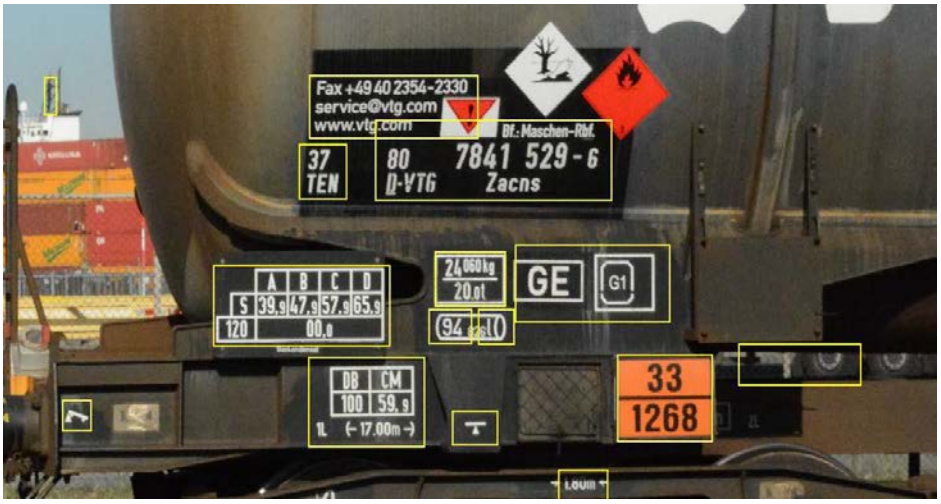
## Market consultation

# Smart camera wagonnumber and GEVI-sign recognition

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ProRail

# Table of Contents

# 1 Wanted: smart camera's for freight train recognition

ProRail is in cooperation with Port of Moerdijk planning for doing a proof of concept (PoC) with smart cameras. The goal is to demonstrate that it is possible to reliably recognize which freight train (Loc+wagon numbers) is passed and which freight wagons are loaded with dangerous goods (GEVI numbers). If so which type of dangerous goods are in the wagons (GEVI code).
(See also https://nl.wikipedia.org/wiki/Gevaarsidentificatienummer )

In order to prepare for the intended proof of concept, ProRail wants to identify which suitable smart camera's with recognition software are available in the market and what the costs are. (*note: where further in this document is stated "smart camera" then the complete system with hardware (camera), recognition software and other components is meant*)

In order to be able to determine, as a supplier, whether the smart cameras to be delivered are suitable, this document provides a brief explanation of the test to be carried out and lists the requirements set by ProRail.

If you can deliver a suitable product (with price indication), ProRail would like to know.

## 1.1 ProRail

ProRail B.V. is responsible for the railway network of the Netherlands: construction, maintenance, management and safety. Employees ensure that every day, 24/7, 1,200,000 travellers and 100,000 tons of goods arrive at their destination, with 6550 trains on 7,000 kilometre track. The railway network is the beating heart of the mobile Netherlands.
ProRail is working on the accessibility of the Netherlands by ensuring an optimal rail network. We distribute capacity on the track, arrange all train traffic, build and manage stations and create new track. ProRail also maintains existing infrastructure such as rail, points, signal and road crossings.

## 1.2 Port of Moerdijk

Port of Moerdijk is the fourth biggest see harbour of the Netherlands. At this harbour and industrial area more than 430 companies have their business. These are large chemical plants, logistics services companies and companies in the manufacturing industry.
With no less than four transport modalities at their disposal, they reach the whole world from Moerdijk. Thanks to the available combination of available space, industry and the ideal location on sea and inland water, the port and industrial area offers plenty of opportunities for further growth. It is an important economic driver for the region and directly and indirectly provides employment for around 18,000 people. The Moerdijk Port Authority organizes the process of development, design, construction, distribution, operation, management and expansion of the port and industrial area. It consists of a team of 30 highly motivated people who together manage and further develop the port and industrial estate.

## 1.3 Registration of freight trains with dangerous goods on railway yards

There are 26 railway yards in the Dutch railway network where freight wagons with dangerous goods can be found. One of these railway yards is the track on the Moerdijk harbor area.

In 2014, ProRail, together with various rail freight operators, developed and implemented the program 'Dangerous Goods Information' (IGS), the mobile application 'Digital Shunting Assistant' (DRA) and the

Wagon Load Information System (W-LIS). The value of the W-LIS and the DRA consists of removing 'blind spots' on railway yards or better knowing which freight wagons contain dangerous goods, where and when.

The application provides a complete and up-to-date overview of which trains with which loads are on the track. In this case, emergency services have immediate insight into the location and contents of vehicles in the event of a calamity. With the introduction of W-LIS, the rail sector meets the legal obligation to deliver timely, complete and accurate information within 15 minutes on vehicles with dangerous goods on railway yards. The mostly manual input into W-LIS requires a continuous deployment of people and resources from carriers and ProRail and has a high risk of false registration

With new technology, such as Smart Cameras, it may be possible to accurately determine which trains have been driven to and left the yard with which wagons and cargo. For this reason, ProRail wants to do tests on the Moerdijk railway yard.

In addition, the registration of vehicles with Smart Cameras makes it possible to store these images in a database where the date and time are recorded. On the basis of this, later analyzes of passed load quantities and vehicle conditions can take place. The car images can also be provided to carriers, car owners and shippers for other purposes (for example, for maintenance purposes or recording damage).

Smart Cameras are now available for multiple purposes. Unfortunately, we havenot seen an application with reliable "near real-time" number recognition (see figure 1) in a railway environment, where freight wagons can pass at 0-120 km / h, all communication must be wireless, and where maintenance must be planned at least a month in advance.


Figure 1: Example of (car) number recognition using a smart camera. The actual car number always consists of 12 digits and in this case is 33 81 7836 253 3.
See also https://nl.wikipedia.org/wiki/Rijtuigcodes_van_de_UIC .

## 1.4 Proof of concept

The proof of concept (PoC) is intended to demonstrate that Smart cameras and recognition software can reliably record which vehicles with or without dangerous cargo the relevant area has been driven in or out.

The tracks are located in a so-called non-centrally operated area (NCBG). At NCBG there is currently no information about the positions of the switches and on track assignment. In the NCBG it isn't known which train runs exactly where and in what composition.

The purpose of this test is to gain insight into and build experience with:

1. Different recognition techniques of smart camera's to determine the passage of trains, wagon numbers en GEVI codes;
2. The reliability and accuracy of the registration and recognition of the wagon numbers and GEVI codes under different circumstances (day/night/weather conditions);
3. The feasibility of deploying these smart camera's at locations where there are no physical data connections are;
4. The feasibility of deploying these smart camera's at locations where is no energy supply (this is not an hard condition for the proof of concept);
5. The degree of autonomy of the smart camera's and recognition software.

## 1.5 Concrete interpretation

In the short term, we want to test 1 different technique from 1 supplier at port of Moerdijk. Our view is that there is Commercial of the Shelf (COTS) hardware available with a defined interface that can be used immediately. We therefore believe that smart camera installation in August 2018 must be feasible.

For this test we are looking for suppliers who can supply smart cameras with recognition software that meet the specifications as listed in Appendix 1.

If software development for the smart camera needs to take place for the purpose of this test, this is for the account of the supplier. All by the smart camera recorded train passages and generated data are real-time made available for ProRail and port of Moerdijk and become the ownership of ProRail and port of Moerdijk.

## 1.6 Next steps

In the long term and if the test proves that the smart camera is sufficiently accurate, this solution will be made available for other NCBGs. This test might therefore be followed by a tender for further rollout.

## 2 Procedure for the market consultation

In order to prepare for the intended proof of concept, ProRail wants to identify which suitable smart cameras are available in the market. With this market consultation we expect to get an idea of the available suppliers and to what extent solutions are available that can meet our functional specifications (see appendix 1) and against which price (indication).

ProRail intends to invite a number of parties that respond to this market consultation to make an offer for the delivery of 1 smart camera at each side of the main track that gives access to port of Moerdijk. This for a testing period of one year.

Responses to this market consultation can be sent by e-mail before Wednesday, 25 juni 12:00u to:

Paul Kootwijk
paul.kootwijk@prorail.nl
tel. 06-265 165 89

Your response should at least consist of:

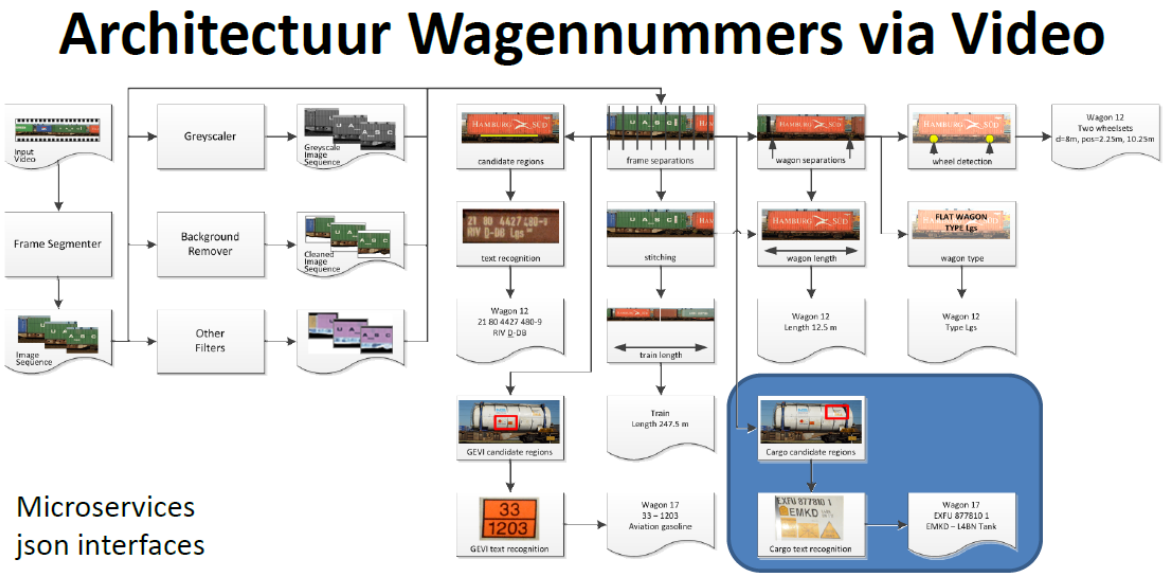
- Contact details
- Product sheet
- An overview showing which requirements and wishes can and cannot be met
- Possible references to application within similar projects.
- Price Indication

ProRail

# Appendix 1: Search direction and basic requirements for the solution

## 2.1 Requirements and wishes regarding the operation of the sensor

F1. REQUIREMENT: Design overview with drawings of the system, system-architecture and outputdata of the camera and the recognised objects to a (for ProRail and port of Moerdijk accessible) database.




*Picture 2: Example of a possible system-architecture and possible outputdata for the recognition of freight wagens.*

F2. REQUIREMENT: The camera images and output data must be available on-line and contain at least the following information:

- Images of the individual cars.
- All individual photos and / or video recordings.
- Recognized objects and text (see F5).

The quality of the photos or videos is such that with the naked eye the numbers on the trains can be read and cars can be recognized. Both by day and night and under the prevailing weather conditions in the

F3. WISH: Delivery of a panorama photo of the entire train (stitched images) of each train passage

F4. REQUIREMENT: The smart camera should autonomously register all train passages (locomotive and cars) and not provide “false positives” (for example, no recordings of a passing truck on the road behind).

F5. REQUIREMENT: Of each registrized train passage the smart camera should send as fast as possible, but at least within 5 minutes, minimal the following information to an on-line database:

- Measurement time
- Driving direction
- Lenght of the train and wagons
- Number of wagons/locomotives en following number in the row.

- For each wagon and following number: identificication of the wagonnumber and the GEVI code.

The registrations are available localy as back-up and become the ownership of ProRail and port of Moerdijk.

F6. REQUIREMENT: The supplier specifies maximum processing time from image recording up to and including sending registered train passage (see F5).

F7. WISH: The smart camera must send the following information to the on-line database as quickly as possible, but always within 5 minutes, from the registered train passage:
- Number of axles per car and axle distance.
- Number of bogies and bogie distance
- Wagentype.
- Loading information other than dangerous goods

F8. REQUIREMENT: The camera must correctly recognize the GEVI numbers in 100% of the cases. For the other information (eg car number), it must be recognized correctly in at least 90% of the cases

F9. REQUIREMENT: Messages that are dropped, sequence changes or message distortions must be detectable.

F10. REQUIREMENT: The Smart Camera must be able to communicate information on availability and reliability to the ProRail maintenance systems (see also F9).

F11. REQUIREMENT: The Smart Camera must be able to give the maintenance organization well in advance that maintenance is required.

F12. REQUIREMENT: The Smart Camera should be able to be placed stand alone at 5 meters from the track on a flat piece of ground in such a way that it does not get in the track or can get in the track caused by (weather) influences from the outside.

F13. WISH: The Smart Camera is battery powered (possibly supplemented with a solar panel).

F14. WISH: The Smart Camera must be able to run autonomously for at least 1 year on this energy source (see F13).

F15. WISH: The replacement of the batteries can be carried out by a ProRail maintenance contractor (see F13).

F16. WISH: Software adjustments on the Smart Camera can also be performed remotely.

F17. WISH: Any configuration adjustments in the Smart Camera can be done remotely.

F18. REQUIREMENT: The performance of the Smart Camera must be guaranteed 24/7, with the recovery time in case of malfunctions occurring after a maximum of 1 working day.

F19. REQUIREMENT: The supplier must describe how to handle (data) security. This describes, among other things, how to prevent unauthorized access to the Smart Camera in order to influence the operation.

F20. WISH: A link can be made with the Genetec Security Center (= new security management system) of the port of Moerdijk

F21. REQUIREMENT: At least the following documentation must be available upon delivery of the smart camera:
- Product sheet with the specifications of the Smart Camera and the communication
- Installation instructions
- Operational management manual

- Interface specification

F22. REQUIREMENT: After 1 year, the Smart Camera can be taken over by ProRail and the port of Moerdijk. The price indication should indicate the costs for 1 year and the additional costs for taking over the Smart Camera after 1 year.

F23. REQUIREMENT: The supplier indicates which customers can be approached for questions and makes demo material available.

F24. WISH: Review on these specifications from the vendor's point of view with any suggestions on the requirements and wishes described above.

## 2.2 Guidelines when using the smart camera on or around the track

All subjects mentioned in 2.2 are requirements (and therefore no WISH) on the smart camera.
For each requirement, it must be proved or made plausible that the smart camera meets this requirement.

### 2.2.1 Attachment to the rail

P1. The smart camera or components are not attached to or between the rails.

### 2.2.2 Placement on or near the rail

P2. The smart camera, incl. Its attachment, is located entirely outside the Profile of Free Space (PVR, see OVS00026).

P3. The smart camera is mounted in such a way that it can never move in such a way that it comes within PVR, and dimensions, weight and mechanical strength of the smart camera are such that in the event it does get inside PVR, there is no danger of train traffic. One can think of:

1. Strength fastening construction
2. Influence of environmental conditions (weather conditions, vibrations, air displacement / pressure differences in tunnels, vandalism)
3. Incorrect assembly (Include correct assembly method in installation instructions)

### 2.2.3 Access to the yard

P4. Placement on / nearby the railway may only take place after written permission from ProRail and under the supervision of a safety officer. The procedures for access to the railway laid down within ProRail are applicable at all times. The possibilities for access to the track are limited and access to the track must be requested at least 2 weeks in advance.

P5. The sensor does not exert any inadmissible forces on the track. (Both horizontal forces parallel to the track, horizontal forces transverse to the track and vertical forces on the track.)

The sensor can be attached and removed without modifying the rail or sleepers (e.g. magnetic fastening or clamping, and not drilling, welding or gluing). The smart camera can easily be placed and removed (eg screwing or clamping, and not drilling, welding or gluing) on a frame or standing on its own base on the ground.

### 2.2.4 Electrical requirements

P6. Electromagnetic influence: see appendix EMC

P7. The smart camera does not establish electrical connections between rails. Think in whole or in part:

1. Bridging insulated/isolated rail joint (IRJ);
2. Electrical connection between both rails of a track;
3. Electrically connecting rails of different tracks (positioned next to eachother). (Such connections can interfere with the correct operation of train detection and / or ATB.)

P8. The smart camera is positioned in such a way that insulation distances and breakdown voltages are not adversely affected. (Especially when placed near power supply systems or the catenary lines)

1. The sensor conforms to RLN00007
2. The sensor does not emit unnecessary electromagnetic signals.
3. The sensor does not affect the communication systems used within the Dutch railway system.

P9. For the following communication systems it can be assumed that the EMC requirements are met:

- LoRa: 868 MHz transceiver, transmit power ≤ 25 mW / +14 dBm
- Bluetooth Low Energy: 2.4 GHz transceiver, transmit power ≤ 10 mW / +10 dBm
- Mobile data traffic (eg 3G / 4G)
- The free 433 MHz band

Other communication systems are explicitly not excluded, but for those systems evidence or substantiation that it does not affect the functioning of existing systems must be provided.

P10. If the smart camera is damaged, the camera must not affect the correct operation of electrical systems in the close neighbourhood.

### 2.2.5 Interaction with drivers

P11. The smart camera does not limit the visibility and recognisability of signals and signs

P12. The smart camera cannot be confused with signals from Appendix 4 of the Rail Traffic Regulations

P13. The smart camera cannot lead to glare of operators. (Pay special attention to possible reflection of sunlight through the housing.)

P14. The smart camera does not give the impression that unauthorized objects have been placed in the track. Housing preferably yellow, grey or black.

### 2.2.6 Electrical voltage on the rails in 1500 DC area

For your information:
The voltage which can occur by the track current circuit between the rails for the purpose of detection is a maximum of approximately 15 V with a frequency of 75 Hz or 50 Hz.

The other voltages that can occur on the rails are common mode voltages (generally do not cause large potential differences between the rails) and (high short-term) voltages as a result of lightning strikes.

In addition to voltage on the rail, the traction return currents flows through the rail which may be several hundred to thousands of amperes.