic a basic data format. It contains Excel data that we put into graphs to see the difference between off-peak and peak times.

Firstly, based on our initial pilot studies, we can tentatively conclude that there is an average reduction of around 10 minutes in travel time during off-peak hours. This nuanced observation suggests that there exists a window of opportunity to optimize operations during periods of lower activity, thereby potentially reducing overall transit times and enhancing operational efficiency. We think this 10 minutes decrease in travel time mainly has to do with a faster Truck Turn Around time at the terminal. So, containers are discharged or loaded faster during off-peak hours at the terminals because its less busy at that time.

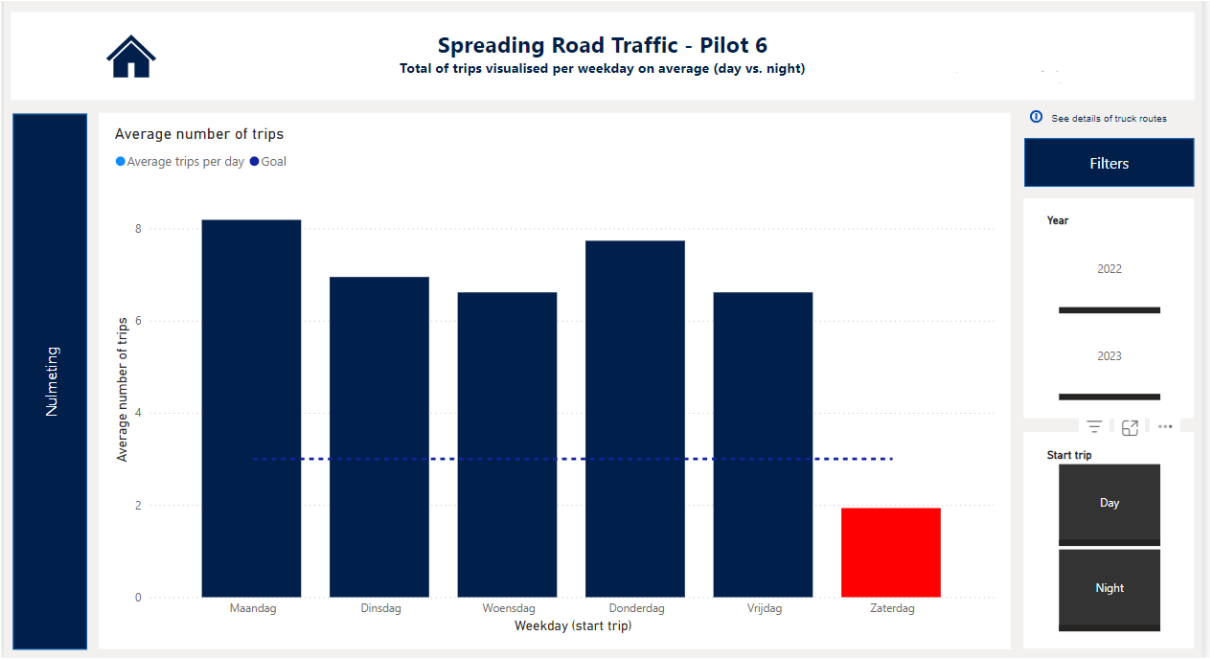
A second finding we thought is worth mentioning is that for the way forward we need to make use of more board computer data instead of excel sheet formats. The board computer data can be easily shared by pilot parties willing to participate and doesn't require manual work. The data itself is also very detailed and can answer our main KPI's.

A third finding we discovered from the second pilot party is that he sometimes makes use of 2 drivers in 1 one truck to maximise the usage of the truck (driving a full 24 hrs). This increases the number of trips per day to, it now being 1 - 3 trips during peak hours (insight collected from the market) to 5 – 8 trips during the full day – 24hrs (this would be incl. the day trips of course to represent the 24hrs). As you can see in below graphs.

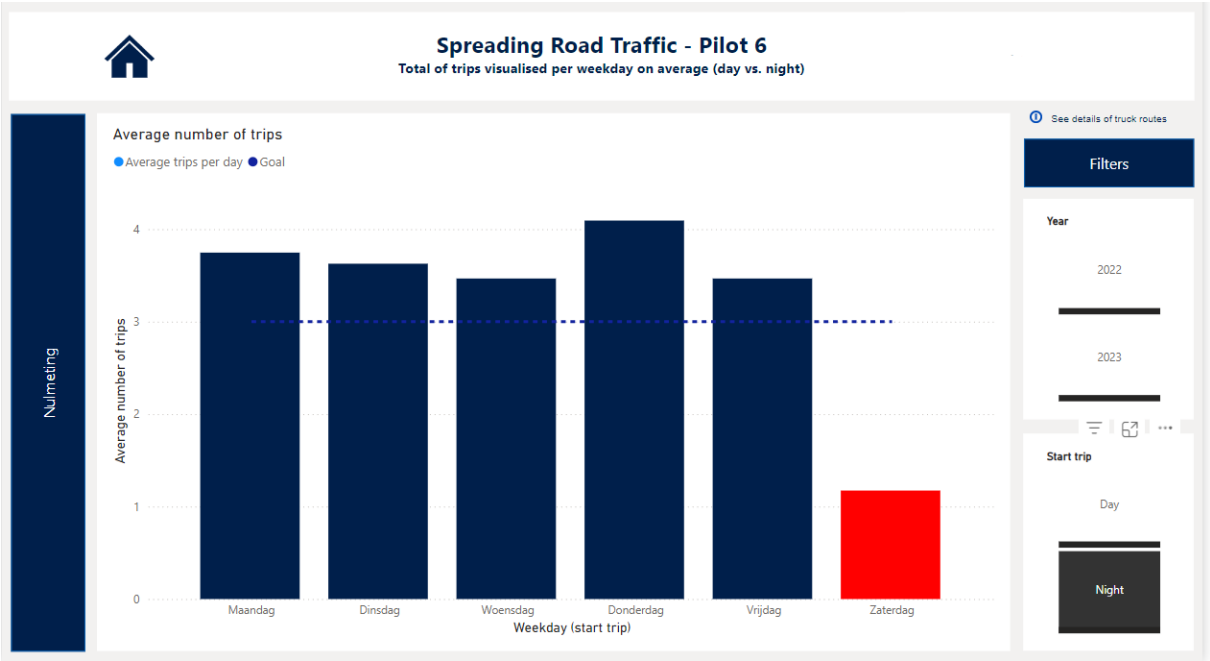
Day time:



Night time (incl. day trips):



Night time (individually):



Not every transport company has the resources to do this, but it could be an argument to launch a campaign to attract more drivers and increase their wages for example so the work itself becomes more attractive. There should of course also be willingness of drivers to actually work during the night. This would also require planners to work during off-peak hours, as they are the backbone of the drivers and the fleet and are needed when something goes wrong.

Another critical takeaway from our analysis pertains to the importance of having a sufficient number of trips to draw accurate and meaningful conclusions. So not only more

pilot parties, but pilot parties with significant amount of trips. This ample sample size not only allows for a more comprehensive understanding of trends and patterns but also enables us to derive actionable insights with a higher degree of confidence.

When we started receiving board computer data from our clients, we could make a more comprehensive dashboard, with extended data. From this board computer we received: coordinates, longitude, latitude and the heading. Together with our data team we plotted this data insert into a refreshed dashboard which gave us a more extended overview of off-peak driving.

Based on 2.9 million trips in 2022 and 2023, 23.6% of the rides are already off-peak. This exceeded our expectations, as we aimed for 20% off-peak rides. Currently, our road team is analysing the data to determine the current percentage and whether there is potential for growth to increase this figure, or if this is the maximum we can achieve with the current container volumes.

We have also examined the differences between off-peak and on-peak rides. Unfortunately, we do not yet have the validated data, as there are still some bugs (excesses) affecting the accuracy of these numbers. Work is underway to resolve this.

We have already presented these results to our clients, the transport companies, and they were pleasantly surprised. Some had an idea that their percentage would be this high, while others did not. Some indicated that these insights serve as an incentive to increase off-peak rides. However, others expressed several challenges they are still facing, including:

- A lack of night planners to assist if issues arise during the night period
- A shortage of night drivers
- Higher personnel costs for night drivers
- Distribution centres and clients are not operational during off-peak hours

We will take this feedback into account as the project progresses. However, we want to emphasize that we cannot solve all problems. We need to start somewhere, and we have done so by making these off-peak times transparent.

In summary, our analysis has shed light on several key insights that hold implications for both operational optimization and strategic off-peak driving decision-making. Which lead to an off-peak driving percentage of 23,6% already. By leveraging these findings, we are confident to drive meaningful improvements in port logistics, ultimately enhancing the efficiency, resilience, and sustainability of maritime operations.

4.2 Validation of Market Needs

Market validation is essential for our ongoing efforts. Through rigorous analysis and interpretation of the data collected from our pilot projects, we seek not only to understand operational efficiencies but also to validate our solutions within the broader market context. Engaging with stakeholders and industry experts, we assess the alignment of our offerings with market needs and demands. Through iterative refinement and validation, we ensure that our solutions resonate with the market, driving sustainable growth and fostering long-term partnerships. Together with involved stakeholders like internal colleagues from road related projects, and TLN (Transport Logistiek Nederland) we make sure to challenge our project and findings to make sure that the market will adapt to it. Because market validation not only validates the efficacy of our solutions but also guides our strategic direction, ensuring that we remain agile and responsive to evolving market dynamics.

4.3 Demo Phase (M10 - M15)

As we transition from the successful completion of our second pilot, we are excited to commence to a more extensive and ambitious phase. Building on the insights gleaned and lessons learned on the previous pilots, like the data analysis needs to come from board computer data. The data itself needs to be from a significant period – at least 1,5 to 2

years to make a proper analysis. And we need a variety of 'different transport companies'. So the fact that we now had a meat importer and a fruit importer/transporter which were both located in different regions in the Netherlands, is already a good variation but we would need even more variety to broaden or regional scope. We are currently embarking on eight additional pilots aimed at further refining and expanding our solutions. This next phase represents a significant stride towards comprehensive market integration. These new pilots show our dedication to getting better and help us provide custom solutions for our clients' diverse needs.

How will we embark these new pilot parties? Hereby a summarised approach:

- Engage & inform them why we think this is relevant and if they would be willing to share their data with us to measure our KPI's (we will be transparent about this). Probably via a Teams call or by visiting them.
- Engage TLN in the process as these parties are their members as well and we would like to hear but also validate our process with them. Are we going in the right direction? Is this also something they believe in? TLN really needs to become an ally of the project.
- We will focus on matching the current KPI's into a PowerBI dashboard where the board computer data serves as the 'raw data'.
- We would need a dedicated data scientist/data analyst to conclude the analysis, build a sold 'board computer script' and create the visualisations in PowerBI.
- We would like the dashboards to at first be on individual basis, because we want to share them with the pilot parties individually. However, for the long run all data should be aggregated and anonymized and 5 –8 main KPI's should serve as a 'front page insights.
- We will tackle this by dividing the work between Celeste & Liselotte, where Celeste will focus on the pilot parties' engagement/stakeholder management and the actual dashboard. Also regularly informing them about the status and potentially even visiting them to ask additional questions or already share some insights. Liselotte will then focus more on the background to allocate resources and make sure we will create a uniform script where the board computer could land. Liselotte will also be responsible for the engagement of TLN and making sure they are up to date.

4.4 Hub-design

Looking at the hub design aspect of this deliverable, a separate working group has been established together with other colleagues from the Port of Rotterdam.

Within the project for optimising road transport, we are examining how hub functions in the hinterland can alleviate congestion pressure (in the Port of Rotterdam and the hinterland), in combination with smarter deployment of road transport in terms of space and time. By shifting daytime trips on weekdays to nighttime and weekends (avoiding peak hours), we aim for higher logistical reliability, a reduction in container truck volume during peak hours on weekdays, and sustainability where possible.

In 2024, a pilot project with a regional hub was conducted in collaboration with transport company Vepco in Moerdijk for six months, utilizing data from the TMS and onboard computers to gain insights. During these six months, it was found that the container volume between Maasvlakte and Moerdijk could be significantly shifted; from approximately 20% during nighttime/weekend to 45-50%. Additionally, the number of trips per shift increased, while the number of trips without a container (referred to as "flat running") decreased. A preliminary conclusion suggests that a regional hub can help mitigate further congestion without negatively impacting operations. However, additional research is needed to

demonstrate a positive business case. The results also prompted consideration of whether the use of a super eco-combi could further enhance the logistical efficiency of a hub. Vepco is willing to collaborate on this.

- In Nieuw Reijerwaard (Ridderkerk-Barendrecht), a temporary reefer hub was opened in July 2024, operated by the company DLG-Logistics in partnership with another party. While the pilot in Moerdijk aimed to serve a larger region with a regional hub, this reefer hub is intended to function locally. DLG-Logistics was already indirectly involved in the Moerdijk pilot and is now willing to contribute data.

Given the above, the proposal for this side project is to continue the pilot in an adjusted form in the first half of 2025. Insights to be gained include:

- The added value of operating during nighttime and weekends for carriers

- The business case for a hub

- Characteristics and differences between a regional hub and a hub with a local function

- The added value of a super eco-combi in combination with a hub

- How and to what extent a hub can reduce flat running

- Insights into hubs and spreading road traffic

4.5 CO2 emissions on spreading road traffic

Currently, discussions are ongoing with WP4 and an external party to explore the CO2 aspect of off-peak driving. We have expressed our desire to understand the difference between off-peak and on-peak driving, so we can clearly see the difference in emissions. We hope to demonstrate that off-peak driving also positively contributes to CO2 reduction. In the coming period, we will continue these discussions.

4.6 Challenges and Opportunities

Our project has been a journey marked by successes and challenges alike. Let's delve into the key obstacles we've encountered:

Initially, generating excitement among market parties proved to be quite a task. Because sometimes the reputation of the Port of Rotterdam in general plays a role. They think we are only here to serve our 'paying customers' which are the deep-sea carriers and deep-sea terminals in their eyes. And they are doubtful if sharing their data would also be for their interest. Sometimes they also don't want to make other transport companies smarter because it can be very competitive field, they operate it. We really need to convince them that this is a win-win situation. And with the future challenges ahead on growing volumes and infrastructural maintenance, something needs to change otherwise the whole supply chain will, sooner or later, get stuck. However, thanks to the Road Transport Sector Consultation (Sectoroverleg Wegvervoer) organized by the Port Authority, the tide began to turn. During these consultations, concerns about traffic congestion, terminal overcrowding, scheduled time slots, and road safety were introduced by industry players. Our project emerged as a potential solution to these pressing issues, linking their interest and driving engagement.

Extracting data from the Port Alert application posed significant challenges. The process was hindered by the sheer volume of data, leading to delays in procedures. Our dedicated team of data scientists worked tirelessly to streamline the data extraction process and

develop compatible formats for integration with our PowerBI system. This process required patience and perseverance as we navigated through technical complexities.

Besides facing challenges in extracting data, we also encountered obstacles due to staffing constraints. The team at Port Alert had their plates full of existing tasks, making it challenging to allocate time for collaboration with Spreading Road.

Despite these obstacles, we remain committed to growth and innovation. By addressing market needs, refining technical processes, and fostering collaboration, we are committed to overcome challenges and drive our project forward. Our dedication ensures that we continue to make meaningful strides towards success in our project.

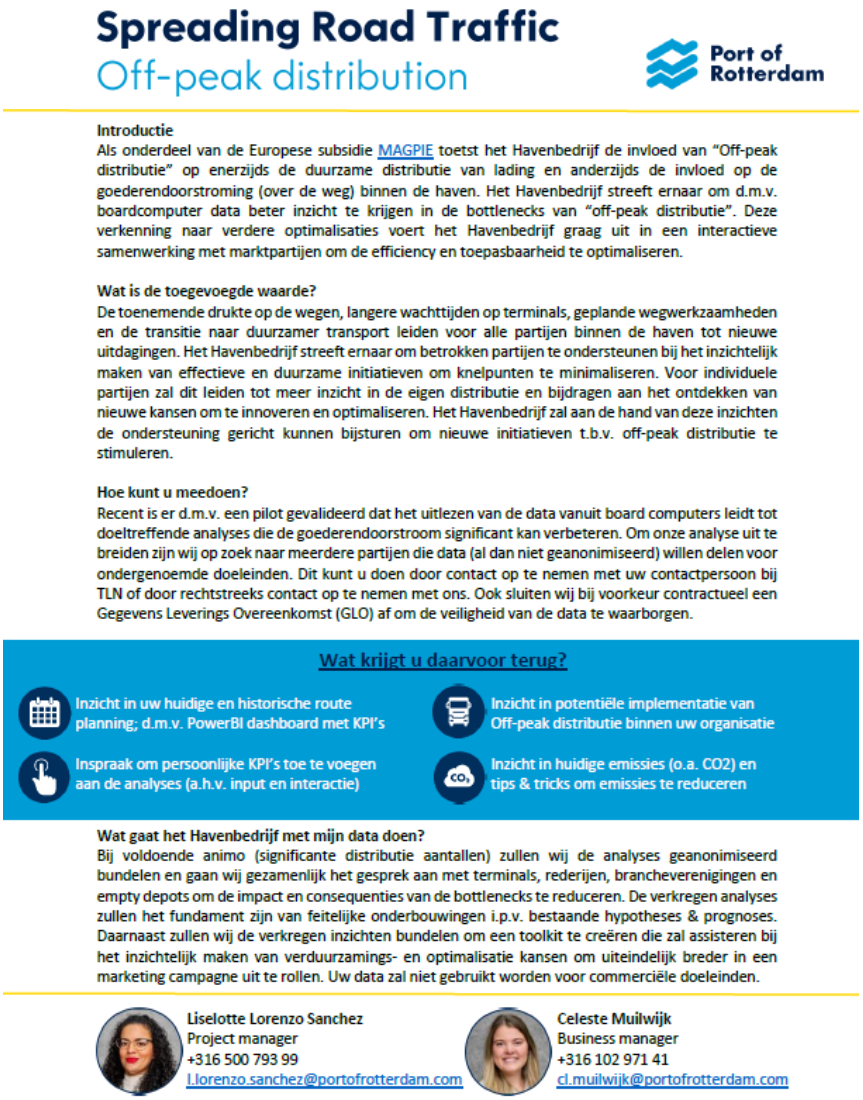
4.7 Lessons learned

The valuable lesson we have learned is the importance of adopting a more intelligent approach, specifically by extracting and analysing board computer data through the dashboard. Applying this method with subsequent clients, we've integrated the data received from this particular customer into a dashboard, offering them real-time insights into the performance of their transports. As project managers, we've acquired valuable initial insights into the client's daily journeys, allowing us to make initial comparisons between daytime and nighttime operations. Preliminary findings suggest that terminals operate approximately 10 minutes faster during the night. To validate these observations, we aim to conduct further pilots and confirm these initial conclusions.

4.8 Next Steps and Future Outlook

As previously outlined, our objective is to finalize all 11 pilots within the upcoming timeframe, ideally wrapping up before Q2 2025. Given the scale of our project, which is relatively modest, and the considerable progress achieved thus far, we anticipate a smooth replication of the methodology employed in the initial 2 pilots across the remaining ones.

Our overarching objective is to develop a comprehensive toolkit. This toolkit will set a standard for market participants seeking to integrate Spreading Road Traffic / Off-Peak Distribution into their operational frameworks with a detailed action plan. This idea arose from the fact that if there will be room to improve or increase off-peak distribution, we would need to convince other market parties to change their way-of-working. For the toolkit we would mainly focus the transport companies because they are our main target group, so together with TLN we thought to create an easy one-pager 'Toolkit' with tips & tricks to either start driving off-peak or drive more off-peak and why it is important. Somewhat similar to the look & feel of below one-pager we created to convince pilot parties to join the project:



Spreading Road Traffic
Off-peak distribution

Port of Rotterdam

Introductie
Als onderdeel van de Europese subsidie MAGPIE toetst het Havenbedrijf de invloed van "Off-peak distributie" op enerzijds de duurzame distributie van lading en anderzijds de invloed op de goederendoorstroming (over de weg) binnen de haven. Het Havenbedrijf streeft ernaar om d.m.v. boardcomputer data beter inzicht te krijgen in de bottlenecks van "off-peak distributie". Deze verkenning naar verdere optimalisaties voert het Havenbedrijf graag uit in een interactieve samenwerking met marktpartijen om de efficiency en toepasbaarheid te optimaliseren.

Wat is de toegevoegde waarde?
De toenemende drukte op de wegen, langere wachttijden op terminals, geplande wegwerkzaamheden en de transitie naar duurzamer transport leiden voor alle partijen binnen de haven tot nieuwe uitdagingen. Het Havenbedrijf streeft ernaar om betrokken partijen te ondersteunen bij het inzichtelijk maken van effectieve en duurzame initiatieven om knelpunten te minimaliseren. Voor individuele partijen zal dit leiden tot meer inzicht in de eigen distributie en bijdragen aan het ontdekken van nieuwe kansen om te innoveren en optimaliseren. Het Havenbedrijf zal aan de hand van deze inzichten de ondersteuning gericht kunnen bijsturen om nieuwe initiatieven t.b.v. off-peak distributie te stimuleren.

Hoe kunt u meedoen?
Recent is er d.m.v. een pilot gevalideerd dat het uitlezen van de data vanuit board computers leidt tot doeltreffende analyses die de goederendoorstroom significant kan verbeteren. Om onze analyse uit te breiden zijn wij op zoek naar meerdere partijen die data (al dan niet geanonimiseerd) willen delen voor ondergenoemde doeleinden. Dit kunt u doen door contact op te nemen met uw contactpersoon bij TLN of door rechtstreeks contact op te nemen met ons. Ook sluiten wij bij voorkeur contractueel een Gegevens Leverings Overeenkomst (GLO) af om de veiligheid van de data te waarborgen.

Wat krijgt u daarvoor terug?

- Inzicht in uw huidige en historische route planning; d.m.v. PowerBI dashboard met KPI's
- Inzicht in potentiële implementatie van Off-peak distributie binnen uw organisatie
- Inspraak om persoonlijke KPI's toe te voegen aan de analyses (a.h.v. input en interactie)
- Inzicht in huidige emissies (o.a. CO2) en tips & tricks om emissies te reduceren

Wat gaat het Havenbedrijf met mijn data doen?
Bij voldoende animo (significante distributie aantallen) zullen wij de analyses geanonimiseerd bundelen en gaan wij gezamenlijk het gesprek aan met terminals, rederijen, brancheverenigingen en empty depots om de impact en consequenties van de bottlenecks te reduceren. De verkregen analyses zullen het fundament zijn van feitelijke onderbouwingen i.p.v. bestaande hypotheses & prognoses. Daarnaast zullen wij de verkregen inzichten bundelen om een toolkit te creëren die zal assisteren bij het inzichtelijk maken van verduurzamings- en optimalisatie kansen om uiteindelijk breder in een marketing campagne uit te rollen. Uw data zal niet gebruikt worden voor commerciële doeleinden.

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There's a growing inclination among market players to explore these methods. By the conclusion of the project, targeted for around Q3 2024, we aim to finalize the toolkit and craft our conclusive report for MAGPIE. Additionally, we aspire to ensure scalability within the project, enabling other MAGPIE-affiliated ports to adopt and enact this concept within their operations. We are mindful of the unique dynamics of smaller ports and their respective markets throughout our project.

5. Conclusion

In conclusion, our in-depth analysis of the data collected from our pilot projects has provided several significant findings that hold promise for enhancing operational efficiency and strategic decision-making. Notably, we observed a tangible reduction in waiting times at the terminal during off-peak hours, suggesting a potential avenue for optimizing operations and reducing overall transit times. In addition to our primary focus on spreading road traffic during off-peak hours, the focus is not on reporting on hinterland hub design. Due to the evolution of the project scope and shifts in market perspectives regarding the issue and problem definition, we have decided to centre our focus and emphasise more on the spreading road part. By incorporating insights from our pilot studies and market analysis, this report aims to provide actionable guidance for stakeholders involved in infrastructure planning and development. Thus, it complements our efforts to promote effective road spreading practices and improve overall transportation efficiency within the hinterland network.

Our aim is to ensure the scalability of our project, enabling broader industry adoption and impact while considering the unique dynamics of smaller ports and their markets. Through continued collaboration and innovation, we are poised to drive meaningful improvements in port logistics, fostering efficiency, resilience, and sustainability in maritime operations.