Qualitative Survey on Fuel Economy Devices

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Summary

In the Netherlands, Novem (the Netherlands Agency for Energy and the Environment) has gained a lot of experience and results in the area of fuel saving in-car devices. In the last decade field experiments have been carried out with econometers, on-board computers, cruise controls and speed and revolution limiters. Some of these feedback devices, however, have become more or less obsolete. This has urged parties in the Netherlands and in Germany to take the first step in developing new-generation 'plug-and-play' devices, so called Modern Drive Devices (MDD). MDD stands for a concept of a fuel economy device that consists of the following features:

- It is a plug-and-play system, which implies that it can be installed in the existing fleet rather easily;
- It can register several variables like fuel consumption, CO_2-emission, aspects of the driving style and distance travelled;
- The performance values of these variables can be presented on a PDA display (e.g. Palm display) in the vehicle;
- The PDA can be taken out to edit or analyse the data in more detail on a PC afterwards by means of a specially designed software package.

Despite strong indications that there is a widespread demand for easy to use and easy to fit in feedback instruments, the exact market potential is not known at this moment. Therefore a market survey is needed.

At the request of Novem and within the framework of OPET (Organisations for the Promotion of Energy Technologies), the Centre for Transport Studies of the University of Twente in the Netherlands has conducted a qualitative market survey on in-vehicle systems, in particular fuel economy devices and the MDD-concept.

The objective of this survey is bipartite:

1. To identify current and future developments of fuel economy devices, and the role of different organisations in these developments;
2. To elaborate and assess the MDD-concept.

In order to achieve this objective, the qualitative survey consisted of two parts. From a strategic point of view, representatives of (inter)national government bodies, branch organisations and consumer organisations have been interviewed. Questions on in-vehicle systems in general were asked, as well as similar questions on fuel economy devices. Also an opinion on the MDD-concept was asked for. From a user point of view, interviews and panel discussions with driving instructors, private car drivers and fleet owners in the Netherlands have been held. For specification purposes, questions on the MDD-concept were asked.

With respect to the current and future developments of fuel economy devices, and the role of different organisations, the following can be concluded. According to the interview results, on-board technologies can provide a significant contribution to reduce fuel consumption. However, the market for fuel economy devices is estimated to be rather limited. Identified market segments with high potential are fleet owners and driving instructors. The car industry and their suppliers take the lead in developing standard and optional in-vehicle systems like fuel economy devices. The organisations in the survey play a moderate and rather reactive role, for example by subsidising R&D in this area, introducing financial incentives for the purchase of fuel economy devices, and setting up public campaigns. The car industry and their suppliers are not expected to be involved in developing fuel economy devices as stand-alone systems. Their involvement is likely to increase if fuel economy devices are integrated with other functionalities. The devices should display interpretable information, preferably in terms of directed advices. Installation of plug-and-play systems in the existing fleet is advised

against by the respondents, because of different types of engines and motor management systems, potential interference with these systems and, as a consequence, warranty and liability problems.

With respect to the elaboration and assessment of the MDD-concept, the following can be concluded. The opinion of respondents in the strategic survey on the MDD-concept is similar to the general opinion on fuel economy devices as stated above. Additionally, the respondents consider an accompanying software package a helpful tool, especially for fleet owners.
The distinguished user groups find the MDD-concept to some extent useful and appealing. Driving instructors and fleet owners value it most. It appears that not all user groups have similar preferences for the information presented on the MDD-display and in the accompanying software package. Considering the costs involved, it is preferable to produce fuel economy devices – like the MDD-concept and the software package – that meet the requirements of more than one user group. With respect to the preferences of the user groups distinguished in this qualitative survey, three types of the MDD-concept as well as the software package are identified. Generally, these types differ from each other regarding kind of information, units of information and time scale (e.g. trip values, aggregated values on a week or month) presented.

1 Introduction

In the Netherlands, Novem (the Netherlands Agency for Energy and the Environment) has gained a lot of experience and results in the area of fuel saving in-car devices. In the last decade field experiments have been carried out with econometers, on-board computers, cruise controls and speed and revolution limiters. Some of these feedback devices, however, have become more or less obsolete.

Therefore, the University of Twente developed a new fuel-efficiency support tool: if actual driving behaviour deviates from an optimal fuel-efficient behaviour, detailed advice is presented to the driver on how to change driving behaviour in order to minimise fuel consumption. A recently carried out field experiment, co-financed by Novem, with the new fuel-efficiency support tool revealed that car drivers were able to reduce fuel consumption by 11% on average due to the support tool (Van der Voort, 2001).

This result has urged parties in the Netherlands and in Germany to take the first step in developing new-generation 'plug-and-play' devices, so called Modern Drive Devices (MDD). The problem with existing equipment for retrofit purposes is that it is either obsolete, has limited or no possibilities of registration and is mostly only suitable for petrol-cars. Furthermore, fitting in this equipment in vehicles costs a lot of time and money. The MDD-concept is based on the principles of easy to use and easy to fit in (at low costs) in current fleet of cars. And moreover, the MDD-concept will be suitable for petrol-, L.P.G.- and diesel-cars. The MDD-concept provides drivers and fleet owners with feedback on driving behaviour and therefore stimulates an energy-efficient driving style.

Recently in the Netherlands, there seems to be a growing demand for reliable feedback and registration devices. Many driving schools, for example, want to be able to make a good trip analysis on driving style and fuel consumption. The demand is likely to grow further in the near future because of the promoting activities of The New Driving Force programme (Het Nieuwe Rijden). As part of the programme amongst others all Dutch driving instructors and examiners will be trained in practising the driving style of TNDF and also in teaching it to their pupils. Despite the strong indications that there is a widespread demand for easy to use and easy to fit in feedback instruments, the exact market potential is not known at this moment. Therefore a market survey is needed.

At the request of Novem and within the framework of OPET (Organisations for the Promotion of Energy Technologies), the Centre for Transport Studies of the University of Twente in the Netherlands has conducted a qualitative market survey on in-vehicle systems, in particular fuel economy devices and the MDD-concept.

The objective of this survey is bipartite:

1. To identify current and future developments of fuel economy devices, and the role of different organisations in these developments;
2. To elaborate and assess the MDD-concept.

Because of this bipartite objective, the survey consists of two points of view that have been worked out parallel to each other. From a strategic point of view, interviews with representatives of (inter)national government bodies, branch organisations and consumer organisations have been held. From a user point of view, driving instructors, private car drivers and fleet owners have been interviewed.

In chapter 2 the method that has been used in this survey is explained. In this chapter the MDD-concept is clarified as well. Chapter 3 contains the approach and results of the strategic part of the survey. It closes with conclusions based on the strategic interviews. Chapter 4

consists of the approach and results of the user part of the survey. Based on the interviews held during this part of the survey, conclusions regarding the MDD-concept are presented as well. General conclusions can be found in chapter 5.

2 Method

In order to achieve the objective of this qualitative survey, interviews have been held from two points of view. From a strategic point of view, representatives of (inter)national government bodies, branch organisations and consumer organisations have been interviewed. Questions on general in-vehicle systems were asked, as well as similar questions on fuel economy devices. Also an opinion on the MDD-concept was asked for.

From a user point of view, interviews and panel discussions with driving instructors, private car drivers and fleet owners have been held. For specification purposes, questions on the MDD-concept were asked as well.

MDD stands for a concept of a fuel economy device that consists of the following features:

- It is a plug-and-play system, which implies that it can be installed in the existing fleet rather easily;
- It can register several variables like fuel consumption, CO_2-emission, aspects of the driving style and distance travelled;
- The performance values of these variables can be presented on a PDA display (e.g. Palm display) in the vehicle;
- The PDA can be taken out to edit or analyse the data in more detail afterwards on a PC by means of a specially designed software package.

Figure 1 illustrates the MDD-concept.

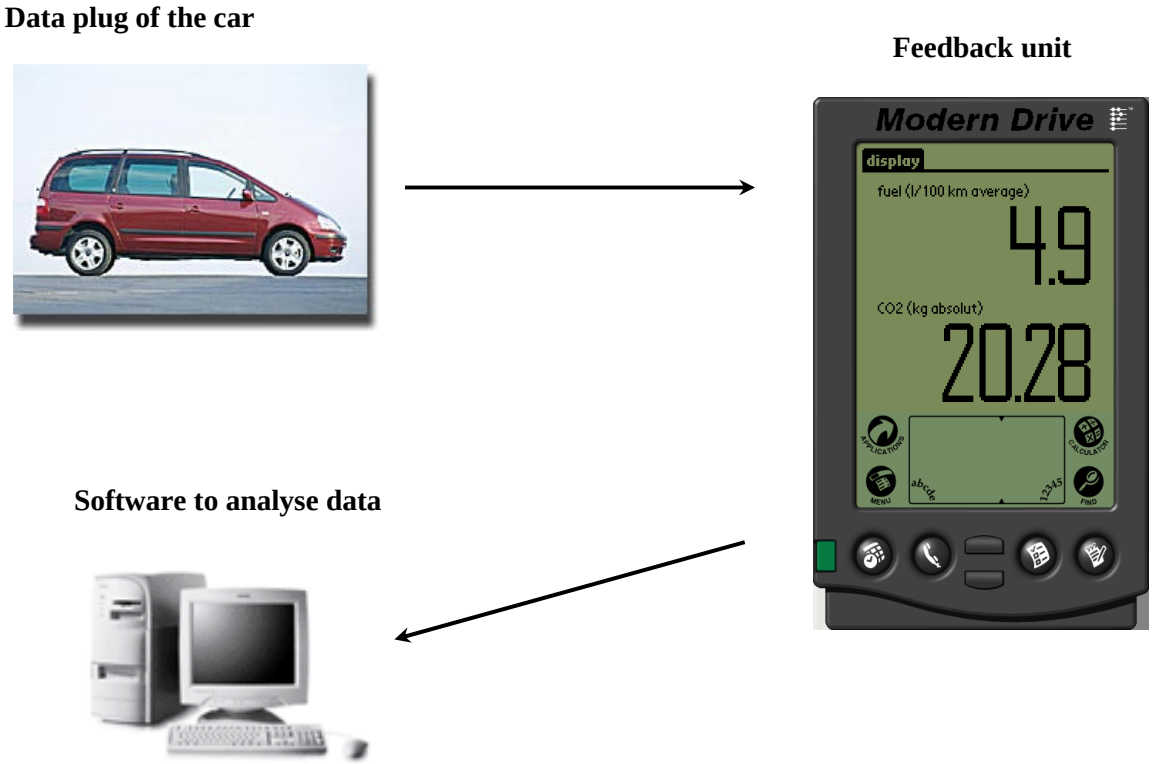

Figure 1. MDD-concept

3 Strategic survey

3.1 Approach

This part of the qualitative survey was conducted in order to investigate the strategic view of several organisations on in-vehicle systems in general and fuel economy devices in particular. Therefore interviews with representatives of the following (inter)national organisations were carried out:

- Directorate-General Energy & Transport of the European Commission;
- Directorate-General Environment of the European Commission;
- Ministry of Transport, Public Works and Water Management of the Netherlands;
- Ministry of Housing, Spatial Planning and Environment of the Netherlands;
- Branch organisation RAI-Vereniging (the Netherlands);
- Branch organisation BOVAG (the Netherlands);
- Consumer organisation ANWB (the Netherlands).

During the first part of the interview, questions on in-vehicle systems in general were asked. Attention was paid to the organisation's point of view on current and future developments of in-vehicle systems. Also the role of the organisation in these developments was investigated; for example by asking whether the organisation is in a position to influence the development of in-vehicle systems or to stimulate the installation and use of these systems. Another question concerned other organisations that – according to the respondent – play an important role in the developments of in-vehicle systems. Finally, questions on (inter)national policy on in-vehicle systems were asked (See Appendix I for questionnaire).

During the second part of the interview, similar questions were asked on fuel economy devices. The last part of the interview concerned the MDD-concept. The representative of the organisation was asked to give a general opinion on the MDD-concept. The market chances for plug-and-play systems (like the MDD-concept) with respect to installation in new cars as well as in the current fleet were also attended to.

3.2 Results

The main results of the strategic survey are summarised into three categories: general in-vehicle systems, fuel economy devices and the MDD-concept.

In-vehicle systems in general

All respondents state that a lot of research is done worldwide with respect to in-vehicle systems, both in a laboratory setting and in field experiments and pilot studies. On-board technologies are being developed rapidly and are also evolving. However, the introduction of fully automated traffic systems is not foreseen within the next 20 up to 30 years. The development time of in-vehicle systems is relatively long, because of the high investments involved and difficult realisation of financial benefits. Furthermore, a lot of partners are required in the development process, for example with regard to providing information.
The car industry and their suppliers take the lead in developing on-board technologies. The R&D in this field is strongly market driven. Due to the large number and the pace of developments, partially withdrawn from the field of vision, it is almost impossible to get a clear, complete and up-to-date overview of the state-of-the-art of in-vehicle systems and the development in the near future. This explains the absence of explicit statements concerning in-vehicle systems in most of the policy documents (see for example Ministry of Transport, Public Works and Water Management, 2000, and European Commission, 2001).
At this moment no (detailed) standardisation of in-vehicle systems is present. The representatives of the organisations in the survey are divided about the desirability of

standardisation. Current in-vehicle systems satisfy basic requirements and standardisation could restrict further development of the systems.
High expectations are uttered with respect to the implementation of advanced possibilities of communication between the vehicle and its environment (e.g. using GPS and GSM). A shift is (fore)seen from road systems via vehicle systems towards personal systems (PDA's). The information presented will more and more suit the personal situation. It is expected that a complete platform will be present in future cars. The driver has to pay for desired facilities and is able to download certain options from the Internet. In addition, it is stated repeatedly that only in-vehicle systems that assist drivers in performing the driving task in a safe, personal and flexible way have a potential. The systems have to be integrated in the dashboard, if possible with removable units, and need to have multiple functions. Applications of in-vehicle systems seem to be interesting for users only for financial and/or logistic reasons.
The organisations participating in the survey play a moderate and rather reactive role in the development of in-vehicle systems. The (inter)national government bodies are merely engaged in subsidising R&D in this area, introducing financial incentives for the purchase of in-vehicle systems, and setting up public (awareness) campaigns and consumer documentation. With respect to the latter two points, also the branch organisations play a role. The Dutch Ministry of Housing, Spatial Planning and Environment introduced the "BPM-vrijstelling" (exemption of purchase tax) as a financial incentive to stimulate the purchase of (fuel economy) in-vehicle systems. The branch organisations contributed to the completion of this incentive measure. The branch organisations state firmly that purchase tax forms a limitation for further development of in-vehicle systems. The ministry also indicated that the use of fuel economy devices could be stimulated by integrating them in the driving school curricula. The Dutch consumer organisation is now taking explorative initiatives to establish directives for on-board technologies. Setting up consumer documentation is done by this organisation as well. The "Mobi-meter" (the proposed Dutch road pricing system (by kilometre driven)) is a good example of an advanced in-vehicle system that communicates with the vehicle's environment using GPS and GSM. The "Mobi-meter forms a good platform for integration of several in-vehicle systems and will therefore stimulate further development of in-vehicle systems. The idea for the "Mobi-meter" is generated by the Ministry of Transport, Public Works and Water Management; the development is in hands of the car industry and their suppliers. The branch organisations emphasise that this is the appropriate way for developing on-board technologies.

Fuel economy devices

Although the main objective of fuel economy devices – reducing CO_2-emission – is fully supported and acknowledged by all organisations, yet the demand for these devices is considered to be limited, in particular with reference to other applications (e.g. cruise control or route navigation systems) and in the after sales market. The importance of driving style for fuel efficiency is recognised. However, in order to reduce its influence, the role of hardware (e.g. automatic transmission, engine technology) is more emphasised than the role of driver supporting in-vehicle systems. The organisations in the survey indicate that the situation should move towards one in which the influence of driving behaviour is restricted by hardware.
Fuel economy devices should not be stand-alone systems, and the devices ought to be cost-effective. Identified market segments with high potential are fleet owners and driving instructors. Fuel economy devices should not only register and display values of relevant indicators, because most drivers require at least a reference framework and preferably instructions for adapting their behaviour. Therefore, the devices should present interpretations of values, or even better support drivers by giving directed advice.
Finally, most of the respondents explicitly state that it has to be kept in mind that other functionalities of in-vehicle devices (e.g. cruise control or stop-and-go systems) also have a positive impact on fuel economy.

MDD-concept

The MDD-concept is considered to be a good example of the potential of new technologies. The use of a PDA (e.g. Palm) offers opportunities to integrate the concept with other, additional functions. The concept should not be a stand-alone system; not only for purchase reasons, but also because most market segments already have a board computer installed in their vehicles. In addition, the MDD-concept has to be cost-effective.

The respondents expect complications with the plug-and-play feature of the concept. The system has to be adapted to each car it will be installed in, because drawing data from the motor management system is strongly related to vehicle brand and type. Also potential interference with these systems has to be taken into account. As a consequence, respondents notify warranty and liability problems.

The information on the display should be expanded with reference indicators and a supporting advice function. The enclosed software package is considered to be a helpful tool, especially for fleet owners to monitor fuel costs, costs of damage and maintenance, and the driving behaviour of their employees. However, privacy problems with respect to the latter point might occur.

3.3 Conclusions

On-board technologies can provide a significant contribution to reduce fuel consumption. However, the market for fuel economy devices is estimated to be rather limited. Identified market segments with high potential are fleet owners and driving instructors. The car industry and their suppliers take the lead in developing in-vehicle systems like fuel economy devices. The organisations involved in the survey play a moderate and rather reactive role, for example in subsidising R&D in this area, introducing financial incentives to stimulate the purchase of fuel economy devices, and for setting up public campaigns. The car industry and their suppliers are not expected to be involved in developing fuel economy devices as stand-alone systems. Therefore, these devices should be integrated with other functionalities. The devices should display interpretable information, preferably in terms of directed advices. Installation of plug-and-play systems in the existing fleet is advised against by the respondents, because of different types of engines and motor management systems, potential interference with these systems and, as a consequence, warranty and liability problems.

4 Elaboration of the MDD-concept

4.1 Approach

The second part of the qualitative survey was conducted in order to investigate the preferences of several user groups with respect to the feedback unit and the software package of the MDD-concept. Representatives of the following distinguished user groups have been interviewed (number of representatives is in parenthesis):

- Instructors of advanced driver training courses (5);
- Instructors of driving school curricula (17);
- Private car drivers (31);
- Fleet owners (12):
    - Business car drivers (3);
    - Service companies (3);
    - Courier companies (3);
    - Lease companies (3).

A literature study was performed to make an inventory of existing fuel economy devices and directives with respect to user interfaces for in-vehicle systems and software packages (Van der Voort et al., 2002). To a large extent, the questionnaire for the interviews has been formulated on the basis of this literature study. Respondents were asked for their appreciation of the MDD-concept in terms of usefulness and appeal. Furthermore, the completion of the MDD-concept was investigated. For example by asking what sort of information is wanted on the display and in the software package, what units of information are desired and which presentation forms could be used best on the display (e.g. digital numbers) and in the software package (e.g. tables and graphs).

The Traffic Safety Centre Rozendom (VVCR) supported this part of the survey by recruiting and selecting the representatives of the user groups and arranging the appointments for the interviews. Private car drivers were recruited from advanced driver training courses. The interviews with private car drivers and a part of the instructors of driving school curricula were conducted as panel discussions. The discussions took place consistent with the questions that were asked during the face-to-face interviews with representatives of the other user groups.

4.2 Results

On the basis of the interviews with representatives of the user groups, specifications for the MDD-concept and the accompanying software package were formulated (see also Van der Voort et al., 2002). In general, the user groups find the MDD-concept to some extent useful and appealing. This goes especially for instructors and fleet owners of courier companies. The MDD-concept is appreciated less by private car drivers and fleet owners of other types of companies. Figure 2 shows the appreciation of the concept with respect to usefulness and appeal. The appreciation was deducted from a questionnaire as a rating on –2 to 2 rating scales. Usefulness was determined by asking representatives their opinion on 5 items (useful-useless, good-bad, effective-superfluous, assisting-worthless and raising alertness-sleep inducing) according to the procedure by Van der Laan et al (1997). Appeal was determined by averaging the ratings with respect to four items (pleasant-unpleasant, nice-annoying, likeable-irritating and desirable-undesirable).

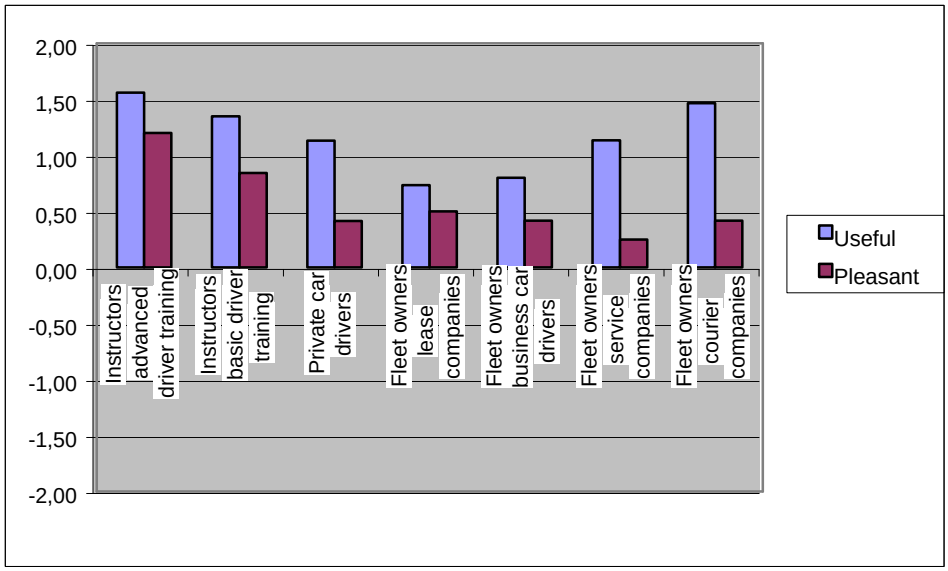

Figure 2. Appreciation of the MDD-concept

Specifications for the MDD-concept

Specifications were formulated for each user group separately at first. After that, the specifications were matched in order to trace the extent of similarity in the preferences of different user groups concerning the MDD-concept and the software package. In consideration of costs, the production of a fuel economy device that meets the preferences of several user groups is preferable to the production of specific devices for each of the distinguished user groups.

It appears that not all user groups have similar preferences regarding the information displayed by the MDD-concept. Each group wants information about fuel consumption and basic characteristics of the driving style. However, driving instructors prefer more detailed aspects of driving style to be presented on the display. Instructors of advanced driver training courses and private car users are interested in CO_2-emission and distance travelled as well. However, it should be noted that the specification for the latter user group could be biased, since all private car drivers were recruited from advanced driver training courses and are therefore more likely to have an interest in the effects of their driving style.

Based on the preferences of the distinguished user groups, three different types of the MDD-concept have been formulated. It should be noted that if other user groups are assumed, other types of the MDD-concept could possibly be identified. Specifications for the MDD-concept based on the distinguished user groups are listed below.

The general specifications that apply to the MDD-concept are:

- Fuel economy devices like the MDD-concept should be suitable for vehicles that run on petrol, L.P.G. (liquid gas) or diesel;
- All information should be presented in 1 decimal;
- Driving instructors prefer a turnable, lighted and for both the trainee and the instructor visible device that, for example, can be fixed to the windscreen;
- The other user groups prefer a device with multiple functions (e.g. combined with route navigation) that can be integrated in the dashboard;
- Possibility to switch between different kinds of information should be present;
- Possibility to turn off the interface should be present;
- Data recording should continue if the motor breaks down accidentally (especially for driving school curricula);
- Recorded data should be saved and stored after ending a trip (i.e. turning off the engine);

- Considering standard in-vehicle systems, there is no wish for duplicate information. An exception is information about speed, because users expect that the value given by the MDD-concept is more accurate than the value given by the speedometer. If no revolution counter is present in the vehicle, driving instructors and private car drivers indicate that this information should be displayed by the MDD-concept.

Table I shows the specifications of each of the three types of the MDD-concept formulated. Type I represents the MDD-concept according to the preferences of fleet owners of business car drivers, service companies and courier companies. Type II represents the MDD-concept according to the preferences of instructors of advanced driver training, private car drivers and fleet owners of lease companies. Finally, Type III represents the MDD-concept according to preferences of instructors of driving school curricula.

Table I: Specifications of the three types of MDD-concept

Specifications	Type I	Type II	Type III
Information about:			
• **Fuel consumption**			
o L/100 km	?	?	?
o Km/l	?	?	?
o L		?	
• **Driving style**			
o Speed		?	?
o Revolutions		?	?
o Acceleration			?
o # too fast accelerations	?	?	?
o # too hard decelerations	?	?	?
o # long idling periods	?	?	?
• **CO_2 emission**			
o g/km		?	
• **Distance travelled**			
o Km		?	?
Presentation of information:			
• **Values**			
o Analogue			
o Digital	?	?	?
• **Timing**			
o Current/total values during driving of:			
▪ Fuel consumption	?	?	?
▪ Driving style	?	?	?
▪ CO_2 emission		?	
▪ Distance		?	
o Average/total values after driving of:			
▪ Fuel consumption	?	?	?
▪ Driving style	? (speed)	? (speed)	?
▪ CO_2 emission			
▪ Distance	?	?	?

Specifications for the software package

With respect to specifications of a software package that can be used to analyse data generated by the MDD-concept afterwards on a PC, different types can be distinguished as well. Preferences among the user groups differ from each other regarding (units of) sorts of information wanted and the time scale presented in the software package. Most fleet owners prefer information about fuel consumption and driving style only, while driving instructors

and private car drivers want information about CO_2-emission and distance as well. Compared with private car drivers, driving instructors indicate that the software package should present more detailed aspects of the driving style. With respect to the time scale, driving instructors are merely interested in trip values, whereas the other user groups additionally demand for aggregated values over longer time scales (e.g. week, month) depending on personal preferences.

Based on the preferences of these user groups in particular, three different types of the software package can be formulated. Again it should be noted that if other user groups are assumed, other types of the software package could possibly be identified. In general, the following specifications apply to the software packages:

- Data generated by the MDD-concept can be analysed by means of Excel;
- All information should be presented in 1 decimal;
- Possibility to display more than one kind of information in a graph should be present;
- Most user groups give preference to automatically loading of information to PC (radiographic instead of using a Palm). Some respondents indicated that they only wish for a software package if the data is loaded automatically to their PC;
- Possibility to make comparisons between trips, persons and vehicles should be present.

Table II shows the three different types of software packages that have been formulated. Type I represents the software package according to preferences of private car drivers and fleet owners of service companies. Type II represents the software package according to preferences of fleet owners of lease companies, business car drivers and courier companies. The software package according to instructors of advanced driver training courses and driving school curricula is represented by Type III.

4.3 Conclusions

Driving instructors and fleet owners of courier companies value the MDD-concept most. It is appreciated less by private car drivers and fleet owners of other types of companies. It appears that not all user groups have similar preferences for the information presented on the MDD-display and in the accompanying software package. Considering the costs involved, it is preferable to produce fuel economy devices that meet the preferences of more than one user group. With respect to the preferences of the user groups distinguished in this qualitative survey, three types of the MDD-concept as well as three types of the software package are identified. Generally, these types differ from each other regarding kind of information, units of information and time scale (e.g. trip values, aggregated values on a week or month) presented.

Table II: Specifications of the three types of software packages

Specifications	Type I	Type II	Type III
Information about:			
• **Fuel consumption**			
o L/100 km	?	?	?
o Km/l	?	?	?
o Effective saving[1]		?	?
• **Driving style**			
o Speed	?	?	?
o Time driven in gear X			?
o Acceleration	?		?
o # too fast accelerations	?	?	?
o # too hard decelerations	?	?	?
o # long idling periods		?	?
• **CO_2 emission**			
o g/km		?	?
• **Distance travelled**			
o Km		?	?
Presentation of information:			
• **Form**			
o Digital (e.g. table)	?	?	?
o Diagram			
• Possibility to display fuel consumption in a graph (course of time)		?	
• Possibility to display time driven in gear X in a pie chart			?
• **Time scale**			
o Trip values	?	?	?
o Aggregated on longer scales (e.g. week, month)	?	?	
• Possibility to display average/total values of trips or other time scales in 1 graph (course of time)	?	?	?
• Possibility to make comparisons between self-indicated time scales	?	?	

[1] Effective saving represents the reduction in fuel consumption as a percentage of the total amount of fuel that *could have been* saved.

5 Conclusions and recommendations

The Centre for Transport Studies of the University of Twente has conducted a qualitative survey on fuel economy devices. The following bipartite objective of this survey was aimed for:

1. To identify current and future developments of fuel economy devices, and the role of different organisations in these developments;
2. To elaborate and assess the Modern Drive Device concept (MDD-concept).

MDD stands for a concept of a fuel economy device that can register fuel consumption, CO_2-emission, aspect of the driving style and distance travelled, and present the values on a PDA display (e.g. Palm display). In addition, a specially designed software package can be used to analyse the data generated by the MDD afterwards on a PC. The MDD-concept is based on a plug-and-play principle, which implies that it can be installed in the existing fleet rather easily.

To achieve the objective, the qualitative survey consisted of two parts that have been carried out parallel to each other: a strategic survey among policy makers and interest groups, and interviews with a priori identified user groups for specification purposes. The user groups distinguished are instructors of advanced driver training courses, instructors of driving school curricula, private car drivers and fleet owners.

Conclusions

Based on the strategic survey, the following can be concluded regarding the development of fuel economy devices, and the role of different organisations.

- Contribution and market potential

On-board technologies can contribute significantly to reduce fuel consumption. However, the market for fuel economy devices is estimated to be rather limited. Identified market segments with high potential are fleet owners and driving instructors.

- Development process

The car industry and their suppliers take the lead in developing in-vehicle systems like fuel economy devices. The organisations included in the survey play a moderate and rather reactive role, for example in subsidising R&D in this area, introducing financial incentives to stimulate the purchase of fuel economy devices, and setting up public campaigns. The car industry and their suppliers are not expected to be involved in developing fuel economy devices as stand-alone systems. Therefore, these devices should be integrated with other functionalities.

- System characteristics

The devices should display interpretable information, preferably in terms of directed advices. Installation of plug-and-play systems in the existing fleet is advised against by the respondents, because of different types of engines and motor management systems, potential interference with these systems and, as a consequence, warranty and liability problems.

Regarding the elaboration and assessment of the MDD-concept, the following can be concluded.

- Opinion

The opinion on the MDD-concept of respondents in the strategic survey is similar to the general opinion on fuel economy devices as stated above. Additionally, the respondents consider the accompanying software package a helpful tool, especially for fleet owners.

- Usefulness and appeal

The distinguished user groups find the MDD-concept to some extent useful and appealing. Driving instructors and fleet owners of courier companies value the MDD-concept most. Private car drivers and fleet owners of other types of companies appreciate it less.

- Preferred information

Not all user groups have similar preferences for the information presented on the MDD-display and in the accompanying software package. Considering the costs involved, it is preferable to produce fuel economy devices that meet the preferences of more than one user group. Based on the preferences of the user groups distinguished in this qualitative survey, three types of the MDD-concept as well as three types of the software package are identified. Generally, these types differ from each other regarding kind of information, units of information and time scale (e.g. trip values, aggregated values on a week or month) presented.

Further development

Having met the objectives of this research, the next step in the development of fuel economy devices would be to build a prototype of the MDD-concept in accordance with the specifications formulated in this report. While writing this report, Modern Drive Technology (Germany) has performed this step by building prototypes of each of the three types of MDD-concept as well as software packages. Before performing a field trial among the distinguished user groups, the prototypes were tested thoroughly by the University of Twente with respect to their technical functionality and performance as well as their accordance with the specification formulated. The tests revealed that the prototypes of both the MDD-concept as well as the software packages were at that point not suitable for full testing by means of a field trial. The major shortcomings related to data measuring, data storage due to the type of Palm used in the prototype, deviations from the specification formulated, questionable user friendliness especially with respect to the software package and finally the questionable reliability of the device in other types of vehicle than the test-vehicle. A full report of the tests can be found in Van Driel et al.(2002a,b). Based on the outcome of the tests it was decided to postpone a large-scale field trial indefinitely. The outcome was in addition used to formulate directives for (the development of) a fuel economy device (Van Driel et al, 2002b).

Recommendation

Combining the outcome of the strategic survey with the test results it is clear that the MDD-concept needs to be developed further before it can be applied on large-scale. The further development should focus on the question of whether the MDD-concept should focus on the after-sales market and if so, whether liability and warranty problems can be solved and the reliability in all types of vehicles can be assured. In addition data measuring and storage should be improved. Since the demand for a device as the MDD-concept is confirmed on both strategic as user level, it is recommended to develop the MDD-concept further and in accordance with the formulated directives for fuel economy devices. A subsidy scheme could stimulate companies to take up the further development.

Acknowledgements

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Appendix 1: Questionnaire used in strategic survey

Qualitative market research within the framework of OPET

Introduction

At the request of the Netherlands Agency for Energy and the Environment (Novem) and within the framework of OPET (Organisations for the Promotion of Energy Technologies), the Centre for Transport Studies of the University of Twente in the Netherlands carries out a qualitative, strategic market research concerning Advanced Driver Assistance Systems. In this respect, governmental organisations (both at a national level (i.e. the Netherlands) and an international level (i.e. EC)), branch organisations and consumer organisations will be interviewed. In this interview we would like to ask you some questions about Advanced Driver Assistance Systems in general and driver support tools that improve fuel-efficiency in specific[2].

Part I: Advanced Driver Assistance Systems in general

Applications of telematic aids and services in the field of traffic and transport are no longer a distant prospect. For example, at the moment, a lot of research is carried out towards so-called Advanced Driver Assistance Systems. These are in-vehicle systems that facilitate the tasks of a driver.

1. Can you – with respect to your organisation's perspective – give the point of view on the recent developments concerning Advanced Driver Assistance Systems?
    - what is this point of view based on; what is the origin of the relevant information ? own organisation, other organisations?
    - suggestions for relevant literature and (policy) reports

2. What are your expectations of the future developments concerning Advanced Driver Assistance Systems; in specific in the short and medium term?
    - what is this point of view based on; what is the origin of the relevant information ? own organisation, other organisations?
    - suggestions for relevant literature and (policy) reports
    - to what extent will traffic and transport be (fully) automated in the future? (regarding the recent developments concerning driver support tools)

3. To what extent is your organisation involved in the developments concerning Advanced Driver Assistance Systems?

[2] Note for the interviewer: During the interview, keep the following in mind: What is going to happen in the field of Advanced Driver Assistance Systems (in specific those systems that help to decrease fuel consumption) concerning legislation, directives, etc. and how can installation and use of such systems be stimulated?

4. To what extent is your organisation in a position to influence the development of Advanced Driver Assistance Systems and stimulate the installation and use of these systems? Do you think your organisation has a pro-active role or a reactive role? And how does this role reveal itself?
    - e.g. legislation, standardization, instructions/rules, promotion of installation, stimulation of use, etc.

5. To what extent can Advanced Driver Assistance Systems contribute to the mission of your organisation?
    - why so/why not?

6. Does your organisation fall under the umbrella of a European or worldwide organisation? If so, what is their point of view on the recent developments concerning Advanced Driver Assistance Systems and which role does this umbrella organisation fulfil in these developments?

7. Which organisations play, according to you, (also) an important part in the development of Advanced Driver Assistance Systems and the stimulation of installation and use of these systems?
    - other organisations like car manufacturers (why is it attractive (or not) to equip cars with Advanced Driver Assistance Systems?)
    - check which role the organisations fulfil in the respondent's opinion: pro-active, reactive
    - how does this role reveal itself ? e.g. legislation, standardization, instructions/rules, promotion of installation, stimulation of use, etc.

[This question is meant for all organisations *accept for* the governmental organisations.]

8. To what extent does the (inter)national policy [from all departments/ministries] correspond with your point of view on Advanced Driver Assistance Systems? And why? Would you like to see any changes in (inter)national policy? And why?

9. Is there in your opinion a (integrated) policy on Advanced Driver Assistance Systems at the national as well as the international level at the moment?

10. Do you have comments or suggestions with respect to Advanced Driver Assistance Systems in general?

Part II: Fuel-efficiency support tools

Besides Advanced Driver Assistance Systems that, for example, enhance safety or optimise the traffic flow, Advanced Driver Assistance Systems can also support the driver to drive more economically. Examples of such systems are cruise control and trip computers that reflect the actual fuel consumption on a human-machine interface.

11. Can you – with respect to your organisation's perspective – give the point of view on the recent developments concerning driver support tools that improve fuel-efficiency?
    - what is this point of view based on; what is the origin of the relevant information ? own organisation, other organisations?
    - suggestions for relevant literature and (policy) reports

12. What are your expectations of the future developments concerning driver support tools that improve fuel-efficiency; in specific in the short and medium term?
    - what is this point of view based on; what is the origin of the relevant information ? own organisation, other organisations?

- suggestions for relevant literature and (policy) reports
- what is the potential of driver support tools that improve fuel-efficiency regarding the general goal: reduction of CO_2?
- what is the potential of driver support tools that improve fuel-efficiency regarding other Advanced Driver Assistance Systems?

13. To what extent is your organisation involved in the developments concerning driver support tools that improve fuel-efficiency?

14. To what extent is your organisation in a position to influence the development of driver support tools that improve fuel-efficiency and stimulate the installation and use of these systems? Do you think your organisation has a pro-active role or a reactive role? And how does this role reveal itself?
    - e.g. legislation, standardization, instructions/rules, promotion of installation, stimulation of use, etc.

15. Do you recognize other roles for your organisation in the development of driver support tools that improve fuel-efficiency and/or the stimulation of installation and use of these tools?
    - if so, which roles?
    - if not, why not?

16. To what extent can driver support tools that improve fuel-efficiency contribute to the mission of your organisation?
    - why so/why not?

[This question applies *only when* the organisation has a European or worldwide umbrella organisation]

17. What is the point of view of your (European or worldwide) umbrella organisation on the recent developments concerning driver support tools that improve fuel-efficiency and which role does this umbrella organisation fulfil in these developments?

18. Which organisations play, according to you, (also) an important part in the development of driver support tools that improve fuel-efficiency and the stimulation of installation and use of these systems?
    - other organisations like car manufacturers (why is it attractive (or not) to equip cars with fuel-efficiency support tools?)
    - check which role the organisations fulfil in the respondent's opinion: pro-active, reactive
    - how does this role reveal itself ? e.g. legislation, standardization, instructions/rules, promotion of installation, stimulation of use, etc.

[This question is meant for all organisations *accept for* the governmental organisations.]

19. To what extent does the (inter)national policy [from all departments/ministries] correspond with your point of view on driver support tools that improve fuel-efficiency? And why? Would you like to see any changes in (inter)national policy? And why?

20. Is there in your opinion a (integrated) policy on Advanced Driver Assistance Systems at the national as well as the international level at the moment?

21. Do you have comments or suggestions with respect to driver support tools that improve fuel-efficiency?

Part III: Modern Drive Devices

At the request of the Novem, research is carried out concerning so-called Modern Drive Devices (MDD). This in-vehicle system is simply to install (also in the existing fleet) and can register fuel consumption, emission of CO_2 and aspects of the driving behaviour. [See explaining slides]

22. What is your opinion of the Modern Drive Devices?

The Modern Drive Devices are a type of so-called “plug-and-play” systems. This means that the system can simply be installed in a car afterwards. Coded data of the motor management system are therefore used. When the codes are decoded, the installation of the MDD is very easy, so that a lot of data can be read.

23. How do you estimate the market chances for these “plug-and-play” systems, with respect to installation in new cars as well as in the present fleet? And why?

24. Do you consider for your organisation a (supporting) part in the development of the Modern Drive Devices and/or the stimulation of installation and use of these devices?

25. Which organisations should play, according to you, (also) an important part in the development of Modern Drive Devices and the stimulation of installation and use of these devices?

26. Do you have comments or suggestions with respect to the Modern Drive Devices?

Closing

Thank you very much for your contribution to this market research. The results of the research will be presented in an international OPET workshop to be held on May 27th in the Netherlands. Hereby I warmly invite you to attend this workshop.