

# Improving incident response in The Netherlands

## 1. Problem Definition

Rijkswaterstaat (RWS) is a division of the Ministry of Infrastructure and Environment and, among other things, ensures road safety in the Netherlands. They do this by operating a 24-hour service called Incident Management. Traffic management centers dispatch road inspectors to secure incident sites, and restore the situation to normal conditions as quickly as possible to ensure optimal traffic flow.

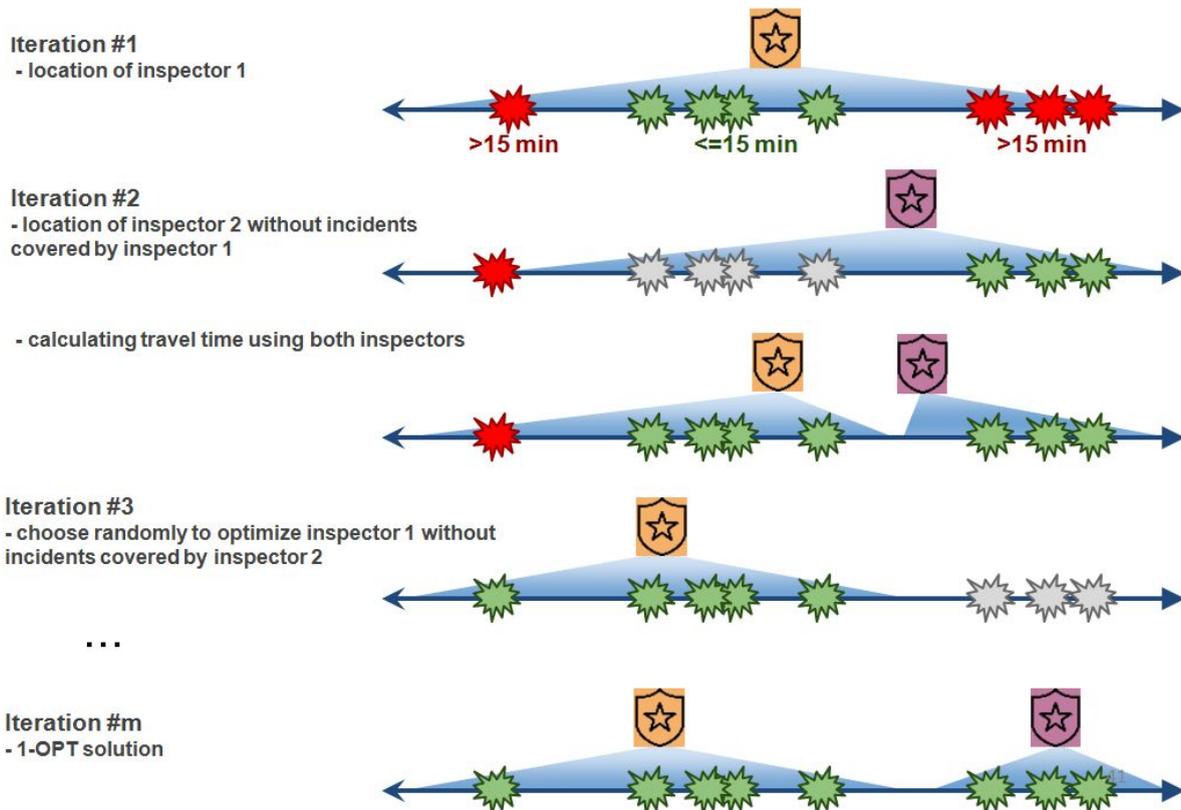
There are approximately 260 road inspectors and 160 traffic managers in the Netherlands that handle 85,000 – 120,000 incidents on the highways each year. Based on incident history, capacity, and domain knowledge, RWS dispatches inspectors to specific deployment areas that RWS believes are most likely to have incidents. To evaluate their performance, they use a Key Performance Index (KPI) of the percent of incidents with response time under 15 and 30 minutes for zones of high and low economic activity respectively during weekday rush hours.

DSSG will help RWS by developing a policy for optimizing stationary and patrolling locations of inspectors on duty to minimize the time it takes them to reach an incident site. The goal is to improve the KPI performance, optimizing safety and traffic flow for road users.

## 2. Analysis

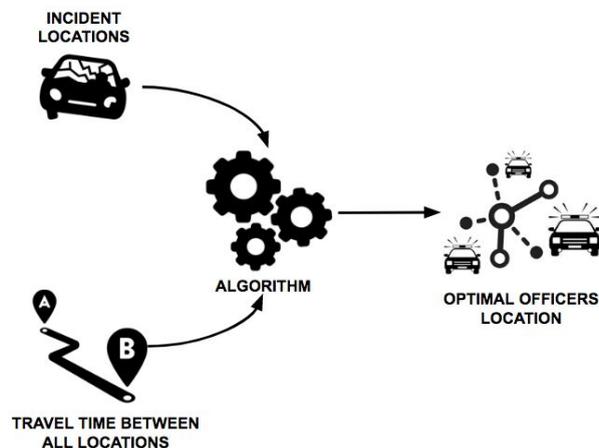
We use historical incident data to determine patterns in incidents relating to time of the day and locations. We acquired travel distance and travel time between kilometer markers within the road network of interest via [Open Source Routing Machine](#). To find the ideal locations of inspectors so that all incidents can be reached within the shortest possible time, a Greedy Incremental Algorithm (GIA) is used in simulations to minimize the average travel time between different inspector locations and probable incident points every time with the addition of a new officer or based on a certain number of officers.

# Greedy incremental algorithm - example



## 3. Preliminary Results

As a proof of concept, we have chosen a segment of highway A4 which goes from Amsterdam to Rotterdam. It is the road with the 8th most incidents on weekdays during rush hours (between 7 A.M. and 9 A.M. and 4 P.M. and 7 P.M.), with 16,500 total incidents between 2014 and 2016.



Using the travel time matrix for this specific road (1km granularity) and the incidents on a specific day, we are able to allocate inspectors along the road optimizing their response time

with the GIA. We also compare our current results to the actual response time of the incidents for this day.

#### **4. Final Deliverables and Future Work**

We will provide RWS with a deployment plan, including the optimal location for each of the 15 inspectors in the Rotterdam area for weekdays at rush hour. The deployment plan will also include analysis on the trade-off between the number of offices and performance, so that RWS can assess the marginal value (in improved KPI) of deploying an additional officer (or officers).

We plan to validate the deployment plan with a trial in Rotterdam in September and October. In the future, we hope that RWS can extend the use of the algorithm to other areas in the Netherlands, and for other time periods such as weekends and non-rush hours.