Rijkswaterstaat
Ministry of Transport, Public Works and Water Management

Longer and Heavier Vehicles in the Netherlands

Facts, figures and experiences in the period 1995-2010

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Content

Preface

Dear reader,

The use of increasingly larger vehicles is part of a natural evolution within the transportation industry. The loading capacity of ships, planes and trains has grown tremendously over the past centuries. As the most important vehicle for our everyday needs, trucks too need to become more efficient and sustainable in their use of energy and financial resources.

By now, we have fifteen years of experience with the use of longer and heavier vehicles (LHVs) in the Netherlands. Relevant facts, statistics and experiences from that period have been recorded and collected in this report.

The conclusions confirm that the use of LHVs in the Netherlands has several benefits, while showing at the same time that potential downsides of LHV use have not materialized. It is fascinating to know that currently more than 400 LHVs are going virtually unnoticed in everyday traffic in the Netherlands. Registration data shows that LHVs are mainly used in markets where transportation via water and rail is rare or non-existent, such as the national distribution of food, flowers and express mail. Even the container market, where road transportation, rail and inland shipping sometimes overlap and compete, shows no evidence of a major shift in the flow of goods.

By replacing regular large trucks, LHVs have a positive effect on the reduction of overall vehicle mileage, operating costs and emissions. In short, LHVs have both economic and environmental benefits. That is why LHVs in the transportation industry are also known as Eco-Combi's. Very well defined, considering the facts in this report. Moreover, LHVs present possibilities that inspire truck and trailer builders to create innovative solutions in response to the need for increasingly efficient road transportation.

Monitoring the daily use of LHVs is first and foremost intended for national political decision-making. But based on our experience, I can also see benefits of LHV-use in the European transportation market. Economical, sustainable and efficient road transport is a major European target. The experiences in The Netherlands, and in other countries like Sweden and Finland, clearly indicate that the benefits are great and the risks non existent or manageable.

We continue to monitor the results during the Experience Phase (Third Pilot) with LHVs until 2011, and the results will be widely published. I am convinced that this report will contribute to the further development of efficient and sustainable road transport.

Camiel Eurlings,
Minister of Transport, Public Works and Water Management

1 An overview of the use of LHVs in the Netherlands

1.1 The reason for using Longer and/or Heavier Vehicle Combinations

Every year, drivers make more and more truck-kilometres on the Dutch road network. The number of domestic tonne-kilometres by Dutch transport companies has increased steadily over the period 2000 - 2008. In this time frame, the average growth was approximately 1% per year, from 31,561 million loaded tonne-kilometres in 2000 to 34,344 million in 2008. The continuing expansion of freight transport by road calls for innovative solutions, in order to facilitate growth and improve sustainability of Dutch transportation. Pressured by market, traffic safety and environmental requirements, Dutch companies and the government are constantly looking for new opportunities to make road transportation as efficient, sustainable and safe as possible. These requirements are:

- Market requirements: lower transportation costs, improved logistical service and improved competitiveness;
- Traffic safety: traffic safety must remain the same or improve where possible;
- Sustainability requirements: lower emissions, less noise and less congestion / improved accessibility.

One of the most practical improvements for companies and government is to increase the loading capacity of trucks by introducing Longer and (possibly) Heavier Vehicle combinations (LHVs).

Figure 1.1 Example of a Longer and Heavier Vehicle Combination (source: Tielbeke Transport)

The European Directive 96/53/EG determines for the entire EU what the legal maximum length and weight for truck combinations in national and international European traffic are. The directive stipulates that the maximum length of a truck combination can be 18.75 meters, while the maximum weight -including load- can

be 40 tonnes. Within their own borders, Member States of the European Union are free to apply different standards for transportation. Starting in 2001, the Netherlands has used this opportunity to experiment with the use of LHVs. As part of these experiments, the maximum total length of an LHV is allowed to be 25.25 meters. The total weight of an LHV is allowed to be 60 tonnes. Regular truck combinations within the Netherlands are allowed to weigh 50 tonnes, which is different from the European Directive of 40 tonnes.

1.2 Use of LHVs in the Netherlands still in trial period

The use of LHVs has been allowed on the Dutch road network since 2001 - under strict conditions and as part of a number of test phases. These test phases for transport companies and shippers are still ongoing. There are three distinct phases.

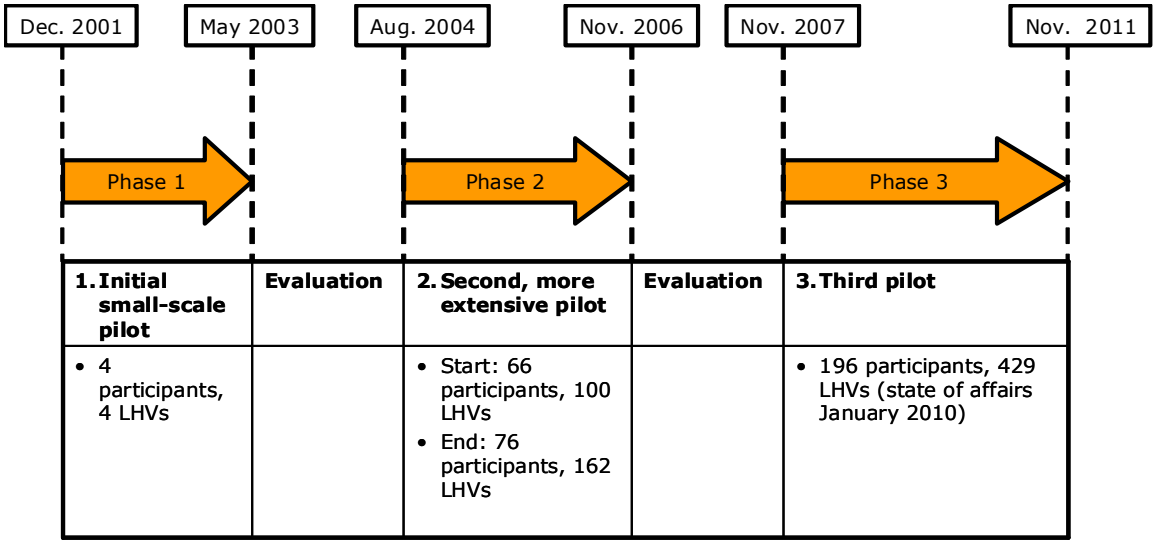

Figure 1.2 Overview of completed and ongoing trials of LHV-use in the Netherlands

1. Initial small-scale pilot (December 2001 - May 2003): During this small-scale First Pilot of approximately one and a half years, four transport companies were allowed to use LHVs.

2. Second, more extensive pilot (August 2004 - November 2006): During this Second Pilot, 66 companies started using LHVs on Dutch roads. Together, these companies operated one hundred LHV-combinations at the start. During this test, the number of participants grew to 76 companies and 162 LHVs.

3. Third Pilot (November 2007 - November 2011): The Third Pilot for the use of LHVs started on November 1, 2007. This so-called Experience Phase will end in 2011. The purpose of this Third Pilot is to study the effects of an increasing number of LHVs in the Netherlands, in terms of traffic safety, traffic management and modal split. The Third Pilot will also consider specific issues from the two previous pilots. There is no longer a limit to the number of LHVs, but they must meet every

requirement for the granting of an exemption. When the results are positive, the Third Pilot may be extended beyond 2011.

In 2009, the use of LHVs in the Netherlands increased dramatically [3]. In November 2008 there were only 109 transport companies and shippers with a total of 194 LHVs, but by October 2009 the use of LHVs had almost doubled, to 190 transport companies and shippers with a total of 398 LHVs. An important reason for this increase is the need for cost reduction due to the economic recession. In the Netherlands, LHVS are mainly used for distribution, especially by supermarket chains, large retailers, the floriculture industry and container transport companies. Until recently LHVs were used almost exclusively for transportation between industrial areas and distribution sites (wholesalers, distribution centres, auctions, etc.), but a rapidly emerging application is the use of an LHV with two so-called city trailers with a length of 10.6 meters in distribution. The following business case illustrates the use of this innovative LHV-combination.

Figure 1.3 Example of an innovative LHV-city trailer combination (source: D-Tec)

Business Case: Emergence of city trailers, use of a LHV-configuration for distribution of supermarket products

The logistics service provider Cornelissen Transport and Logistics, located in Nijmegen, was the first transport company to start using a new LHV-combination with two 10.60 metre city trailers for urban distribution. This combination with -interchangeable- trailers has a maximum load capacity of 84 rolling containers or 40 block pallets. In urban distribution, the driver can leave one trailer at a coupling station on the outskirts of a city, take the other trailer into town for loading/unloading and then return to exchange trailers for a new drop-off. Now that the first of Cornelissen's city trailers is operational, and other transport companies will soon be using similar trailer-combinations, a trial period for this kind of vehicle combination has started. The trial will determine the usefulness of this particular LHV-city trailer for daily supermarket distribution. Meanwhile, other transport companies have shown interest in the concept, and in addition to new refrigerator/freezer trailers, city trailers are being used for non-conditioned goods.

Source: D-Tec website, accessed November 27, 2009

1.3 Literature on LHV-use in the Netherlands

The first report on the possible use of LHVs in the Netherlands appeared in late 1996. After that, all aspects of the use of LHVs in the Netherlands between 2001 and the present have been examined, tested and evaluated: traffic safety, impact on infrastructure, vehicle technology, business economics, sustainability, operational business processes, operational use on the road, the effect on other road users and impact on the modal shift. More than 30 reports on the use of LHVs in the Netherlands have been published. They are listed in the bibliography. This publication includes an overview and summary of Dutch literature on LHVs, and uses direct quotations from these studies where possible. The bibliography in the back of this report is up to date, and when relevant, new facts or insights have been added.

1.4 Reading Guide

The first three chapters (2 - 4) concern the introduction of LHVs in the Netherlands, focusing on regulation, requirements and the impact of LHVs on the existing infrastructure. The remaining three chapters (5 - 7) describe the results of various studies and the way in which LHVs are being used. Every chapter concludes with a summary of key points. Specific definitions are explained in the glossary (appendix A).

2 Details of LHV-configurations in use

2.1 The LHV as an exception to the Directive 96/53/EC

The European Directive 96/53/EC determines the maximum length and weight for truck/trailer combinations for national and international traffic in Europe. The dimensions follow the modular structure of the European Modular System (EMS). In Sweden and Finland, this modular system has been in use for several decades [5]. The EMS-components are the truck, trailer, tractor and semi-trailer. The EU Directive includes size and weight requirements for these components. The maximum total length of LHV-combinations is based on combining these components. The Directive stipulates that the maximum total length of a regular truck/trailer combination is 18.75 meters, while the maximum total weight is 40 tonnes, including cargo.

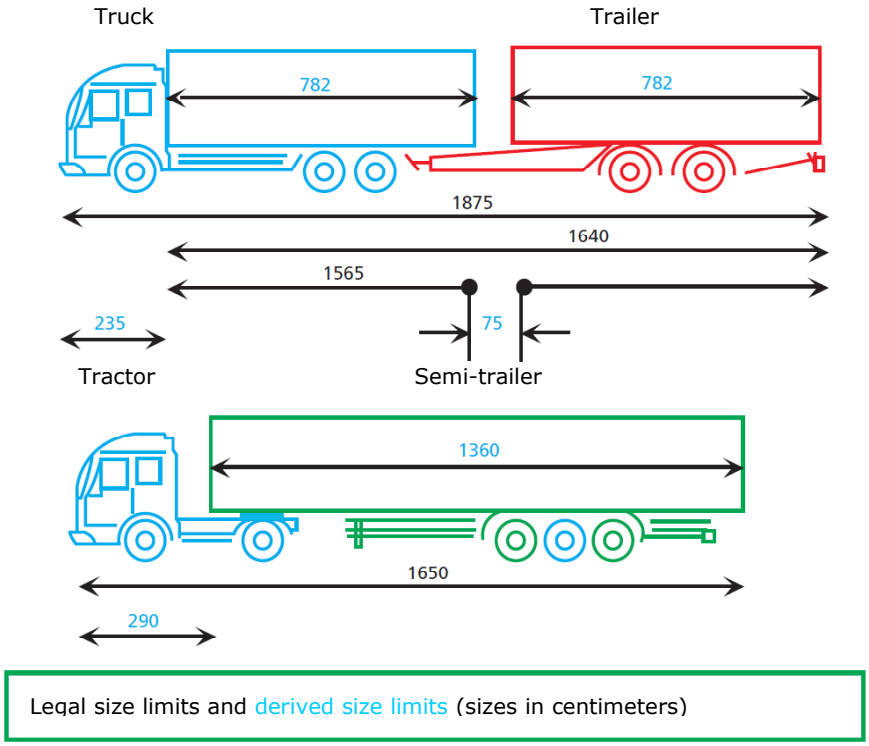

Figure 2.1 Legal size limits for commercial vehicles under Directive EC/96/53 [5]

The Member States of the European Union have the option to deviate from this directive. This happened in the Netherlands during the 1990s, when a maximum total truck weight of 50 tonnes was sanctioned. From 2001 on, there have been experiments with longer, heavier vehicles using the EMS-components. The advantage of this approach is that LHVs consist of components that can also be used by regular trucks. The exceptions for LHVs are:

- The total maximum length of an LHV is 25.25 meters. This comes with certain requirements for the total load length of the vehicle, which is between 18.00 meters (minimum) and 21.82 meters (maximum);
- The total weight of an LHV cannot exceed 60 tonnes.

2.2 Five LHV-configurations in a modular system

Within the maximum length of 25.25 meters an LHV can consist of different components. Not every possible configuration is permitted in the Netherlands. The illustration below shows five LHV-configurations that are allowed [5]. Prior to use in trials, these configurations were tested extensively for traffic safety impacts and other criteria by the Dutch National Vehicle Authority (RDW).

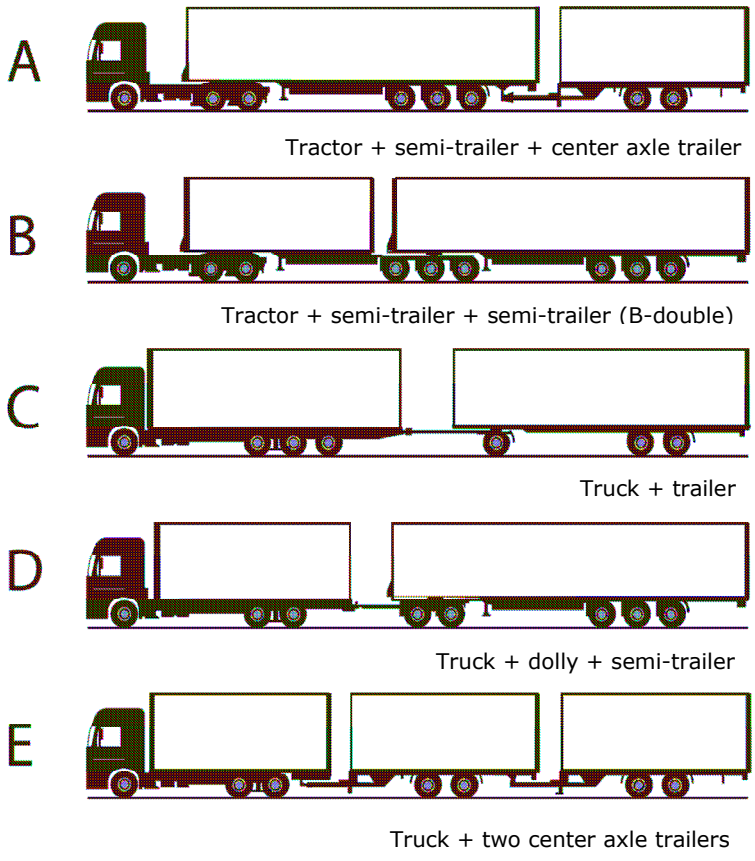

Figure 2.2 Five LHV-configurations that are used in the Netherlands [5]

A-configuration (tractor + semi-trailer + centre axle trailer):
The A-configuration consists of one tractor with a 13.60 meter semi-trailer and a trailer (source picture: Tielbeke Transport). This A-configuration has two pivotal points, which also function as coupling points. These are the kingpin/fifth wheel coupling (between tractor and semi-trailer) and a jaw/drawbar coupling (between the semi-trailer and the trailer).

B-configuration (tractor + semi-trailer + semi-trailer):
The B-configuration consists of a towing unit coupled with a semi-trailer equipped with a fifth wheel coupling (source picture: D-Tec).

This fifth wheel coupling connects a second semi-trailer to the first one. This configuration is internationally known as the B-double, and it is deployed in several markets. When transporting containers, the configuration should be able to accommodate three 20-foot containers. Since 2007, the B-configuration has become popular as a city-trailer configuration for distribution. In this case, there are two trailers; measuring 8.00 meters and 13.60 meters; or 10.60 meters each.

C-configuration (truck + trailer): The C-configuration consists of a long truck with a trailer (source picture: [5]). Before 2007, the C-configuration was hardly used, because in volume transport only a small part of the extra load length was being used. Also, it is harder to interchange components with regular truck/trailer combinations.

D-configuration (truck + dolly + semi-trailer):
The D-configuration consists of a truck with a dolly and a semi-trailer (source picture: Noy Logistics). A dolly can have a single or a double axle. During trials prior to the Third Pilot (through 2007), the D-configuration was by far the most popular.

E-configuration (truck + two centre axle trailers):
The E-configuration consists of a truck with two centre axle trailers (source picture: Jan Krediet b.v.). This

combination is often used to transport removable containers (which can be uncoupled from the vehicle and temporarily left behind).

In tests prior to the Third Pilot (through 2007) the D-configuration was most often used by transport companies and shippers. Almost two thirds of LHVs (63 out of 100) were of the D-configuration type. The C-configuration was not used at all. The A-configuration was used 16 times, the B-configuration 14 times and the E-configuration 7 times. Meanwhile, more than two years later, there are more than 400 LHVs on the road, most of them B- or D-configurations.

National Vehicle Authority(RDW): Creativity shows in development of LHV-configurations

Test Site in Lelystad

For the Dutch government, traffic safety is a prerequisite for the admission of LHVs on to Dutch roads. Until 2007, every LHV-configuration was tested on traffic safety aspects by the National Vehicle Authority (RDW), and if necessary tested on the test track in Lelystad. Nowadays, LHV-components are inspected separately and the middle component is subject to a design review. If there are any doubts with respect to the stability of the LHV-configuration, the entire vehicle combination will be tested completely. In recent years, the RDW has seen truck and trailer manufacturers in the Netherlands make many innovations in the design and construction of LHVs. There is a growing number of LHV-configurations that receive a good technical assessment. The RDW supports the new maximum and minimum load-length requirements that apply to LHVs since the start of the Third Pilot. This ensures the design and deployment of LHV-combinations that are technically safe and stable.

Source: Interview with the National Vehicle Authority (RDW), November 2009

2.3 Technical vehicle requirements for LHVs

Exceptional transport vehicles (for instance for oversize loads or carnival rides) have always been exempt from legal maximum weight and dimension requirements in the Netherlands. Because of the occasional nature of these exemptions, there are no additional technical requirements for the construction or the engine power of these vehicles. If necessary, traffic safety is warranted by the use of pilot vehicles. Unlike exceptional transport vehicles, LHVs are a more regular form of transportation. LHVs can drive without accompanying pilot vehicles. But in order to ensure traffic safety, LHVs are subject to additional technical requirements. The basic principle is that LHVs cannot be less safe than regular truck combinations.

For the 2004-2006 pilot trial, an initial set of technical requirements was created for LHVs. Since then, these requirements have been reviewed and updated for the Third Pilot (2007-2011). Some of the former conditions have been removed, because the Second Pilot showed that they were not essential. Others have been updated and reformulated. The most important LHV-requirements from the Third Pilot, in addition to those of height and weight, are [21]:

1. EMS-concept: As mentioned before, the dimensions of LHVs are based on the European Modular System (EMS-concept). Tractors and loading units should consist of conventional components. An additional coupling is allowed only to connect a third component.

2. Axle loads: LHVs are subject to the same axle load requirements as regular vehicles. Because of its length, an LHV is likely to have more axles. This means that the axle load of an LHV is likely to be lower than a regular truck. Overloading can lead to excessive wear on road pavement and structures such as bridges and tunnels. For the Third Pilot, the requirement to monitor axle loads was introduced. All axle loads (except for the front axle of the towing vehicle) should be monitored from the cabin with an accuracy of +/- 100 kg. Axle load meters are already installed on LHVs because of the mandatory EBS (Electronic Brake System).

3. Braking performance: The bottom line is that the stopping distance of an LHV should not exceed the stopping distance of a regular truck combination. All components of an LHV-combination (tractors and loading units) must comply with EC brake system regulations. The braking forces that are generated must prevent a trailer from 'pulling' or 'pushing' the towing vehicle. During the Third Pilot the brake signal is transmitted through an EBS. The LHV has a standard maximum vehicle weight and, because of its length, more axles. The axle load remains within the legal limits and each axle is equipped with the mandatory braking power. The stopping distance of an LHV is therefore no greater than of a regular truck combination. LHV-stopping distances have been extensively tested by the Dutch National Vehicle Authority (RDW) and the results support the above conclusion.

4. Acceleration: As established during the pilot trial, the towing vehicle of an LHV is required to have a minimum amount of engine power. LHVs are required to have more engine power than regular truck combinations. The requirement was reformulated for LHVs in order to make merging onto motorways easier.

5. Vehicle Stability: The vehicle stability of an LHV must meet or exceed the vehicle stability of regular truck combinations. The RDW has tested LHVs for stability, focusing on the following topics:

- The drift angle of an LHV was measured at a speed of 25 km/h. The drift angle is the degree to which the rearmost component deviates from an LZV's original track. This cannot be more than 70 cm;
- No part of an LHV may move more than 50 cm beyond the tangent when coming out of a turn;
- A truck combination shall not display unstable handling when forced to make a sudden avoidance manoeuvre across one lane (and back) at a maximum speed (80 km/h);
- An emergency stop at maximum speed shall not lead to uncontrolled behaviour of the vehicle combination.

Tests have shown that, because of its greater length, an LHV-combination on a straight track is more stable than a regular combination. Some LHV-configurations are slightly less stable when turning than a regular truck combination. The safe turning speed for an LHV is therefore slightly lower than for regular truck combinations. It is likely that additional stability requirements such as ESP

(Electronic Stability Program) will be available by the time LHVs can be formally admitted. Currently, there are no such requirements, but it is likely that these systems will become mandatory under European legislation.

6. Swept path: When an LHV describes a complete circle with an outer radius of 14.5 meters, the swept path cannot be larger than 8 meters. This means that during this circular motion an LHV-combination must stay within the area that is marked by an outer circle with a radius of 14.5 meters and an inner circle with a radius of 6.5 meters. The LHV-configuration covering the largest swept path is the E-configuration. This requirement is largely consistent with the one for exceptional transport vehicles (with a maximum length of 22 meter). However, the requirements for LHVs are stricter, because an LHV needs to complete a full circle. Regular truck combinations are limited to a swept path of 7.20 meters with an outer circle of 12.5 meters. This means that an LHV may need more space than a regular truck combination when turning a corner.

Figure 2.3 An LHV during a swept path test [21]

7. Blind spot: There are two requirements concerning the field of vision that must be met in order to obtain an exemption for operating an LHV:
- Fitting a blind spot mirror on the right side of the vehicle (this also is valid for regular truck combinations in the Netherlands);
- Fitting a forward-looking mirror that shows the front of the truck, as well as its right front side. This requirement varies slightly from the one for regular truck combinations.

8. Additional vehicle requirements for traffic safety: In order to obtain exemption for operating an LHV, there are a number of additional traffic requirements that need to be complied with:
- Side protection;
- Splash guards/anti-spray devices: to prevent water from splashing up;
- Highly visible continuous side marking;
- LHV-marking sign on the back of the rear vehicle that indicates the lateral shape of the vehicle combination as well as its total length in meters.

9. Other conditions: An LHV is not always allowed on the road. LHVs cannot be used under icy road conditions or poor visibility (less than 200 meters). The exemption conditions also specify the following restrictions:
- No access to 30 km-zones, major shopping and residential areas, unless they belong to a core LHV-route;
- A general ban on overtaking vehicles that can go faster than 45 km/h.

2.4 Summary: Requirements for, and use of LHV-configurations

- The use of LHVs in the Netherlands is based on five different configurations derived from the modular EMS-concept. The advantage of using the EMS concept is that the individual modules of an LHV can be used in regular truck transport. The total length of an LHV is not allowed to exceed 25.25 meters, while the total weight of an LHV is not allowed to exceed 60 tonnes.

- The pilot trials showed that, until 2007, the truck with dolly and semi-trailer (D-configuration) was the most popular of the five LHV-configurations that are allowed in the Netherlands. However, in 2009 the B-configuration -a tractor with two semi-trailers- quickly became more popular. This is mainly due to the increased use of the LHV city trailer concept for national distribution. The C-configuration is hardly ever used.

- Over the past two years, EMS-modules for LHVs have been subject to important technical innovations, resulting among others in the creation of a double city trailer. This innovation helps coach and trailer manufacturers make it through the economic recession, and gain a competitive edge in the near future.

- Unlike exceptional transport vehicles, an LHV is a more regular form of transport. The LHV can drive without a pilot car. But in order to ensure traffic safety, LHVs must comply with additional technical requirements. Basic principle is that LHV-combinations cannot perform worse than regular truck combinations when it comes to traffic safety.

- Obtaining an LHV-exemption is subject to a number of different technical vehicle requirements. These technical requirements have in some cases been slightly reformulated during the Third Pilot (2007-2011), based on lessons learned during the first two pilots. Stricter requirements include the transmission of brake signals through an EBS (Electronic Brake System) and monitoring axle loads from inside the cabin. There are additional rules for side protection and equipping the vehicle with ABS (anti lock braking system).

3 Impacts of LHV use on road infrastructure

3.1 Road infrastructure requirements leading for use of LHVs

The basic principle that guides the LHV Dutch policy is that LHVs should fit the existing road infrastructure and not the other way around. The road network on which LHVs are allowed already has a relatively high share of (heavy) freight traffic. It consists of three parts:

- The basic Dutch network of motorways, managed by the Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat);
- So-called 'LHV-core areas' such as industrial areas, ports and auctions house areas, which can be the starting point or destination of an LHV-trip. A regional or local road management authority (province or municipality) assesses the roads within these core areas and determines their suitability for LHV-use;
- Roads that connect motorways and LHV-core areas, often rural (provincial) roads. These are often the responsibility of regional road management authorities.

After a 2007 study into the strength of bridges and other structures, the Dutch motorway network has been cleared for use by LHVs up to 60 tonnes by the national road administrator Rijkswaterstaat. Regional road administrators are not required to make roads suitable for use by LHVs. An LHV may only use infrastructure that is already suitable. This includes structures, bridges, roundabouts and other specific facilities. With additional vehicle requirements, such as braking distance, acceleration and minimization of blind spots, the difference between operational behaviour of LHVs and regular truck combinations has been minimized.

The use of LHVs should follow the requirements of the existing road infrastructure. This applies to the impact on (1) pavement, and (2) structures (bridges, tunnels, and viaducts). It includes road design, but not rest areas (3). The fact that rest areas need to be adapted to the use of LHVs was already known in the Netherlands. In recent years, several studies have been dedicated to the effects of (large scale) LHV-use on Dutch road infrastructure.

3.2 Impact of LHV-use on road pavement

Two processes can cause road pavement damage [19]. The first process is called deformation. The impact of axle pressure over time causes asphalt to stretch and warp. This effect is in part permanent. Ultimately, deformation of the pavement will require maintenance and repair. The second process is fatigue. The constant movement of axles across the pavement generates force and causes deformation in the road construction, which may cause the material to split. In the long run, these two processes may cause cracks and ruts.

Deformation damage is influenced by two factors: axle load pressure and duration. LHVs usually have more axles than regular trucks, so the average axle load is lower. This generally causes less road damage from rutting. Axle pressure duration primarily depends on speed, but also on the number of axles. Since LHVs often have

more axles, asphalt will be exposed to more axles and therefore has less time to recover. An LHV therefore generates longer pressure impact times.

Table 3.1 illustrates the damage caused by different types of LHVs in comparison with a regular truck with an axle pressure of 2. Axle pressure of *n*-power 2 means that when axle pressure doubles, the total damage quadruples. The table below shows that an LHV causes equal or less (deformation) road damage than a regular truck. With higher values for *n*, the relatively positive effects of an LHV will only increase.

Type	**Axle load**	**Influence of axle power (n = 2)**	**Influence of axle pressure (linear with # axles)**	**Total effect**
Regular truck with 5 axles	5 x 10 tonnes	100%	100%	100%
LHV with 5 axles	5 x 10 tonnes	100%	100%	100%
LHV with 8 axles	8 x 6.25 tonnes	39%	160%	63%
LHV with 10 axles	10 x 5 tonnes	25%	200%	50%

Table 3.1 Summary of LHV-impact on deformation damage when n = 2 [19]

Fatigue damage to road pavement is caused by large numbers of axle passages. Traffic pressure will cause a road surface to bend with every passing vehicle. Over time, fatigue damage will cause functional or structural damage in the form of cracks. The extent to which axle pressure contributes to this damage depends on the magnitude of the induced stress and strain. When pavements are well constructed, and axle loads are within limits, each axle will only minimally contribute to road damage. Millions of axles can pass before maintenance is necessary. Axle loads contribute to fatigue damage as *n*-power of 4.

Table 3.2 illustrates the damage caused by different LHVs in comparison to a regular truck. The conclusion is that the contribution of an LHV to fatigue damage is equal or less.

Type	**Axle load**	**Influence of axle power (n = 4)**	**Influence of passages**	**Total effect**
Regular truck with 5 axles	5 x 10 tonnes	100%	100%	100%
LHV with 5 axles	5 x 10 tonnes	100%	100%	100%
LHV with 8 axles	8 x 6.25 tonnes	15%	160%	24%
LHV with 10 axles	10 x 5 tonnes	6%	200%	12%

Table 3.2 Summary of LHV-impact on fatigue damage [19]

The evaluation shows that an LHV has the same impact as a regular truck with the same number of axles. Generally speaking, LHVs have more axles. Because axle loads have a greater effect on road damage than the duration of this pressure, the total effects on road damage are positive. This suggests that LHVs generate no negative impact on rutting, cracking and the life of pavement. Increasing the weight of an LHV to 60 tonnes should not have a negative impact on pavement quality, as long as one does not exceed the maximum axle load.

3.3 Impact of LHV-use on bridges and structures

At the start of the Third Pilot in November 2007, LHVs were not allowed to be heavier than regular trucks. In earlier trial periods the maximum vehicle weight was 60 tonnes. Since it was unclear what impact LHVs had on traffic infrastructures, the minister of Transport, Public Works and Water Management decided to allow a maximum vehicle weight of only 50 tonnes. Based on results of the studies mentioned below, this decision has been reversed for the Third Pilot.

There are two damage processes that are relevant to bridges and other traffic structures. One is damage to the primary support system (main beams), and the other is damage to the secondary (sub-)support system (long beams and cover plates) [19].

LHVs are unlikely to create any additional damage to the primary structure of concrete traffic infrastructures. But in the case of steel structures, LHVs that are heavier than 49 tonnes may cause damage. If the used loading capacity of trucks increases with the use of LHVs, more trucks that are heavier than 49 tonnes will be cross these structures. Then, the use of LHVs may cause an (marginal) increase in damage to steel structures.

In terms of damage to the secondary support system, it is important to note that LHVs generally have more wheel sets and lower axle loads. Axle load contributes with a specific *n*-power, while the number of axle load passages contributes in a linear fashion. It should also be noted that the extra wheels on an LHV are offset by the fact that two LHVs replace three regular trucks. It is therefore obvious that LHVs do not cause more damage to a secondary support structure than regular trucks.

Research by TNO [8] has shown that 60-tonnes LHVs do not have a more negative impact on the strength of bridges and other infrastructures than regular 50-tonnes truck combinations, assuming that the weight is distributed evenly across the entire length of the vehicle. Weight distribution is essential and under current LHV-regulations guaranteed by a minimum length requirement for load floors of 18 meters. Because the impact of a 60-tonnes LHV on a structure is not greater than of a 50-tonnes tractor/semi-trailer combination (the heaviest conventional truck combination possible), the condition of those structures is not relevant for the admission of 60-tonnes LHVs on Dutch roads. As long as there are no weight restrictions for a bridge or viaduct, and it is therefore open to conventional 50-tonnes vehicles, it can also be used by LHVs with a maximum weight of 60 tonnes. As a result, the Dutch road management authorities agreed in May 2008 to allow LHVs of up to 60 tonnes on all roads that are suitable for LHVs.

A secondary result of the TNO research mentioned above is that a regular 50-tonnes tractor/semi-trailer combination appears to exert more pressure on a structure than a 60-tonnes LHV, pertaining to both the bending and the lateral forces of the vehicle combination. This applies when the load is evenly distributed across the axles of an LHV, which is the case with all LHV-configurations that currently exist. One condition is that the distance between the front and rear axle must be greater than 18 meters. Based on these results this has been added as a vehicle exemption requirement for the Third Pilot.

These calculations were made using original design requirements and not the current condition of motorway infrastructures in the Netherlands. This is due to the fact that older structures were often designed with antiquated standards and outdated assumptions for traffic density. On the basis of new views, these structures have a shorter life span than originally assumed.

3.4 Impact of LHV use on road and rest area designs

3.4.1 Road design

The use of LHVs generally causes very few problems for road design. This is partly due to the LHV exemption requirements, which in fact exclude certain roads from use. One example is the fact that railroad crossings may only be used if they have an extension of red light duration (i.e. extra time between the start of the red light signal and lowering of the railroad barrier), and when there is sufficient space after the crossing.

Sections of road that connect to a main road via an acceleration lane should at the very least have a width and length span that complies with the minimum requirements. In some cases it is impossible to conform to the regulations, for instance due to a lack of space. In those cases the situation should be evaluated locally. If possible, adjustments should be made or compensatory measures taken. If traffic safety cannot be guaranteed, short acceleration lanes should be excluded from the LHV-network.

3.4.2 Driver experience with road design

The Second Pilot (2004-2006) included interviews with a number of LHV-drivers about their experiences with obstacles in the traffic infrastructure [22]. They were specifically asked about negotiating roundabouts, and manoeuvring during loading/unloading and parking. The following came up during the interviews:

- LHV-drivers must be very alert around small roundabouts, because space is limited. The advisory list 'LHVs on the secondary road network' of the deals with this issue and has been made available to all regional road management authorities (see Section 4.2);
- In some cases it is necessary to use hatched road markings or part of a different lane. However, this does not significantly differ from a regular truck combination;
- Dedicated lanes for left- and right-turning traffic at traffic lights are in some cases very short. Due to its extra length, this become problematic sooner for an LHV than for a regular truck combination;
- Given the extra length of an LHV, parking in regular truck parking spaces sometimes poses a problem: an LHV will stick out. In some locations there already are special parking spaces for LHVs;
- When crossing an intersection, an LHV-driver should be extra alert because he is crossing with a truck combination that is extra long. Most drivers seem to be aware of this situation and assess the risk well;
- Taking a longer route when exactly following the roads, to which the exemption applies, is seen by some drivers as unnecessary. They see no 'danger' in taking the shortest route. Here too, drivers should simply stick to the rules.

Business case: Experiences from an LHV-driver from Tielbeke Transport

The driver has had many years of experience driving an LHV between Zwolle and Breda, and he enjoys it because the additional vehicle length is challenging. When on the road, there are almost no motorists who notice that they are dealing with a 25.25 meter LHV, instead of a regular, 18.75 metres truck. Only fellow truck drivers seem to notice. The driver nevertheless believes that the markings on the side and back of the LHV make it sufficiently clear to other road users that they are dealing with an LHV.

Driving the LHV on provincial roads and motorways is easy to do. This has been addressed during training. Around warehouses standard procedures apply, and the layout of the surrounding area allows for extra maneuvering space. Enforcement by the National Police Agency (KLPD) has been very limited. Only once a Tielbeke driver was checked, which happened at the beginning of the test period. There have been no accidents involving Tielbeke's LHVs.

In addition to a regular LHV-combination, Tielbeke operates one 'advanced' LHV-combination for supermarkets. Four LHV-drivers have started driving it. Again, properly handling the new combination requires practice.

The driver mentions one thing that can be improved, namely the option of overtaking mobile cranes on the motorway. LHVs are not allowed to overtake anything, but mobile cranes often move no faster than 65/70 km per hour. An LHV-driver is supposed to trail behind. Maybe certain sections of motorway can be designated for overtaking? Parking spaces are another matter that requires attention, but Tielbeke barely ever uses them. The use of gas stations poses no problem for Tielbeke's LHVs because they tend to visit a number of fixed gas stations that offer enough room.

Source: Interview with driver from Tielbeke Transport, October 2009

3.4.3 Rest Areas

The size of parking spaces in rest areas is one of the few examples that require future infrastructure adjustments [14]. All rest areas near motorways are managed by the Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat), which is the Dutch national road management authority. Rest areas have multiple functions [14]. Drivers can refuel, take a bathroom break, eat and/or rest. Refuelling at a rest area usually does not cause any problems. In rare cases, when fuel pumps are positioned at an angle, an LHV may block an adjacent pump.

There are three kinds of parking spaces: herringbone and interlock parking (parking at an angle), and parking parallel to the road. Herringbone and interlock parking spaces are designed for regular truck/trailer combinations and are therefore in most cases too short for LHVs. Parallel parking spaces can usually be used by LHVs, but the problem is often that other road users do not park their vehicles close to each other for privacy reasons, so the chance of finding enough space for an LHV is small. Fellow drivers are often not willing to move their trucks in order to make room because of the tachograph regulations. Tachographs are programmed in such a way that a driver has to begin his break anew after he starts his truck. In reality, there will not always be sufficient space available for an LHV-combination to find parking.

There are three scenarios for the adaptation of rest areas: none, minimal and major adaptations. Rijkswaterstaat has chosen to make minimal adaptations; only in strategic locations rest areas will be adapted to accommodate LHVs. The basic idea is that drivers find at least one rest area during a long journey within the Netherlands. The idea is to provide additional rest area capacity through better coordination with the market.

Interviews and observations have shown that LHV-drivers do not use rest areas much [14]. They often prefer facilities away from the motorway because of lower prices. Refuelling usually happens at fixed locations such as the parent company; coffee- and lunch breaks are taken at the parent company or at the customer in the core LHV-area. This is possible because the maximum distance for an LHV-trip in the Netherlands is 350 kilometres.

3.5 Summary: Impacts of LHV use on road infrastructure

- The basic principle that informs Dutch policy towards LHVs is that the use of LHVs should fit within the existing infrastructure and not the other way around.

- After a 2007 study into the strength of bridges and other structures, the motorway network has been cleared for use by LHVs up to 60 tonnes by the Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat).

- A 60-tonnes LHV should not have a negative impact on pavement quality, as long as the maximum axle load is not exceeded. An LHV with five axles causes the same amount of deformation and fatigue damage as a regular truck combination. The impact is even smaller when an LHV has more than five axles.

- The use of 60-tonnes LHVs does not cause a more negative effect on the strength of bridges and other structures than conventional 50-tonnes combinations, provided that the weight is distributed proportionally across the length of the vehicle. Unless there is a weight limitation for a bridge or viaduct, an LHV with a maximum weight of 60 tonnes can use it.

- There appear to be very few traffic situations in the Netherlands that clearly require some kind of adjustment to the road layout and infrastructure in order to allow LHVs. One reason is that LHVs are longer, but not wider than regular trucks. An LHV therefore typically blends in nicely with the existing infrastructure, which is specifically studied when assessing an LHV-exemption application for a core area.

- Parking spaces in rest areas come in three different versions: herringbone and interlock parking (parking at an angle) and parking spaces parallel to the road. All types of parking spaces may pose problems for LHVs, because they usually are not long enough. There are three scenarios for the adaptation of rest areas: none, minimal and major adaptations. The national road management authority (Rijkswaterstaat) has opted for minimal changes; only in strategic locations will rest areas be adapted to accommodate LHVs. This means that drivers should find at least one rest area during a long journey within the Netherlands.

4 LHV-regulation: exemptions and enforcement

4.1 LHV-regulation in the Netherlands is exemption-based

A transport company needs a special LHV exemption in order to deviate from legal requirements and thus use an LHV in the Netherlands [5]. Licensing the use of LHVs is not possible due to the current European directive EC/96/53, which only allows exemptions. An exemption system is different from a licensing system. Under a licensing system someone is 'granted' something; the license holder can be actively requested to demonstrate that he/she is acting in accordance with the license. In the case of an exemption it is up to the government to check that the law is upheld. An exemption, unlike a license, cannot be revoked.

4.1.1 Conditions for LHV exemption

Exemptions are subject to certain conditions. These conditions have been laid down in the policy rule 'Policy regulation on approvals and exemption permits empirical phase LHV 2009'. A policy rule is a kind of directive which government bodies, within their jurisdiction, can use to issue regulations that have no legal status, but that can be waived only in exceptional cases. The Dutch National Vehicle Authority (RDW) is authorized to do so and it may, if necessary, change the policy rule at any time. In order to be transparent towards the citizenry, the RDW is obliged to publish changes to policy rules in the Staatscourant, the official publication of the Dutch government. The latest version of the policy rule (September 2009) has been attached to this report as appendix D.

In section 2.3 the LHV vehicle requirements were described in detail. Below is a brief overview of the requirements for drivers, freight and the circumstances under which driving of a LHV is allowed. An overview of these conditions for LHV exemption can be found in the policy rule.

1. Requirements for drivers: All drivers who want to operate an LHV-combination are required to obtain a special certificate: the CCV certificate 'Longer and Heavier Vehicles Driver'. The CCV is the Dutch organization that tests and accredits professional drivers. In order to obtain the accreditation a driver needs to pass a combined theoretical and practical test, which takes on average 1 to 2 days. The test focuses on: checking the vehicle and related documents, participation in traffic, energy-efficient and environmentally conscious driving, and manoeuvring skills. The test is preceded by practical training from specially certified instructors.

Apart from the mandatory license, there are two additional conditions:
- Drivers must have a minimum of five years experience with a truck combination;
- During three preceding years, the driver may not have lost his driver's license or have had it revoked because of a misdemeanour or felony.

2. Requirements for freight: An LHV may not be used for the transportation of hazardous materials, livestock or liquid cargo in tanks with a volume over 1000 litres.

3. Requirements for the conditions to operate an LHV: The LHV-exemption cannot be used under icy road conditions or poor visibility (less than 200 meters). Additionally, LHVs are not allowed to overtake any motor vehicle going faster than 45 kilometres per hour.

4 Requirements for participation in the study: The exemption provision requires participating companies to supply data and information about the use of the LHV-exemption, for the benefit of the study, when requested by the government.

4.1.2 LHV-network in the Netherlands

The basic principle for allowing LHVs on the Dutch road network is that they use suitable roads as much as possible. This means that LHVs mainly use roads that already carry a lot of truck traffic. LHVs are not allowed in city centres, residential areas and 30km zones. The road network onto which LHVs are allowed consists of three parts: the basic network, the LHV core areas and roads that connect core areas to the basic network [5].

The basic network consists of motorways and other roads managed by the Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat). LHVs are allowed on motorways without exception. There are certain areas where overtaking is allowed only by trucks of up to 50 tonnes, for instance on the A12 motorway near Zeist, because of the condition of a local road structure. The remaining roads managed by the Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat) have been released for LHV-use, if local conditions allow it. In most cases these are 80km-roads of supra-local significance. Most important requirement for the release of these roads is a total ban on overtaking by an LHV.

A core area is defined as an area without agricultural or residential zoning (in terms of road classification), in which one or more companies are located that function as a destination or starting point for an LHV-trip. Examples include industrial areas, ports and auctions. Connecting roads are roads that connect the core area to the basic network. In most cases these are main arteries, managed by Provinces, such as the N201, near the Aalsmeer flower auction. In January 2010 there were 427 core areas where regional road authorities allow LHVs. Among all core areas the Port of Rotterdam had the most exemption requests.

Connecting roads and core areas are added regularly. The map in appendix B gives a complete overview of the LHV-network per September 16, 2009.

4.2 Procedure for issue of an exemption

Four different bodies in the Netherlands are involved in the issue of LHV-exemptions and supervision of compliance with exemption requirements. [5]:

- The National Vehicle Authority (RDW) is a semi-governmental organization which monitors vehicles in the Netherlands from development to dismantling, both technically and administratively. It is also responsible for the issue of LHV-exemptions. The issue of an LHV-exemption is subject to approval of the road administrator(s) in question;

- Road management authorities: The Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat) manages the national Dutch road network, and government bodies such as provinces and municipalities manage regional and local roads;
- The Inspectorate for Transport, Public Works and Water Management (IVW): The IVW monitors compliance with laws and regulations when it comes to transportation, traffic safety and water management. The IVW is responsible for supervising the way in which the requirements for an LHV-exemption are fulfilled. These supervising activities are included in the IVW Annual Plan;
- The National Police Agency (KLPD) and the regional traffic police monitor daily use of LHVs on the road.

For the time being, the admission of LHVs is managed through annual exemptions. The advantage of using exemptions is that traffic situations can be assessed annually for negative changes that may render them less suitable for LHVs. This way the process of admitting the use of LHVs for truck transport in the Netherlands remains closely supervised.

Getting an LHV-exemption in the Netherlands requires taking the following steps [5]:

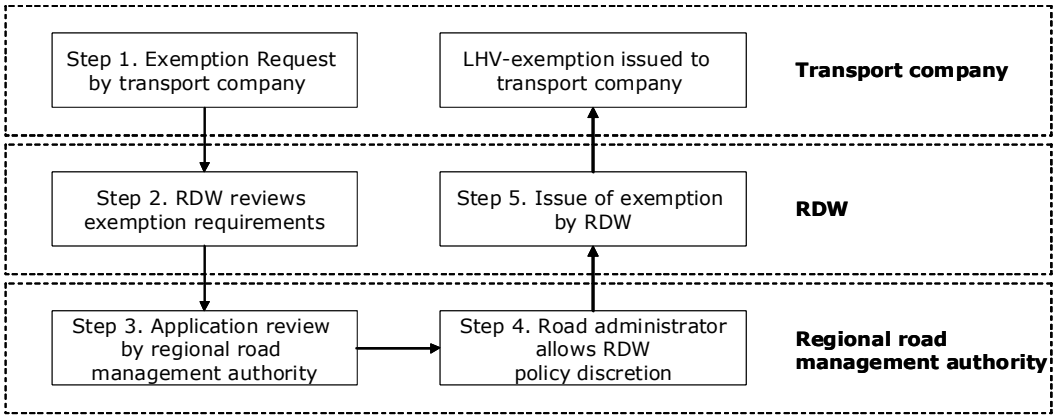

Figure 4.1 Roadmap LHV-exemption request procedure by the National Vehicle Authority (RDW)(based on [5])

Step 1. Exemption Request by transport company
A transport company, which wants to operate an LHV, is required to apply for an exemption to the RDW. The exemption will be granted for the tractor or truck. Each tractor or truck that is used as part of an LHV-combination is subject to an exemption. The exemption is granted by annotating the vehicle registration. A transport company applies for an exemption to operate from a particular location within a specific core area.

Step 2. RDW reviews exemption requirements
The RDW evaluates an application in terms of exemption requirements. If all exemption requirements are met, the design of the middle vehicle component is inspected. If there are any doubts, the entire combination is inspected.

Before granting the exemption, the RDW needs to have the approval of the road administrators involved. The RDW requests road administrators to determine whether the core area in question and the most logical connection to the basic network are suitable for use by LHVs.

Step 3. Application review by regional road management authority
The RDW requests road management authorities to decide whether a core area and connecting roads (or stretch of road) are suitable for use by LHVs. There are more than 400 road management authorities in the Netherlands that can autonomously decide whether or not to allow LHVs on the roads in their respective areas.

In order to support road administrators in their assessment process, the Ministry of Transport, Public Works and Water Management in 2007 commissioned a task force 'LHVs on the secondary road network'. This task force included representatives of transport companies and shippers, a number of companies that use LHVs, representatives of traffic safety organizations, and several road management authorities. The task force has analysed the secondary road network and has indicated for every individual traffic situation whether or not it is sensible for LHVs to use a road, in terms of road design and traffic safety. Decisions on traffic situations have to be made unanimously. One and a half years of discussion and additional research led to the publication of the advisory list 'LHVs on the secondary road network' [5] of the National Technology Platform for transport, infrastructure and public space (CROW).

The list includes 44 positive recommendations and 17 action points about situations in which the use of LHVs is not desirable. For example: LHVs are only allowed to enter a railroad crossing if it has 'extended red time duration', i.e. a longer period of time between the start of the signal and the lowering of the barriers. In addition, there has to be enough road length past the railroad crossing, this implies that it is not possible to use a railroad crossing when there is an intersection closely following it.

The advisory list is not binding. Road management authorities are autonomous and can make independent decisions based on certain considerations. A road administrator could decide to allow LHVs in an industrial area for local economic reasons and consequently decide to make special arrangements for bicyclists at intersections in order to ensure traffic safety. Conversely, a road administrator can decide to reject an application even though, according to the advisory list, the use of LHVs would be safe. This could for instance happen when the core area to which an exemption application pertains, includes a bicycle route for school going children.

Step 4. Road administrator allows RDW policy discretion
In order to simplify the administrative process for issuing LHV-exemptions, a road administrator can authorize the RDW to make autonomous assessments by granting policy discretion. This means that a road administrator allows the RDW to issue an exemption for every LHV-application regarding a core area and its connecting roads. Thus, the RDW does not have to consult with the local road administrator to obtain permission for the same core area, over and over again. This autonomous policy discretion is valid for one year. It allows a road administrator to annually review possible changes in a situation.

Step 5. Issue of exemption by RDW
The autonomous policy discretion given to the RDW by a regional road administrator is the basis for the issue of one-year exemptions for the basic road network, a specific core area and connecting roads. The RDW cannot issue an exemption for a road connecting a motorway to a core area, until policy discretion is obtained for the entire route from all road administrators involved.

4.3 Experiences with enforcement of LHV-exemptions

Supervision of the operational use of LHVs is the responsibility of the Inspectorate for Transport, Public Works and Water Management (IVW), which does periodic, retrospective monitoring through administrative systems, the Dutch National Police Agency (KLPD) and the regional traffic police (everyday road use). Supervision of LHVs is part of regular surveillance of truck transportation, and does not significantly differ from supervision of other forms of heavy traffic. One practical problem with regular inspections is that LHVs do not always fit on existing test equipment because they are longer than regular truck combinations.

4.3.1 Enforcement by Inspectorate for Transport, Public Works and Water Management (IVW)

Between October 15 and December 15, 2008, the IVW visited 100 of the (then) 120 companies with LHV-exemptions. The inspection focused on compliance with exemption requirements for LHVs (length, weight, route, vehicle configuration and driver skill, use of axle load meters, and freight). Included was information from several Weigh-in-Motion checkpoints on the main road network to examine the degree in which LHVs were overloaded. These dynamic weighing installations are connected to a video system and they use pavement sensors to measure axle loads and total weight of passing vehicles.

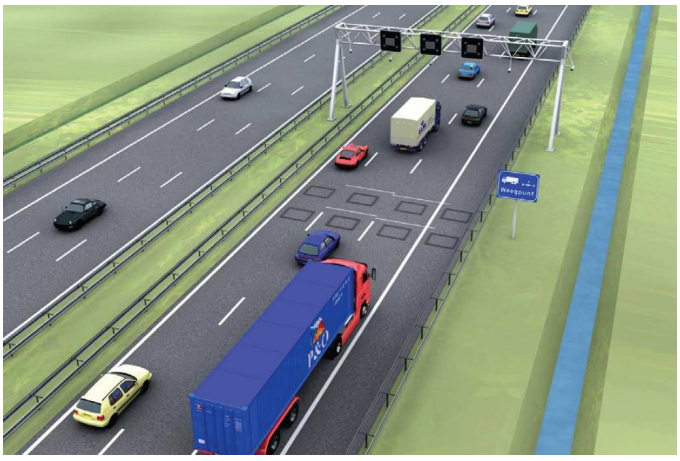

Figure 4.2 Overview Weigh-In-Motion Video system (source: Directorate General for Public Works and Water Management, 2004)

Inspections also focused on the experiences of exemption holders regarding the use of LHVs to date, and on compliance with the Working Hours Decree for the transportation sector. The results were:

- The following exemption conditions were observed by all companies that were surveyed: the maximum length was within limits, configuration of the LHV-combination complied with the requirements, driver qualifications were in order and there were no transgressions regarding cargo;
- Exemption holders have to deal with many LHV-requirements. Robust administrative systems that safeguard compliance with laws and regulations are therefore of great importance. Inspection of business practices shows that LHV-exemption holders are adequately following the rules;
- The added length and weight of an LHV requires strict compliance with laws and regulations. Most companies use trip planning to avoid violation of the Working Hours Decree. This can be done by having drivers work in shifts or by prohibiting weekend driving. Eleven companies were cited for minor violation of driving hours. In general, however, compliance with the Working Hours Decree by LHV-companies was good;
- When it comes to (over-)loading LHVs, most companies appeared to have taken adequate measures. Approximately half the LHVs that were checked at a Weigh-In-Motion station weighted less than 30 tonnes, and circa 92.5% weigh less than 50 tonnes. Only 7.5% of vehicle trips took advantage of the extension to 60 tonnes for an LHV. Among container transport companies there were a number of companies that made several overloaded trips.

LHV-passages at WIM-VID-points in total vehicle load	**2008-07**	**2008-08**	**2008-09**	**2008-10**	**2008-11**	**2008-12**	**Total %**
Total number of passages	2292	1835	1868	2745	2347	2357	100.00%
Under 30 tonnes	1247	1129	1001	1349	1188	1137	52.45%
Between 30 and 40 tonnes	663	414	554	963	833	851	31.82%
Between 40 and 50 tonnes	248	170	174	211	145	155	8.20%
Between 50 and 60 tonnes	107	100	126	203	169	199	6.72%
Above 60 tonnes	27	22	13	19	12	15	0.80%

Table 4.1 Few LHV-passages with a total weight of more than 50 tonnes at Weigh-In-Motion-Video stations [10]

In conclusion, the results of LHV-company inspections were as follows:

- Holders of LHV-exemptions are aware of the importance of complying with the rules. Exemption holders generally comply with the rules;
- Companies that were inspected considered the inspection process to be a very positive experience. Exemption holders who needed to make improvements were very willing to comply;

- The Inspectorate for Transport, Public Works and Water Management (IVW) is positive about the way in which exemption holders follow the law and it does not expect any problems moving forward.

4.3.2 Enforcement by traffic police and National Police Agency

The National Police Agency (KLPD) and regional traffic police are aware of the exemption conditions for LHVs. During surveillance rounds they monitor compliance, for instance with the ban on overtaking. Police also follow up on tips, for example about LHVs driving in locations where they are not allowed. In case of a violation, a citation is issued, but exemptions cannot yet be withdrawn.

During an expert session that was part of a study on traffic safety (2009) [1], enforcers shared their experiences with regards to compliance with LHV-exemption requirements. The KLPD states that LHVs stand out in a positive way during regular traffic safety inspections. Equipment is generally in order and LHV-drivers are deemed to be very responsible. They are extremely conscious of the movements of other traffic participants. Special training, certification and additional requirements for LHV-drivers very much contribute to this, according to the police. Also, companies seem to stick to the routes that are authorized for LHVs.

According to experts, LHVs have identical, or in some cases even better braking power and visibility than regular truck combinations because of the additional requirements imposed on LHVs.

4.4 Summary: Exemptions and enforcement on LHV use

- A transport company needs a special exemption in order to deviate from legal requirements and thus use an LHV in the Netherlands. Licensing LHVs is not possible due to the current European directive EC/96/53, which only allows exemptions.

- Exemptions are subject to certain conditions. These conditions have been laid down in the policy rule 'Policy regulation on approvals and exemption permits empirical phase LHV 2009'. A policy rule is a kind of directive which government bodies, within their jurisdiction, can use to issue regulations that have no legal status, but that can be waived only in exceptional cases.

- The basic principle for allowing LHVs on the Dutch road network is that they use suitable roads as much as possible. This means that LHVs mainly use roads that already carry a lot of truck traffic.

- The LHV-network consists of: the basic network, the core areas and connecting roads. The basic network consists of motorways and other roads managed by the Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat). A core area is defined as an area without agricultural or residential zoning (in terms of road classification), in which one or more companies are located that form a destination or point of departure for an LHV-trip. Examples are industrial areas, ports and auction house areas. Connecting roads include roads that connect a core area to the basic network. In most cases these are main arteries that are managed by Provinces.

- The advisory list 'LHVs on the secondary road network' of the National Technology Platform for transport, infrastructure and public space (CROW) supports road administrators in their assessment of roads for LHV-suitability. The list analyses the secondary road network and assesses every individual traffic situation for LHV-use in terms of road design and traffic safety.

- Every one of the more than 400 road management authorities in the Netherlands can autonomously decide whether or not to allow LHVs in their respective areas.

- Supervision of the operational use of LHVs is the responsibility of the Inspectorate for Transport, Public Works and Water Management (IVW), which does periodic, retrospective monitoring through administrative systems, the National Police Agency (KLPD) and the regional traffic police (everyday road use).

- When it comes to (over)loading LHVs, most companies appear to have taken adequate measures, according to an investigation by the Inspectorate for Transport, Public Works and Water Management (IVW). Approximately 92.5% of LHVs weigh less than 50 tonnes. Only 7.5% of vehicle trips take advantage of the extension to 60 tonnes for an LHV. Among container transport companies there were a number of companies that made several overloaded trips.

- During an expert session that was part of a study on traffic safety (2009) [1] the National Police Agency (KLPD) stated that during regular traffic safety inspections, LHVs stand out in a positive way. Equipment is generally in order and LHV-drivers are considered to be very responsible. Special requirements for LHV-drivers play an important part in this, enforcers say.

5 Traffic safety: objective and subjective perception

As a condition for practical trials with LHVs, the Ministry of Transport, Public Works and Water Management has stipulated that traffic safety may not be affected in a negative way. The effect of the use of LHVs on traffic safety can be measured objectively, with facts and figures. However, the subjective traffic safety experience is also relevant when a new type of vehicle, such as an LHV, is introduced. Subjective traffic safety can be tracked by looking at experiences and perceptions of road users involving LHVs in traffic. During the trial periods, the effect of LHV use on both objective and subjective traffic safety has been studied extensively and in several different ways.

Objective traffic safety has been studied during the Second Pilot (2004-2006) [22] and in an accident analysis report in 2009 [1]. Additional observations have been made for the advisory list 'LHVs on the secondary road network' in 2008 [5] by the Institute for Traffic Safety Research (SWOV), by having researchers drive along in LHVs [7].

The subjective perception of traffic safety in relation to LHVs has been examined in 2005 through a survey among one thousand motorists [30]. This study was repeated in 2009 [2]. Given the relatively small number of LHVs and the types of road on which these vehicles usually run, the studies thus far have only focused on motorists.

5.1 Objective traffic safety: few accidents with LHVs

In 1997 a project group called 'Longer and Heavier Vehicles' concluded that for an LHV the risk characteristics are similar to those of a regular truck combination, as long as they meet a number of preconditions [33]. The most important LHV pre-conditions involve braking systems, vehicle stability and the driver's field of vision. The project group noted that safety is also related to the roads on which an LHV operates. For instance, the time it takes to clear a railroad crossing can cause problems, as do short acceleration lanes and the relatively large turning circle of LHVs. Additionally, driver skill is considered important.

Objective traffic safety is largely determined by the number of kilometres that LHVs are driven and by certain LHV-specific features. For instance, the use of LHVs will lead to an overall decrease of the number of vehicle kilometres, which has a positive effect on traffic safety. Alternatively, LHV-specific characteristics could increase the risk that an LHV is involved in an accident with a greater likelihood of serious consequences.

5.1.1 Objective traffic safety during the Second Pilot (2004-2006)

During the Second Pilot, objective traffic safety was studied in several different ways. In addition to listing the number of incidents, researchers interviewed people and observed driver behaviour [22].

Because of the limited scope of the trial, it was relatively easy to identify the accidents involving LHVs, which happened within the trial period. On top of that, transport companies were obliged to report such accidents. During the Second Pilot no major accidents occurred.

For the benefit of the monitoring study, representatives of the CCV (the organization that accredits professional drivers) and members of the traffic enforcement division of the National Police Agency (KLPD) were interviewed. They all said that they had the impression that LHV-drivers are the elite among professional drivers. They are clearly more involved and more responsible about their jobs than the average truck driver. But the expectation is that, as LHVs become more common, less qualified drivers will also get to drive these vehicles. The scope of this effect cannot be predicted; adhering to the requirements for LHV-drivers (see 4.1) seems to be essential.

Observing the driving behaviour of LHV-drivers did not show a negative impact on traffic safety either. Because of their special training, drivers are well aware of the added length and weight of LHV-combinations. Drivers indicated that they are extra alert when merging in and out of traffic. Thanks to mirrors and cameras there seems to be no problem with the vision of the driver in complex traffic situations.

Because LHVs only take specific routes, drivers are usually well aware of possible problems on the road. Driving on the secondary road network can be more difficult. With regards to road design, the following points require extra attention, according to LHV-drivers:

- Sharp turns: When making a sharp right turn, LHV-drivers sometimes need to use two lanes in order to properly make the turn;
- Intersections: During interviews some LHV-drivers indicated that sorting lanes at certain intersections are sometimes too short. Drivers sometimes also need to move over hatched road markings, but this situation does not differ from driving a regular truck combination. It is an issue that needs attention, because LHVs (and regular trucks) can quickly fill a sorting lane and thus block the main road. This may have a negative effect on traffic flow and traffic safety;
- Acceleration: LHV-drivers feel that it takes longer to gain speed in an LHV, even though tests have shown that the acceleration speed of an LHV is not lower than of a regular truck. The green light window of some traffic lights is too tight and short lanes make merging difficult;
- Parking: At this moment there are not enough LHV-parking spaces. In addition to that, drivers are calling for the installation of special LHV-coupling sites in core areas in order to make maximum use of the flexibility of the LHV-concept;
- Manoeuvring space: Driving in reverse with an LHV is more problematic than with regular trucks. This is especially problematic around distribution centres where space is sometimes limited. The installation of dedicated loading/unloading docks is very much welcomed by LHV-drivers;
- Road work: In the event of road work there currently is insufficient consideration for LHVs in terms of detours and road blocks;
- Breakdown areas: Some breakdown areas are too short for LHVs.

5.1.2 Observation study for the CROW advisory list (2008)

In 2008 the Institute for Traffic Safety Research (SWOV) was asked to investigate the accident risk that an LHV poses in comparison with a regular truck combination [7]. The findings, included in the CROW advisory list, related to: 1) the interaction with vulnerable road users (pedestrians, cyclists and moped riders) at intersections, 2) the possible effect of two-wheelers being sucked in by LHV-drag and 3) the risk during twilight or darkness. Below are the results.

1. Interaction with vulnerable road users at intersections

Accidents between trucks and vulnerable road users often happen at intersections. Annually, about 18 people die when they get caught in the blind spot of a truck making a right turn. This happens especially in an urban environment. Prior to this observation, the SWOV had two hypotheses:

- Before moving to the right, an LHV is likely to move to the left in order to make the turn; cyclists and moped riders will therefore not expect an LHV to move in their direction.
- Drivers of LHVs are likely to monitor the rear swerve of their truck more closely in their mirrors than drivers of regular truck combinations. This may prevent them from paying enough attention to other traffic.

The study included sixty practical observations. Researchers spent considerable amounts of time with truck drivers on the road during regular trips. Intersections and roundabouts were closely monitored.

The conclusions of the study were:
- In situations where bicyclists are not positioned immediately next to an LHV, the problem does not occur. When, under similar circumstances, bicyclists are positioned immediately to the right of an LHV, they are not in any more danger than next to a regular truck combination;
- The swerve and/or catching up of the trailer is continuously monitored by the drivers, but rarely at the expense of observing other traffic;
- LHVs do not seem to be especially dangerous in the interaction with vulnerable road users at intersections, mostly because these situations are taken into account when routes are assessed for use by LHVs. For example, by only assigning roads that have a separate infrastructure for bicyclists.

2. The effect of LHV-drag on two-wheelers

A passing vehicle displaces air, which may create a negative effect on two-wheelers on the road or on a bike path adjacent to the road. Tests performed on the National Vehicle Authority (RDW) test track in Lelystad have shown that LHVs are no different than regular truck combinations in this respect. There is no additional danger for mopeds on straight roads and intersections.

3. Risk during twilight or darkness

LHVs are required to have contour markings on the back, whereas regular truck combinations hardly ever have those. As far as rear end collisions go, an LHV probably has the advantage during twilight and darkness. The presence of side markings does not make a difference between various truck combinations. The risk of a side collision seems greater for LHVs when they cross a road during twilight or darkness. Overtaking an LHV is more risky when you do not notice that you are dealing with an LHV. The mandatory sign on the back indicating the length of an LHV must therefore be clearly visible at night. This has been incorporated in the exemption requirements for the Third Pilot.

5.1.3 Objective traffic safety during the Third Pilot (2007-2011)

The main question of the study into objective traffic safety (completed in December 2009) was whether the use of LHVs on the Dutch road network could lead to problems with traffic safety, traffic flow and road design [1]. In order to find out how many accidents involving LHVs have occurred since the start of the Third Pilot, the LHV-registrations database at the National Vehicle Authority (RDW) was cross-referenced with police accident records. Because the number of LHVs in this period is too small to draw reliable conclusions at a national level, the accidents that happened were thoroughly described and analysed. Based on the accident analysis, working hypotheses were submitted to experts (LHV-drivers who were involved in an accident, other LHV-drivers, road administrators and enforcers).

From 2007 to mid 2009, eleven accidents involving LHVs were recorded. All these accidents only caused material damage. None of the accidents involved vulnerable road users. Not every accident that occurs is recorded by the police. However, given the high documentation rate of accidents causing injuries and/or death, it is unlikely that an accident like that has occurred involving an LHV. In seven out of eleven accidents, one of the LHV-specific characteristics may have played a part (i.e. the extra length or swerve). These accidents are all typical truck accidents, i.e. the kind that is relatively common in regular truck traffic. Also, three of the accident locations were known to be accident hot spots. Two out of seven LHV-accidents can be attributed with certainty to a manoeuvre by the other person involved.

In conclusion, accident analysis does not give any indication that an LHV creates a higher accident risk than a regular truck combination. Interviews with the experience experts have yielded a few points of interest:

- LHV-drivers believe that their vehicles are not recognizable enough from the sides, so during overtaking or merging, other road users may find out too late that they are dealing with a vehicle that is extra long. Especially in situations with short merging lanes, and on busy motorways with a high density of entries and exits this may be risky;
- Poor weather conditions (strong winds and icy roads) in combination with lower axle pressure due to a light or small load, may also cause an increased safety risk for LHVs. Drivers suspect that an LHV that is about to tip over may be harder to control than a regular truck.

Interactions with slower traffic always create an increased safety risk. This is not any different for LHVs than for regular truck traffic. As reported by the drivers, most of the potentially risky situations for LHVs happen on the main road network. They also indicate that they encounter very little slow traffic on their routes. Other experience experts agree that the creation of designated LHV-routes seems to work very well. Vehicle requirements, and the special training for LHV-drivers seem to be a success. Similarly, no issues with regards to traffic flow have been encountered.

Experience experts have mentioned a few possible improvements:

- Vehicle Requirements: It is advisable to do a follow-up study to see if the engine power requirements are sufficient. Another possible improvement would be to increase side visibility of an LHV for the benefit of other road users. A further study into the lateral movement and/or swerve of LHVs is recommended, especially under poor weather conditions in combination with a limited load;
- Road administrators: In accordance with the CROW-publication 'LHVs on the secondary road network' [5] it was recommended to maintain the current restrictions on LHVs in urban areas. It is also recommended to create a separate Incident Management Protocol for LHVs. When building new traffic infrastructure there should be more emphasis on creating longer areas for breakdowns and parking spaces, and on creating more parking spaces suitable for LHVs. Furthermore, short merging lanes should be avoided when possible. In the case of roadwork on an LHV-route, detours and roadblocks should preferably be able to accommodate LHVs. At the very least there should be a way to notify the affected transport companies in a timely manner;
- Exemption issuing authority: It is recommended to see if the intended LHV-route can be incorporated into the practical exam for an LHV-driver.

5.2 Subjective safety: experiences of motorists

A survey of over 1,000 motorists [2] in the autumn of 2009 studied the support for LHVs in the Netherlands, with emphasis on traffic flow and safety. The study is representative for Dutch motorists. A similar survey was conducted in 2005 by TNS-Nipo [30]. Where possible, the results have been compared.

Included in the 1,000 motorists questioned in 2009 is a group of nearly 150 people with practical experience regarding LHVs in traffic. A motorist is considered to have direct experience with LHVs if he or she has been directly involved in a traffic situation with an LHV, such as overtaking.

The survey showed that there is little opposition to LHVs among motorists. More than four-fifths (83%) felt positive or neutral about this type of trucks. One in eight (12%) motorists had negative feelings towards LHVs. Interestingly, resistance towards regular truck traffic was higher: 20% of the motorists held a (very) negative view. Motorists who have practical experience with LHVs show the least aversion: 87% of them are positive or neutral towards LHVs; 11% are 'opposed'.

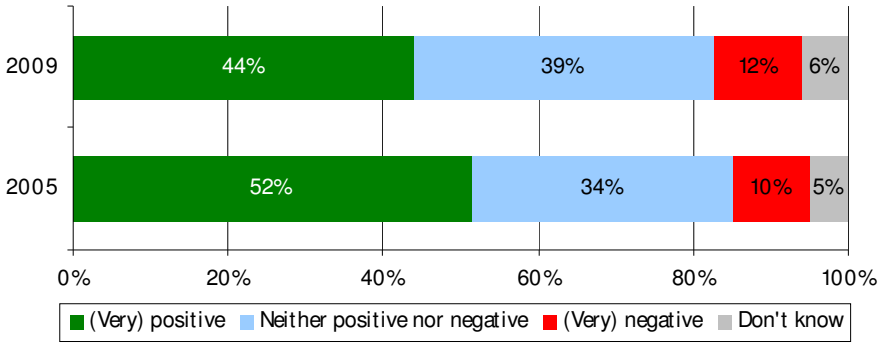

Figure 5.1 *How do you generally view LHVs? (2009 n = 1008, 2005 n = 513) [2]*

The vast majority (95%) of respondents felt safe in traffic and does not consider traffic to be dangerous (81%). Motorists who feel less positive about truck traffic in general and LHVs in particular more often find traffic to be unsafe and dangerous. Motorists generally expect improvement rather than worsening of traffic flow when LHVs are allowed on the road (34% versus 27%). Furthermore, approximately one quarter of motorists believe that traffic safety would improve by allowing LHVs. This is significantly higher than in 2005, when only 14% expected a positive impact on traffic safety.

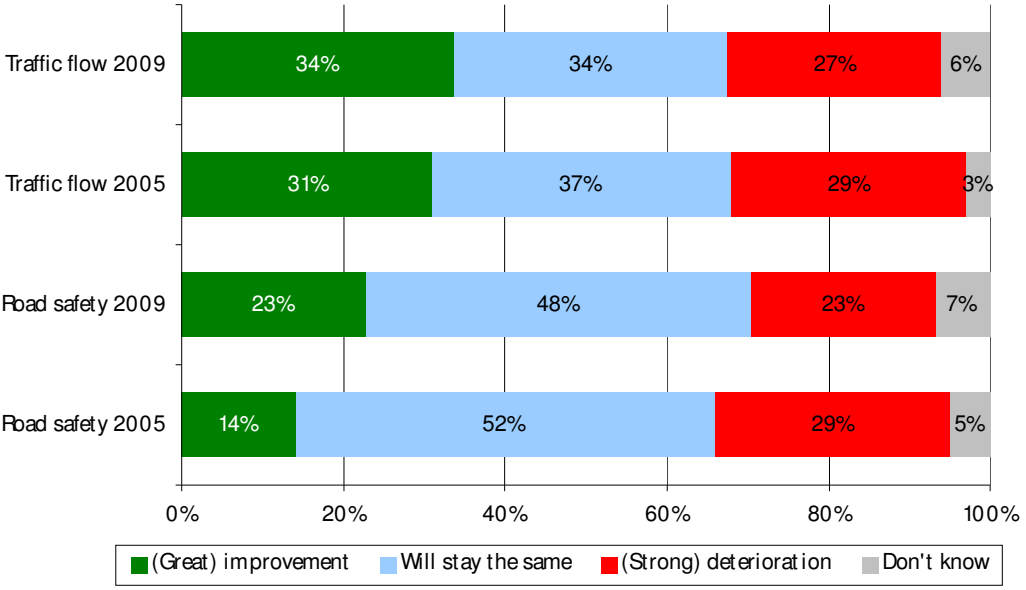

Figure 5.2 *Effect of general admission of LHVs on traffic safety and traffic flow. (2009 n = 1008, 2005 n = 513) [2]*

Almost all motorists who have had a specific experience with an LHV had this experience on a motorway. In most cases (87%) the situation was not considered dangerous. A small part of this group (12%) did find the situation dangerous. What is considered dangerous is the idea that an LHV-driver may not notice a motorist, that it may be hard to overtake an LHV, and the expectation that an LHV has a

longer stopping distance and is likely to swerve more than a regular truck combination.

All motorists were shown video clips of manoeuvres for overtaking, merging and turning. (For the turning manoeuvre, two lanes merge into one after the turn.) The manoeuvres were performed from the perspective of a passenger car following another passenger car, a regular truck and an LHV. These videos have been used in both the 2005 and the 2009 surveys. The manoeuvres with LHVs were considered to be less dangerous in 2009 than in 2005. Three fifth of motorists (62%) considers them as not (very) dangerous at all, versus 55% in 2005. The majority of motorists (about 85%) does not feel unsafe in the presence of an LHV. More than 10% feels unsafe. This group is mostly 'anxious' because of the blind spot of LHVs, and expects the driver to not have enough vision to see all cars. These feelings of unsafety differ little from those with regards to regular truck traffic.

LHVs must comply with a number of additional requirements to be admitted on the road. Without knowing these requirements, motorists believe that special provisions should be made for LHV-drivers (they should have more driving experience and special training), as well as for the roads on which LHVs are allowed (not in city centres), and also for the vehicle itself (the cargo should be thoroughly fastened, not be too heavy and not include hazardous materials). Often mentioned is also the fact that longer and heavier trucks should not be allowed to overtake and should not have a longer stopping distance. The suggestions from motorists largely correspond with the conditions for LHV-exemption that are set by the National Vehicle Authority (RDW). Once the requirements for longer and heavier trucks are communicated to motorists, a very large majority (93%) think that these are sufficient to ensure safety. That is higher than in 2005 (87%).

In summary, the survey indicates that among motorists there is little resistance to LHVs, and that they usually do not feel unsafe with LHVs in traffic. Based on these findings, there seems to be no reason to change the existing policy towards (the admission of) LHVs on the Dutch road network.

5.3 Summary: General effects of LHV use on traffic safety

- As a condition for practical trials with LHVs, the Ministry of Transport, Public Works and Water Management has stipulated that traffic safety may not be affected in a negative way. The effect on both objective and subjective traffic safety has been extensively studied during the pilot trials.

- The effect of the use of LHVs on traffic safety can be measured objectively, with facts and figures. However, the subjective traffic safety experience is also relevant when a new type of vehicle, such as an LHV, is introduced. Subjective traffic safety can be tracked by looking at experiences and perceptions involving LHVs and other road users in traffic.

- There have been no major accidents during the Second Pilot (2004-2006). From 2007 to mid 2009, eleven accidents occurred involving an LHV. In all of the eleven cases there was only material damage. No vulnerable road users were involved in these accidents.

- In seven out of eleven accidents, one of the LHV-specific characteristics may have played a part (i.e. the extra length, or swerving). However, these seven accidents all are typical truck accidents, i.e. the kind of accident that is relatively common in regular truck traffic.

- Observations of the behaviour of LHV-drivers and interviews with experienced experts (such as road administrators and enforcement) suggest no deterioration of traffic safety when LHVs are admitted. LHV-drivers generally stand out because they are clearly more serious and more responsible about their work than the average truck driver. However, discussions with LHV-drivers and other experience experts produced a number of attention points about road design and LHVs, among others on sharp turns, intersections and road works.

- In observational research in 2008, the risk of a right-turning LHV to vulnerable road users, compared with a regular truck combination, was studied. The survey indicated no additional risk, especially because this issue is explicitly taken into account when LHV-routes are assessed. For example, LHVs are only allowed on roads with a separate infrastructure for bicyclists.

- Overtaking an LHV during twilight or darkness can be risky if you have not noticed that you are dealing with an LHV. The mandatory length-markings on the back of an LHV must therefore be clearly visible at night. This has been incorporated in the exemption requirements for the Third Pilot.

- Surveys among 1000 motorists in 2005 and 2009 indicate that there is little resistance to LHVs and that motorists do not usually feel unsafe when they encounter LHVs in traffic.

6 Practical experience with LHV use in business

6.1 Practical experience with the operational use of LHVs

As of January 2010, there were 196 companies with a total of 429 exemptions to operate an LHV-combination. Most of these companies applied for an LHV-exemption to save on transportation costs by carrying more volume per trip. Another important factor is CO2 emission-reduction. The operating costs for LHVs are only marginally higher than for regular truck combinations, while they can carry up to 50% more cargo per trip. In the case of city trailers this could be as much as 100%.

In order to benefit from the use of LHVs, a company should have very regular flows of goods between two or more fixed locations, and this flow should be guaranteed for the mid-to-long term. Adjustments may be necessary in distribution areas, in order to give an LHV enough manoeuvring space around the docks for loading and unloading. This means that a company generally makes careful considerations before applying for an LHV-exemption, in spite of the potential cost benefits.

6.2 Overview: practical experience with LHV use in the Netherlands

Since 2001, LHV-use in the Netherlands has been studied during three test trials: a small-scale pilot (2001-2003), a large-scale pilot (2004-2006) and the current Third Pilot, which started in 2007. The experiences are summarized below.

6.2.1 Initial small-scale pilot - 2001-2003

During the period 2001 - 2003 an initial small-scale pilot study was held [32]. The most restrictive condition of this trial was that LHVs could only be used for combined transport. Companies were initially very enthusiastic about the trial, but ultimately could not participate because of the strict requirements. In the end there were four participants: three container and a waste transport company. The results were positive:

- The companies managed to successfully integrate LHVs into their new or existing transport processes, and generated significant cost savings;
- The use of LHVs led to a reduction in fuel consumption and CO2-emissions per tonne-kilometre;
- There have been no incidents or accidents with LHVs during the trial;
- The benefits of LHV-use depended strongly on the governing conditions.

Based on these results the decision was made to set up a second, more extensive trial.

6.2.2 Second, large-scale pilot - 2004-2006

Although the first trial adequately showed the practical feasibility of LHV-use in the Netherlands, the results did not produce enough action points for policymaking. A

larger study should provide insight into the consequences of LHV use for participating companies, but especially the consequences on a national level [22]. When an LHV-exemption was granted, the participants were required to surrender data for research. For that purpose, the second, large-scale trial used specially designed trip forms. With these digital forms drivers could submit data after completing a trip, such as fuel consumption or kilometres travelled. These trip data were analysed to show the impact on traffic safety, the environment and the modal split, when market potential for LHVs would be completely exhausted.

At the start of the Second Pilot in 2004 there were 66 participating companies with a total of around 100 LHV-combinations. The monitoring study of the trial is based on this number. In the end 76 companies participated, with a total of 162 LHV-combinations. Enthusiasm for a participation in the pilot increased when the strict requirement of combined transport was lifted, making participation more interesting for many companies. The main results from the monitoring study were:

- Market potential for LHVs: A study examined to what extent transportation in the Netherlands could be done by LHVs. Depending on the restrictions, between 7 and 31% of regular truck movements with a payload of more than 20 tonnes could be performed by LHVs. This means that in the future a maximum of 6,000 to 12,000 LHVs could operate on Dutch roads. These LHVs will replace 8,000 to 16,000 regular truck combinations. On balance, the number of truck combinations on the road will decrease by 2,000 to 5,000.

- Long trips with LHVs: Average trips during the trial were significantly longer for LHVs than for regular truck combinations (137 versus 75 km). However, the average number of stops per trip (and thus the amount of delivery addresses) did not vary much. This led to the conclusion that the distance between two delivery points is larger for LHVs than for regular truck combinations. This is due to the fact that LHVs are deliberately used for longer journeys. The 'profit' from using an LHV must be made during the trip, since loading and unloading on average takes longer.

- LHVs offer more efficient transport volumes: The used loading capacity for goods of heavy weight is generally lower than for volume goods. That is because goods of heavy weight are usually transported in so-called shuttles, which return empty. This percentage for both LHVs and regular truck combinations is just below 50%. For volume goods, LHVs offer higher efficiency benefits, and the used loading capacity increases from 67% to 73%. LHVs appear to transport more goods, both absolutely and relatively speaking, and relatively less loading capacity remains unused. In conclusion, within the trial period, LHVs had a more efficient loading capacity than a regular truck combination.

- LHV-routes on motorways in the Netherlands: During the trial, LHVs primarily used motorways, mainly in the western part of the Netherlands (Randstad). The map on the following page shows the routes that were taken during the LHV-trial, based on submitted trip forms. Purple routes have been used more than 100 times, orange routes 50-100 times and green routes 15-50 times. The Rotterdam area appears to be mostly used by container transport companies. The trial included several flower transporters who primarily used routes between flower auction houses in Aalsmeer, Naaldwijk and Bleiswijk.

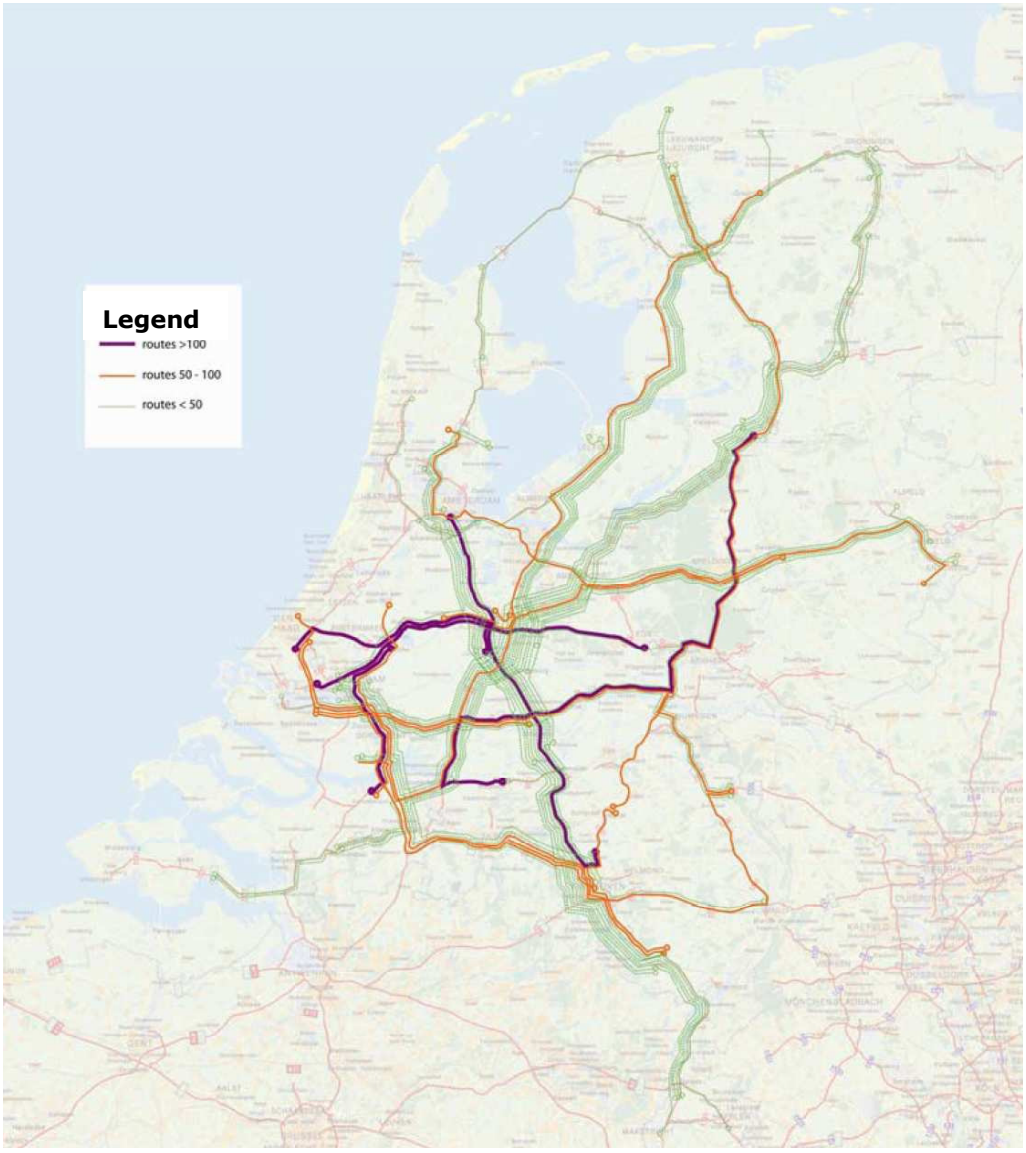

Figure 6.1 LHV-routes used during Second Pilot 2004-2006 [22]

The results of this test were also positive, meaning that admission of LHVs on this scale did not have unwanted effects. As expected, the trial showed that LHVs contribute to a reduction of fuel consumption, emissions, and traffic congestion. Admission of LHVs did not lead to a deterioration of traffic safety and there were no indications of the emergence of a reverse modal shift. The increasing number of participants in the trial demonstrated that the use of LHVs can be attractive to transport companies, even within a small country like the Netherlands.

The trial was followed by a transitional period. Participants from the Second Pilot could continue under the same conditions, but no new exemptions were granted. This transitional period lasted until November 1, 2007.

6.2.3 *Third Pilot - 2007-2011*

On November 1, 2007 the Third Pilot for the introduction of LHVs started. This phase will end in 2011. By October 2009 there were 190 companies with LHV-exemptions, and 150 of them have been categorized by the type of market they cover. There are several sectors, of which retail (24%), container transport (22%) and floriculture (14%) are the main three.

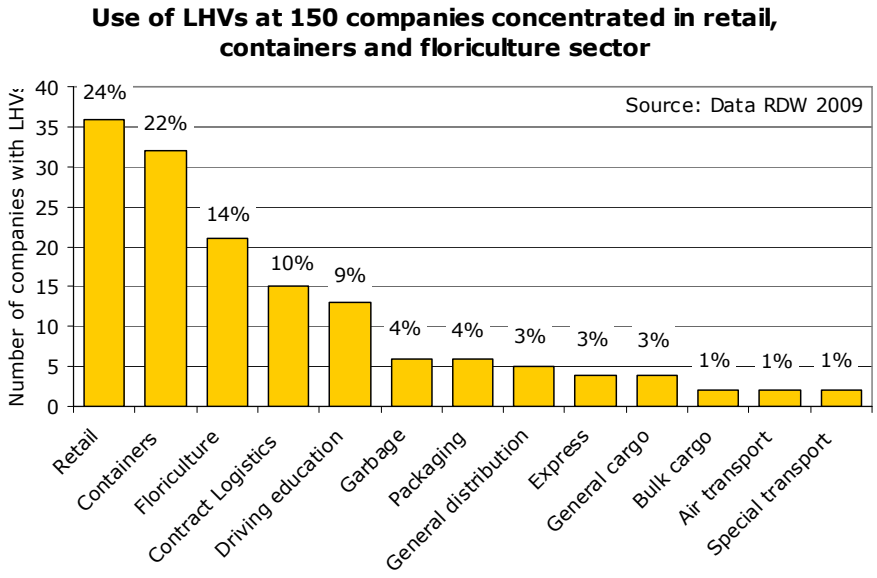

Figure 6.2 Sectors in which 150 companies with LHV-exemptions operate, as of September 2009 (source: Data RDW)

Business Case: More efficient distribution of groceries with LHVs

Left: Peter Leegstraten

Albert Heijn is the largest supermarket chain in the Netherlands and part of the global Ahold group. Albert Heijn (AH) didn't decide to start using LHVs until late 2009. AH intended to start using a double LHV-city trailer earlier, but it was not ready for use due to technical reasons. AH did not want to use different LHV-configurations because they are often unsuitable for store-distribution. AH only wants to use a limited variety of semi-trailers in its fleet. Per mid-February 2010, Albert Heijn uses a total of 15 LHVs in different configurations. Mid-2010, the use of LHVs will be evaluated by Albert Heijn to assess in which way and with which configurations the retail company want to carry out part of it's distribution. The first experiences are promising.

The distribution concept that Albert Heijn has in mind works as follows: for longer trips between a distribution center and a city with several AH-stores, an LHV is used. On the outskirts of town, the semi-trailers are uncoupled and taken to the stores one by one.

For distribution to the stores, AH intends to use tractors running on alternative fuel (natural gas/LNG). The idea is to subsequently minimize empty LHV-runs by collecting freight from local suppliers; collect packaging (pallets, empty bottles and crates etc); or transport volume goods between AH-distribution centers and sister companies Etos, Gall & Gall and Albert, so the LHV never runs empty.

The main reasons for AH to start using LHVs are fuel savings, increased logistics efficiency and a reduction of CO2 emissions (part of AH's policy on corporate social responsibility). AH also has other reasons to use LHVs. The company expects that in the future it will be difficult to find drivers, while fuel cost will continue to rise. Traffic jams can be avoided when using LHVs. This can be done by driving to a city with a quiet LHV early in the morning, uncouple and take care of distribution with one city trailer. When it is empty, the other trailer can be taken for a second distribution run. The return trip happens after rush hour. In this case, distribution takes place outside the regular workday. Especially for areas outside the Randstad this concept seems practical. AH calculates a break-even distance of 1 hour and 15 minutes and expects a 35% cost reduction by using LHVs. Adjustments to the docks and the maneuvering space around distribution centers still have to be made.

Source: Interview with Peter Leegstraten, transport manager at Albert Heijn, November 2009

6.3 Average cost benefit of LHV-use to companies

The second field trial (2004-2006) included a calculation of the cost benefits of the use of LHVs compared to regular truck combinations. This calculation was made for companies in three sectors (containers, general cargo and bulk), because of the different transportation cost per sector [22]. The higher costs per kilometre were multiplied by the benefit of 40% extra cargo per trip (on average), upon which the total cost benefit was calculated. In an online survey, participating companies were asked to submit cost per kilometre for both LHVs and regular truck combinations over 20 tonnes.

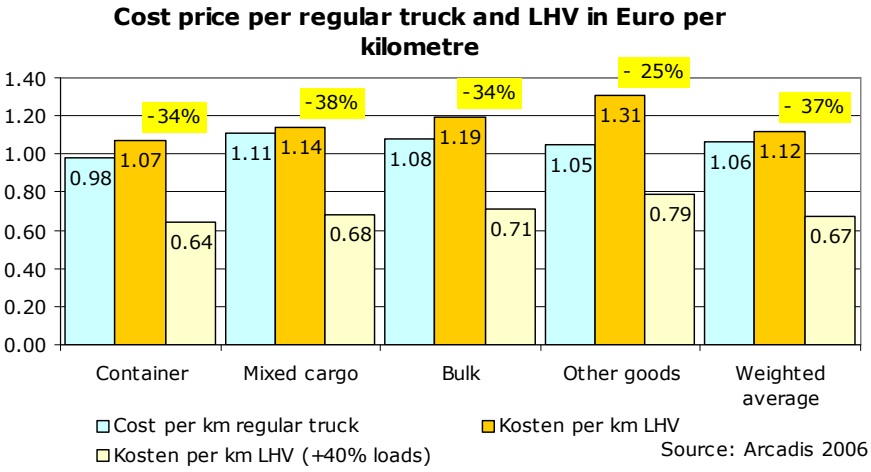

Figure 6.3 Cost per kilometre of LHV versus regular truck [22]

The figure on the previous page shows that the difference in kilometre cost between an LHV and a regular (heavy) truck combination is relatively small in the cargo and container sectors, despite a much larger loading volume. Because an LHV needs fewer vehicle kilometres to move the same volume, the largest gains can be made in containers and general cargo. The loading capacity of an LHV is 40% larger, which means that cost savings per trip are between 25% and 38%. In the short term, these financial gains are divided between the shipper and the transport company. In the long run, this is not acceptable in a competitive market, and savings will possibly be passed on to the consumer.

Business case: Dachser commits to LHVs for major customers

Logistics provider Dachser is committed to using LHVs in the near future, in the form of the Eco-Combi. The aspect of sustainability is certainly very important for the CEO of Dachser Benelux, Aat van der Meer. "But efficiency is the main benefit. An LHV will let you transport 50% more, so you need fewer cars." Dachser, whose Dutch offices are in Waddinxveen and Zevenaar, has just put a second LHV into operation in December 2009. A third 25.25 meter-long LHV will follow in January 2010. "In time, we want to have six of them in the Netherlands, for as many customers. Those six customers cover about sixty percent of export volume, so LHVs suddenly have become a very important tool."

Aat van der Meer sees the LHV as a way to realize his company's growth strategy in the Netherlands. With Philips and Fellowes (supplier of office products) Dachser has customers that require transportation of large volumes within their own network. A few months before, Dachser's first LHV was put into operation to move freight for Philips. According to Dachser, this LHV-truck can transport up to 40 percent more cargo per trip than a regular truck combination. The use of LHVs should give both Dachser and Philips a 'green' added value. By making fewer trips, the total CO2-emissions are reduced and in spite of the larger loading volume of the LHV, the increase in fuel consumption is zero. "Using LHVs is part of our commitment to environmentally friendly business," says Pascal Gielen, transportation manager of Philips Lighting. "It improves traffic flow. And on top of that, it is now possible to quickly move large quantities over the road." Dachser Benelux is pleased with Philips' decision to use LHVs. Gielen is looking forward to seeing LHVs on the road in more countries. "We can already service many areas in the Netherlands with this LHV. In countries around us, however, there is opposition to their introduction. It is our ambition to deploy these trucks all over Europe."

Source: www.logistiek.nl, retrieved September 9 and December 9, 2009

6.4 Operational experience of LHV-use by companies

During the Second Pilot, transportation companies had the following experience with LHVs [22].

- Management and Planning: In most cases, an LHV can be incorporated fairly easily into an existing planning system. Extra effort is required to deploy an LHV in the most efficient way within an existing schedule. One advantage of LHVs is that loading capacity can be used more optimally because of its larger size. For instance, one LHV and one regular truck combination (almost completely full) can be used to move 85 Euro pallets, whereas in the old situation three regular combinations had to be used (one of which was only partially loaded);
- Loading and unloading: Loading and unloading an LHV requires more time than a regular truck combination, because it holds more cargo. In addition to that, the time required to manoeuvre LHVs around loading docks can be longer too. During the Second Pilot (2004-2006), the average handling time difference (regular versus LHV) went up from 60 to 87 minutes. This is an increase of 32%, which is consistent with the increase in cargo volume/load capacity of an LHV compared to a regular truck combination;
- Cost: At the time of the study, almost half (48%) of the transport company's cost consisted of staff and approximately 20% of fuel. These two factors largely determined the cost of transportation. During the trial, participants were asked (in an online survey) how the cost structure of LHVs differed from regular truck

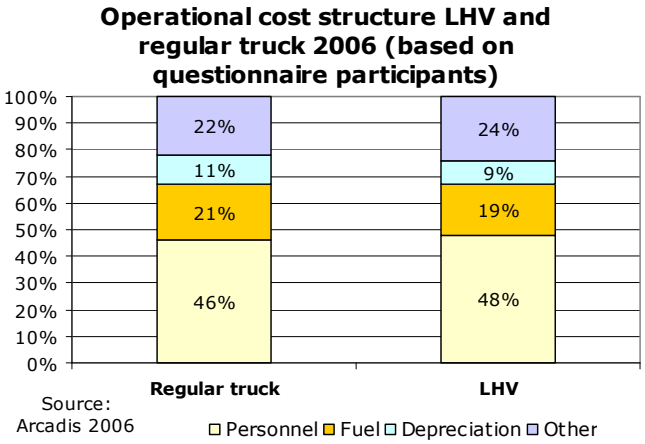

Figure 6.4 Little difference in economic cost between LHVs and regular truck combinations [22]

This figure above shows that, as far as cost structure goes, there are relatively few differences between LHVs and regular truck combinations during the trial. LHVs have higher staff cost, but lower fuel and depreciation costs. The cost structure does not include the savings per trip that can be achieved with LHVs, which would have a positive impact on the cost of an LHV;

- Return on investment: During the Second Pilot, all participants were asked whether the investment in an LHV could be recovered over the duration of the trial. The response differed per participant. A determining factor was whether an entirely new LHV (price circa € 200,000) was purchased or if an LHV was

assembled from existing equipment, with some adjustments (cost approximately € 25,000 - € 50,000). In the first case, the return time certainly exceeded the duration of the test; in the second case, many participants could already generate sufficient additional income within the trial period to make the investment profitable. When making the investment, many of the participants speculated that the test would be extended beyond 2006. It should be noted that various components of a newly purchased LHV can also be used as part of a regular truck combination. In most cases, only the dolly is an additional module which cannot always be used in a traditional truck configuration.

6.5 Innovations in the logistical process through use of LHVs

There have only been minor innovations in the logistical process during the Second Pilot (2004-2006). For the most part, participants limited themselves to incorporating LHVs into their existing logistics and processes as well as possible. The innovations included:

- Loading and unloading cargo through centre-axle trailers and semi-trailers (behind trucks). This eliminates the need to uncouple trailers for loading and unloading, which keeps the load/unload time to a minimum;
- Container transport with the double-B concept, which gives transport companies the option to use a 3-TEU truck to move all containers to a loading dock;
- For some companies distribution has been centralized in order to make optimal use of LHVs. The result is a reduction in the number of transport kilometres;
- Shuttle Transport between distribution centres: the LHV is used to go back and forth between distribution centres during night hours. This will generate efficiency benefits by creating a 'concentrated flow' with LHVs. It also reduces travel time of day-time trips, which offers benefits in terms of the Driving Hours Decree and additional travel time due to congestion during the day.

The expectation was that the number of innovations would increase during the Third Pilot, which happened indeed. The most important innovation was the increased use of LHV-combinations with two city trailers of about 10.60 meters. This allows stores in urban areas to be supplied easily, and they hold up to 100% more cargo.

Business case Cornelissen Transport: innovation by use of LHVs

Cornelissen Transport is a logistics service provider with a fleet of approximately 90 vehicles in ownership and 30-40 rented vehicles. At the time of the interview, the company operates three LHVs. Two additional LHVs are on order and will be delivered in March 2010. The three current LHVs each have a different configuration. The first LHV (in use since 2005) is a truck with trailer (C-configuration). This LHV is used for moving cargo between distribution centers. The second LHV is a B-configuration combination with an 8 meters semi-trailer and a 13.60 meters semi-trailer. The third LHV is a B-configuration city trailer with two equal semi-trailers of 10.55 meters. The second and third LHV can be used in network distribution, because the trailers can be uncoupled. The second and third LHV-configurations seem to have the most potential for the future, according to Cornelissen. Cornelissen expects to purchase several more city-trailers, most likely in a ratio of 25% with 8 and 13.60 meter loading areas and 75% with two equal semi-trailers of 10.55 meters.

Cornelissen is one of the pioneers of LHV-use in the Netherlands. The first LHV was a challenge in terms of planning and warehousing. The extraordinary new concept had to be incorporated into the existing logistics operation. An LHV, for instance, needs extra maneuvering space around a distribution center. These problems have been solved and LHVs are now being used daily.

LHVs are sustainable in everyday use, because they use only 10% more fuel while they can transport 50% more cargo. For Cornelissen it is imperative that they have a high degree of capacity utilization. This can only be done with regular customers. The LHVs are cheaper to use. Based on experience, the company estimates that for supermarket distribution, an LHV costs 10% less to operate than a regular truck combination. These cost savings are relatively low, but that is due to the relatively short distances in this type of transport.

Some of Cornelissen's major customers, such as Albert Heijn and Kruidvat, are strong motivators for investing in LHVs. Together with its customers, Cornelissen believes that innovation in road transportation can contribute to a reduction of congestion, emissions and fuel use. In spite of the recession of 2009, which caused an overall decline in cargo of 10-15%, Cornelissen and its customers have high expectations of the development of LHV-technology. The innovation that currently interests Cornelissen most is loading and unloading of the two semi-trailers without uncoupling the second trailer. In the right location, this can generate substantial time savings of up to one and a half hours per day.

Source: Interview with Mr. Zwart of Cornelissen Transport, October 2009

6.6 Summary: Practical experience of LHV-use in business

- The practical use of LHVs has been studied in the Netherlands since 2001 during three test periods: a small-scale First Pilot (2001 - 2003), a large-scale Second Pilot (2004 - 2006) and a Third Pilot (2007 - present).

- Experiences from the First Pilot were positive. The four participating companies successfully integrated the LHV into their operational processes and this created substantial cost savings. Deployment of LHVs also led to a reduction of the use of fuel and of CO2-emissions per tonne-kilometre.

- The Second Pilot (2004-2006) showed that the potential size of the LHV-fleet in the Netherlands, depending on restrictions, is 6,000 to 12,000 LHVs. The average LHV-trip was significantly longer during the trial than a regular truck combination (137 versus 75 km), and the loading capacity of LHVs was more efficiently used than of regular combinations.

- Initial results from the Third Pilot show that the use of LHVs is becoming more popular. As of January 2010 there are 196 companies with a total of 429 LHV-exemptions. Companies that use LHVs in the Netherlands are mostly found in the retail sector (24%), container transport (22%) and floriculture (14%).

- The transport companies interviewed for this trial indicate that reduced transportation cost and CO2-emissions are the most important reasons to apply for an LHV-exemption. The cost per kilometre for an LHV is on average 6% higher than for a regular truck combination. The cost for bulk and containers (heavy goods) are a little higher (10% and 9%). For general cargo this percentage is 3%. However, the average load capacity of an LHV is almost 40% higher, resulting in average savings of around 35% per LHV-trip.

- The Second Pilot showed that participants can often easily integrate LHVs into their logistics planning. The return on investment for LHVs is manageable in most cases, especially because of their modular character. Several components of a newly purchased LHV can also be used as part of a regular truck combination.

- The most significant innovation of the Third Pilot is the increasing popularity of an LHV-combination with two 10.60 metre long city trailers. This allows stores in urban areas to be supplied - and they can carry up to twice the amount of cargo.

7 The impact of LHVs on sustainability and modal shift

7.1 Research on emissions and the impact on the modal split

Dutch transport policy promotes co-modality. This means that it aims to strengthen each individual modality, without favouring one of the transportation modes over another. The policy is aimed at improving efficiency and optimising cooperation between the modes. A policy focused on modal shift only was deliberately abandoned since the 1990's. This does not mean that government measures should lead to a reverse modal shift, making freight transport less sustainable. That is why the Ministry of Transport, Public Works and Water Management wants to closely monitor the effects of LHVs on the modal split.

During the First and Second Pilot, the effects on sustainability have been calculated by using actual data on fuel consumption at a vehicle level [32] [22]. During the Second Pilot (2004-2006), general statistical data were used to estimate the impact on a national level. In a separate study in late 2004, noise measurements were conducted on LHVs [31]. The results can be found in 7.2.

The effects of LHV use on the modal split have been researched both quantitatively and qualitatively. The Second Pilot included a macro analysis [22] and in 2008 a baseline measurement was performed at a representative number of multi-modal inland terminals [6]. In the latter study, the number of incoming and outgoing goods was measured by modality use. The follow-up measurement is scheduled for 2011. If the follow-up measurement shows that there has been a shift compared to the baseline measurement, research will focus on possible explanations, including the admission of LHVs. At that point it will also become clear how reality compares to theoretical analysis. The baseline measurement is not included in this study because there is no relevant information yet.

Both the Second Pilot and the Third Pilot included interviews and a survey with stakeholders on the expected effect of LHV-use on the modal split [4]. The results can be found in 7.3.

7.2 The effect of LHVs on sustainability

7.2.1 Reduction of CO2, NOx and PM10 emissions

The emission of pollutants is directly linked to fuel consumption per transported weight. Thus, a decrease in fuel consumption directly leads to a reduction of CO2- and NOx-emissions. The production of fine particles (PM10) is directly linked to the type of engine and fuel consumption.

A study by the Centre for Energy and Clean Technology in 2000 (quoted in [22]) showed that emissions of CO2 and NOx decrease when LHVs are used instead of regular truck combinations. An LHV can carry more cargo per trip than a regular truck combination. This uses less fuel per tonne of transported weight, and a reduction in fuel consumption leads to lower emissions. The reduction in emissions

is calculated on the basis of a trip length of 150 km. The benefits of the use of LHVs can be found in Figure 7.1.

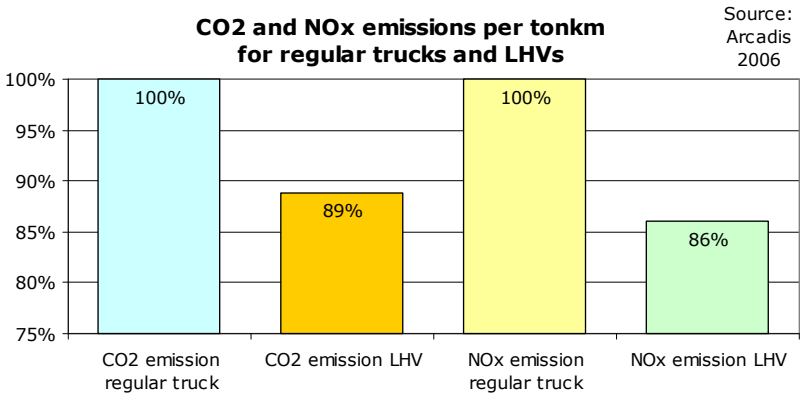

Figure 7.1 CO2 and NOx emissions of LHVs and regular truck combinations [22]

The conclusion from the figure above is that the use of LHVs will lower CO2-emissions per transported tonne by 11% (from 63 to 56 grams of CO2 per tonne-km). NOx-emissions per transported tonne also decrease because of the use of LHVs. In this case the emission reduction is 14% (from 0.43 to 0.37 grams of NOx per tonne-km). As expected, the average fuel consumption of an LHV-combination is slightly higher than of a regular truck combination. But in terms of fuel consumption per transported tonne, LHVs perform better than regular truck combinations.

Calculations made during the Second Pilot show what the exact emissions reduction in the Netherlands would be, with the maximum potential of circa 11,000 LHVs on the road. The use of LHVs would ultimately reduce the number of truck kilometres by 459 million annually, compared to a situation with only regular truck combinations. This will also generate fewer emissions of CO2 and NOx. Compared to the emissions of the entire truck fleet, the reduction is around 4% for NOx and 6% for CO2. An LHV can make 41% more tonne-kilometres per litre of fuel. On a macro-economic scale, the use of LHVs has substantial environmental benefits.

The production of fine particles (PM10) is linked to the type of engine and fuel consumption. The Third Pilot stipulates the use of Euro 4 engines as a minimum requirement. The emission of fine particles has not been measured by CE, so no results are available. But similar to CO2 and NOx, it is likely that a decrease in fuel consumption results in decreased emissions of particulate matter. Moreover, the National Vehicle Authority (RDW) data show that by the end of 2009, most companies in the Third Pilot are using Euro 5 engines in their LHV tractor trucks.

7.2.2 Noise aspects of the use of LHVs

The noise generated by a truck originates from three major sources [31]. These are:

- Engine: A major source of noise is the engine of the vehicle. Adding insulation around the engine can bring the noise level of a vehicle down to the mandatory limit of 80 dB(A);

- Tire/road surface contact: The amount of friction between tire and road surface determines the noise. Major contributing factors are the number and size of contact surfaces, and friction. Weather conditions also affect the amount of noise. Measurements show that an additional axle (as is the case with most types of LHVs) on the road generates an increase in noise that is barely measurable;
- Aerodynamics: The aerodynamics of an LHV are largely dependent on the contact surfaces with the surrounding air. Different LHV-configurations generate different levels of noise due to the number, shape and size of contact surfaces with the air.

A study conducted in late 2004 measured LHV-sound levels [31]. The LHV in question was a B-configuration, designed to carry 3 TEU containers. Measurements show that this combination yields a noise level increase of approximately 0.8 dB(A) compared to a regular 2 TEU-truck combination. If the decrease in the number of trips is figured into the noise increase per passage, the total sound level benefit is 0.6 dB(A). The practical benefit of this is limited, since a decrease of 1 dB(A) or less is barely audible to humans. The same calculations show that a wet road surface has more effect on noise emission levels than whether or not a truck is an LHV. Transportation of other loads than containers has not been measured for noise.

7.3 The effect of LHVs on the modal split

A modal shift is the shift of freight flows from road to other modes of transportation, such as rail or inland shipping. Transportation of goods by rail or inland shipping may, under certain circumstances (depending on distance, fuel and pre-and post-transport needs) be less harmful to the environment. Because a modal shift may lead to fewer emissions per transported tonne, governments often implement policies to this effect. The Dutch government has not been conducting an active modal shift policy for years. Evaluation of previous policies shows that government intervention through incentives and tax increases does not have the desired effect [11] [12]. A reverse modal shift means that goods that were initially transported by rail or inland shipping are going to be moved over the road.

The Second Pilot included a macro analysis and a survey among monitored study participants [22]. The Third Pilot also included interviews with terminal operators, shippers and transport companies [4].

7.3.1 Macro analysis of the effect on modal shift by LHV-use in the Netherlands

The second field trial (2004-2006) [22] included a macro analysis of the maximum theoretical reduction in the use of rail transport and inland shipping due to the use of LHVs. This macro analysis is based on the price elasticity of road transport. In other words: lower cost due to LHV-use will generate an increase in road traffic. The expected price elasticity for road transport is around 0.75. This means that a 1% price drop generates 0.75% extra in transportation. This elasticity relates to all road transport, while the price cut only applies to LHVs. The number of LHV-trips is expected to increase to 324,000 annually, which will lead to 58 million additional LHV-kilometres. In the long term this will generate a 5.1% increase in LHV-road kilometres in theory.

This analysis also includes a calculation of the maximum reverse modal shift on the basis of (cross-)elasticities. This amounts to 0.8 for rail transport and 0.1 for inland

shipping. The analysis shows that in theory a maximum of 505,000 extra tonnes of freight could be transported by LHVs that were originally moved by inland shipping (357,000 tonnes) and rail (148,000 tonnes). This limited increase of 0.1% in road transport, would take away 0.3% from inland shipping and 2.7% from rail transport. Therefore, this maximum estimated modal shift for the Netherlands is considered to be limited.

7.3.2 Survey among the participants in the Second Pilot (2004-2006)

In the early days of the introduction of LHVs in the Netherlands, there was a constructive discussion about the possible consequences of the use of LHVs for the modal split. The idea was that the costs per transported unit are lower for an LHV than for a regular truck combination. This, some say, may mean that freight that is currently transported via rail or inland shipping, could start moving by road again. If all this would cause a major reverse modal shift, transportation in the Netherlands would become less sustainable.

A survey during the Second Pilot showed that the vast majority of participants (90%) thinks that LHVs will not cause a measurable reverse modal shift [22]. The reason is that the current distribution in transportation across different modes usually has a very practical and logical background. In the following cases goods are usually transported by road: Just-In-Time, perishable goods, short-term assignments, small quantities, dense distribution, or when origin and destination are not located near water or rail. In other cases, lower costs will make transport by water or rail the obvious choice.

A small number of participants (10%) thinks that, under certain circumstances, a reverse modal shift could happen. Without exception, they refer to competition with inland shipping - especially with regards to the market for containers and bulk, where the time factor is usually less important. A shift from water transport to road transport with LHVs is ultimately feasible for shorter distances (between 75 and 100 kilometre), if there would be a need for pre- or post-transport by road. Road transport becomes more attractive, when long distance transportation per LHV becomes cheaper. But even within these submarkets a reverse modal shift will only occur under special circumstances, for instance when there is a lack of capacity in inland shipping. In all other situations, inland shipping remains cheaper.

7.3.3 Interviews with stakeholders in the Third Pilot (2007-2011)

Arguments similar to the ones that are mentioned above showed up in fourteen interviews that were done by Ecorys in 2009 at a representative number of multi-modal inland terminals in order to supplement the baseline measurement. The interviews were conducted among six transport companies, three shippers, three inland terminals and two regional Transhipment Centres [4].

The general conclusion from the interviews is that LHVs do not pose a threat to the use of inland waterway shipping and rail. The majority of the fourteen interviewees does not expect a reverse modal shift, even if international transportation by LHVs would become possible. Two of the six transport companies think that a reverse modal shift may occur if LHVs are also admitted to Belgium and Germany. Two terminal operators only expect this to happen if the maximum weight would be

increased to 70 tonnes - which is totally unrealistic, both in the Netherlands and Europe.

The reason that a reverse modal shift is not forthcoming is because the various modes (road, rail and inland shipping) each operate within their own sub-markets. Moving heavy goods and large volumes over long distances is almost exclusively done by water and rail. Moving light goods over short distances is almost always done by road. An LHV will therefore mostly take cargo away from regular road transportation, but the effects on the modal split (the distribution of total freight transportation across different modes) will be marginal.

The limited effect of LHVs on the modal split was confirmed by a study into a forced modal shift from road to rail or water [11]. The result of this study was that the possibilities for a modal shift in freight transport in the Netherlands are limited. The study centered around a simulated modal shift from road to rail and inland shipping of 10% and 20% respectively, as a function of the total vehicle mileage in the Netherlands in 2015. Even with a high degree of forced policy (pricing, subsidies and additional) restrictions, the study ultimately does not produce more than a 5% shift.

The main reason why a forced modal shift does not work is that 90% of vehicle kilometres in the Netherlands relate to commodities and end-products (vans and pallet transport, but excluding containers). Inland shipping and rail have little to offer for this market segment. With the conclusion that the potential for a modal shift in freight transportation is limited, the study agrees with the findings of other studies in this area.

A second opinion from the Netherlands Institute for Transport Policy Analysis, part of the Ministry of Transport [12], confirmed these findings. The conclusion of this second opinion was that the choice for a mode of transportation is generally more determined by the intrinsic qualities of the modalities than by policy incentives.

7.4 Summary: The impact of LHVs on sustainability and modal shift

- The Dutch policy on different modes of transportation promotes co-modality. That does not mean that government measures should lead to a reverse modal shift. The Ministry of Transport, Public Works and Water Management therefore wants to closely monitor the effect of LHVs on the modal split.

- Calculations show that by using LHVs instead of regular truck combinations, exhaust emissions can be reduced. With LHVs, CO2-emissions per transported tonne can be lowered by 11% (from 63 to 56 grams of CO2 per tonne-km) based on a transportation distance of more than 150 km. NOx-emissions can be reduced by 14% (from 0.43 to 0.37 grams of NOx per tonne-km).

- If market potential for LHVs in the Netherlands is fully used, a reduction of 4% for CO2-emissions and 6% for NOx-emissions can be achieved.

- The production of fine particles (PM10) is directly linked to engine type and fuel consumption. It is likely that a reduction in fuel consumption will also lead to a reduction in emissions of particulate matter. Even though the exemption requirements of the Third Pilot stipulate the use of Euro 4 engines, the National Vehicle Authority (RDW) data show that most companies by the end of 2009 are using Euro 5 engines in their tractor trucks.

- A limited noise reduction of 0.8 dB(A) can be achieved by the use of LHVs, based on a reduction in the number of trips and a slight increase in noise emission. A decrease of 1 dB(A) or less is barely audible to humans. The same calculations show that a wet road surface has a greater influence (1 dB(A) or more) on the noise production of trucks than the fact if it is a regular truck or not.

- Macro analysis included in the Second Pilot shows that a limited reverse modal shift from water to road is possible in theory. Calculations about the price effect of LHVs show that the theoretical maximum estimated increase in road transported tonnage is approximately 500 thousand tonnes. This includes a limited increase of 0.1% of road transportation. This maximum increase would reduce inland shipping by 0.3%, and rail transport by 2.7%.

- A survey among participants of the Second Pilot, and interviews with terminal operators, shippers and transport companies during the Third Pilot, showed that a reverse modal shift is not very likely to happen. According to these stakeholders, the current segmentation in the transportation market has a very practical and logical background. Many product/market combinations will only experience a shift from regular truck combinations to LHVs.

Appendix A Glossary

Accident hot spot	Traffic location where accidents occur more frequently than average.
A-configuration	The A-configuration LHV consists of a tractor with a 13.60 metre semi-trailer and a trailer.
Autonomous policy discretion	Flexibility granted by a road administrator to the National Vehicle Authority (RDW), after assessing the suitability of a road (section) for LHV-use, to autonomously assign exemptions for that same road (section) without having to ask for renewed approval from the road administrator.
Axle load	The force generated by a cargo load on an axle and subsequently on the pavement.
Axle passage	The movement of an axle past a specific point. An LHV moving along a specific point in the road creates between 5 and 10 axle passings, depending on the number of axles.
Basic network	The network of motorways in the Netherlands, managed by the Dutch Directorate General for Public Works and Water Management (Rijkswaterstaat), on which LHVs are allowed.
B-configuration	The B-configuration LHV consists of a towing unit, pulling a semi-trailer with an extra fifth wheel, to which a second semi-trailer is attached.
B-Double	International term for what is known in the Netherlands as B-configuration.
Bulk	Loose cargo such as sand, coal, etc.
C-configuration	The C-configuration LHV consists of a long truck with a trailer.
CCV	The CCV is the organization that tests and accredits professional drivers in the Netherlands.
City trailer	A trailer that is approximately 10.60 metre long, specifically suited for use in urban areas.
Co-modality	Concept launched by the European Commission (mid-term review White Paper 2006): the simultaneous use of transportation modalities for their strengths ('co-modality') rather than giving priority to certain modes ('modal shift').

Core area	Area without agricultural or residential zoning restrictions (in terms of road classification), where one or more companies are located that are the origin or destination for an LHV-trip. Examples are industrial areas, ports or auctions.
Coupling point	Hinge point between two vehicles at which they are connected.
CROW	National Technology Platform for transport, infrastructure and public space.
CROW Advisory list	Advisory list, prepared by CROW, which analyses the road network, describes all occurring traffic situations in the Netherlands and indicates for every situation if it is advisable to admit LHVs (positive advice), or if a potential problem may arise (attention list).
D-configuration	The D-configuration LHV consists of a truck coupled with a dolly and a semi-trailer.
Directive 96/53/EC	European Directive which determines the maximum dimensions and weight of truck combinations and associated vehicle components for international road freight transport.
Dolly	A trailer used to couple a semi-trailer to a towing vehicle, whereby the dolly -equipped with a fifth wheel- carries the front of the semi-trailer.
E-configuration	The E-configuration LHV consists of a truck, coupled with two centre-axle trailers.
EMS	European Modular System, that consists of a limited number of specific vehicle components with which standard configurations can be made.
Euro Pallet	A standardized wooden pallet (120 x 80 cm), used to stack goods for storage or transportation.
Exemption	Authorization given by the government to deviate from certain regulations. In the case of an exemption it is up to the government to monitor adherence to the law.
Fifth wheel coupling	A dish-shaped plate, with a wedge-shaped slot, placed on the chassis of a tractor (or truck), used to attach a semi-trailer.
First Pilot	Initial small-scale pilot trial with LHVs (2001-2003), in which four transport companies participated.

Floriculture	The cultivation and trade of flowers, plants and other non-edible crops.
General cargo	Goods that are not measured by size or weight but by number of pieces.
Incident Management	Set of measures designed to clear a road for traffic as soon as possible after an incident has occurred, meanwhile observing traffic safety, representing the interest of potential victims and controlling possible damage.
Inland Terminal	A secondary distribution hub, where freight is transferred from one means of transportation to another.
IVW	Inspectorate for Transport, Public Works and Water Management, a Dutch public department that monitors and promotes the safety of transport via road, water, air and rail.
Jaw / drawbar coupling	Coupling device to connect a trailer to a towing vehicle.
Kingpin	The coupling pin underneath a semi-trailer. When coupling, a driver moves his tractor with open fifth wheel coupling underneath the semi-trailer; the kingpin drops in the fifth wheel and is automatically secured.
KLPD	National Police Agency. The KLPD is a national police force which carries out independent, supporting and coordinating services for, and on behalf of the Dutch police.
Lanes	A limited stretch of road where traffic waits before moving in a certain direction.
LHV	Longer and/or Heavier Vehicle, with a maximum length of 25.25 meters and a maximum weight of 60 tonnes.
License	Official (necessary) consent from the government to perform an activity that is normally prohibited.
Loaded tonne kilometres .	See tonne-km
Modal shift	A shift of freight flows from road transport to other modes of transportation such as rail or inland shipping.
Modal split	The segmentation of freight flows into different modes of transportation such as road, rail, inland shipping, coastal shipping and pipeline transport.

Network of main roads	The network of main roads is a continuous network of main national roads, defined by the following: a road user enters the network via entries and exits via an exit-ramp. The part in between belongs to the network. This means that all interchanges, connecting roads, rest areas, and main lanes belong to the main road network.
Network of secondary roads	Roads that are not part of the main road network.
Objective traffic safety	Safety on the road measurable with facts and figures.
Policy Rule	A policy rule is a directive that can be used by government bodies, within their jurisdiction, to issue regulations that have no legal status, but that can only be waived under special circumstances.
Price elasticity	Number that shows by what percentage the demand for certain goods varies, when the price of another commodity changes by 1%.
RDW	The National Vehicle Authority (RDW) is the executive authority that tracks vehicles from development to demolition, both technically and administratively.
Regional road administrator	Manager of a regional road network in the Netherlands. This can be a province, municipality or water board.
Rest area	A location along a motorway, which (in the Netherlands) only connects to the motorway, and not to secondary roads. At the very least, a rest area consists of a parking area. Optional additions are a gas station, a roadside restaurant and/or a hotel.
Reverse modal shift	Since transportation by rail or inland shipping is considered to be less harmful to the environment, some governments seek a modal shift - away from road transportation to these modes of transport. A reverse modal shift is the shift of volume from inland shipping and rail to road transportation.
Rijkswaterstaat	Directorate General for Public Works and Water Management: executive agency that is part of the Dutch Ministry of Transport, Public Works and Water Management, responsible for the practical implementation of the construction, management and maintenance of roads and waterways that are administered by the State.
Second Pilot	Trial period (2004-2006) in which 66 companies participated with a total of 100 LHVs.

Semi-trailer	Trailer without its own drawbar.
Subjective traffic safety	The qualitative assessment of traffic safety based on experiences and perceptions.
Swept path	The maximum area (in square meters) covered by a vehicle when travelling a certain distance, for instance while making a turn or at a roundabout.
SWOV	The Institute for Traffic Safety Research is a Dutch scientific research institute in the field of traffic safety.
Third Pilot	The current trial period with LHVs (2007-2011) to study the effects of an increasing number of LHVs on traffic safety, traffic flow and the modal split in the Netherlands.
Tonne-km	The uniform unit to measure transport performance, equal to moving a 1 tonne load (1000 kg) over a distance of 1 kilometre.
Tractor	Truck with its own engine without cargo space, intended to pull (semi-)trailers.
Trailer	Separate, unpowered vehicle attached to a truck by means of a drawbar.
Truck	Truck with its own engine and cargo space.
Truck combination	A combination of several different EMS vehicle components.
Two-wheelers	Motorized and non-motorized vehicles with two wheels, including bicycles and motorcycles.
Used loading capacity	The ratio between the used loading capacity and total available cargo capacity of a vehicle.
WIM	Weigh-in-motion, a roadside measurement system that measures the axle loads of passing freight vehicles.
WIM-VID	The combination of a WIM-system and video cameras.

Appendix B Map with list of the LHV-network per September 16, 2009

Appendix C Bibliography

This bibliography contains an overview of all major Dutch research publications on the use of LHVs in the Netherlands, in reverse chronological order (all titles in English translations). The majority of these publications are used and cited in this report.

[1] Arcadis, Monitoring traffic safety - Longer and Heavier Vehicles [Monitoring verkeersveiligheid – Langere en zwaardere vrachtwagens], December 2009

[2] I&O Research, Survey car drivers - Longer and Heavier Vehicles [Survey automobilisten - Langere en Zwaardere Vrachtwagens], December 2009

[3] Ministry of Transport, Public Works and Watermanagement, Update on Third Pilot Longer and Heavier Vehicles [Stand van zaken Ervaringsfase Langere en Zwaardere Vrachtauto's], Progress report November 30, 2009

[4] Ecorys, Monitoring Modal Shift Longer and/or Heavier Vehicles (LHVs), in-depth interviews terminals, shippers and transport companies [Monitoring Modal Shift Langere en/of Zwaardere Voertuigen (LZV's), diepte-interviews terminals, vervoerders en verladers], 2009

[5] CROW, LHVs on Secondary Roads, recommendations to road administrators for assessing traffic situations [LZV's op het onderliggend wegennet, advies aan wegbeheerders voor het beoordelen van verkeerssituaties], 2009

[6] Ecorys, Monitoring Modal Shift Longer and/or Heavier Vehicles (LHVs), the baseline measurement (final report) [Monitoring Modal Shift Langere en/of Zwaardere Voertuigen (LZV's), de nulmeting (eindrapport)], 2008

[7] SWOV, Observation Report LHVs [Verslag observaties LZV's], 2008

[8] TNO, Comparison Tractor-trailer combinations and LHV-Ecocombi with respect to the impact on road structures [Vergelijking Trekker-Oplegger-Combinaties en LHV-Ecocombi's met betrekking tot de invloed op kunstwerken], 2008

[9] DVS/Directorate General for Public Works and Water Management & Arcadis, Effects LHV on the practice of Rijkswaterstaat [Effecten LZV's voor de uitvoeringspraktijk van Rijkswaterstaat], 2008

[10] IVW, Compliance LHV exemption conditions - situation report [De naleving van LHV-ontheffingsvoorwaarden - stand van zaken eind 2008], late 2008/2009

[11] Policy Research Corporation, Research into the effects of a forced modal shift [Onderzoek naar de effecten van een geforceerde modal shift], 2007

[12] KIM/Ministry of Transport, Public Works and Watermanagement, Forced modal shift - second opinion [Geforceerde modal shift - second opinion], 2007

[13] University of Groningen, The impact of growth in truck traffic on the behaviour of other traffic at motorway interchanges [De invloed van de groei van vrachtautoverkeer op het gedrag van ander verkeer bij in- en uitvoegstroken op snelwegen, een simulatoronderzoek], a simulator study, 2007

[14] DVS/Directorate General for Public Works and Water Management, Rest areas for longer freight vehicles [Verzorgingsplaatsen voor langere vrachtvoertuigen], 2007

[15] OVW, report Longer and Heavier Trucks - Third Pilot [Rapport Langere en Zwaardere Vrachtauto's – Ervaringsfase], 2007

[16] EVO, KNV, TLN, Ecocombi must remain at 60 tonnes [Ecocombi moet 60 ton blijven], 2007

[17] Oranjewoud, Impact of LHVs on road structures [Impact LZV's op kunstwerken], 2007

[18] Construction Department/Directorate General for Public Works and Water Management, Quick-scan: Damage effects of LHV vehicles and short stocky vehicles (asphalt trucks and concrete mixers) to the Dutch road network [Quick-scan: Schade effecten LHV voertuigen en korte gedrongen voertuigen (betonmixers en asfaltwagens) op het Nederlandse wegennet,], 2007

[19] Oranjewoud, freight traffic and infrastructure, impact growing traffic [Vrachtverkeer en infra, invloed groeiend wegverkeer], 2007

[20] SWOV, Draft Opinion on follow-up test LHV [Concept advies betreffende vervolgproef LHV], 2006

[21] RDW, Long and heavy truck combinations, proposal Third Pilot regime, free flow of vehicles traveling on quality road network [Lange en zware vrachtautocombinaties, Voorstel regime ervaringsfase, vrije uitwisseling voertuigen rijdend over het kwaliteitsnet wegen], 2006

[22] Arcadis, Monitoring Research LHVs in the Second Pilot, results of second pilot with LHVs on Dutch roads [Monitoringsonderzoek vervolgproef LZV's, Resultaten van de vervolgproef met langere of langere en zwaardere voertuigcombinaties op de Nederlandse wegen], 2006

[23] RDW, Stability Aspects of LHV-combinations [Stabiliteitsaspecten van LHV combinaties], 2006

[24] Directorate General for Public Works and Water Management, WIM-NL report Container LHVs [WIM-NL rapportage Container LZV's], 2006

[25] CROW, Quick scan publications LHVs, Effects introduction Long and Heavy Vehicles for guidelines road network based on CROW publications [Quick scan publicaties LZV's, Gevolgen invoering Lange Zware Voertuigen voor richtlijnen wegennet aan de hand van publicaties CROW], 2006

[26] Haskoning, Assessment CROW publications on LHVs, appendix 2 traffic engineering [Beoordeling CROW-publicaties op LHVs, bijlage 2 verkeerstechniek], 2006

[27] Haskoning, Assessment CROW publications on LHVs, appendix 3 constructions [Beoordeling CROW-publicaties op LZV's, bijlage 3 constructies], 2006

[28] RDW, Long and heavy truck combinations, LHV Phase II, test experience summary [Lange en zware vrachtautocombinaties, LHV fase II, een overzicht van testervaringen], 2006

[29] SEO, Memorandum potential penetration LHVs [Notitie potentiële penetratiegraad LZV's], 2005

[30] TNS NIPO Consult, Responses to LHVs in traffic [Reacties op LZV's in het verkeer], 2005

[31] DGMR/ Ministry of Transport, Public Works and Watermanagement, Noise measurement along heavy trucks [Geluidsmetingen langs zware vrachtauto's], 2004

[32] Traffic Test, Practical test LHV, results of a trial with longer and / or heavy vehicle combinations on Dutch roads [Praktijkproef LHV, resultaten van een proef met langere en/of zwaardere voertuigcombinaties op Nederlandse wegen], 2002

[33] NEA, increase maximum vehicle length for combination vehicles in domestic transport [Verhoging maximale voertuiglengte voor combinatievoertuigen in het binnenlands vervoer], 1997

[34] TNO, Longer and heavier trucks [Langere en zwaardere vrachtauto's], 1996

Appendix D Policy Rule

GOVERNMENT GAZETTE
Official publication of the Kingdom of the Netherlands since 1814.

No. 13876
17 September 2009

Beleidsregel keuring en ontheffingverlening ervaringsfase LZV 2009 **(Policy regulation on approvals and exemption permits empirical phase LHV 2009)**

31 August 2009
No. JBZ 2009/2705/jg

The Management Board of the RDW (Dutch vehicle approval and information authority),

Having regard to article 4, subsections four and five of COUNCIL DIRECTIVE 96/53/EC of 25 July 1996 laying down for certain road vehicles circulating within the Community the maximum authorised dimensions in national and international traffic and the maximum authorized weights in international traffic (OJEU L 235) and section 149a, subsection 2, of the Dutch Road Traffic Act 1994[1], the motor vehicles decree *Besluit voertuigen*[2] and the exceptional load transport operations exemption permits decree *Besluit ontheffingverlening exceptionele transporten*[3]

Decision:

§ 1. General

Article 1 Definitions

The definitions of the terms used in the Dutch Ministerial Decree *Regeling voertuigen* (motor vehicle regulations) have been adopted for the purposes of the implementation of this policy regulation. In addition, the following definitions shall apply:
a. Scope for autonomous decisions on LHVs: the current data used by the road authority to designate a road or road section as suitable for driving an LHV for which the RDW (Dutch vehicle approval and information authority) may issue an exemption permit for LHVs subject to the applicable restrictions and regulations concerned and without requiring the permission referred to in section 149b, subsection 2, of the Act and article 4 of the Exceptional Load Transport Operations Exemption Permits Decree;
b. LHV: vehicle combinations with a loading space length of at least 18 metres, or a comparable loading space length if the vehicles are equipped for the transport of removable load structures, comprising no more than three vehicles equipped for the transport of goods and measuring up to a maximum lenght of 25.25 m and weighing up to 60 tonnes, and for which an exemption permit as referred to in article 3 has been issued;
c. LHV core area: an area designated as such at the level of the road segment, within the scope for autonomous decisions, by the road authority and the RDW (Dutch vehicle approval and information authority), where one or more companies are actually established and which has not been designated for residential purposes or agricultural use in the locally applicable zoning plan;
d. LHV distributor road: road or road section which forms a link between through-roads and an LHV core area;
e. LHV through-road: a road with a national or international function for long distance traffic;
f. Access road LHV: road or road section, not being an LHV through-road or LHV distributor road which serves to provide access to premises of applicants or which is located in an LHV core area;
g. Combination of foreign vehicles: combination of vehicles for which the registration numbers of the tractive motor vehicle and the towed vehicles have been issued by an EU member state other than the Netherlands.

Article 2 Scope

This policy regulation shall apply to the processing of an application for approval and exemption permit for an LHV on the basis of article 149a, subsection two ,of the Act.

Article 3 Types of LHV exemption permits

1. The LHV exemption permits are divided into:
   a. the LHV basic exemption permit;
   b. the incidental LHV exemption permit, and
   c. the LHV training exemption permit.

[1] Bulletin of Acts and Decrees (Stbl.) 2004, 687.
[2] Bulletin of Acts and Decrees (Stbl.) 2009, 143
[3] Bulletin of Acts and Decrees (Stbl.) 2005, 438

2. The RDW (Dutch vehicle approval and information authority) issues an LHV exemption permit as referred to in section 1, for the registration number of the tractive motor vehicle, provided the suitability of the LHV vehicle combination is apparent from:
   a. an annotation on the vehicle registration certificate, as referred to in article 12, subsection 2;
   b. an LHV certificate as referred to in article 12, subsection 3, or
   c. an LHV approval certificate as referred to in article 13, subsection 1.

3. An LHV basic exemption permit as referred to in subsection 1, item a, may be issued for:
   a. roads within the scope for autonomous decisions on LHVs;
   b. a period not exceeding one year, and
   c. no more than one tractive motor vehicle.

4. The incidental LHV exemption permit, referred to in subsection 1, item b, is intended for:
   a. accessing the establishment, in the case of a necessary route from or to the location of the actual establishment of the applicant, which has not in any case been designated for residential purposes or agricultural use in the locally applicable zoning plan and is intended for, or is in aid of, providing one applicant with access to roads within the scope for autonomous decisions on LHVs, or
   b. events, in the case of a necessary route from or to the location of an event for, or also in aid of, LHVs, or
   c. congestion problems, when roads or road sections are temporarily entirely or partially inaccessible, and may be issued for roads or road sections which:
      i. connect to the roads or road sections referred to in the LHV basic exemption permit which has already been issued, or
      ii. connect to the roads or road sections referred to in the ad hoc LHV exemption permit which has already been issued.

5. An incidental LHV exemption permit may be issued for:
   a. roads which are not within the scope for autonomous decisions;
   b. a period of:
      i. no more than one year, in the case of an incidental LHV exemption permit as referred to in subsection four, item a, on the understanding that the period of validity of the LHV basic exemption permit issued to the applicant is not exceeded;
      ii. no more than two weeks, in the case of an ad hoc LHV exemption permit as referred to in subsection four, item b, or
      iii. the duration of the congestion on the understanding that the period of validity of the LHV basic exemption permit or incidental LHV exemption permit, as referred to in subsection four, item a, which has been issued to the applicant is not exceeded.
   c. An incidental LHV exemption permit may be issued for up to four registration numbers of tractive motor vehicles, provided that the registration numbers concerned are indicated on the application form, as referred to in article 5, subsection 1.

6. An LHV training exemption permit may be issued:
   a. for training and examination concerning the certificate of an LHV driver for driving on the roads which are specifically included for that purpose in the scope for autonomous decisions on LHVs, and for the roads leading to these roads from the location of the business establishment;
   b. for a period not exceeding one year, and
   c. for no more than one tractive motor vehicle.

Article 4 Exemption permit document with annexes

An LHV basic exemption permit comprises:
a. a cover page, which in any case indicates the details of the applicant and the registration number, possibly in combination with the vehicle identification number (VIN) of the tractive motor vehicle;
b. if applicable, a vehicle annex with the registration numbers, possibly in combination with the VIN of the towed vehicles;
c. various road annexes, comprising:
   1. roads under the state's administration, and/or
   2. one or more LHV core areas of one or more road authorities, and
d. various annexes which include details of restrictions, general regulations and, if applicable, special regulations.

§ 2. Applying for exemption permits

Article 5 Applying for the exemption permit

1. An LHV exemption permit applicant must submit the application using the type of application form stipulated by the RDW (Dutch vehicle approval and information authority).

2. The application form will be provided as a written document.

Article 6 Method of submitting the application

Only written applications may be submitted.

Article 7 Withdrawing an application

1. An exemption permit application may only be withdrawn by means of written notice of withdrawal submitted by the applicant.

2. The withdrawal of a submitted application will only be processed in accordance with the RDW (Dutch vehicle approval and information authority) rates decree[4] if the withdrawal takes place within 24 hours of the application's registration and provided a decision has not already been sent.

Article 8 Time required for processing exemption permit applications

In principle, applications that come within the scope for autonomous decisions on LHVs are processed within 5 working days.

Article 9 Expansion of LHV core areas

In addition to the provisions of article 4, item c1, during the period of validity of an LHV basic exemption permit which has already been issued to the applicant, an application may be submitted in connection with the expansion of the LHV core areas.

Article 10 Foreseeability of expansion of LHV core areas

The RDW (Dutch vehicle approval and information authority) shall announce the new LHV core areas at least once every quarter, in the manner it sees fit.

§ 3. Assessment of the suitability of roads and road sections for LHVs

Article 11 Permission in respect of the suitability of roads for LHVs

The RDW (Dutch vehicle approval and information authority) requests road authorities to adopt the assessment criteria included in annex A when assessing the suitability of roads for the determination of the scope for autonomous decisions on LHVs.

§ 4. Assessment of the suitability of vehicles for use as LHVs

Article 12 Annotation on vehicle registration certificate for an LHV or LHV certificate

1. An annotation on the vehicle registration certificate for an LHV or an LHV certificate as referred to in article 3, subsection 2, items a and b, shall be provided upon request, subject to the RDW (Dutch vehicle approval and information authority) having conducted an assessment and finding that the requirements of annex B have been met.

2. An annotation shall be placed on the vehicle registration certificate, if the vehicle has a Dutch registration number.

3. An LHV certificate shall be issued, if the vehicle has a foreign registration number.

4. An application as referred to in subsection 1 shall be made using the model application form stipulated by the RDW (Dutch vehicle approval and information authority).

Article 13 LHV approval certificate

1. An LHV approval certificate shall be issued for:
   a. commercial lorry combinations which were permitted up to 31 October 2006 on the basis of the

[4] The Dutch Road Transport Directorate's Fees Decree is published annually in the Government Gazette.

Decree establishing the Official LHV Advisory Committee *Instellingsbesluit Ambtelijke adviescommissie LZV*[5], the policy regulation on issuing LHV exemption permits *Ontheffingverlening LZV 2006*[6] or the policy regulation on the transitional trial period for issuing LHV exemption permits *Beleidsregel overgangsperiode proef ontheffingverlening LZV*[7], or

b. a combination of foreign vehicles.

2. With the exception of the marking of the vehicle at the rear, a commercial lorry combination as referred to in subsection 1, item a, shall meet the conditions referred to in the policy regulation on the transitional trial period for issuing LHV exemption permits *Beleidsregel overgangsperiode proef ontheffingverlening LZV*.

3. In the case of a combination of foreign vehicles as referred to in subsection 1, item b, a statement issued by the competent authority in the European member state in which the vehicles are registered shall indicate that vehicles meet the requirements stipulated by the member state concerned for the purposes of the modular concept referred to in article 4, subsection 4, item b, of Directive 96/53/EC. These requirements shall provide a level of protection which in the opinion of the RDW (Dutch vehicle approval and information authority) is at least equivalent to the level referred to in national investigations for the use of vehicles in an LHV.

4. Annex B and annex D, part 1 shall serve as a reference for the assessment of the equal level of protection of a foreign combination of vehicles.

Article 14 model LHV certificate and model LHV approval certificate

1. An LHV certificate as referred to in article 12, subsection 2, shall be issued in accordance with the model included in annex C, part 1.

2. An LHV approval certificate as referred to in article 13, subsection 1, shall be issued in accordance with the model included in annex C, part 2.

§ 5. Exemption permit restrictions and regulations

Article 15 Exemption permit restrictions and regulations

1. Each LHV exemption permit shall be subject to the restrictions referred to in annex D, part 1.

2. Each LHV exemption permit may be issued subject to the general regulations referred to in annex D, part 2. These restrictions may apply in respect of, amongst other things:
   a. vehicle documents;
   b. LHV driver's documents;
   c. extraordinary conditions;
   d. place on the roadway;
   e. vehicle and LHV dimensions and masses in unladen situation and laden situation;
   f. requirements for tractive motor vehicle with an annotation on the vehicle registration certificate or LHV certificate;
   g. requirements for towed vehicles with an annotation on the vehicle registration certificate or LHV certificate;
   h. LHV turning circle;
   i. LHV loading space length;
   j. LHV vehicle's rear marking;
   k. cooperation in provision of information on use of LHV exemption permit.

§ 6. Final provisions

Article 16 Transitional rules

1. An LHV approval certificate as referred to in article 13, subsection 1, item a, valid until 1 November 2011 is issued as a matter of course for vehicle combinations which are permitted within the scope of the decree establishing the official LHV advisory committee *Instellingsbesluit Ambtelijke adviescommissie LZV* and the policy regulation on issuing LHV exemption permits *Ontheffingverlening LZV 2006* as well as the policy regulation on the transitional trial period for issuing LHV exemption permits *Beleidsregel overgangsperiode proef ontheffingverlening LZV*.

2. Vehicles approved on the basis of article 12, subsection 1, may form part of a combination of vehicles as referred to in subsection 1, provided that upon request the vehicles concerned are included on an LHV approval certificate.

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[5] *Government Gazette (Stcrt.)* 2003, 245
[6] *Government Gazette (Stcrt.)* 2006, 72
[7] *Government Gazette (Stcrt.)* 2006, 182

3. The LHV exemption permits issued prior to the entry into force of this policy regulation shall continue to be valid.

Article 17 Revocation

The *Beleidsregel ervaringsfase ontheffingverlening LZV* (Policy regulation on LHV exemption permits empirical phase)[8] shall be withdrawn.

Article 18 Entry into force

On the second day following the date of its publication in the Government Gazette (Staatscourant) this policy regulation shall enter into force with retroactive effect as from and including 1 May 2009.

Article 19 Short title

This policy regulation may be cited as: *Beleidsregel ervaringsfase ontheffingverlening LZV 2009* (Policy regulation on LHV exemption permits empirical phase 2009).

An announcement along with explanatory notes relating to this policy regulation will be published in the Government Gazette.

The Management Board of RDW,
on the latter's behalf:
Managing Director,
J.G. Hakkenberg

[8] *Government Gazette (Stcrt.)* 2007, 207; most recently amended by policy regulation dated 16 June 2008 *(Government Gazette* 2008, 126).

ANNEX A, AS REFERRED TO IN ARTICLE 11

The assessment criteria for roads for the determination of the scope for autonomous decisions on LHVs as referred to in article 11 read as follows:

1. For roads under the state's administration:
   a. Motorways/roads, insofar as they come under recommended roads in CROW publication 260, *LZV's op het onderliggend wegennet* (LHVs on the subsidiary road network);
   b. Motorways which, if not fitted with a traffic control system at junctions to other roads, have a filter lane, and an emergency lane at least 250 metres long after the end of the filter lane.
2. For roads under the administration of the provincial authorities, municipal authorities and water authorities
   a. LHV through-roads, insofar as they
      1. come under recommended roads as indicated in CROW publication 260, *LZV's op het onderliggend wegennet* (LHVs on the subsidiary road network), and
      2. if not fitted with a traffic control system, have a filter lane, and an emergency lane at least 250 metres long after the end of the filter lane.
   b. LHV distributor roads, insofar as these roads and the intersections come under recommended roads as indicated in CROW publication 260, *LZV's op het onderliggend wegennet* (LHVs on the subsidiary road network).
   c. Access roads LHV, providing that:
      1. these roads do not have a traffic sign with a zone indication as referred to in article 66, subsection 2, and Annex 1, A1, Road Traffic and Traffic Signals Regulations 1990 (RVV 1990), whereby a maximum speed applies of 30 km/h, unless they are located in an LHV core area;
      2. these roads or road sections are not located in a shopping area or residential area;
      3. there are no traffic signs with a plate attached below them indicating permitted delivery times for motor vehicles, and
      4. these roads or road sections are located in an LHV core area which is sufficiently wide for the required LHVs manoeuvres.
   d. The roads which do not meet the requirements in subsections a, b or c, in cases concerning up to the last 5 km to or from an LHV-core area and, in terms of dimensions, roads in accordance with CROW publication 260, *LZV's op het onderliggend wegennet* (LHVs on the subsidiary road network), and which may be safely used by LHVs in the opinion of the road authority.

ANNEX B, AS REFERRED TO IN ARTICLES 12 AND 13

Approval requirements for an annotation on the vehicle registration certificate for an LHV or the issuing of an LHV certificate

Article 1 approval requirements for LHV tractive motor vehicle

1. A tractive motor vehicle shall:
   a. belong in category N2 or N3, as referred to in article 1.1 of the Dutch Ministerial Decree *Regeling voertuigen* (under category N vehicles '*voertuigen van de voertuigcategorie N*') and for which a registration number is stated without any restrictions on use;
   b. be equipped with a compressed-air braking system (EBS) as referred to in ECE 13[1] par. 5.1.3.1.2;
   c. have a coupling for coupling a trailer or semi-trailer which meets the requirements set out in Directive 94/20/EC[2] and shall also be suitable for the larger forces (higher D and V values) of the LHV;
   d. without detriment to article 5.3.48, subsection 5, of the Dutch Ministerial Decree *Regeling voertuigen*, shall be fitted with lateral underrun-protection, which meets the requirements set out in article 1.1 of the annex to Directive 89/297/EEC[3] and comprises a continuous, smooth surface, apart from the exception referred to in article 1.1 of the annex to Directive 89/297/EEC in respect of commercial vehicles for special purposes;
   e. be fitted with spray-suppression systems which meet the requirements of Directive 91/226/EEC[4];
   f. be fitted with clear reflecting markings as referred to in, and installed in accordance with, Directive 76/756/EEC and made of a material which complies with ECE regulations no. 104 class C[5],
   g. be fitted with underrun-protection as referred to in Directive 2000/40/EC[6], or with protection which demonstrably provides the same level of safety;
   h. if it is not a commercial vehicle as referred to in article 5.3.45, subsection 12, of the Dutch Ministerial Decree *Regeling voertuigen*:
      1. without detriment to article 5.3.45, subsection 15, of the Dutch Ministerial Decree *Regeling voertuigen*, be fitted on the right side with facilities to improve the field of vision as referred to in article 5.3.45, subsection 11, of the Dutch Ministerial Decree *Regeling voertuigen*;
      2. be fitted at the front with:
         a. a front mirror, as referred to in article 5.3.43, subsection 7, item a, of the Dutch Ministerial Decree *Regeling voertuigen*, or,
         b. another mirror by means of which it is possible to see the road section bounded by:
            – one traverse vertical plane through the outermost point of the front of the vehicle cab;
            – one traverse vertical plane 2.00 m in front of the vehicle;
            – one longitudinal vertical plane parallel to the longitudinal vertical median plane going through the outermost side of the vehicle at the driver's side;
            – one longitudinal vertical plane parallel to the longitudinal vertical median plane 2.00 m outside the outermost side of the vehicle opposite to the driver's side.

         The front of the field of vision within this boundary shall be rounded off on the passengers side with a radius of 2.00 m.
   i. be fitted with an indicator on which the pressure of the rear axle(s) or the rear axle system or per axle system of this vehicle as well as the information supplied through the data cable of the braking system (CANbus) relating to axle pressures is indicated, with a measuring instrument accuracy of at least 0.1 tonne or 100 kg;
   j. have an engine power in kW, determined in accordance with Directive 80/1269/EEC, calculated on the basis of the sum of: 5 x permissible maximum combination mass in tonnes.
   k. not be fitted with a tank or liquid container for a liquid load with a volume exceeding 1000 l;
   l. not be fitted for the transport of cattle as referred to in article 1 of the Dutch Health and Welfare of Animals Act[7].

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[1] UN ECE regulations no. 13 concerning uniform technical prescriptions for the approval of braking systems of commercial road vehicles.
[2] Directive 94/20/EC of the European Parliament and of The Council of 30 May 1994 relating to the mechanical coupling devices of motor vehicles and their trailers and their attachment to those vehicles (OJEC L 195).
[3] Council Directive 89/297/EEC of 13 April 1989 on the approximation of the laws of the Member States relating to the lateral protection (side guards) of certain motor vehicles and their trailers (OJEC L 124).
[4] Council Directive 91/226/EEC of 27 March 1991 on the approximation of the laws of the Member States relating to the spray-suppression systems of certain categories of motor vehicles and their trailers (OJEC L 103).
[5] UN ECE regulations no. 104 with uniform technical prescriptions for the approval of retro-reflective markings for heavy and long vehicles and their trailers, concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions
[6] Directive 2000/40/EC of the European Parliament and of the Council of 26 June 2000 on the approximation of the laws of the Member States relating to the front underrun protection of motor vehicles and amending Council Directive 70/156/EEC (OJEC L 203).
[7] *Bulletin of Acts and Decrees* (Stb.*)* 1992, 585

Article 2 Approval requirements for LHV towed vehicles

1. The towed vehicle shall:
   a. belong in category O3 of O4 as referred to in article 1.1 of the Dutch Ministerial Decree *Regeling voertuigen* and for which a registration number is stated without any restrictions on use;
   b. be equipped with a compressed-air braking system (EBS) as referred to in ECE Regulations 13, par. 5.1.3.1.2;
   c. without detriment to article 5.12.48 of the Dutch Ministerial Decree *Regeling voertuigen*, shall be fitted with lateral underrun-protection, which meets the requirements set out in article 1.1 of the annex to Directive 89/297/EEC, and comprises a continuous, smooth surface, apart from the exception referred to in article 1.1 of the annex to Directive 89/297/EEC;
   d. be fitted with spray-suppression systems which meet the requirements of Directive 91/226/EEC;
   e. be fitted with clear reflecting markings as referred to in, and installed in accordance with, Directive 76/756/EEC and made of a material which complies with ECE regulations no. 104 class C[8],
   f. not be fitted with a tank or liquid container for a liquid load with a volume exceeding 1000 l;
   g. not be fitted for the transport of cattle as referred to in article 1 of the Dutch Health and Welfare of Animals Act.
2. If the towed vehicle is designed to move another vehicle:
   a. the EBS data exchange between the tractive motor vehicle and this other vehicle shall be transferred; the towed vehicle's own braking system may be temporarily decoupled from this;
   b. the braking system shall be protected as referred to in Directive 71/320/EC[9], annex I, subsection 2.2.1.18;
   c. the coupling for coupling a trailer or semi-trailer shall meet the requirements set out in Directive 94/20/EC and shall also be suitable for the larger forces (higher D and V values) of the LHV;
   d. shall be designed in such a way that data on the pressure per axle or per axle system of this vehicle is supplied through the data cable of the braking system (CANbus) for further processing, or shall have an indicator on which the pressure per axle or axle system is indicated, with a measuring instrument accuracy of at least 0.1 tonne or 100 kg.

Article 3

The following applies for an LHV:

1. In addition to the provisions of the Dutch Ministerial Decree *Regeling voertuigen*, the maximum permissible sum of the axle loads of a centre-axle trailer which is to be moved by another trailer shall not exceed the sum of the axle loads of the towing trailer.
2. In addition to the provisions of article 5.18.31, item a, of the Dutch Ministerial Decree *Regeling voertuigen,* the combined sum of the axle loads of two centre-axle trailers to be moved by a commercial vehicle shall not exceed 1.5 times the sum of the axle loads of the tractive motor vehicle or the permissible maximum towable mass indicated in the registration number register or on the tractive motor vehicle's vehicle registration certificate.

[8] UN ECE regulations no. 104 with uniform technical prescriptions for the approval of retro-reflective markings for heavy and long vehicles and their trailers, concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions.

[9] Council Directive 71/320/EEC of 26 July 1971 on the approximation of the laws of the Member States relating to the braking devices of certain categories of motor vehicles and of their trailers (OJEC L 202).

ANNEX C, PART 1, AS REFERRED TO IN ARTICLE 14, SUBSECTION 1

Model LHV certificate

LHV certificate

IKS Department (Individueel Keuren Speciaal/Special Individual Approvals)
PO Box 777 – 2700 AT Zoetermeer
Tel +31 (0)79 345 8302 Fax +31 (0)79 345 8034

Issued taking into account the provisions set out in the policy regulation on approvals and exemption permits empirical phase LHV 2009 (Beleidsregel keuring en ontheffingverlening ervaringsfase LZV 2009), Government Gazette (Staatscourant) no..... , publication date…….

This document concerns a certificate, as referred to in article 12, subsection 1, of the policy regulation on approvals and exemption permits empirical phase LHV 2009 (Beleidsregel keuring en ontheffing-verlening ervaringsfase LZV 2009).

Issued for: commercial vehicle / trailer / semi-trailer
Registration number:
Make:
VIN code:

This vehicle may be used in an LHV as referred to in the policy regulation approvals and exemption permits empirical phase LHV 2009 (Beleidsregel keuring en ontheffing-verlening ervaringsfase LZV 2009). Besides being subject to the details and conditions stated in the vehicle document, the use in an LHV is also subject to the following particular details:

Depending on the type of vehicle, the following texts shall be indicated. These texts are the same as those which would be indicated on the vehicle registration certificate of a similar Dutch vehicle, under the heading 'bijzonderheden' (particular details). Where necessary; additional conditions shall also be indicated.

1.	In long and heavy commercial lorry combinations			
2.	– max mass self-braking	:	kg	
3.	– max mass centre-axle braking	:	kg	
4.	– max mass semi-trailer braking	:	kg	
5.	Distance from centre of coupling to centre of coupling	:	cm	
6.	Distances from centre of coupling to centre of coupling.....	:	cm and	cm
7.	Movement of semi-trailer using driven axle(s) is not permitted.			
8.	– max combination mass	:	kg	
9.	Geometric wheel base	:	cm	

The Management Board of RDW,
on the latter's behalf,
Head of the IKS department of the
Vehicle Technology Division,

Place, date

(embossed) stamp

ANNEX C, PART 2, AS REFERRED TO IN ARTICLE 14, SUBSECTION 2

Model Approval Certificate

LHV approval certificate

IKS Department (Individueel Keuren Speciaal/Special Individual Approvals)
PO Box 777 – 2700 AT Zoetermeer
Tel +31 (0)79 345 8302 Fax +31 (0)79 345 8034

Issued taking into account the provisions set out in the policy regulation on approvals and exemption permits empirical phase LHV 2009 (Beleidsregel keuring en ontheffingverlening ervaringsfase LZV 2009), Government Gazette (Staatscourant) no. ....., publication date.....

The combination of vehicles described below concerns a:

Commercial lorry combination, as referred to in article 13, subsection 1, item a, of the policy regulation approvals and exemption permits empirical phase LHV 2009 (Beleidsregel keuring en ontheffing-verlening ervaringsfase LZV 2009).
The loading space length meets the requirements set out in annex D, under 2, article I, subsection 2, of the policy regulation.
The combination need not be fitted with the axle-load meters referred to in annex D, under 2, article K of the policy regulation.

Combination of foreign vehicles, as referred to in article 13, subsection 1 item b, of the policy regulation approvals and exemption permits empirical phase LHV 2009 (Beleidsregel keuring en ontheffing-verlening ervaringsfase LZV 2009).
This combination need not be fitted with the axle-load meters referred to in annex D, under 2, article K of the policy regulation.
The tractive motor vehicle shall be fitted with facilities to improve the field of vision as referred to in article 5.3.45, subsection 11 of the Dutch Ministerial Decree *Regeling voertuigen*.

Driving this assembly while not in possession of an exemption pursuant to article 149a, subsection 2, of the Dutch Road Traffic Act 1994 is prohibited.

This certificate ceases to be effective on 1 November 2011.

Overview of combination configuration A

registration numbers

	motor vehicle	semi-trailer	centre-axle trailer	comment
1				
2				
3				
4				
5				
6				
7				

Overview of combination configuration B

Registration numbers

	motor vehicle	leading semi-trailer	rear semi-trailer	Comment
1				
2				
3				
4				
5				

Overview of combination configuration C

registration numbers

	motor vehicle	trailer		comment
1				
2				
3				
4				
5				

Delivery date 15-09-09

Overview of combination configuration D

registration numbers

	motor vehicle	dolly	semi-trailer	comment
1				
2				
3				
4				
5				

Overview of combination configuration E

registration numbers

	motor vehicle	leading centre-axle trailer	rear centre-axle trailer	comment
1				
2				
3				
4				
5				

The Management Board of RDW,
on the latter's behalf,
Head of the IKS department of the
Vehicle Technology Division,

Place, date

(embossed) stamp

Delivery date 15-09-09

ANNEX D, AS REFERRED TO IN ARTICLE 15. RESTRICTIONS AND REGULATIONS

1. LHV restrictions

Article A LHV dimensions and turning points

An LHV shall have:
1. no more than 2 turning points;
2. a total length of no more than 25.25 m including the load and taking into account the measurement method stipulated in article 5.1a.1, subsection 2, item a, of the Dutch Ministerial Decree *Regeling voertuigen*.

Article B Combination prohibition

An LHV exemption permit shall not be used in combination with an exemption for exceptional load transport.

Article C LHV exemption and transport of indivisible load

The transport of an indivisible load in the manner referred to in articles 5.18.13 and 5.18.14 of the Dutch Ministerial Decree *Regeling voertuigen* is not permitted when an LHV exemption permit is being used.

Article D Prohibition on equipment for and transport of liquid load

An LHV shall not be equipped or laden with a tank for a liquid load with a volume exceeding 1000 l.

Article E Prohibition on transporting hazardous substances

An LHV shall not transport hazardous substances in volumes exceeding those referred to in the UN number series 1.1.3 of the ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road).

2. General regulations

Article A Vehicle documents

The documents issued for the vehicle or vehicles in connection with an LHV and the vehicle documents required for the LHV exemption permit shall be present when the LHV exemption permit is used. It shall be possible to show along with the LHV exemption permit a valid, original copy of these documents which has been certified by RDW (Dutch vehicle approval and information authority).

Article B LHV driver's documents

1. The LHV driver must be in possession of:
   a. a valid driving licence for driving motor vehicles covered by driving licence categories C and E;
   b. a certificate of professional competence to drive a commercial lorry as referred to in the certificate of professional competence regulations *Regeling getuigschrift vakbekwaamheid*, or shall meet the requirements set out in article 2.7.2 of the working hours decree *Arbeidstijdenbesluit*, and
   c. a valid, special LHV professional driver certificate *CCV-certificaat 'Rijvaardigheidstoets langere en/of zwaardere voertuigen'* issued by the Central Office for Motor Vehicle Driver Testing *Stichting Centraal Bureau Rijvaardigheidsbewijzen*. Other professional requirements which have been issued in another member state of the European Union or a state which is not a member of the European Union but which is party to a treaty which covers this subject, or also covers this subject and binds the Netherlands shall be deemed to be equivalent to this professional requirement, as shall those which assure a level of professional competence which in the opinion of *Stichting Centraal Bureau Rijvaardigheidsbewijzen* is at least equivalent to the level intended by the national professional requirements.
2. The documents referred to in subsection 1 which are issued for the driver shall be present in the vehicle when the exemption permit is being used.
3. Subsection 1, item c, shall not apply to the use of an LHV training exemption permit, providing that:
   a. the user of the training exemption permit has been in possession of a valid driving licence for at least five years which entitles the person concerned to drive motor vehicles covered by driving licence categories C and E;
   b. the user of the training exemption permit has not been disqualified from driving during the past three years and the driving licence issued to the person concerned has not been declared invalid or withdrawn, and
   c. written and personalised instructions present in the vehicle can be produced to demonstrate that on the day of the inspection the user was driving along the shortest route permitted by the exemption permit on the way to or returning from a training course, under the supervision of a qualified instructor, in connection with preparing for the certificate or an examination for the certificate referred to in subsection 1, item c.

Article C Extraordinary conditions

1. The LHV exemption permit's use shall not be permitted when there are icy patches on roads and when weather conditions restrict visibility to less than 200 metres.
2. If such conditions arise, use of the LHV exemption permit shall be terminated as soon as possible.

Article D Place on the roadway

An LHV is prohibited from overtaking any motor vehicles which are permitted to drive faster that 45 km per hour.

Article E Dimensions and mass of LHV vehicle combinations

Any combination of vehicles to be formed by an LHV shall meet the requirements for use stated in chapter 5, part 18, of the Dutch Ministerial Decree *Regeling voertuigen*

Article F Tractive motor vehicle LHV

The tractive motor vehicle of an LHV shall be fitted with:
1. lateral protection as referred to in article 5.3.48, subsection 8, of the Dutch Ministerial Decree *Regeling voertuigen* and comprises a continuous, smooth surface;
2. clear reflecting markings as referred to in, and installed in accordance with, Directive 76/756/EEC and made of a material which complies with ECE regulations no. 104 class C[1],

Article G Towed vehicle LHV

The towed vehicle of an LHV shall be fitted with:
1. lateral protection as referred to in article 5.12.48, subsection 5, of the Dutch Ministerial Decree *Regeling voertuigen* and comprises a continuous, smooth surface;
2. clear reflecting markings as referred to in, and installed in accordance with, Directive 76/756/EEC and made of a material which complies with ECE regulations no. 104 class C[1].

Article H LHV turning circle

An LHV shall be capable of describing a complete circle on each side within an area bounded by two concentric circles, the outer one having a radius of 14.50 m and the inner one having a radius of 6.50 m, without one of the vehicles outer points extending beyond the circumference of the circles.

Article I LHV loading space length

1. The loading space length, which is the distance between the foremost point at the outside of the loading space behind the driver's cab and the rearmost point at the outside of the rearmost trailer, minus the distances between the rear side of the loading space of the vehicles and the front side of the loading space of the trailing vehicles, shall be at least 18.00 m and no more than 21.82 m.
2. Contrary to the provisions of subsection 1, the maximum permissible length of the loading platform shall not apply to commercial lorry combinations as referred to in article 13, subsection 1, item a.

Article J LHV rear vehicle's marking

1. An LHV's rearmost vehicle shall be fitted with a horizontal marking as referred to in article 5.18.36a, of the Dutch Ministerial Decree *Regeling voertuigen*, on which the side contour of the LHV concerned shall be marked in black along the entire height of the yellow area.
2. If the marking is divided across two signs, the aforementioned contour of the combination shall be fitted on the sign attached to the left half of the vehicle.
3. The total length of the LHV in metres shall be indicated in black on the marking.

Article K Presence of axle reading instrument on LHV

1. With the exception of the tractive motor vehicle's front axle, it shall be possible to indicate the static axle loads that occur on an LHV with a measuring instrument accuracy of 100 kg. Moreover, use shall be made of the pressure that occurs in the suspension spheres of each axle.
2. The provisions of subsection 1 shall not apply to commercial lorry combinations or a combination of foreign vehicles provided with an approval certificate as referred to in article 13.

Article L Cooperation in provision of information on use of LHV exemption permit

At the request of the Dutch Ministry of Transport Public Works and Water Management, the applicant and

[1] UN ECE regulations no. 104 with uniform technical prescriptions for the approval of retro-reflective markings for heavy and long vehicles and their trailers, concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions.

user of an exemption permit shall be obliged to cooperate in any investigation concerning experiences with, and the deployment of, the LHV and the LHV exemption permit.

Article M

In an LHV the combined sum of the axle loads of two centre-axle trailers which are joined one behind the other shall not exceed 1.5 times the sum of the axle loads of the tractive motor vehicle.

Article N

In an LHV the sum of the axle loads of a centre-axle trailer moved by another trailer shall not exceed the sum of the axle loads of the towing trailer.

Article P

The total mass of an LHV shall not exceed the figure referred to in article 5.18.17b subsection 2, part b, of the Dutch Ministerial Decree *Regeling voertuigen*, unless the tractive motor vehicle is fitted with an axle-lift device as referred to in annex I, item 2.14, of Directive 97/27/EC.

Explanatory note

As a result of the implementation of the motor vehicles decree *Besluit voertuigen* and the Dutch Ministerial Decree *Regeling voertuigen* (motor vehicle regulations) the legal basis for the policy regulation on LHV exemption permits empirical phase *Beleidsregel ervaringsfase ontheffingverlening LZV* no longer exists. They must therefore be published once again.
The opportunity has also been taken to amend articles 3, 4, 9 and 10 in line with exemption permit practice.
Article 3: given the definition in article 1, item a, the explicit naming of LHV core areas could be dispensed with here.
In article 4, the formulation of current practice concerning road annexes has been improved. A road annex shall be provided which includes details of national highways, referred to as the basic network (basisnet), possibly issued in combination with road annexes with details of LHV core areas. Article 9 indicates that a party may submit an application for the expansion of LHV core areas during the period of validity of a basic exemption permit. To this end the RDW uses the Internet to announce the newly obtained LHV core areas, as stipulated in article 10. The LHV core areas amendment subscription referred to previously in article 10 proved not to meet demand, as large numbers of parties opted to make use of the provisions of article 9 for the expansion of LHV core areas.
The provisions on line marking and contour marking have been brought into line with Directive 76/756/EEC. Moreover, the omission concerning the calculation of the LHV's engine capacity has been rectified.

The Management Board of RDW,
on the latter's behalf:
the Managing Director,
J.G. Hakkenberg

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