Summary

The Dutch Department of Waterways and Public Works is manager of the network of motorways in the Netherlands. This brings along responsibilities for the construction and management of the roads and for a smooth, safe and reliable flow of traffic. In order to perform these tasks correctly several measuring systems have been implemented under, along and above the motorways in the past forty years. These roadside systems determine the conditions of and on the motorways through point measurements. In the coming years a part of these systems will be replaced, the existing system expanded and new systems developed.

The in-car technology has been undergoing large-scale developments in recent years, both in quality and in quantity. In order to increase active safety numerous systems measure the vehicle behavior and due to the rise of advanced driver support functions, modern vehicles generate a great deal of data on the conditions of and on the road. This is the same data the road manager collects with the roadside equipment. When a portion of the motorway users transmits this information to the road manager, a floating car data measuring system is created. The expectation is that in the near future this will form a better measuring system than a traditional roadside system.

The measurements performed by the Dutch Department of Waterways and Public Works are used for different purposes. The application determines to great extend the requirement of the measurements. In this thesis five areas of application are distinguished:

- Dynamic traffic management: warning and regulating the flow of traffic
- Research: policymaking, evaluation and traffic models
- Road management en maintenance: quality control of the road surface
- Enforcement: compliance with traffic rules
- Future requirements: new applications for motorway users

Within these five areas many different applications can be distinguished, each dictating different requirements from the measurements. These requirements are focused on the accuracy and reliability, the time period in which the measurement is obtained in and the location this takes place. In this thesis an analysis is made of the role of floating car data in the future measuring systems of the Dutch Department of Waterways and Public Works. A measuring system for weather conditions is worked out in detail.

Seven weather aspects are distinguished that influence traffic to such extent that measurements are justified. These seven aspects are two primary elements, the temperature and the humidity, and five combinations, wind, cloudiness, fog, sunlight and precipitation. An analysis is made of the development of these aspects, their influence on traffic and the measurement requirements. This last part is formulated for a warning application, because those requirements are of the highest standard. This results in high values for the accuracy and reliability, a short measuring period and a compact measuring density.

There are at the moment four roadside systems that perform weather measurements: the road slipperiness system, Weerbeeld (Weather Image), the fog observation system and the wind warning system. The only system that is not under the management of the Dutch Department of Waterways and Public Works is Weerbeeld, which is a product of the Royal Dutch Meteorological Institute and is purchased external. The data it provides is not detailed enough for direct application in road management, but it provides a good indication of the weather development. The other three systems are only applied on weather sensitive locations and therefore do not comply with the requirements. Extending the system to a complete motorway coverage and meeting all requirements is possible, but this cost hundreds of millions of euros and implementation is not feasible. A more realistic measuring system using roadside equipment can be implemented for a fraction of the costs and forms a usable approximation of the requirements. Two drawbacks are that data consists of point measurements and maintenance forms a threat for personnel and traffic and influences both the road and traffic.

Through floating car data all weather aspects can be measured with the exception of cloudiness. Not all measurements are directly focused on the weather aspect, but are derived form measurement on the effects. The implementation of a measuring system that conforms to all the requirements cost over a hundred million euros and can't be realized on every location for every moment of the day. Differences in traffic intensity between motorways and the time of day lead to high requirements on the penetration rate. This is the number of vehicles that provide floating car data as a percentage of the total traffic flow. It is even possible that a penetration rate of a hundred percent is not able to meet the requirements.

Based on the results of this report, the future measuring systems of the Dutch Department of Waterways and Public Works should not solely consist of roadside equipment or floating car data, but should combine the information of both. This makes it possible to generate data of predictable quality at a certain location and time of day and have complete motorway coverage at most locations during the day. The data provided by Weerbeeld forms the basis of the weather development and the roadside equipment and vehicles on the motorway verify and differentiate this data. Most of the developments concerning floating car data will be performed by market parties, the primary task of the Dutch Department of Waterways and Public Works is to get involved in the process. Extending floating car data to the remaining road network and different measuring applications is simple and costs shouldn't be extremely high. De interest of other market parties and the possibilities they provide, make a quick and affordable development possible.