European Commission

Initiative for Diagnosis of Electronic Systems in Motor Vehicles for PTI

Final Report

31st December 2005

Contents

1. Preface

1.1. About the report

This final report is an abstract of results over two years of project work. All partners have finished their parts of the defined work. This report contains a conclusion of the 3 modules, which will be described in chapter "Module Description". This final report is based on the "Interim Report" which was accepted by the EU-Commission in January 2005. All results in detail are published on our IDELSY website:

http://www.idelsy.info/

The homepage was used to make the project progress transparent for all partners and the EU-Commission. It was very important for the research group to have such an instrument to coordinate this project, therefore all preliminary results and detailed information can be found on the homepage.

1.2. Motivation

Reducing the number of road accidents and road fatalities within the European Member states is one of the main targets of European, National and local traffic policies. Achieving this goal has become an increasingly urgent and challenging task with the enlargement of the EU and the accompanying increase in passenger and commercial traffic.

Driver assistance systems and other complex electronic controlled systems improving the safety of vehicles are state of the art. In that context, the proposed project IDELSY' Initiative for testing of electronic systems, will show the possible options for a significant increase of reliability and safety of such systems and therefore the safety of European road transports systems as a whole.

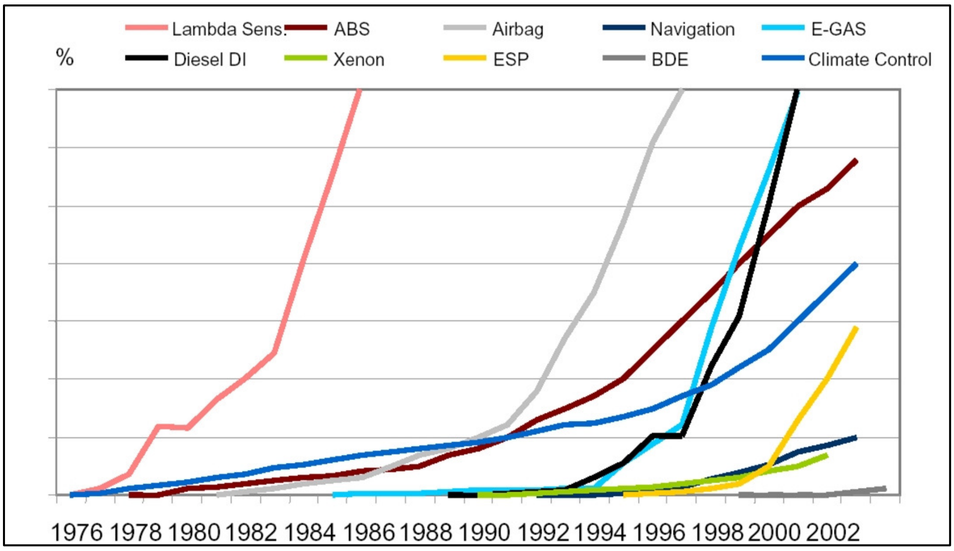


Figure 1.1: Increasing installation rates of electronic components [Bosch]

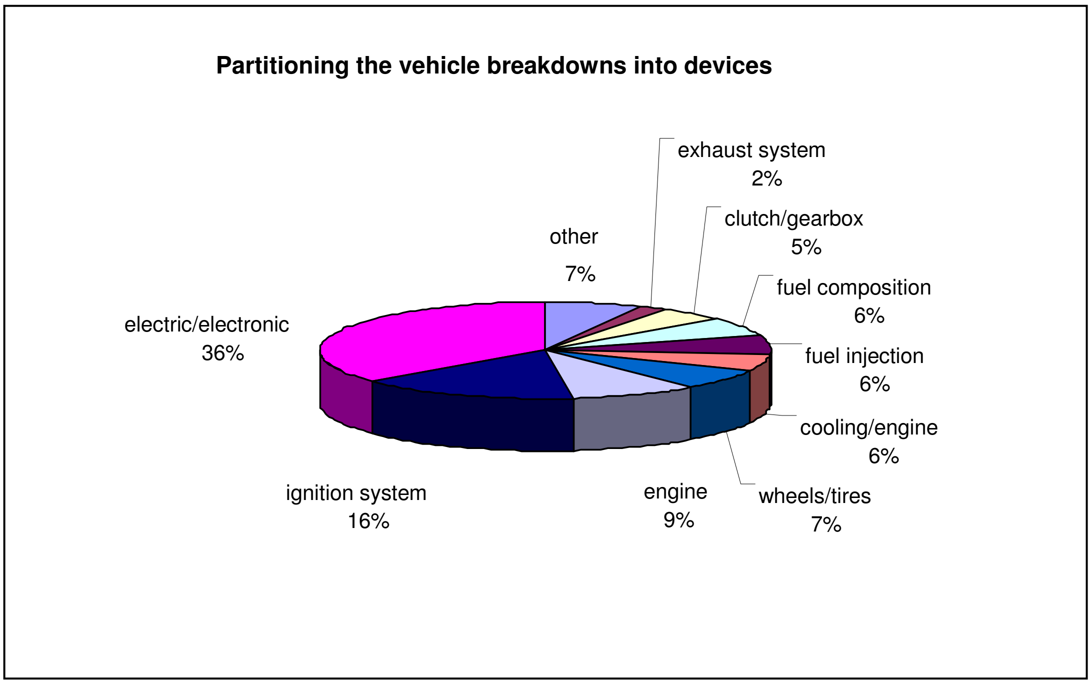
An early diagnostic on detection of malfunctions or worn parts prevents accidents and reduces injuries. Therefore, scan tools and test procedures have been developed to address these problems. It was proposed that these tools should be used in the course of periodic vehicle inspections in order to verify the functionality and safety of electronic control units, of electronic components and electronic systems during their life cycle on the road.

Legal regulations already exist with regard to the design and integration of OBD (On Board Diagnostic) systems in the regular monitoring of exhaust gas emissions.

The general target of this project is to verify the current technical feasibility for the use of generic scan tools within the periodic technical inspection (PTI) for passenger vehicles and in future for commercial vehicles too. Amendments of Directive 96/96/EC would be necessary for the introduction of test procedures for electronic components with a view to improve the roadworthiness of vehicles.

The German roadside recovery service was called out over 3.5 million times last year to deal with emergencies on German roads – an all-time record. Around 36 percent of these breakdowns were caused by faults within the vehicles' general electronics system – with cars of all makes and all ages equally affected.[1]

Figure 1.2: Vehicle breakdowns [http://www.adac.de]



Today's drivers are not in every case, in the position to be enough informed on the system behaviour of the complex electronic system.

Having in mind the overall strategic issue to increase the road safety within the new advanced driver assistance systems (ADAS) the PTI procedures should taken into account an appropriate test of there systems to ensure their safe function over the whole life time of the vehicle

2. Introduction

2.1. Safety in road traffic

One definition of safety is: “Freedom from unacceptable risk of physical injury or of damage to the health of people, either directly or indirectly as a result of damage to property or to the environment.” [2]

The strongest argument for the increasing application of electronic systems in vehicles is the rising safety requirements in road traffic. Today’s modern driver assistance systems such as ESP (Electronic Stability Program), EPC (Electronic Power Control) or Active Steering, compensate for some driver errors. The ESP System for example recognizes via wheel speed sensors and lateral acceleration sensors if the car is about to slide out of a turn breaking automatically applied to the relevant wheels to restore traction. The car is then slowed down, but control is still maintained and the car can be driven safely through the curve without causing an accident.

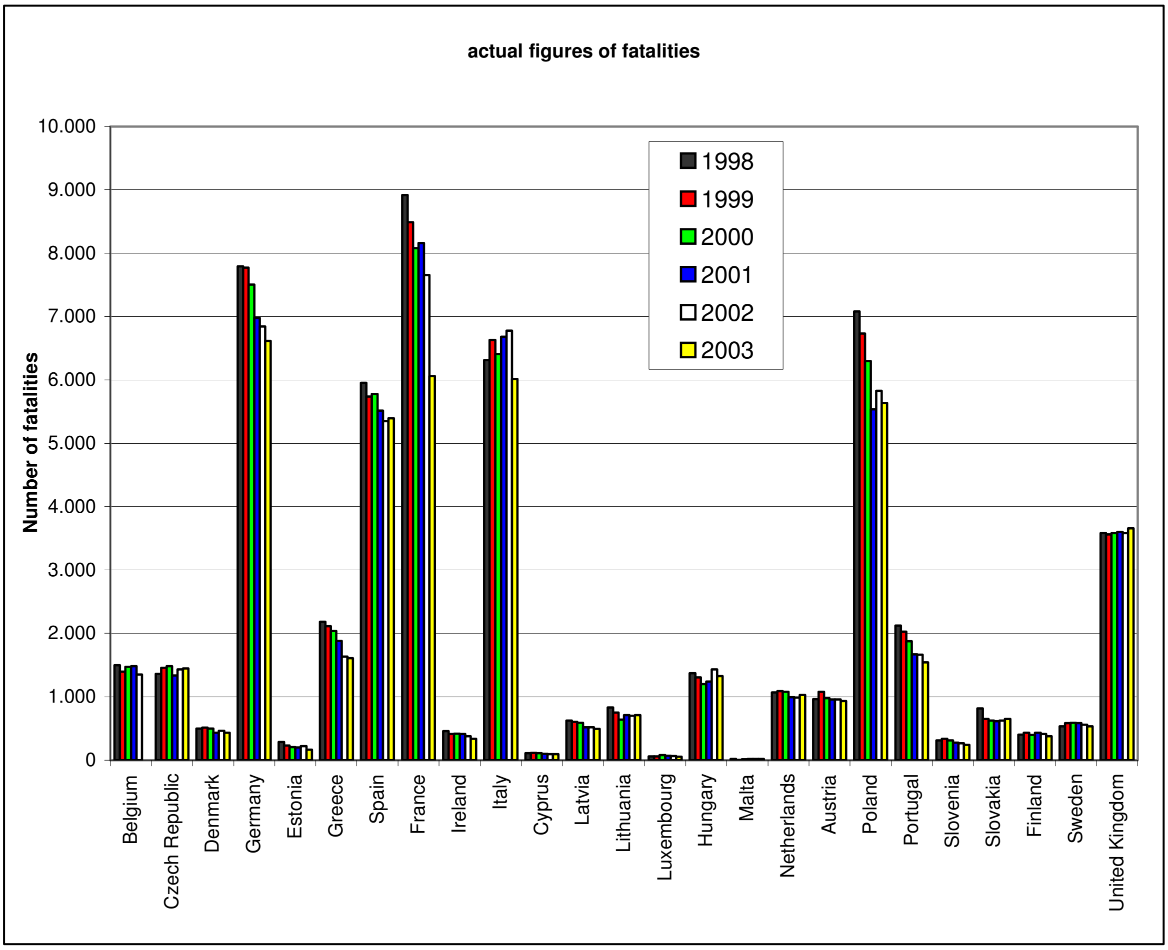


Figure 2.1: Actual figures of fatalities [http://europa.eu.int]

The Figure gives an overview of actual figures of fatalities on European (EU25) roads. Fatalities are all persons dying within 30 days from the day of the accident. For Member States not using this definition corrective factors were applied.

The European statistic shows that the number of accidents with fatalities diminishes every year. For example the total number fell from 55.151 in 1998 to 49.807 in 2002.

Over the last 14 years, there is also a declining number of fatalities in traffic accidents.

The aforementioned accident evolution in figure 2.1 shows the statistic of motor accident fatalities down in 1991 from approximately 70.000 to approximately 46.000 fatalities in 2003.

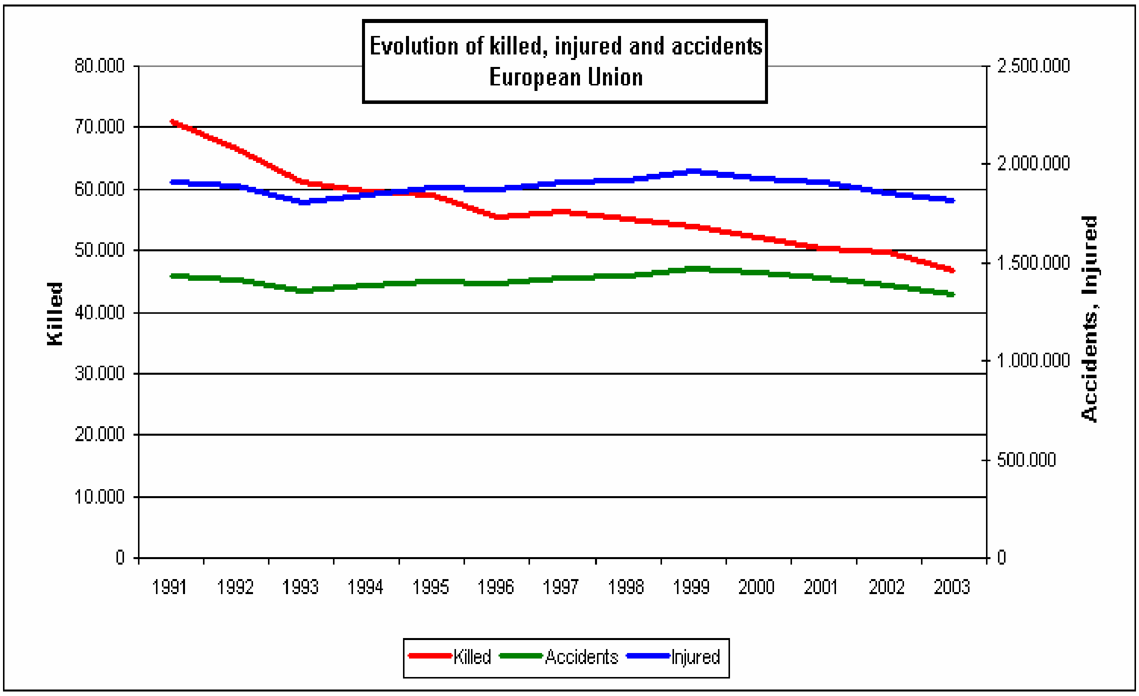


Figure 2.2: Accident evolution in the European Union. [http://europa.eu.in]

Despite the facts that make every year the number of registered vehicle in the European Union and in Germany increase.

In Germany for example, the number of registered motor vehicles increased from 19.778.775 cars in 1975 up to 45.022.926 in 2004. The following chart illustrates the growing number of registered vehicles in Germany.

A very large contributor to this evolution is due to the electronic safety system development over the last 15 years. Of course much can be attributed to the development of the traditional mechanical components and modern safety systems. Today, the combination of electronic systems and better mechanical structure makes modern vehicle safer.

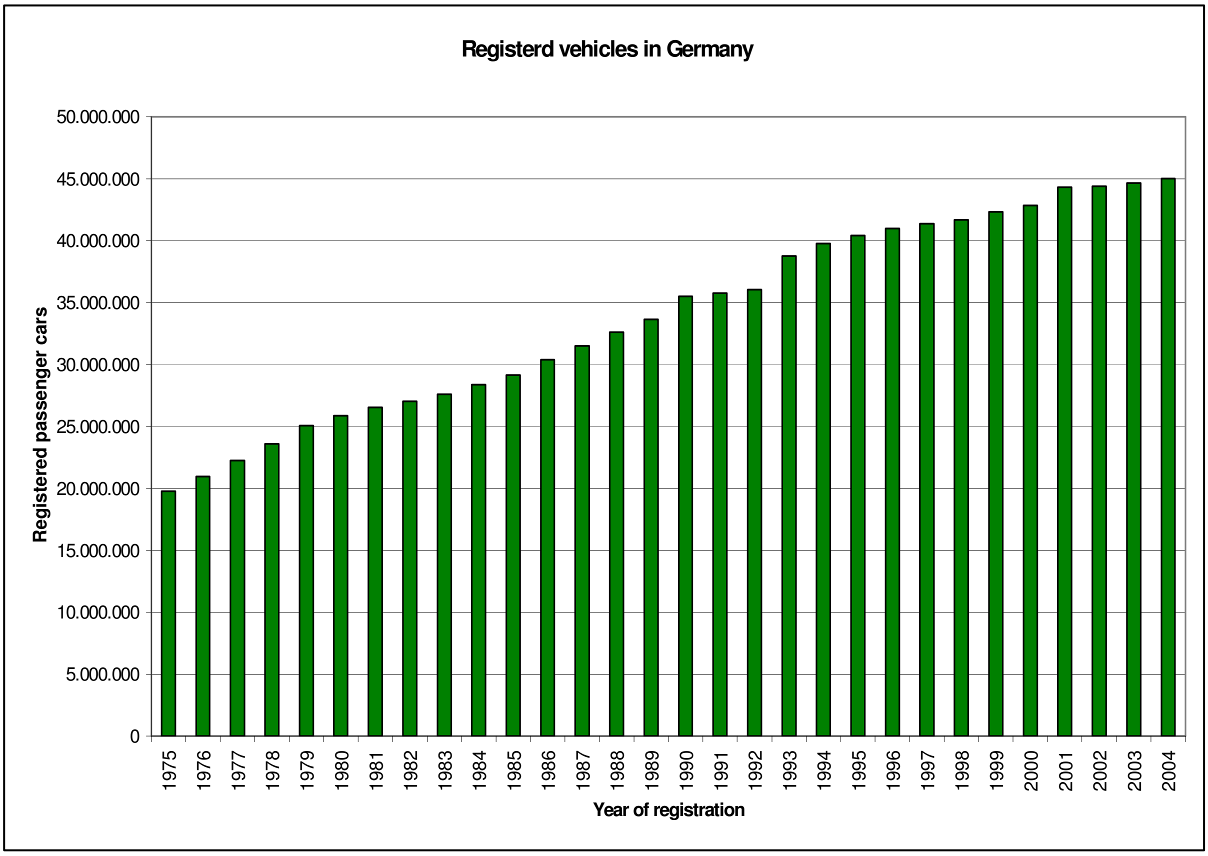


Figure 2.3: Registered vehicles in Germany [http://www.destatis.de]

This trend seems set to continue in the foreseeable future. It is therefore very important that the new electronic driver assistance systems help the customer to drive safely with their cars.

Another big step must be to assert that the additional systems run accurately and without any additional risk for the driver. With this in mind the automobile industry has over the past few years developed various methods for the early detection of defects in vehicle components, such as diagnostic tests capable of detecting errors and faults in electronic control devices. This means that regular checks of these devices could minimize the risk of a breakdown.

3. Challenges of safety critical electronic components

In the primary stages of vehicle technical evolution, the area of vehicle electronics first found a use in purely electrical systems for the energy provision of lighting and driving elements. Current and future vehicles, however, require complex networks of microelectronic controls and mechatronic-integrated vehicle systems. These controls include important sensor and actuator functions for active and passive safety elements, as well as for aspects of comfort and energy and information management in the vehicle. In the future, new types of driver assistance and intelligent surveillance systems will further improve the safety and comfort of the vehicle. The majority of vehicle functions in the future will be realised through flexibly configurable and programmable hard and software structures. [3]

Another aspect for the increasing number of electronic components in modern vehicles is the following declaration: “Today 90% of innovation in vehicles will be realised because of or with electronics.” [4]

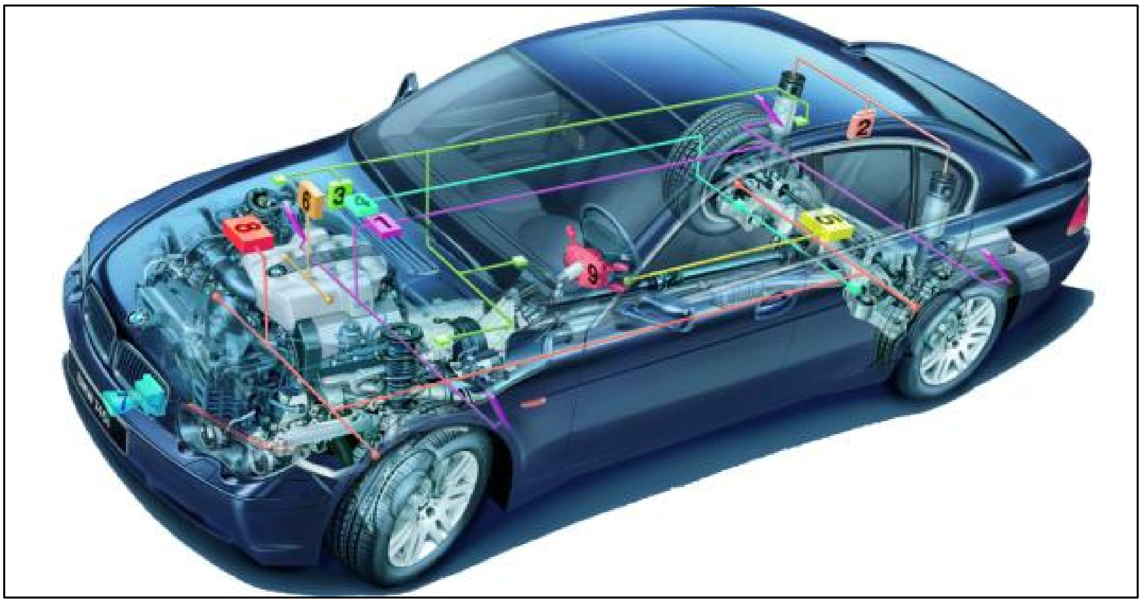


Figure 3.1: Premium car with some electronic components [www.BMW.de]

A modern premium car like the BMW 750i, or the latest Mercedes S-Class have up to 60 Electronic Control Units (ECUs). The integration of these systems offers more than 1 billion options to interact and more than 1 billion sources of error.

3.1. Different possibilities of errors

What really is the meaning of the word error or failure? The dictionary of German language defines error as: *‘location with a failure, location which derives from the surrounding in a disturbing way’*.

This definition is certainly right in the classic, mechanical sense. Up to now, only ‘classic’, mechanical failures were pinpointed in the PTI, although it had to discriminate between the failures. A very good example of these failures is the wear of certain materials. Such failures can easily be detected, as an example brake discs lose their thickness during use; when they become too thin, they might break. A comparable effect can be seen with tyres: they lose their tread during use and must be replaced after a certain time. This wear too can be detected relatively easily. The environmental conditions also pose a certain threat to the materials, as an example: corrosion of the exhaust system can lead to holes in the system causing higher gaseous emissions or noise. These failures can also be detected and the environmental impact can be predicted relatively precisely. There are, however, failures which can occur unexpectedly, such as-material fatigue-without obvious previous wear. Material fatigue is a process, which happens in materials which are exposed to oscillating, re-occurring mechanical stresses. The material fatigue occurs in components of general mechanical engineering, transportation, aero, or marine- engineering and can lead to malfunction of the entire construction or to the complete breakdown of the system. [5] These failures often result in a sudden rupture within the material. They can often only be detected using complex special measurement equipment, such as electron microscopes or ultra-sound measuring systems; they can not therefore be detected at the Periodical Technical Inspection (PTI).

3.2. About the On Board Diagnosis

There are different ways to assess the safety of electronic components. There are different new development strategies and different methods for controlling the electronic components on board of the vehicle. In the past the diagnosis interfaces were not standardised. So there were a lot of different interfaces depending on the various manufacturers. With the integration of one very important new regulation coming from USA, the so called OBD and OBD II only one interface for all manufacturers was standardised. Its official name is “Section 1968.1 of Title 13, California Code of Regulations (CCR).

Many items were overtaken into the European regulations for exhaust emission type approval (Directive 70/220/ EEC).

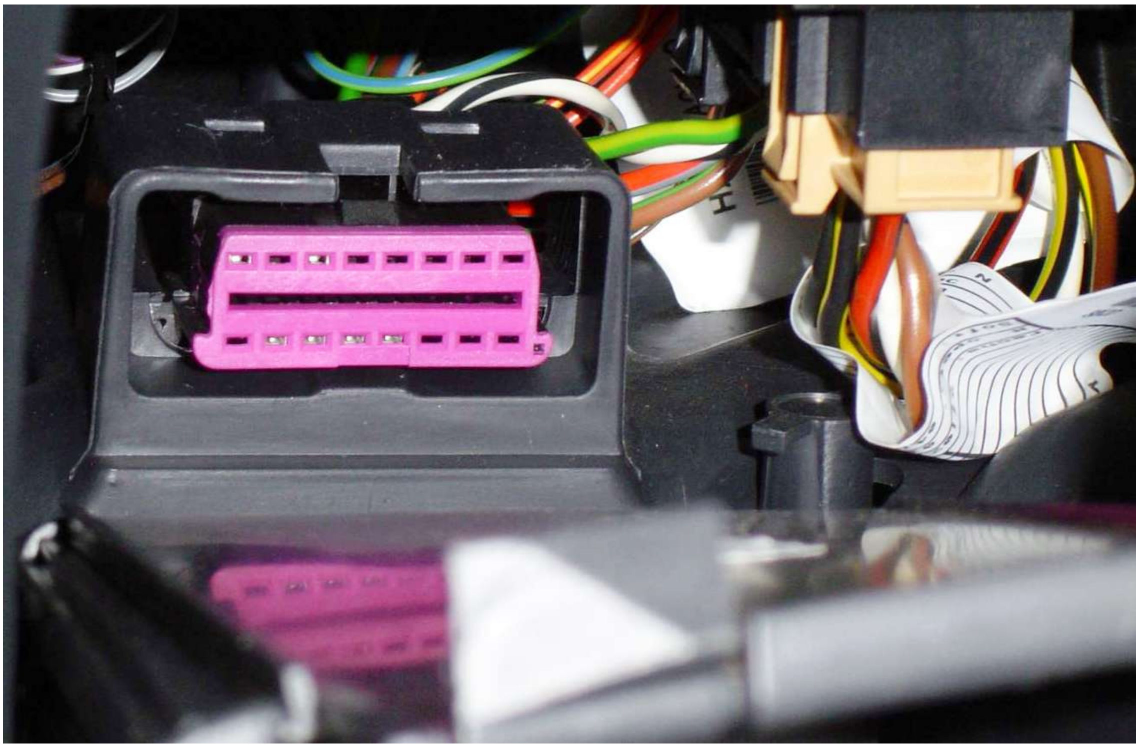


Figure 3.2: Typical OBD interface in vehicles

4. Scope of the study

The European Union authorised in 2003 a research project with the aim to evaluate if it is possible to find a practical PTI test procedure for electronic components by using a generic scan tool for the existing vehicle fleet in Europe. The study is called IDESLY, Initiative for Diagnosis of Electronic Systems, and has been carried out by seven technical inspection agencies, of three different countries.

4.1. EU Research Project IDELSY

For a Technical Inspection Agency it is also very important that the vehicles on the road pose no safety risk to other road users. Safety critical electronic components have more or less no unique performance requirements to be checked for a periodical inspection. More and more customers request the testing of new systems like ESP, Airbags and other systems during the PTI.

The IDELSY project is partly funded by the EU, and is supported by several technical services from several European Member States. In its goal to enhance European road safety. IDELSY provides collective support for the EU - Commission to improve the existing regulations suitable for the new generation of motor vehicles. In front of this overall target, seven European technical inspection organisations launched a research project at the beginning of 2004

From the point of view of the EU Commission it is desirable that member states clearer with this subject, develop test procedures, discuss these with all the relevant interest groups and contribute proposals for modifications to "European Law".

So the newly founded research group make an application for the so called IDELSY (Initiative for Diagnosis of Electronic Systems) research project.

4.2. Aim of the study

Due to rapid technological advances, modern motor vehicles contain an increasing number of complex electronic control systems with safety related functions. These control-systems must be integrated into PTI, in order to detect possible malfunctions and hence reduce accidents. The procedures should be user friendly in practice and should make use of modern diagnostic tools

Another fundamental project goal is to establish proposals for EU regulation for PTI with regard to electronic components. These proposals will be discussed with the various interest groups when they have been formulated.

From a technical point of view information on the actual status of the system should be accessible via the so-called CARB (California Air Research Board) Interface, which already exists in modern vehicles. Today’s CARB Interface is standardised only for the exhaust related use, other information on different systems like ABS, ESP, and Airbags are not generally standardised but available by using the generic scan tools. The CARB interfaces flexibility is already prepared for future evolution.

4.3. Participating Organisations

The seven participating technical inspection organisations were:

RWTÜV Fahrzeug GmbH (Coordination Participant)
Langemarckstraße 20
D-45141 Essen

TÜV Rheinland Kraftfahrt GmbH
Am Grauen Stein 5
D-51105 Cologne

TÜV NORD STRASSENVERKEHR GMBH
Fahrzeugsystem- und Verkehrsleittechnik
Am TÜV 1
D-30519 Hannover

DEKRA Automobil GmbH
Entwicklung Prüftechnik
Handwerkstraße 15
D-70565 Stuttgart

TÜV Süddeutschland
TÜV Verkehr und Fahrzeug GmbH
Gottlieb-Daimler-Straße 7
D-70794 Filderstadt

APPLUS ITEUVE
Technology, S.L.
Campus UAB
PO Box 18
E-08193 BELLATERRA (Barcelona), Spain

Vehicle & Operator Services Agency (VOSA)
Testing Standards Policy and Strategy
Room 109
Berkeley House, Croydon Street
Bristol BS5 0DA, England

4.4. Project cooperation

RWTÜV was appointed to coordinate the complete research project. For communication with the other partners and sharing the results it was necessary to create a communication platform.

4.4.1. IDELSY homepage

The idea of the IDELSY homepage was established in consultation with all members of the IDELSY working group. The function of the homepage should be to have a platform for exchanging information. News, views, dates and progress updates were all published on the website, as well as the single development stages of the project. It is most important that this modern and accessible mode of communication is maintained

The IDELSY Homepage will continue to exist beyond the end of the project, so that every step of the work which was done can be reconstructed in the future.

At the initial meeting of the IDELSY project the best methods to coordinate and to control the proceedings of all partners was discussed. The idea was to establish an "IDELSY Homepage", with a private area, where the project coordinator RWTÜV would be able to publicise the collected results, the 'to-do' list and the status of the project progress. It is easier to have one central base for the information exchange, than to send every partner each stage of progress via email. In this way, they were ensured that every project partner was able to see the current status of IDELSY project.

A homepage frame was therefore designed by the Project Co-ordinator and the website was presented to the partners.

Next steps were to apply the domain for the website.

To guarantee that all data is kept confidential, an entrance portal is used, which is password protected.

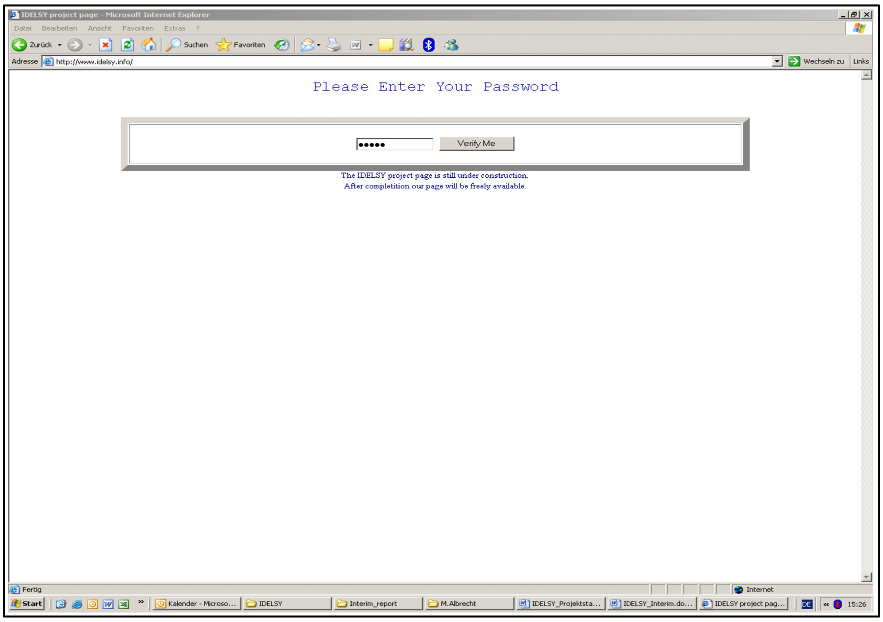


Figure 4.1: Password protected entrance portal [www.idelsy.info]

The whole homepage was created to guarantee a better information flow. The "welcome page" should contain a few introduction sentences about the project and a link to private area.

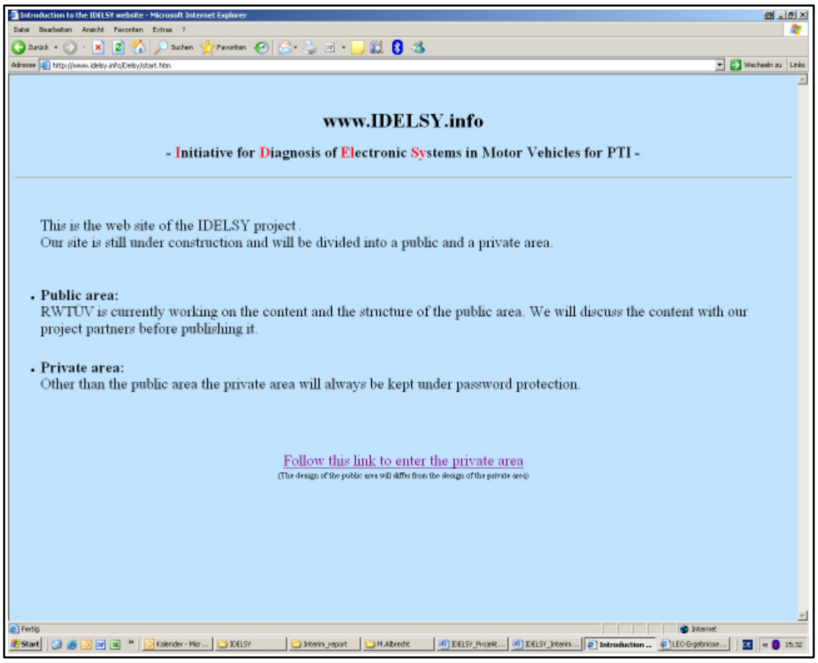


Figure 4.2: IDELSY welcome page [www.idelsy.info]

All actual items or tasks were published on the website, so that the partners were able to acquire the latest information immediately. The project management was accountable for the support of the homepage. That means that all actual information, such as project news, meeting agendas, meeting protocols, or test results were collected by RWTÜV and revised before being published on the website.

4.5. Project Structure

The whole project was structured in three modules. The modules were fixed by the working group. A time schedule stated when the three different modules began and when they had to be finished.

The following modules are a description according to the call for proposals.

4.5.1. Description of Module 1: Diagnosis data pilot trials

The main item of the first module was the determination of pilot data from 500 vehicles and the selection of a diagnostic tool.

Based on system characteristics such as suitability for use with PCs, possibility of integrating the system into the available test technology and equipment in the inspection centres, as well as the desirability of covering the vehicle systems already on the market, and also based on positive experiences from the different automotive manufacturers, the Bosch Diagnosis Tool KTS 520 or other devices from the KTS family were selected as the reference device. The diagnostic tools are either already available or will be purchased.

<u>Specification of test procedure</u>

The test procedure includes the following steps:

- Establishing communication
- Read-out of available data
- Storage of data in a specified format
- Determination of the data/displays available to the owner of the vehicle on the dashboard
- Initiation of available test routines
- Data transfer and data collection

The year of manufacture of the vehicles to be inspected is between 1998 and 2001. The selection process also has to consider distribution of the vehicle samples throughout the EU Member States, after a statistical analysis. In addition, a customer questionnaire has been developed which deals with the following themes:

- MIL (Malfunction Indicator Lamp)
- Repair of electronic systems
- Driver behaviour by MIL on
- Defects to electronic systems and their repair

<u>Staff Training</u>

Initially, the project managers were trained on the KTS 520. Local staff was then trained by the project managers. In addition to the creation of a telephone matrix which includes all those taking part in the project, a hotline was established for each project manager.

Implementation of diagnosis

It was planned to examine 500 vehicles, approximately 90 for each project partner. Vehicles were only examined with the agreement of the client.

Evaluation of data

One project partner will undertake to collate the diagnosis data / measuring results in accordance with a procedure agreed beforehand. This information will then be placed at the disposal of the other project partners. The same applies for assessment of the customer questionnaire. Based on all the results the partners will agree as to how the assessment of individual items of diagnosis content for use in the main exhaust engine inspection should be carried out. Individual observations from the participants or evaluation of the data in the form of a workshop are possible here. A further aim of the evaluation is the determination of tasks with regard to diagnostic tool/vehicle communication as well as investigation of the suitability and usability of the diagnostic tools used in terms of the general vehicle population.

4.5.2. Description of Module 2: Design and development of test procedures

Creation of possible test procedures

The design of test procedures aimed at the electronic systems of motor vehicles will be achieved by making use of interactive communication between the diagnosis tool and the respective vehicle system:

Elements to be included in the test:

- System identification
- System state (error memory and bulb check/self-test)
- Actual values of systems being tested
- Actuators

The above mentioned steps can be seen as a general test procedure for modern electronic controlled system. It looks like a pyramid, that includes as a basic information the knowledge of the system which is build in. All other steps are basically pending on the appropriate identification of the actual fitted system.

This test procedure may be adapted to what is technically possible in the case of the individual vehicle system, and should be designed so as to be realistic and useful.

The minimum scope of the test is the installation test and precise recognition of the system state.

Experience from Module 1 will be used and taken into consideration when designing the test procedure.

The following systems will be primarily taken into consideration according to the above definition:

- Engine management
- Brake system/brake management system
- Electronic stability systems (ESP)
- Advanced headlight systems (high voltage discharge technology)
- Passive safety equipment (Airbag)

The defined test procedure will first be tested under laboratory conditions.

All the electronic systems which have been taken into consideration will be investigated by the project partners on vehicles from different manufacturers. Altogether 10 vehicles will be included in the investigation. The vehicles will be selected after discussion and agreement by all the project partners.

A comparison will also be made between the KTS 520 and other generic scan tools available on the market, as well as against the diagnostic tools of the individual vehicle manufacturers.

The following results are expected from the investigation under laboratory conditions:

- Definition of the test procedure
- Specification for the diagnostic tool

<u>Evaluation and optimisation of test procedure</u>

Evaluation of the test procedures developed in Module 2 was carried out at selected test facilities of the project partners. The test procedure was tested and optimised with regard to its ease of application in practice.

The aim of the practical trials was in particular to transfer the test procedure to different types of vehicles. The results from Module 1 were taken into consideration when selecting the vehicles. The number of vehicles selected is linked to the results from Module 1 and not more than 100.

The results of the evaluation and the further procedure for the field test will be presented to European Commission DG TREN (TAC) CITA-Working-Groups and discussed for a wider common understanding.

4.5.3. Description of Module 3: Field trials

Selection of locations for field trials

In selecting the testing stations, the different PTI-strategies in each of the European Countries was taken into account

The assumption was, that there will be a total of 28 locations for the field trials and that the test procedure will be carried out on between 1,000 (minimum) and 2,500 vehicles.

After around 1,000 vehicles have been tested, an intermediate analysis of the results has been carrying out an intermediate analysis of the results. Future procedures or alterations thereof have been defined from these results.

Drafting of documentation (official forms, data collection and evaluation programs)

Work involved in the preparation of the field test was distributed among the project partners by agreement. With regard to drafting of the documentation and the data collection and evaluation programs it must be considered that standardised (uniform) data collection and documentation make the evaluation process easier.

Staff training

Staffs were trained by the individual project partners, working separately. The diagnostic devices have been tested within the framework of the training for their user-friendliness and the time needed by the staff of the inspection bodies to carry out the tests.

Implementation of field trials

The field trials have mainly carried out by staff from the inspection bodies. The existing hotline to the project manager is maintained during this phase. Two weeks after the start of the field test, the staff involved exchange experiences via the project partners. A report has been written based on the information gathered here and is placed at the disposal of the project partners.

Evaluation

Data collection and evaluation should be carried out on a centralised basis by one of the project partners (RWTÜV).

4.6. Statistic data of the vehicle fleet in Europe

As seen under Module 1, one task was to collect data of the existing vehicle fleet in Europe. DEKRA and RWTÜV created a template for the statistic data, so that every partner was able to record the collected data in one common template.

This task was to collate and compare a variety of important information from the different European countries. The information within these statistics helped us to select a group of cars with the CARB-Connector, because the CARB- or OBD II-Connector was implemented in vehicles built from 1995. Most cars built in Europe since 1999 are equipped with the connector, so the decision was made to examine the cars manufactured from 1999 up to 2003. The statistic data provided the information about the new registered cars.

With the exception of VOSA, each partner also had to collect data from one or more other countries. It was considered necessary to get an overview of the vehicle fleet in Europe, to ensure that the chosen vehicles fitted into the general scope

For the complete statistic table of new registered cars from 1990 – 2005 listed by manufactures and by country, see Annex 1.

5. Module 1: Diagnosis data pilot trials

5.1. Usability test of different scan tools on different cars

This work package was intended to find out which Scan-Tool is able to support the most demands of findings already generated. Finally a “reference tool” was defined that was used during the whole main test.

The following items give the direction and the objectives for the evaluation:

1. Capability to serve different communication protocols
2. Covering most common vehicle
3. Ability to connect to a PC/Laptop or running diagnostic software on a PC/Laptop
4. Ability to generate a protocol of each test for evaluation and interpretation
5. Handling under inspection conditions / on the road
6. Support for solving special diagnostic problems

5.1.1. Diagnostic scan-tools for evaluation

For the evaluation of a suitable diagnostic scan tool the following tools were tested:

1. Bosch KTS 520

2. AVL DISCAN8000
3. Tecno Reflex 3130
4. Gutmann Mega Macs
5. TEXA Axone 2000
6. Sun Modis
7. Techmess ST6000

5.1.2. Tool test procedure

The test procedure is based on testing different vehicle in the following diagnostic items:

- Finding the connector
- Identification of the electronic control unit currently to be tested
- Number of responsive electronic control units
- Fault memory reading and deleting
- Actual value and system status
- Actuator test

5.1.3. Table of diagnostic Scan Tools (physical property)

Table 5.1: Comparison of different scan tools

Manufacturer **name of scantool**	**AVL DiTest** **DiScan 8000**	**TECNO** **Reflex 3130**	**BOSCH** **KTS**	**Techmess** **ST-6000**
Handheld	Yes	yes	no	yes
PC			Combination with PC/Laptop	Combination with PC
Dimension lxwxh (mm^3)	290x340x90	210x270x55	170x120x35	214x292x63
Weight (g)	ca. 3000	1300	ca. 1100	1100
Case-material	Metal	plastics	plastics	plastics
Ports (printer, external power supply,...)	* RS232 * Compact Flash Card * Smart card interface * Car interface (for connecting the car) * USB-interface * Oscilloscope-measuring cable * Power supply * Connector for external VGA-Monitor	* Diagnostic cable * Power supply * USB-interface * RS232 * external VGA-Monitor * Grounding connection	* Diagnostic cable * Multimeter: measuring cable * USB-interface * serial connector * Power supply (ports of PC/Laptop)	* RS232 * for diagnostic cable * Memory card * Smart card
Multimeter integrated resp. integrable	Yes	yes	yes	yes
Scope integrated resp. integrable	Yes	yes	no	yes
ASA-network	No	no	yes	no
Display-Art	Colour display	Colour display	Display of PC/Laptop	LCD- Graphic display
Display-dimension	ca. 12cm x 9cm	11,5x9 cm (320x240 Pixel)		ca.12cm x 9cm
Keyboard	membrane keyboard	membrane keyboard	Keyboard of PC/Laptop	membrane keyboard
Price of the tool	3.530 €	4.551 €	1.695 €	2.800 €
Update price per year	518 €	461 €	430 €	379 €

Table 5.2: Comparison of different scan tools

manufacturer **name of scantool**	**Gutmann** **mega macs 55**	**SUN** **MODIS**	**TEXA** **Axone 2000**
Handheld	Yes	yes	yes
PC	Combination with PC		
Dimension lxwxh (mm³)	310x345x65	197x356x86	310x140x60
Wight (g)	5700	2579 with plug-in modules	1500
Case-material	Metal	plastics	plastics
Ports (printer, external power supply,...)	* Power supply * 2 Scope - measure cable * Multimeter - measure cable for diagnostic cable / alternatively clip-on ammeter * RS232 * external Monitor * Printer * ISDN	* for diagnostic cable * Accumulator plug-in * Infrared-output for printer * Power supply * USB-port * Serial port * Slot for flash-cards * Slot for lab-scope-module * Slot for Scanner-module	* Power supply * for diagnostic cable * Connection socket parallel / serial * Module slot * Slot for memory-card
Multimeter integrated resp. integrable	Yes	yes	yes
Scope integrated resp. integrable	Yes	yes	yes
ASA-network	yes, ASA-network software must be available	no, but connection to SUN diagnostic platform "SDP" will be occur soon	no, perhaps future possibility to connect the ASA network
Display-Art	Graphic-LCD-Display / Monitor	LCD	Graphic
Display-dimension	194x147 / 15"	640x480	320x200 Pixel
Keyboard	membrane keyboard	rubber keys + four-way thumb pad for easy scroll	membrane keyboard
Price of the tool	8.380 €	6.700 €	3200 €

manufacturer	Gutmann	SUN	TEXA
name of scantool	mega macs 55	MODIS	Axone 2000
Update price per year	Partner licence per month : 40,90 €		First year free later 500 €

The Price range of the tools are from about 1500,00 EUR up to 8500,00 EUR. Also there are costs on updates of the tools. They are between about 400,00 and 500,00 EUR per year.

5.1.4. Assessment of the diagnostic scan tools

To find out which generic tool is able to communicate in the most instances with the ECUs it was necessary to compare the selected Scan-Tools. The following seven tools were selected for a usability test.

Bosch KTS 520

Figure 5.1: Bosch KTS 520 [http://rb-aa.bosch.com]

Bosch KTS 520	
Positive	**Negative**
Modular program structure, permitting special diagnostic demands	Real-time value - only four values at the same time
Operation is very easy	for the protocol you must save the results manually
It covers a large selection of vehicles	
The multiplexer needs only one cable and searches automatically the correct pin	
possibility of diagnostic software to run on a PC/Laptop	
Can be combined with commercially available PCs or Laptops using the serial or standard USB interface	

AVL DISCAN 8000

Figure 5.2; AVL Discan 8000 [www.avlditest.com]

AVL DISCAN 8000	
Positive	**Negative**
Robust tool, steel cabinet	Getting used to the users interface needs some time
Advices for special diagnostic problems available	Relatively heavy
French and Italian vehicles are good represented	Memory Card remained prominent in use

TECNO Reflex

Figure 5.3: TECNO Reflex [www.tecnogmbh.de]

TECNO Reflex	
Positive	**Negative**
Lightweight and well finished tool	Getting used to the users interface needs some time
Advice for special diagnostic problems available	Memory Card remained prominent in use
French and Italian vehicles are good represented	

Gutmann Mega Macs

Figure 5.4: Gutmann Mega Macs [www.gutmann-italia.com]

Gutmann Mega Macs	
Positive	**Negative**
Cable connection and accommodation within the tool tower is very well executed	very heavy tool (6,3 kg)
Actual value eight of them can be showed simultaneously	Function keys change during the operation
Guided diagnoses and extensive component- and system information	Vehicle type selection follows not the alphabetic structure
It covers a large number of vehicles	
There is an access to the current trouble box for all Mega Macs user	

Texa Axone 2000

Figure 5.5: Texa Axone 2000 [www.trem.ch]

Texa Axione 2000	
Positive	**Negative**
Screen layout is very well defined	Selector switch for pinning is not up to date
Can be modular extended	Actual value can't be showed in a graphic form
High quality casing	The sockets and plugs get in the way

SUN MODIS

Figure 5.6: SUN Modis [www.sun-diagnostics.com]

SUN MODIS	
Positive	**Negative**
Program flow is like the PDL 1000	
Robust casing	The scroll 4-way thumb pad is not very useful
There are a lot of connection possibilities also for additional equipment	Choosing Keys for pin adaptation is very complicated

Techmess

Figure 5.7: Techmess [www.aecs.net]

Techmess	
Positive	**Negative**
Easy to handle especially when surfing through the diagnostic menu	No internal accumulator
lightweight	Vehicle data were not displayed during the diagnostic process
Covers most French and Italian vehicles are good represented	reading the Display is not very easy

5.1.5. Tested vehicles

For testing the capability of the tools there were eight cars chosen, each with a different manufacturer with a production year, between 1999 and 2003 (the years chosen as the vehicles have a CARB-Connector).

Manufacturer	Type	initial registration	Cubic capacity (l)	engine power (kW)	engine
BMW	320i	05.2000	2,0	110	Otto
Citroen	Xantia	04.1999	1,9	66	Diesel
Opel	Astra	05.2002	1,8	92	Otto
Mazda	626	03.1999	2,0	85	Otto
Mazda	6	07.2003	1,8	88	Otto
Renault	Twingo	03.2003	1,2	43	Otto
VW	Golf IV	09.2000	1,4	55	Otto
VW	Golf IV	07.2001	1,4	55	Otto

Table 5.3: List of tested vehicles

BMW 320i

Diagnostic tool / Accessory	AVL DiScan 8000	BoschKTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
	Tecno Reflex 3130					
	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth
Engine control device	EOBD	I,R,C,AV,AA	I,R,C,AV,AA	I,R,C,AV,AA	I,R,C,AV,AA	I,R,C,AV
Brake system	vehicle not in the table	I,R,C,AV		I,R,C,AV,AA	I,R,C	
Airbag		(I,R,C)*	I,R,C,AV	I,R,C	I,R,C	I,R,C,AV
Dashboard		(I,R,C)*				I,R,C,AV
Gearbox control		(I,R,C)*			I,R,C,AV	
Heating/air conditioning		I,R,C,AV,AA	I,R,C,AV	I,R,C	I,R,C,AV	I,R,C,AV
Immobilizer/anti theft device		I,R,C,AV		I,R,C,AV		I,R,C,AV
Central locking system						
Radio						
Park assistance		(I,R,C)*				
Central electronic/body control		(I,R,C)*				
Illumination/Light		I,R,C,AV,AA				I,R,C,AV,AA

Legend:	I: Identification	AV: actual value/status
	R: read failure memory	AA: activation of actuators
	C: clear failure memory	(.....)* : system not uniquely identified

Citroen Xantia 1.9 turbo diesel

Diagnostic tool / Accessory	AVL DiScan 8000 / Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth
Engine control device	I,R,C,AV,AA	I,R,C	I,R,C,AV,AA		I,R,C,AV,AA	
Brake system	I,R,C,AV,AA	(I,R,C)*			I,R,C	I,R,C,AV,AA
Airbag	I,R,C,AV	I,R,C		(I,R,C)*	I,R,C	I,R,C

Opel Astra 1.8

Diagnostic tool / Accessory	AVL DiScan 8000 / Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth
Engine control device	OBD	I,R,C,AV,AA	EOBD	I,R,C,AV	I,R,C,AV,AA	OBD
Brake system	I,R,C,AV,AA	(I,R,C)*	I,R,C,AV,AA	I,R,C,AV	I,R,C,AV	I,R,C,AV,AA
Airbag	I,R,C,AV	(I,R,C)*		I,R,C,AV	I,R,C	I,R,C,AV
Dashboard		(I,R,C)*		I,R,C,AV,AA	I,R,C	I,R,C,AV,AA
Immobilizer/anti theft device		I,R,C	I,R,C	I,R,C,AV		I,R,C,AV,AA
Central locking system		(I,R,C)*		I,R,C,AV		
engine cooling		(I,R,C)*				
steering assistance				I,R,C,AV		I,R,C,AV,AA

Mazda 626 2.0

Accessory \ Diagnostic tool	AVL DiScan 8000 Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth
Engine control device	manufacturer Mazda not in the vehicle table	Location of the diagnostic socket is shown. No diagnostic possible - pin for flashing code is not available.	No note for the location of diagnostic socket for this Mazda	Mazda 626 with 2,0l not available in the vehicle list	manufacturer Mazda not available in the vehicle list	Mazda 626 only with OBD socket - available in the vehicle list (the tested vehicle did not have any OBD-socket)
Airbag						

Mazda 6 1.8

Accessory \ Diagnostic tool	AVL DiScan 8000 Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth
Engine control device	EOBD	EOBD	EOBD	EOBD	EOBD	EOBD
Brake system		(I, R, C)*			is not in the list	
Airbag						

Renault Twingo 1.2

Diagnostic tool / Accessory	AVL DiScan 8000 / Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth
Engine control device	EOBD	I, R, C, AV, AA	I,R,C,AV,AA	I,R,C,AV	EOBD	I,R,C,AV,AA
Airbag						

Volkswagen Golf 1.4

Booth VW Golf IV had the same results.

Diagnostic tool / Accessory	AVL DiScan 8000 / Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000	VAG Tester
	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth	Test depth
Engine control device	EOBD	I,R,C,AV,AA	I,R,C,AV,AA	I,R,C,AV	I,R,C,AV,AA	I,R,C,AV,AA	I,R,C,AV,AA
Brake system					I,R,C,AV	(I,R,C)*	I,R,C,AV,AA
Airbag	I,R,C,AV	I,R,C	I,R,C,AV	I,R,C,AV	I,R,C	I,R,C,AV,AA	I,R,C,AV,AA
Dashboard	I,R,C,AV	I,R,C,AV,AA	brake with new start	I,R,C	I,R,C,AV,AA	I,R,C,AV,AA	over immobilizer/anti theft device
Immobilizer/anti theft device	I,R,C	over instrumen-tation		I,R,C,AV	over instrumen-tation		I,R,C,AV
CAN-Bus (Controller Area Network)	I,R,C,AV	I,R,C	I,R,C	I,R,C	I,R,C	I,R,C,AV	I,R,C,AV

5.1.6. List of testable vehicle-manufacturers

Manufacturer \ Scan tool	AVL DiScan 8000	Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
Alfa Romeo	x	x	x	x	x	x	x
Audi	x	x	x	x	x	x	x
Autobianci	x	x	x	x			x
Autolatina			x				
Bertone			x				
BMW	x	x	x	x	x	x	x
Buick							
Cadillac	x	x	x	x			
Changan			x				
Chevrolet	x	x	x	x			
Chrysler	x	x	x	x	x		X
Ciadea			x				
Citroen	x	x	x	x	x	x	X
Dacia			x	x			
Daewoo	x	x		x	x		X
Dahiatsu	x	x		x			X
Dodge							
Fiat	x	x	x	x	x	x	X
Ford	x	x	x	x	x	x	X

Table 5.4: Testable vehicle manufacturer

Table 5.5: Testable vehicle manufacturer

Manufacturer \ Scan tool	AVL DiScan 8000	Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
FSO			x				
Honda	x	x	x	x	x		X
Hyundai	x	x	x	x	x		X
Innocenti	x	x	x				X
Isuzu	x	x			x		
Iveco			x				
Jaguar	x	x		x	x		X
Jeep	x	x		x			X
KIA	x	x	x	x			X
Lada			x	x			
Lancia	x	x	x	x	x	x	X
Land Rover	x	x		x			X
Lexus	x	x		x			X
Lombardini				x			
Lotus							X
Mazda	x	x	x	x	x		X
MCC (Smart)	x	x	x	x			X
Mercedes Benz	x	x	x	x	x	x	X
MG			x	x			X
Mini (BMW)			x	x			X
Mitsubishi	x	x	x	x	x		X
Nissan	x	x	x	x	x		X

Scan tool Manufacturer	AVL DiScan 8000	Tecno Reflex 3130	Bosch KTS	Techmess ST-6000	Gutmann Mega macs 55	Sun Modis	Texa Axione 2000
Opel	x	x	x	x	x	x	X
Peugeot	x	x	x	x	x	x	X
Plymouth							
Porsche	x	x	x	x	x		X
Proton	x	x					
Renault	x	x	x	x	x	x	X
Rover	x	x	x	x	x	x	X
RVI			x				
SAAB	x	x	x	x	x		X
Santana			x				
Seat	x	x	x	x	x	x	x
Skoda	x	x	x	x	x	x	x
Subaru	x	x	x	x	x		x
Suzuki	x	x	x	x			x
Tata			x				
Toyota	x	x	x	x	x		x
Vauxhall			x				
Volvo	x	x	x	x	x		x
VW	x	x	x	x	x	x	x
miscellaneous	x	x	x	x			x

Table 5.6: Testable vehicle manufacturer

5.1.7. Conclusion of the assessment

First of all it has to be mentioned, that the available tools are much better, compared with earlier generations of scan tools 5 years ago. The following statements represented the most important experiences.

1. None of the tested diagnostic scan tools fulfils all demands for 100%because of the diversity of vehicle models and fitment not technical. Target focus for the existing scan tools are workshops and not PTI.
2. The engine management can be interfaced with all diagnostic scan tools at least via the on board diagnostic protocol because it is standardized at ECE 98/69/EC.
3. The main function “error code reading” and “error code deleting” of the motor management worked on all vehicles.
4. The operation menus have been implemented using different methods.
5. Bosch and Gutmann are in agreement about conducted diagnostic expert systems. The user has got the option to solve any special problems by using database with a lot of special information
6. Only some diagnostic scan tools can run on an PC or a laptop, because they are more software based. So the price is lower if hardware (laptop) is already available.
7. The price range is quite large .

   -complete solutions like the Gutmann Mega Macs with a greater hardware range is more costly

   -completely PC based tools like the Bosch KTS 520 are cheeper
8. The tests showed that Bosch KTS 520 covers the most vehicles/systems
9. The most universal diagnostic tool proved to be the BOSCH KTS 520
10. Bosch supported a protocol to collect all diagnostic data generated by each test for statistic evaluation.

Over all the BOSCH KTS 520 fulfilled the most demands and proved to be the best tool to carry out the tests. Under different conditions and with different parameters the other diagnostic scan tools may be considered suitable

In conclusion, following the initial usability test, the IDELSY research group chose the Bosch KTS 520 as the most suitable tool for the project.

5.2. Development of preliminary test procedures

The development of a new test procedure depended initially on the abilities of the Bosch KTS 520 compared with OEM tools. The guideline had to contain all questions which were to be answered in detail. The guideline was developed by RWTÜV and DEKRA. Additionally there was the need to define a format/structure for the results. It was therefore considered to examine a few cars under laboratory conditions to define an appropriate test procedure.

5.3. Test procedure requirements

To find the best method to create a preliminary test procedure it was necessary to assert the requirements. This section gives an abstract description of the expected content of the test procedure to be defined.

- The test procedure should include the use of the KTS-tool and furthermore also other opportunities to detect inconsistencies of the respective electronic system.
- A benchmark between the OEM tools and the generic scan tool was used to define the more or less 100% test content which is available in combination with an OEM original tool.
- The test procedure must be feasible in practice under PTI conditions. There is one exception to this rule: The test procedure to be defined in current phase of the IDELSY project is allowed to contain a lot of test steps and is consequently allowed to be very time consuming.
- The test procedure shall have the character of a form. As already mentioned there is a template available that defines the appearance of the test procedure document.
- Both documents (test procedure document and test report) must be WinWord documents (IDELSY design) and must have a high quality. Both documents appear under the name of the responsible project partner in the IDELSY project report.
- The test procedure shall not restrict itself to the usage of the KTS device. In fact the procedure shall consider the car as a whole and all opportunities of electronic interrogation. Some examples:
    (1) Opportunities for visual inspection in the car.
    (2) Malfunction Information Lamps (MIL)
    (3) There are numerous test facilities and tools available under PTI conditions. Can we make use of these facilities and tools?
    (4) The test procedure should be including a combined test. An example would be to generate real time values at the roller brake tester and record them using the diagnostic tool

The test procedure document must be <u>self-explanatory</u>.

Execution of a preliminary investigation of 10 vehicles

For the pre test phase each partners had to test 10 cars, at least more than one car per manufacturer to get an overview of the possibilities of the tools and the test procedure. It was a comparison between the Bosch KTS 520 and the OEM-Tools.

The idea behind this task was: "Acquire more information about the existing opportunity for electronic interrogation of on board systems".

The following assignment of project partners to OEMs was agreed:

RWTÜV	Toyota, Kia, Chrysler, Mitsubishi
DEKRA:	Mercedes Benz, Smart, Opel
TÜV Nord:	VW, Skoda, Hyundai, Audi
TÜV Süd:	BMW, Fiat, Alfa-Romeo, Honda
TÜV Rheinland:	Mazda, Citroen, Ford (Germany)
VOSA:	Ford, Suzuki, Nissan, Proton
APPLUS:	Seat, Volvo, Renault, Peugeot

Table 5.7: Distribution of manufacturer which had to be tested

This means:

- Perform an in depth test for approx. 10 cars
- Do not only use the KTS, use at least one or two OEM specific devices as well.
- Investigate cars of the manufacturers which you are responsible for (see protocol of the kick-off-meeting).

After testing the first ten cars per partner the results attained were often very different. Some vehicles proved to be very good to test; it was possible to get a lot of information, almost identical to the results with the OEM tool, but some manufacture like Chrysler, Toyota or Mitsubishi delivered no results. It depends on the manufacturer and the year of construction. Volkswagen, Audi and Mercedes delivered the best results. The new cars from 2004 and 2005 were in most cases not in the Bosch KTS database, but they were also not in our focus for the whole project.

5.4. Test procedure document

On the experience of the first 70 tested vehicles the test procedure was defined and formulated as a guideline for the next stage of the project.

The development of an specific test program for the BOSCH KTS-Software was initiated to enhance the whole procedure of the test.

5.5. Statistic data

As seen under Module 1, one task was to collect data of the existing vehicle fleet in Europe. DEKRA and RWTÜV created a template for the statistic data, so that every partner was able to write down the collected data in one common template.

This statistic data is necessary to ensure that the results of the project cover statistically the numbers of cars registered in Europe.

5.5.1. France, Italy

<u>France</u>

The total number of registered cars increased from 25.10 million in 1995 to 29.16 million in 2002.

The registration of new passenger cars per year varies between 1.71 million in 1997 and 2.25 million in 2001.

Looking at the newly registered cars per year there is an increasing share of diesel engine cars from 47,6% in 1994 to 63,2% in 2002.

Most of the cars belong to the national so called “inférieure”-class: slightly decreasing from 43,6% in 1995 to 37,2% in 2003 / 38,1% in 2003. The next important class of cars is the national so called “moyenne inférieure”-class with a steadily increasing part of 28,2% in 1995 to 34,4% in 2003. Together these two classes have a share of 72,5% of the French market in 2003.

Referring to the average lifetime and the distribution of the cars in use (see spread sheet: segment 1 (age of cars ≤ 4 years) or segment 2 (age of cars 5-7 years) or segment 3(age of cars ≥ 8 years)) reliable data could not be found in public sources; to do own calculations was also not possible, because of the lack of reliable data for the date of first registration and when vehicles were scrapped.

<u>Italy</u>

The total number of registered cars increased from 29.91 million in 1996 to 33.71 million in 2002.

The registration of new passenger cars per year varies between 1.65 million in 1994 and 2.41 million in 2003.

Looking at the newly registered cars per year there is a dramatic increase in the share of diesel engine cars from 9,1% in 1994 to 48,3% in 2003.

Most of the cars belong to the national so called “Segmento B: Utilitaire”-class with a percentage of about 40% (41,5% in 2003): these are cars like: Fiat Punto, Opel Corsa, Lancia Y, Ford Fiesta, Renault Clio, VW Polo, Peugeot 206, Toyota Yaris, Nissan Micra, Citroen Saxo. The next import size of car-class is national so called “Segmento C: Medie”-class with a percentage of about 26% (26,3% in 2003): these are cars like: VW Golf, Opel Astra, Renault Megane, Ford Focus, Fiat Bravo, Fiat Brava, Ford Escort, Citroen Xsara, Fiat Stilo, Opel Zafira.

Together these two classes held a share of 67,8% of the Italian market in 2003.

Looking at the numbers of newly registered cars in the EU during the years 1994 – 2002 the national markets of Germany, France, Italy and the UK can be recognised as the four greatest within the EU.

During all these years mentioned above the national market of Germany was the greatest of all national EU-markets with a range of newly registered cars from 3.209.224 in 1994 to 3.802.176 in 1999. France, Italy and UK follow at the places two to four in changing sequence:

Italy:	**1.671.396 in 1994**	**–**	**2.423.084 in 2000**
France:	**1.713.030 in 1997**	**–**	**2.254.732 in 2001**
UK:	**1.910.933 in 1994**	**–**	**2.563.631 in 2002**

In all national markets the percentage of diesel engines was increasing greatly during the later years.

National market of France and Italy

During the years 2002 and 2003 it can be seen that within the „TOP 10“-model-ranking in the national markets of France and Italy the French and Italian manufactures hold a high percentage of the Italian market: 2002: 58% of the TOP 10 models were made by Italian manufactures

2003: 44,6% of the TOP 10 models were made by Italian manufacturers

Within the Italian market the Italian manufacturers held a share of 46,1% of the registered cars per year in 1994, decreasing to a share of 28% in 2003.

French market: 2002: 95,1% of the TOP 10 models were made by French manufactures

2003: 92,7% of the TOP 10 models were made by French manufacturers

Summary

Within the different national markets of the EU those of France and Italy are in the top four largest markets.

Especially within the French market, cars of French manufacturers have a very great share.

The share of Italian cars within the national Italian market is less compared with the share of French cars within the French market, but never the less it is a considerable number.

It is therefore important that French and Italian cars be included in sufficient numbers in the project.

Sources of information

To gather statistical data about the existing vehicle fleet in France and Italy information from the following sources were evaluated by us:

- Web-site :Association Auxiliairie de l` Automobile : AAA ; internet address : www.acea.be
- Web-site :Unione Nationale Rappresentanti Autoveicoli Esteri ; internet address: www.unrai.it
- VDA Booklet: Verband der Automobilindustrie: „Tatsachen und Zahlen, 67. Folge 2003“
- Web-site: Comite des Construkteurs Francais d`Automobiles ; internet address : www.ccfa.

5.5.2. Spain and Portugal

Q1: Fleet renewal:

Looking at the percentage of each segment over the total of cars registered, we can see that the percentage of “Segment 1” has been increasing since 1997 while “Segment 3” has been reducing. In that sense, the percentage of “Segment 1” over the total number of registered cars in 2002 is over 30% and in most of these vehicles, electronic devices such as ABS, airbags, etc. are present.

Taking into account that the IDELSY project focus on vehicles after 1999, we can see that the increase of electronic systems in these vehicles is very high.

With regard to Portugal, it was not possible to find out more detailed information, but we also have to consider the relatively small fleet of vehicles in that country (3,8M vehicles compared to 18,7M vehicles in Spain, for example).

Q2: Manufacturers to focus on:

The chosen manufacturers cover a wide range of sales in Spain and Portugal (over the 95% of new registrations). With the exception of Proton, which has a very reduced presence in these markets. We can consider that other manufacturers are representative of the market share.

5.5.3. Austria, Switzerland, Germany

Austria

- The total number of cars is approximately 4 million. This has remained constant since 1998.
- New cars, which come in the fleet every year, are about 300.000.
- The renewal is 7.5 % per year.
- The percentage of diesel engines increased from 53 % (of the new cars) in 1998 to 72 % in 2003.
- The main sized cars are the medium with about 73 %.
- The average lifetime is 8.5 years.
- Audi, BMW, DC, Fiat/Alfa, Ford, Mazda, Opel, Peugeot, Renault, Skoda, Toyota and VW are the most common manufacturers. They have a market share of about 70 % per year.

Switzerland

- The total number of cars was approximately 3.75 million in 2003 and increased from 3.4 million in 1998.
- New cars, which come in the fleet every year, are about 300.000.
- The renewal is 8 % per year.
- The percentage of diesel engines increased from 2.6 % (of the new cars) in 1998 to 18 % in 2003.
- The main sized cars are the medium one with about 52 %.
- The average lifetime is 7 years.
- Audi, BMW, DC, Fiat/Alfa, Ford, Opel, Peugeot, Renault, Toyota and VW are the most common manufacturers. They have a market share of about 72 % per year.

Germany

- The total number of cars was approximately 44.7 million in 2003 and increased from 41.7 million in 1998.
- New cars, which come in the fleet every year, are between 3.500.000 (1998) and 3.240.000 (2003).
- The renewal is 7.2 % per year.
- The percentage of diesel engines increased from 15.5 % (of the new cars) in 1998 to 40 % in 2003.
- The main sized cars are the medium one with about 48.5 %.
- The average lifetime is 7.4 years.

- Audi, BMW, DC, Fiat/Alfa, Ford, Opel, Peugeot, Renault, Toyota and VW are the most common manufacturers. They have a market share of about 81% per year.

5.5.4. United Kingdom

The statistical data for the vehicle fleet and market share in the UK was provided by The Society of Motor Manufacturers & Traders LTD (SMMT)

Data Available for the UK Market Share

- The data was only available for Lexus from 1999
- The data was only available for the Mini from 2001

Manufacturer Trends

- The numbers of Vauxhall and Rolls Royce have stayed fairly constant.
- Ford, Rover and Volvo have all shown a decrease in numbers
- All other manufactures have shown an increase in numbers.

Data Available for the UK Vehicle Fleet

- The new registrations for the UK parc does not follow the given spread sheets as we use more categories. UK uses 9 categories the spreadsheet given has only 3.
- Over the last 5 years the UK fleet for new cars has remained fairly stable, around 2,000.000. However the diesel fleet has shown a progressive increase from 343.372 to 602,623.
- Alternative fuels are still very low, but showing an increase from 357 in 2000 to 2847in 2002.
- The economic life of the vehicles has not changed staying around 6.5 years as a minimum to 7.5 years as a maximum.
- The total number of vehicles has shown a progressive increase since 1993 to 2002.
- The registration of new vehicles has increased each year apart from 1999, which showed the only slump in the number of new vehicles.

UK New Registrations by segment

- Minis have shown a progressive increase over the years.
- Medium lower upper and executive saloons have stayed about the same in numbers.
- Sports Cars have increased in numbers from 23.365 in 1993 to 60,114 in 2002.

- Dual Purpose and Multi Purpose vehicle have shown the largest increase of 80,000 vehicles in each segment.

These statistics show that the saloon car market has stayed around the same with a large increase in Dual and Multi purpose vehicles. Sports cars and Minis have also showed a large increase in new registrations.

All detailed statistic tables for each country is available on the IDELSY homepage:

http://www.idelsy.info/Delsy/delsy-project.htm Results & Links

5.6. Customer questionnaire

For further experiences of the customer there was a questionnaire created which could be used within the study to acquire information about the experience of vehicle owners with electronic systems in their cars. The customer should fill out the questionnaire or be interviewed by the person who tested the car. The questionnaire was created by RWTÜV / VOSA and the English translation was done by VOSA. APPLUS translated the questionnaire to the Spanish language.

The aim of the questionnaire was to find out, if the customers have experienced electronic problems with their cars and what action they have taken to overcome the problem. Also a target was to find out, how the vehicle user recognises the errors and if they find it useful to monitor the reliability of electronic systems in vehicles. The complete customer questionnaire you can see as Annex 2.

5.7. Staff Training

Bosch employees trained the project manager. It was necessary to get an introduction in handling the tool and the software.

5.8. Specification of the test procedure document

The task of the project partner was to create a test procedure for the next step of the project.

Two different documents were created from which the partners could choose one.

The main information we wanted to acquire from this test phase were:

Data for test and vehicle identification

a) General data

- Date
- Operator
- Organisation

b) Vehicle

- Manufacturer
- Type
- VIN (Vehicle Identification Number)
- Code-no. to1, 2, 3 (optional)
- Cubic capacity of the engine
- Power output
- Engine type (petrol or diesel)
- First registration
- Mileage

Visual inspection – which systems are present and the self test routine

a) Look at malfunction indicator lamps for

- engine
- ABS/ESP
- airbag
- lighting control (Xenon light – have to have an automated control device)

b) Ignition on engine off (IoEo)

c) Observation of indicator lamps

d) Is the indicator lamp extinguished after a few seconds? Sometimes there are different procedures needed for extinguishing the MIL`s

System Diagnostic

a) Engine control

What functions are available? (For example: identification, error memory, erases error memory, actual values…..)

- Read out the identification
- Read out the error memory

- Document the available actual values (e.g. RPM, temperature, RC-codes, lambda sensor values, fuel trim)
- DTC (diagnostic trouble codes)

b) Airbag

What functions are available? (For example: identification, error memory, erase error, actual values, , ...)

- Read out the identification
- Read out the error memory
- Document the available actual values (e.g. resistance of ignition circuit)
- DTC (diagnostic trouble codes

c) ABS/ESP

What functions are available? (For example: identification, error memory, erase error memory)

- Read out the identification
- Read out the error memory
- Document the available actual values
- Read out special actual values

  (5) wheel speed sensor values of all wheels (test it on the roller brake bench or by driving) – document the value

  (6) steering wheel angle (turn the steering wheel to the left or to the right) – document the value

  (7) lateral acceleration (drive onto a ramp) – document the value

  [(2) and (3) can alternate be tested by driving a turn, therefore the vehicle speed also has to be documented - document the three values]

  (8) brake pressure (test it on the roller brake tester and read it out at a fixed braking force)

  Remark: A special type of ESP called "trust" / "trust plus" on some Smart vehicles. The "lateral acceleration" is found under "engine control". On this system "steering wheel angle" and "brake pressure" are not available.

- document the available actuators, which can be activated
- actuate special actuators

  (1) actuate the pump motor (listen to the noise) – document the test

(2) actuate the "solenoid valves" / "ESP function" for all wheels (test it on the roller brake-tester) – document the test

d) Lighting control

What functions are available? (For example: identification, error memory, erase error memory ...)

- Read out the identification
- Read out the error memory
- Document the available actual values
- Document the available actuators

With a power-on test a visual test (movement of lights, up and down, should be seen).

You can see the complete test procedure document as Annex 3.

To specify the test procedure it was decided that the examination of 70 vehicles gave enough information. Therefore the project partners although decided to have another evaluation phase during the creation process of the test procedure on 60 vehicles per partner in Module 2.

6. Module 2: Design and development of test procedures

6.1. Execution of the proposed test procedure

The first Step in Module 2 was to test another 60 vehicles per partner. Within the scope of the test series: - control unit identification, operating parameter readouts, values of operating parameters, tools for self-diagnosis (setting units testing) and the content of fault memories was determined. Furthermore, bases for the statements of handling and usage as well as access time of individual control units were established. The location was now the PTI stations of each project partner. All used the established test procedure and filled in the results.

6.2. Findings

The test result of the 60-vehicles - per partner - test series proved that the readout feasibility of control units depended largely upon the vehicle systems tested. Thus, approximately 48.4% of all engine control units tested enabled full system access using the BOSCH KTS 520 scanning tool, of the airbag and ABS systems full access to the control units was minimized to 17.7% (airbag unit) and 30.6% (ABS). With respect to electronic lighting control unit, no reliable statement can be offered due to the low installation rate it was encountered with this type of equipment.

Of the vehicle systems fault memories that were also tested fault entries were recorded by approx. 16.1% of all engine control units as well as 1.6% of both, airbag and ABS systems.

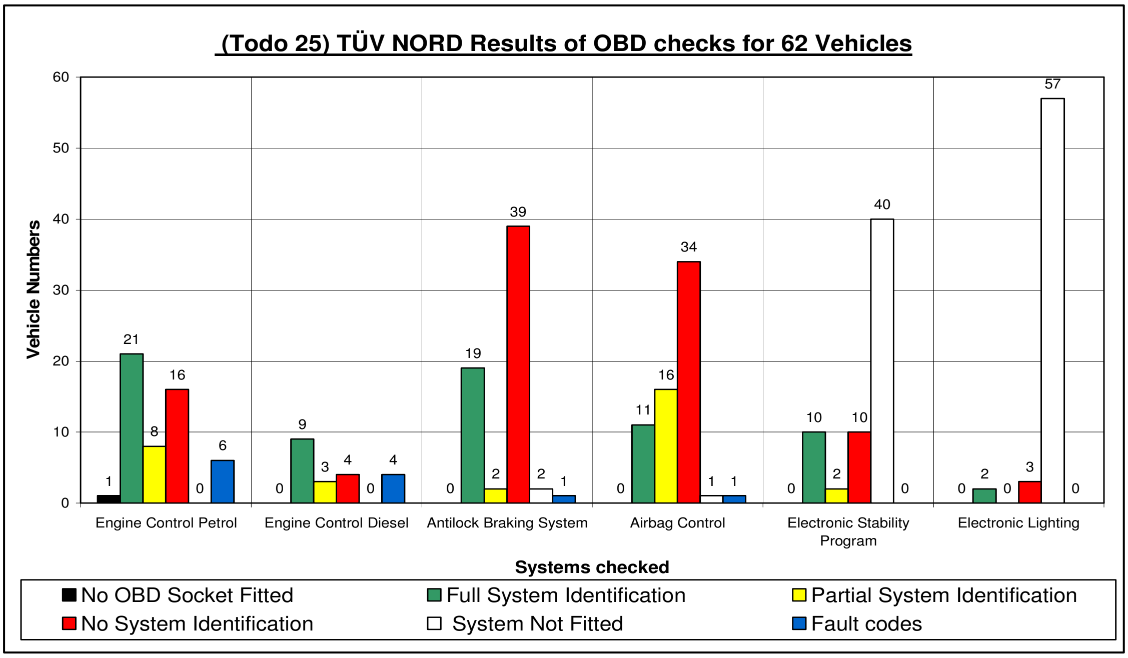


Figure 6.1: Results of 62 tested cars [www.idelsy.info]

Because of the relatively low number of vehicles for each vehicle make tested, the intensity of readout problems of control units varied using the BOSCH KTS 520 tool. Access to the Mazda and Mitsubishi make was almost always denied. However, readouts of the Mercedes Benz, MCC Smart and Volkswagen were mostly successful.

Additionally, the readout feasibility of control units using the BOSCH KTS 520 scanning tool largely depended upon the distribution rate of the individual vehicle makes and versions.

Further important information of this test phase was the testing time per vehicle. It was found that the time varied between 5 minutes to 10 minutes for the standard test procedure. If the test procedure will be integrated into the existing PTI the time frame will be decreased.

Conclusions

The documentation of preliminary test phase was quite difficult and time consuming because the test protocol was filled in by hand. Therefore with after several discussions with Bosch and the project partners it was decided to develop new software for the field trial, called the IDELSY Manager. The Bosch KTS standard software was developed for use in garages and so it was quite difficult to apply it for the field trial. For the implementation in PTI the software was uncomfortable to handle and was too slow

A requirement specification for an IDELSY Software was generated, and Bosch was able to develop a software application for our project. One big requirement was the storage of the test results. It was not possible to start the field trial with a need to record the results on paper. The IDELSY Manger generated a test protocol which was easy to evaluate and to show the customer, so that it was possible to demonstrate to them a clear result of our inspection. Another requirement for a ‘user-friendly’ evaluation Access Database was to be able to store the test protocols in an XML-Format (E**x**tensible **M**arkup **L**anguage). It is a generic language which is easy to handle and to process into other software tools.

6.3. Description of the IDELSY-Manager

For a short introduction you can see the screenshot. Choosing the vehicle manufacturer is the first step of the ECU investigation, after filling in the data of the car like year of manufacturing, mileage and so on.

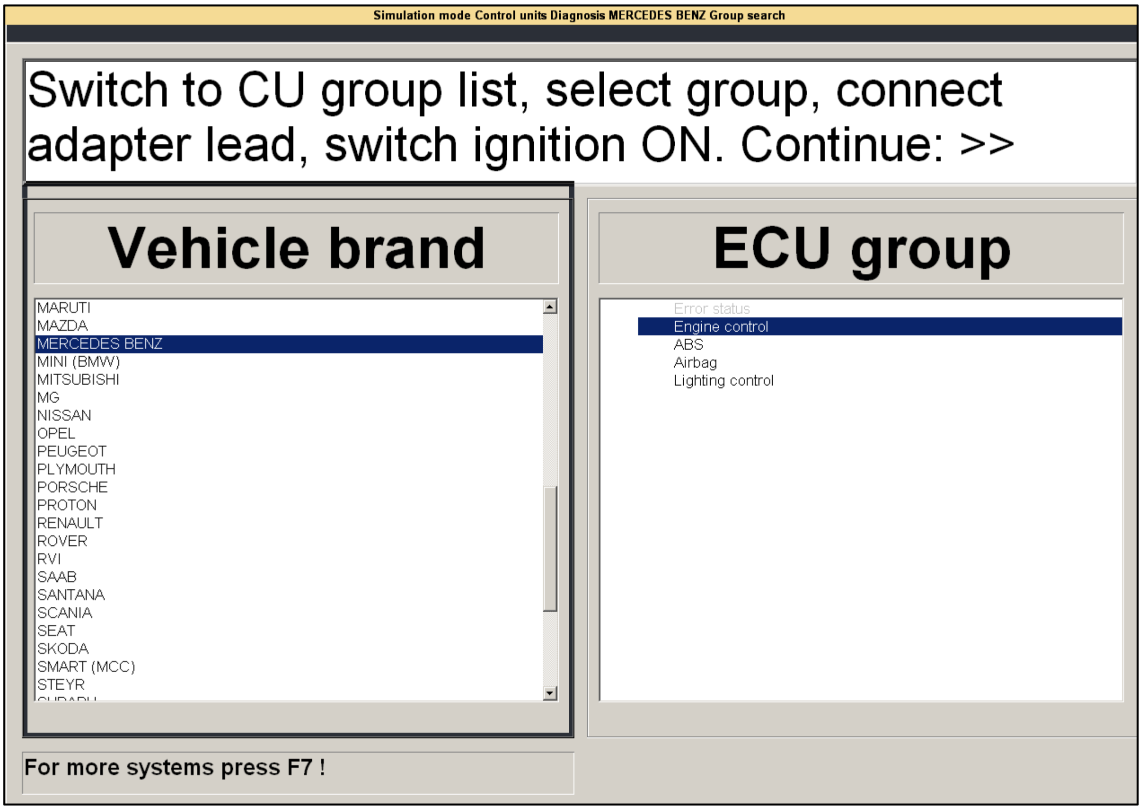


Figure 6.2: Vehicle selection [screenshot IDELSY Manager]

The next step is to choose which ECU you wish to examine. In the IDELSY Manager Version 2.0 it was adapted to reflect our interest and it showed only the four selected ECUs.

After choosing the ECU the KTS 520 will search the implemented Control Unit. If the implemented ECU is stored in the Bosch Database it takes up to 90 sec to identify it clearly, which means the engine control unit, gives the data of its manufacturer, its serial number, etc. The second possibility is a “no clear identification”, with options between diverse ECUs. In this case it is possible to choose one of these substitute systems and to get information about the error memory, but it can not be guaranteed that the received information is 100 % accurate. It was decided it would be necessary to note when the identification was not clear and that the information may therefore be inaccurate.

One of the main targets in this project was to find out if it is possible to read the error memories of the four different ECUs. In accordance with this target we read the error memory and stored the results.

The software is able to show the error memory of the respective ECU. We stored the result and informed the customer. In most cases the errors were a so called “sporadic” error; this means that the error was a short-lived error. From sometime in the past, for example perhaps the battery had for a short time suffered from low voltage.

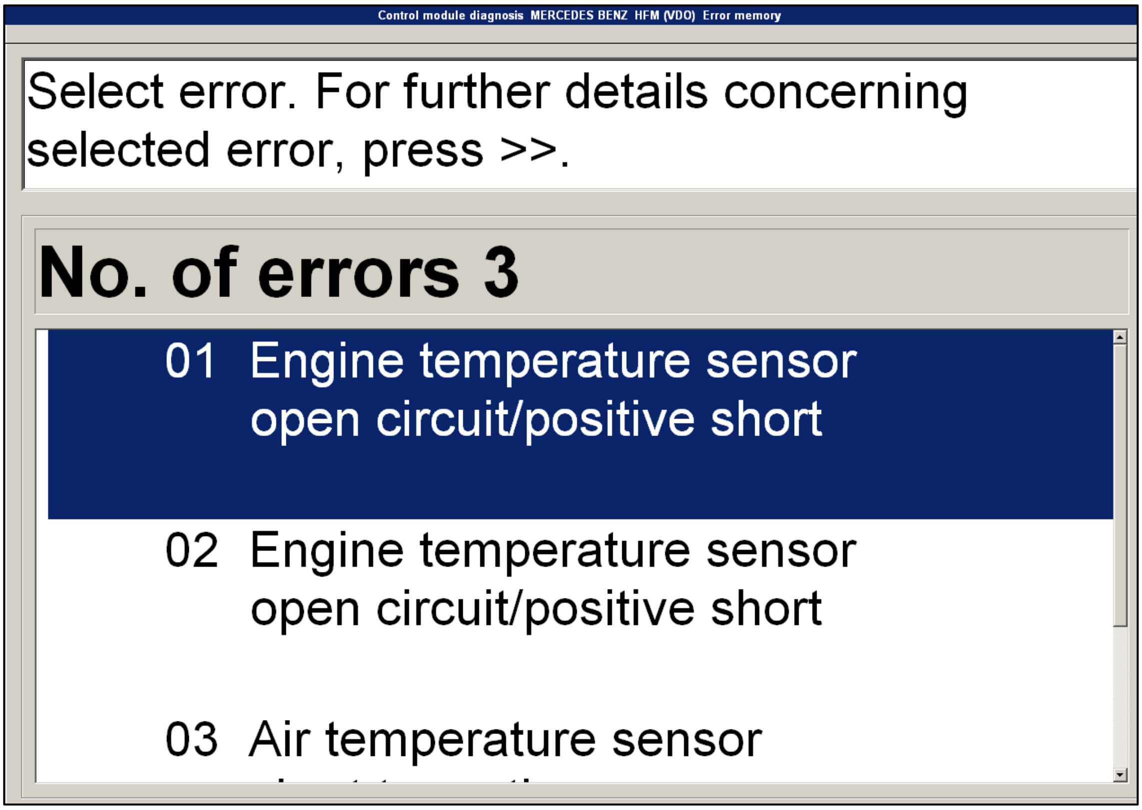


Figure 6.3: Error memory of a engine control system [screenshot IDELSY Manager]

The other case was "active" errors, which have to be shown in the dashboard with an illuminating warning lamp if they have influence of the proper functionality of a safety critical or emission depending system.

In case of the engine control, the ECU Identification, the error memory and the actual values, like engine speed, battery voltage etc were stored.

For the SRS (Secondary Restraint System) -, or Airbag control unit it was necessary to store the identification data, like ECU name, number etc. and the error memory. In some cases it was possible to activate an airbag functional test, which means all components for the airbag system simulate a crash and ask the depending systems if it is possible to activate the airbag. This self test feature was informative but not necessary to activate and to save in the IDELSY Manager.

For the light control system (all vehicles with Xenon headlights from 1996 have to have an automatically light regulation) it was fixed to store the identification, the error memory and if possible to execute and activator functional test. This test means to activate the headlight regulation electric motor and to move the headlights to the upper bound, to the lower bound and back into the initial position.

For the ESP/ABS system it was tried to trigger some actuators like the ESP functional test. It is an ESP self test where all ESP relevant components and systems are going to be activated separately for each wheel for a few seconds.

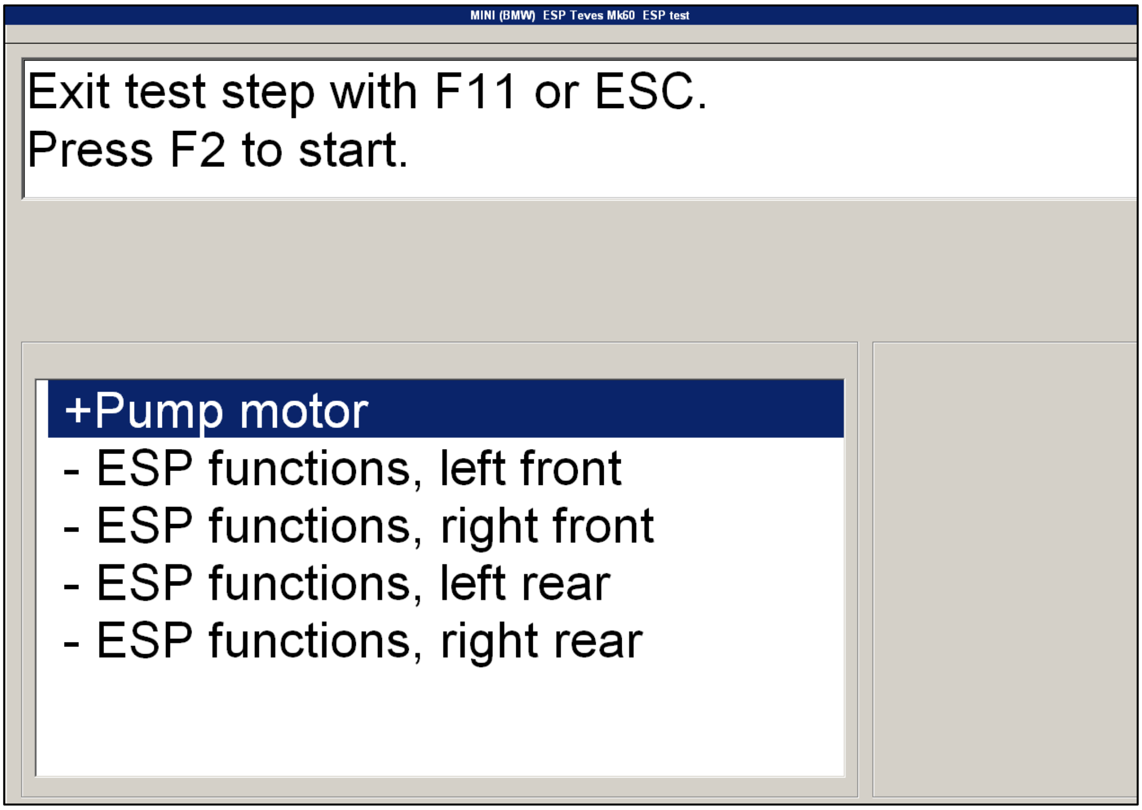


Figure 6.4: ESP functional test [screenshot IDELSY Manager]

It was important to abide the order of testing steps. Further more it is important to fill out the additional protocols, like “no connection”, or “ABS actuators” and so on. In this protocol it had to be noticed if it was not possible to get a connection to the ECU.

After starting to work with the IDELSY Manager and to train the test station staff, it was possible to test from 1 up to 7 vehicles per day, person and test station.

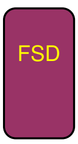
The Project and the results of Module 1 and 2 were presented at the CITA Conference in Dublin in 2004.

For the complete test protocol, see Annex 4.

The handling of the IDELSY Manager is described in Annex 5.

6.4. The test procedure

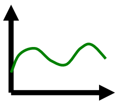
The test procedure can be built up into a pyramid (see figure).



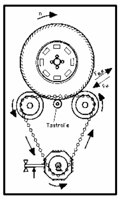
For the project it was important to identify which ‘system build’ is in the car. For future use a database which stores all vehicles with standard equipment and also any additional fitment which is safety relevant. In Germany a fist step has been taken for next year with the **F**ahrzeug/ vehicle **S**ystem **D**ata (FSD). This database will be used for a regular PTI procedure for vehicles built after 2006.

A behaviour test was integrated into the test routine. Therefore a check list was created to record the visual inspection items. According to this list it was checked if systems are on board. Also it was filled in if the MIL – Indicator illuminated or not. The question now was, is the result in accordance with the trouble code read out? For a test procedure within PTI, it would be able to attain another structure of documentation because the PTI report will contain all this information. In this case the scan tool can be more integrated as for the IDELSY project.

One well known function is reading out of trouble codes for different safety relevant systems. It was also important to compare the stored data with the displayed system status (MIL).



Another part of the pyramid is to read out actual values. This test procedure includes the check of sensors, actuators, connectors, wires and the CPU. A good example is given for the wheel speed sensors and pressure modulators at ABS/ESP–systems



To actuate some components like an ABS pump is the high level test item. The combination of already existing equipment, such as a roller brake tester, and modern scan tools can support a highly efficient and reliable test result. For a 100% solution on every new vehicle a standardisation is required. Within IDELSY, this test was possible on approximately 30% of the systems

It was documented what system tests were available to conduct and which not.

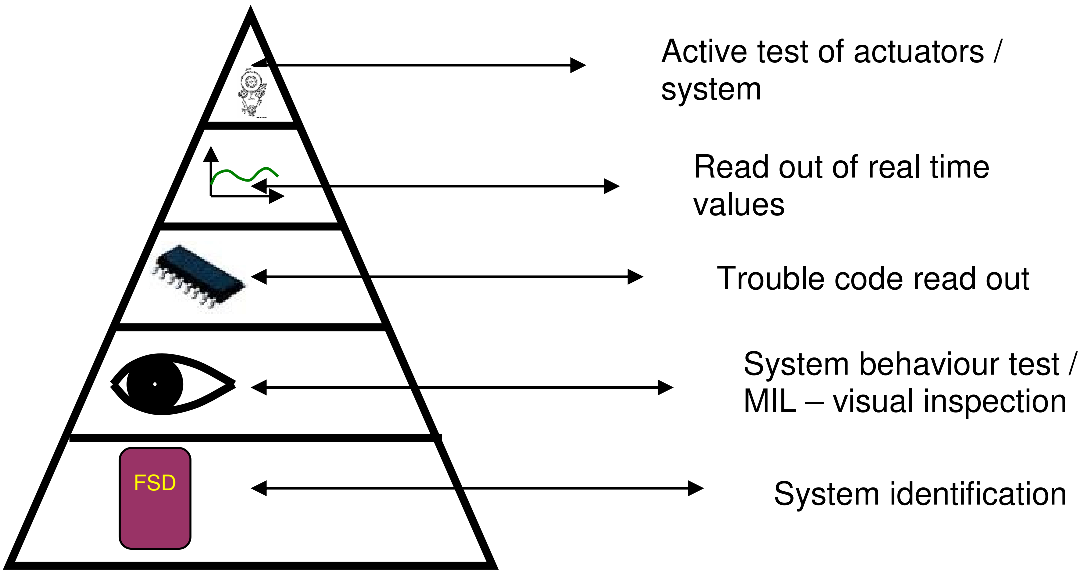


Figure 6.5 test pyramid

7. Module 3: Field Trial

In Module 3 it was decided to start the field trial at test stations of the project partners. VOSA tested vehicles at a large used car supermarket which was also a test station (MOT-Station). According to the project plan the test was to be carried out at 28 PTI stations for the complete test phase on 1500 to 2500 vehicles.

The challenge of this method of an electronic system investigation was to integrate it into the existing PTI procedure. Due to the fact that most of the customers were in hurry, good argument to persuade them to attend a further inspection and to fill in a customer questionnaire was needed. The most efficient argument at that time was the published frequent negative reports regarding the reliability of electronic systems in motor vehicles. Open discussions with the costumer about the over all target and the need for an updated PTI scheme were accepted in most cases by them.

7.1. Asian cars

Within the field trial we found that a small group of Asian cars were not fully capable of being scanned. It was therefore decided to examine another 5 Asian car makes with OEM tools and another generic tool to find some reasons for this very different result, compared with the European vehicles. See full evaluation as Annex 6.

7.2. Evaluation with IDELSY Database

The complete field trial takes about six month, starting in January 2005 and finished in July 2005.

For the evaluation of all results an Access Database was developed. The requirements were defined within an IDELSY project meeting. It was needed to transfer directly the test protocols (XML-Files) into the database.

Another advantage is the option for individual query of data and to filter one special car, manufacturer, and year of construction, mileage, or errors in special ECUs. Although it was possible to export fixed queries to Excel for a specific diagram or presentation.

The database support was centralized. RWTUV had the role to collect all incoming test data and to fill the database.

7.3. Test results

Before starting the field trials the following processes were established:

- Standardised data collection
- Development of a unique database to evaluate the test data and customer questionnaires

- Established a country based hotline and general hotline for the project manager to the project leader organisation
- Regularly data transfer from the project partners to the centralised database
- Regular ‘experience’ exchange with Bosch (creation of IDELSY manager)

7.3.1. Results of the technical field test

After the 6 month field trial 2234 vehicle data sets were stored.

There are 38 different vehicle makes represented. 23 of the 38 makes are from Europe.

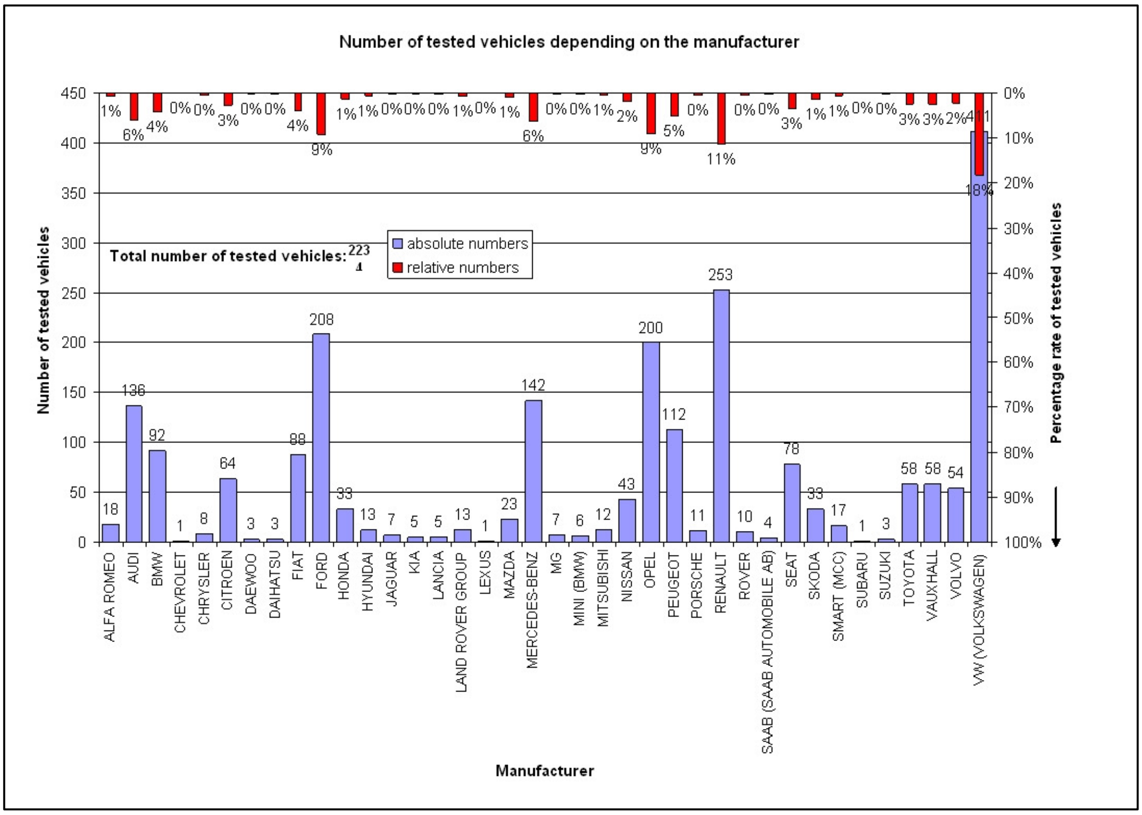


Figure 7.1: All tested vehicle depending on makes [IDELSY Database]

The manufacturer (with different models) which has the most cars in the test was VW with 411 or 18%. The second was RENAULT with 253 or 11% of all cars and the third manufacturer was FORD with 208 cars or 9% of all.

The OEM with the least cars in the test was in each case CHEVROLET, LEXUS and SUBARU with only one tested vehicle.

Compared with the findings under Module 1 the vehicles inspected in this study reflect the statistical distribution of vehicles to the different vehicle manufacturers. This distribution was the subject of a previous study under Module 1. Some distortion occurred, as some large European countries (such as Italy and France) were not covered. The main goal of the complete project was to make a feasibility study for the use of generic scan tools in the to days field and to achieve the percentage of available communication with the most important electronic controlled safety relevant systems.

The following results are the evaluation of the IDELSY Database:

From the 2234 tested vehicles, 2217 had an engine control unit fitted.

But in unusual engine/vehicle combinations the details were not accessible from the IDELSY database. This problem can arise when the tester does not fill in the “Visual Inspection” protocol, where he has to check the fitted systems and simultaneously enter the fitted engine control system which may (is) not be in the Bosch IDELSY Manager Database, causing a break in the communication thread. That happened in 17 of 2234 test cases, fewer than 1%, so it is negligible.

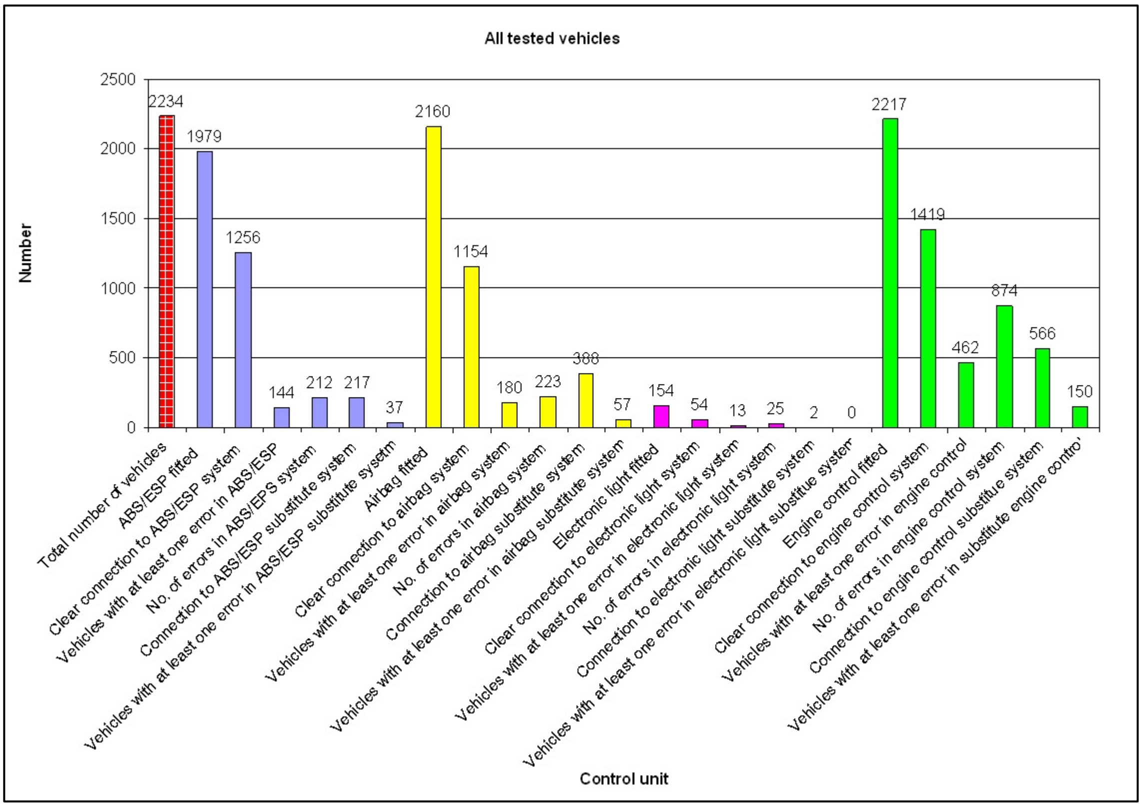


Figure 7.2: Connection to ECUs and errors [IDELSY Database]

As you can see in the table a clear connection was achieved with the engine control unit in 1419 tested cars. In 462 cars we detected errors codes which were stored in the memory, which means that 33% of the cars with a well established connection had a trouble code in the engine control unit. Overall we detected 874 stored trouble codes, which means that in many vehicles there were multiple errors.

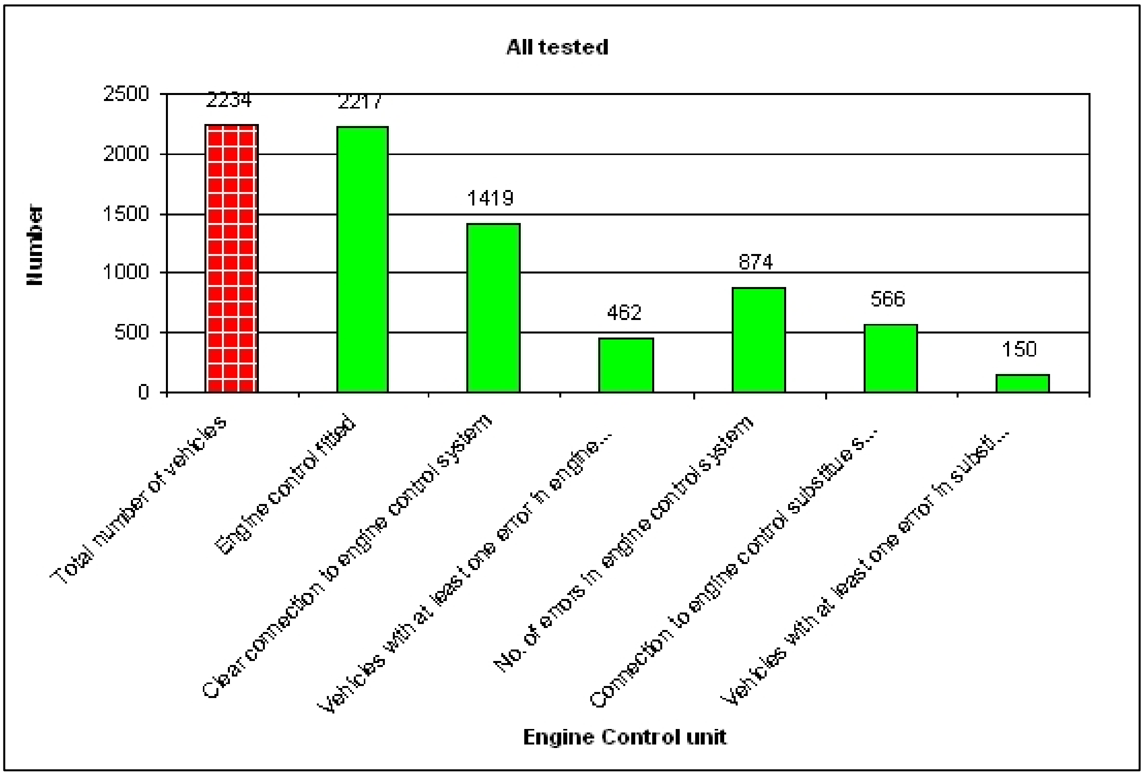


Figure 7.3: Results of the Engine Control Units

In 566 cases we got a connection to a substitute system that means the KTS did not make a clear connection and had two or more ECUs proposed for selection. When you choose one of these substitute systems to read out the error memory it is not 100% reliable that the stored data or errors are correct. In 150 cars or 11% of the 566 or 26% of the connection to substitute systems we found stored errors.

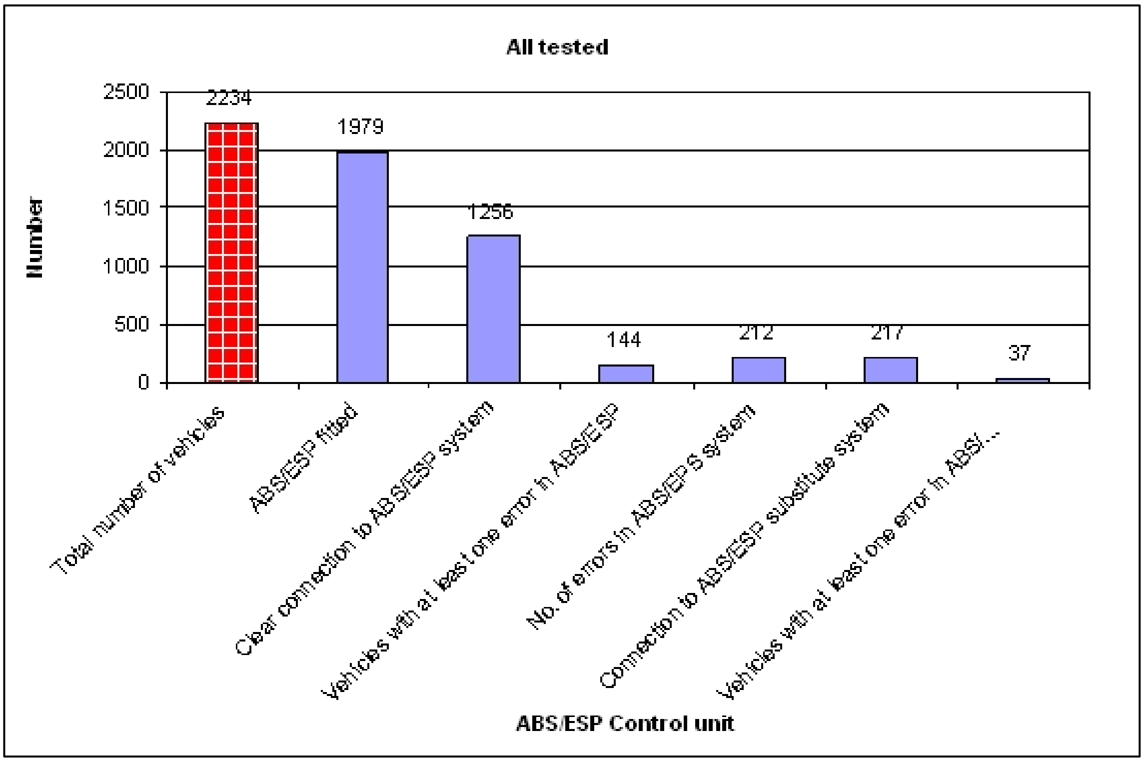


Figure 7.4: Results of the ABS/ESP Control Units

ABS/ESP system had 1979 of all cars or 89% fitted. A high rate of 1256 ECUs or 63% were uniformly identified. The error rate in this system was very low with 144 systems or 11% with a stored error. All in all there were 212 stored errors detected. Furthermore in 217 cases there was the possibility to choose a substitute system and in 37 subsystems errors were stored.

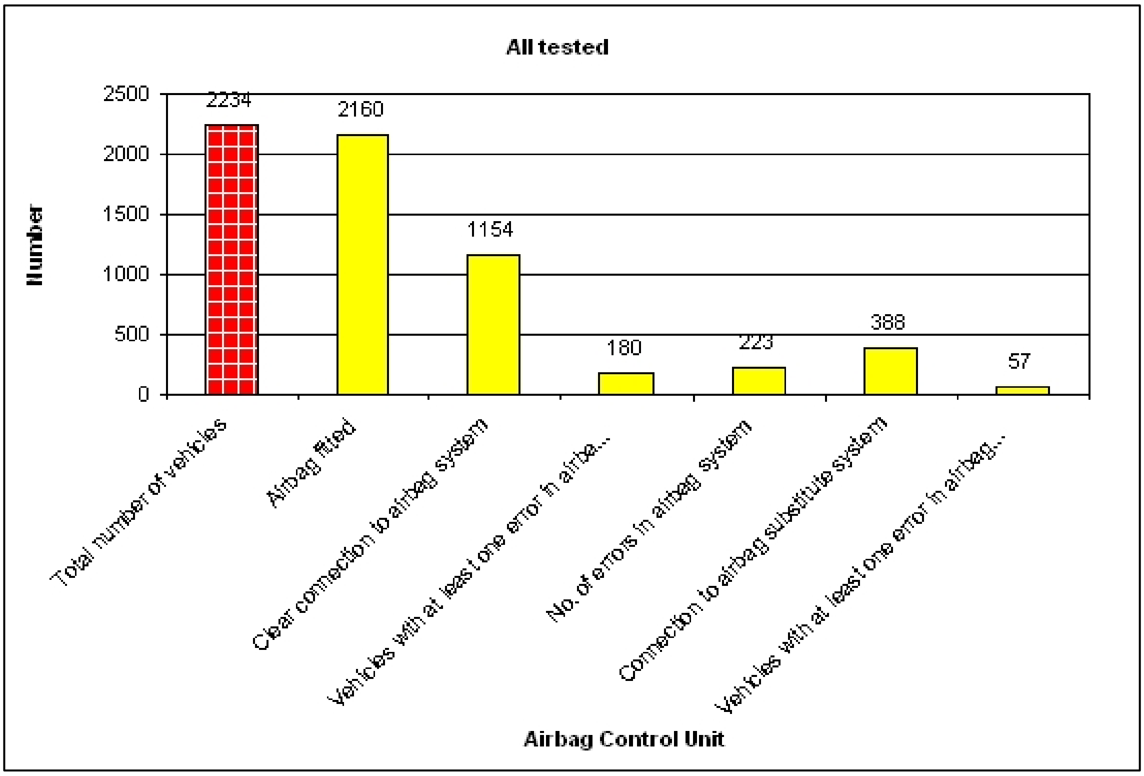


Figure 7.5: Results of the Airbag Control Units

2160 or 97% of all cars had an airbag. There was clear identification of 1154 airbag control units. In 180 cases or 16% stored errors in the error memory were found. Another 388 connections to a substitute system was possible. There were 57 errors.

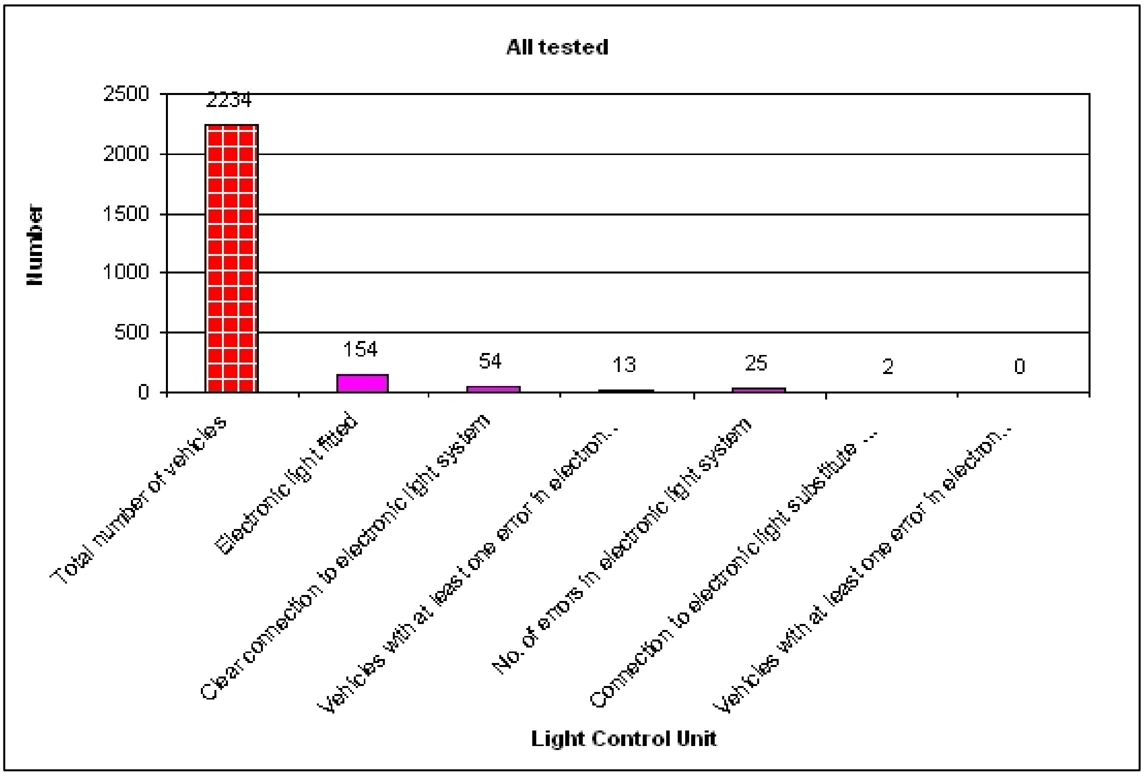


Figure 7.6: Results of the Light Control Unit

The light control unit was the ECU with the least application. Only 7% or 154 cars had a light control system fitted. It was possible to access 54 or 35% of them of which 13 or 24% of these 54 vehicles had an error stored, a total of 25 errors were detected. In two cases substitute systems were accessed none of which had error. Both were taken, the clear connection and the connection to a substitute system (which can be the correctly built in system). The detailed information with every manufacturer is found at Annex 7.

7.3.2. Results of the customer questionnaire

The evaluation of all customer questionnaires was accomplished from the project manager using a specifically designed Excel-Sheet.

After 3 months into the field trial it was recognised that the existing questionnaire was too extensive and too complex for most customers. So it was decided to re-draft the questionnaire. (The complete former questionnaire you can find as an Annex 3). The new form had only 4 questions as well as the vehicle data, it was of course anonymous. All in all there were 446 customer questionnaires evaluated, which mean statistically every fifth customer was prepared to fill in the questionnaire.

In the graphic below you can see an overview of the evaluation.

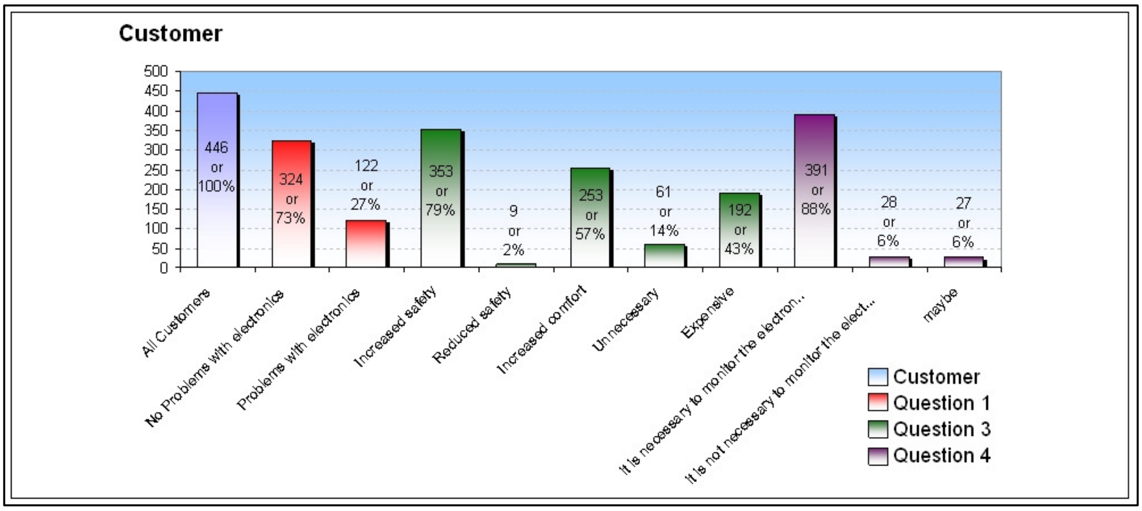


Figure 7.7: Evaluation of the questions 1,3 and 4 [IDELSY Database]

The first question after filling in the vehicle specific dates was: “Have you ever had any problems with your vehicles electronic systems and If you had an error, how many?”

122 or 27% of the interviewed customer answered with “yes, they had problems with at least one of their electronic system”. Even 10% of those 27% interviewed customers had more than one electronic error.

Only the respondent who answered the first question with “yes” had to answer the second question. The others had to go to question 3.

Question 3 was: “Which of the following terms do you associate with the increase in electronic systems?” This was the list of possible answers. Multiple answers were possible, that is why there were received at least more than 100%.

Increased safety	Reduced safety	Increased comfort	Unnecessary	Expensive	Other

Table 7.1: Possible answers of question no. 3.

353 or 79% of all 446 interviewed customers said that electronic systems increase the safety. Only 9 persons or 2% thought it reduced safety. Over half: - 57% or 253 customers thought that the electronic components increase the comfort. Just 61 persons or 14% considered that the electronics are unnecessary. Nearly half: - exactly 192 or 43% of all customers were in complete agreement that the electronic components are very expensive.

Question 4 was: “Do you consider that the reliability of electronic systems needs to be monitored?”

The majority, 391 customer or 88%, thought that it is necessary to monitor the electronic components in PTI. Only 28 persons or 6% were against it and said that they do not think it is necessary. 27 customers or 6% said “maybe” it is necessary.

Question 2 was: “How did the error/s come to your attention?” This was the list of possible answers. Multiple answers were possible, that is why there were at least more than 100% received.

	Audible warning	Warning light on dashboard	On-board computer message	Informed by garage	Other
Error 1					

Table 7.2: Possible answers of question 2

Eleven people or 9%, of the customers who recognised an error, noticed an audible warning. 100 people or 82% saw a warning light on the dashboard. 25 persons or 20% got an on-board computer message. 20 persons or 16% of the customers were informed by the garage. 5 volunteers or 4% had a different way of noticing that they had an electronic error in their vehicle. Question two could only be answered by the 122 customers who had problems with their electronic components.

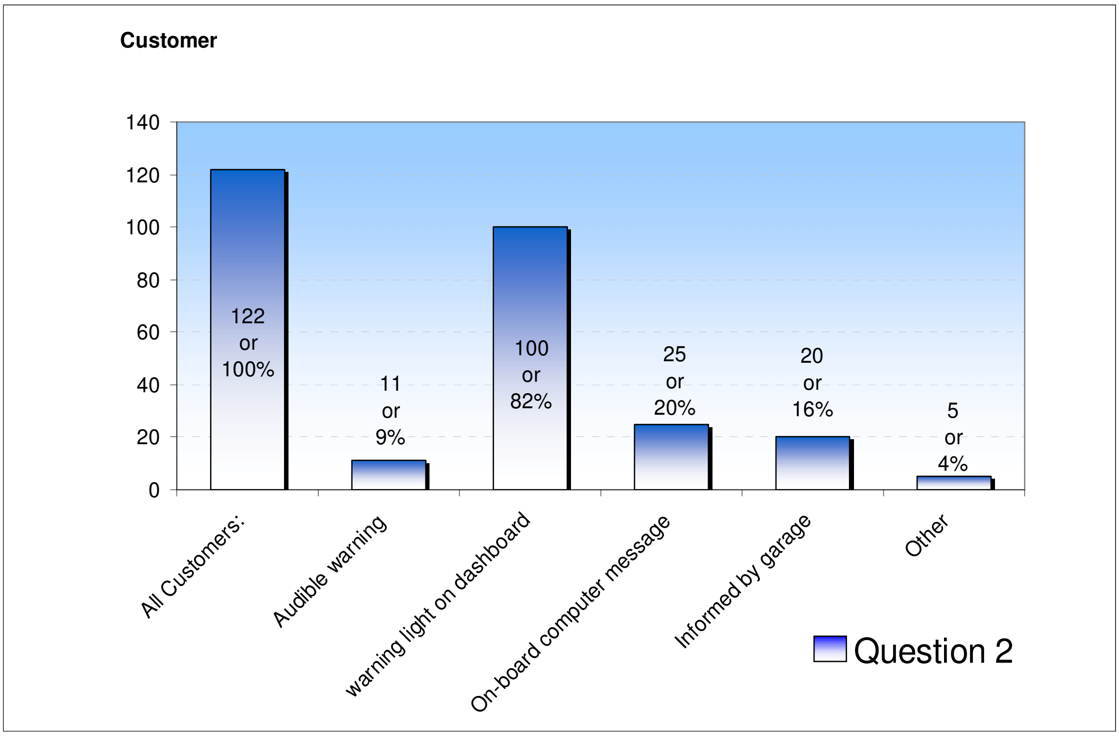


Figure 7.8: Evaluation of question 2 [IDELSY Database]

8. Discussion and outlook

The results in chapter 7.3 were just the documented data. While evaluating these facts it was very important to analyse all aspects of the results and to find possible future uses for the data. The results of this research project would help to achieve an improvement in the PTI, or they could perhaps form the basis for further projects.

8.1. Discussion of the results from the field trial

It was very important to define the principle specification for an scan tool used within a PTI procedure. The needs for PTI are quite different to the needs for garages. After the adaptation of the scan tool within two steps, it was clear to see the better performance and acceptance by the involved operators.

The average examination time was reduced from 20 minutes to 10 minutes with the latest IDELSY Manager version. Teaching the operation of the tool to the staff was fast and straightforward since the staff at the inspection stations were eager to learn and already had some experience in the use of computers.

The willingness of customers to cooperate was highly welcome. It was however important to explain the reason for the inspection of the electronic components, which was relatively easy, as the customers already knew about the many recalls by vehicle manufacturers relating to problems with electronic components.

As a total of 2234 vehicles have been tested, this study can be characterised as representative. The vehicles inspected in this study reflect the statistical distribution of vehicles to the different vehicle manufacturers. This distribution was the subject of a previous study. Some distortion occurred, as some large European countries (such as Italy and France) were not involved.

The analysis of the data was performed with the IDELSY database, which also had the possibility of graphical outputs.

It has to be mentioned that the Bosch KTS 520 in cooperation with the IDELSY Manager was able to obtain significant vehicle specific data from vehicles via the OBD-interface. The ECUs chosen by us were also in the database, with some exceptions. It should, however, be mentioned that the available data base depends very much on the vehicle manufacturer and on the other hand on the strategic calculation of the tool manufacturer. So from the tool manufacturer at the first step all data will be generated for the most registered vehicle types. Vehicles within manufacture guarantee were maintained by the manufacturer specific garages. The main focus is therefore more on older vehicles and the vehicle fleet which is mostly required by the independent garages

At Subaru, for example, only the anti-lock brake ECU could be accessed. This problem which occurred with the Asian vehicle manufacturers was discussed between the partners and Bosch. Bosch assured further investigation into the problem and will try to better integrate these manufacturers.

As seen in the statistics in chapter 7.3.1, a differentiation is necessary between ‘clear connection’ and ‘connection to a substitute system’. This is necessary, as the connection could only be made with a subsystem in the case of about 26% of the ECUs for engine control, 11% of the anti-lock brake ECUS, 18% of the airbag ECUs and nearly 1% of the light control ECUs. As the analysis of these substitute systems and of the errors stored there resulted in a similar error rate as got with the cases of ‘clear connection’, support from Bosch was requested. They stated that the ‘connection to a subsystem’ will – in 95 % of all cases – still produce the correct data, stored errors and measured values. With this information, it was possible to draw up the following table.

	Engine ECU	ABS/ESP	Airbag	Light Control
Percentage of connections established to ECUs	90%	74%	71%	36%
Percentage of ECUs with stored errors (depends on the percentage of connection)	44%	14%	21%	24%

Table 8.1: Percentage of connections made to an ECU

The given percentage in the first line relate to the number of systems fitted, not to the total number of vehicles. The errors relate to the percentage of connections.

The technical feasibility is thus proven. It should be highlighted that our cooperation partner Bosch still has possibilities for improvement in the area of the database, especially with the Asian manufacturers. Such vehicles like Toyota cannot be described as rare on the European market. The percentages of successful read-outs show that it is possible for an inspection organisation to perform the diagnosis of the electronic components.

The error rates of the different manufacturers and their particular ECUs seem to be high at first glance, but the analysis of the errors which were read out of the different error memories was not part of this project. It is probable that a large percentage of the errors recorded are sporadic errors:- which appeared once in the vehicle but were not active after that and would not influence the functioning of the ECU concerned.

8.2. The results of the customer questionnaires

One important part of the entire field-trial was the cooperation with the clients. The aim of this research project was the inspection of vehicles which were due for a PTI and duly arrived at the inspection stations. It was important to convince the customers that it is necessary to inspect the electronic components. One of the most important arguments used to persuade them was that the result of the voluntary inspection of the electronic components did not influence the outcome of the PTI. It was offered as an additional, free service. To our surprise, customers were often very willing to have this inspection performed. Many of them had already had electronic problems with their vehicles and thought it would be interesting to have the possibility to 'look into' the ECU. The customers often required some explanation, as they were not aware that computers – ECUs – were installed in their vehicles. On average most customers were unable to differentiate between electric and electronic and so-called electronic problems turned out to be a defective lamp. The high interest in these inspections was additionally supported by the negative press reports of problems with electronics of the various vehicle manufacturers. Some customers even appeared a short time after the initial test, to have a test performed on their second vehicle.

A total of 446 customers were interviewed. The important questions for us were: Did they ever have experience problems with vehicle electronics; if yes, how did they become aware of them; what did they think about electronics in vehicles, and, did they think that the electronic components should be inspected during the PTI? See figures 7.7 and 7.8.

It was surprising that 73% of the questioned customers had problems with electrics/electronics. This possibly had an effect on the answer about the introduction of an inspection of the electronics: 88% of the customers agreed that such an inspection is a good idea.

Despite the fact that a high percentage of the customers had positive associations with the electronics, such as improved safety, there was evidently a clear scepticism about the reliability of the electronics.

The customers subjectively would feel safer if during PTI these abstract electronic components could be checked. Most of the customers were aware that the price for the PTI would have to be increased. The customers were not directly asked about a possible price increase. As a result within the discussions during the tests a majority of the customers were prepared to pay an extra €10 for the increased safety.

8.3. Outlook

The field trial indicated clearly that the technical prerequisites for an implementation of a scan tool based test procedure are positive. The Bosch KTS 520 allows a complete test of the four Electronic Control Units within approximately up to 10 minutes. The examination time will be influenced by the fitting of the vehicle, the speed of communication (k-line, CAN, etc.) and the experience of the testing staff. Time will be saved if the vehicle will be tested at periodical inspection because the customer and vehicle data have been filled in already.

The staff should be trained very dedicated to carry out the additional inspection. Knowledge of the stuff is one of the most important things within this new technology.

It has to be stressed, in the view of the growing number and importance of the electronics and advanced driver-assistance-systems (ADAS) that the future PTI procedures should become a dynamic process which is capable to follow the development of new and safety relevant vehicle systems.

Generic scan tools which can be used universally on different vehicles, have undergone tremendous developments.

Still there are some gaps but compared with the status 5 years earlier, the coverage, the function and availability of information has increased.

The results from IDELSY will again accelerate the development for scan tools which are capable to be used for the PTI.

Recommendations addressed to the scan tool manufacturers

Early update of data bases for new models,

Today, only data for vehicles older than 2 or 3 years are generally available.

Special procedure and content for PTI purposes

Today scan tools are made for the use of garages; diagnostic functions and repair guide lines are key elements for this PTI is more related with the regulatory framework; e.g. condition of authorised equipment/functions and clear definitions of pas fail criteria

Recommendations addressed to the road authorities

Phase in an approach for the use of scan tools within the PTI as an update of the existing regulation 96/96/EC

Under the harmonised European regulation, national approaches should supported to get wider understanding and experiences of this technology

Road safety is strongly influenced by modern vehicle systems; the safe function of those systems should be part of the European PTI procedure to achieve the full advantage over the whole lifetime of these systems

IDELSY propose the following steps for the assessment of electronic components during road worthiness testing:

First step:

- Input of the IDELSY results into AUTOFORE
- Proposals for future strategies of road worthiness actions in Europe through AUTOFORE
- Decision about the implementation of the proposed strategies for road worthiness actions in the Technical Adaptation Committee (TAC)

Second step:

- Team up of a working group with the defined stakeholders (for example: DG TRANS, DG Enterprise, ACEA, EGEA, CLEPA, CITA, etc.)
- Definition of the following items:
  - Description of the process to select safety relevant systems for the for road worthiness tests
  - standardised interface
  - standardised communication protocol
  - standardised automatically guided test procedure (read out of error codes, test routines for sensors and actuators)
  - failure modes
  - pass or fail criteria
  - Specification of the Scan-Tool
  - Definition of amendments to the existing EEC regulations

- Beside the definition phase a European project with all stakeholders should be installed to evaluate the following items:
  - Actual errors in safety relevant electronic systems in the field
  - Experiences and assessment of different scan tools including the OEM used
  - Experiences and assessment of defined test procedures and protocols
  - Failures simulation on electronic systems to get experience about pass/fail criteria and assessment of the existing OBD applications
  - Cost effectiveness studies

Third step:

- Decision about the amendments within the European Commission

- Implementation of the new test routine in the field

In the future the part of electronic systems in the automotive sector will still increase. More and more safety and environment relevant electronic systems will influence the car and driver behaviour. Due to the lifetime cycle of the vehicles it seems to be necessary to have test routines which are able to do a full system identification and detects serious errors, to prevent accidents, injures and environmental impacts. With these measures the environmental situation and road safety will be improved.

All project partners are sure that IDELSY contributes to the overall goal of the European Commission to reduce traffic accidents and fatalities in the near future.

9. Bibliography

[1]	www.adac.de
[2]	Functional safety of electrical/electronic/programmable electronic safety-related systems, (IEC 61508), www.iec.ch
[3]	R. Leunig and other authors, Robert Bosch GmbH, *Autoelektrik Autoelektronik*, Vieweg Verlag, Braunschweig/Wiesbaden, ISBN 3-528-13872-6
[4]	William E. Perry: *Software Testen*, MITP-Verlag, Bonn, 2002, ISBN 3-826-60887-9
[5]	Prof. Dr.-Ing. habil. H.-J. Christ Institut für Werkstofftechnik Lehrstuhl für Materialkunde und Werkstoffprüfung Universität-Gesamthochschule Siegen, http://www.uni-siegen.de/

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12. Annex

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2	Preliminary test procedure document
3	Complete customer Questionnaire document
4	Complete test protocol of one car generate by the IDELSY Manager
5	The IDELSY Manager guideline
6	Validation of Asian Cars (Todo 33)
7	Complete evaluation of the field trial