Car·2·Lab

Digital Learning Tool
Telematics kit

Co-funded by the
Erasmus+ Programme
of the European Union

BGZ

Project coordination
BGZ Berliner Gesellschaft
für internationale Zusammenarbeit mbH
www.bgz-berlin.de
www.car2lab.eu

Author

Prof. Dr. -Ing. Michael Lindemann
Ralf Lipinski
Karolina Kędzia - Wojciechowska
Ryszad Kędzia

Photo credit

Rear view of luxury car © Sergey Nivens – Fotolia.com

Design

Franziska Zahn, Qin Feng, Elisabeth Schwiertz, Steven Gräwe, Martin Popp

2018

CONTENTS

Introduction

This document summarizes the specification process for the Telematics Box (TB) as part of the whole telematics system (= Telematics Kit (TK)). The requirement definition is a result of the following conferences and meetings:

Tab. 0.1: Conferences and Workshops for TB and TK Specification

Date	Contents
13.10.2016	Kickoff-Meeting. Discussion of TB functions between all partners
17.10.2016	Workshop at guild. Definition of TB requirements
15.11.2016	Phone conference between Berlin partners. Definition of TB requirements
10.01.2017	Workshop at VIOM. TK and TB specifications and consideration of partners feedbacks
08.03.2017	Workshop at VIOM. Final specifications of TB and TK after feedback from Mechatronika

Beginning with the Kickoff meeting of the project the requirements of the TB and TK have been defined. The lead of the specification process was in Berlin regularly supported by all partners from Poland, Italy, Denmark.

Functional Requirements for the Telematics Box

Moveable Box/Trolley Case

The following requirements are defined for the moveable box/trolley case:

Tab. 0.1: General Requirements for Trolley Case

No.	Requirement
1	Easily moveable box/trolley case
2	Desktop solution for classroom
3	Mountable in workshop environment
4	Plug&play for in vehicle usage
5	Options for • CAN-bus connections • ODB2- connections • Direct sensor connections
6	All parts included
7	External power source options • 12-24 VDC in Vehicle • 110-230 VAC classroom/workshop

The carrying box should fulfill at least the following requirements:

Tab. 0.2: Requirements for Carrying Box for Measurement Instruments

No.	Requirement
1	Lockable, sturdy universal carrying case
2	Padded with a 1 cm thick foam
3	6 cm thick, removable, customizable foam cube layer
4	Double notch in the closing edge for protection against dust or rain

The Separate telescopic trolley is used for easy transportation of the case and should fulfill the following requirements:

Tab. 0.3: Requirements for the Telescopic Trolley

No.	Requirement
1	Dimensions: 380 – 960 mm
2	50 mm wheels – ball bearing
3	Removable, the case can be positioned on a table without the handle.
4	5.5 mm mounting holes
5	Material Aluminum
6	Weight: 1 kg

The following figures give illustrate the requirements above and give an idea of the outline and dimensional details of the box/trolley case:

Fig. 0.1: Example for trolley box and details

General Layout of the Telematics Box

The following figure illustrates the general layout of the telematics box and its operation modes (simulation and real car application).

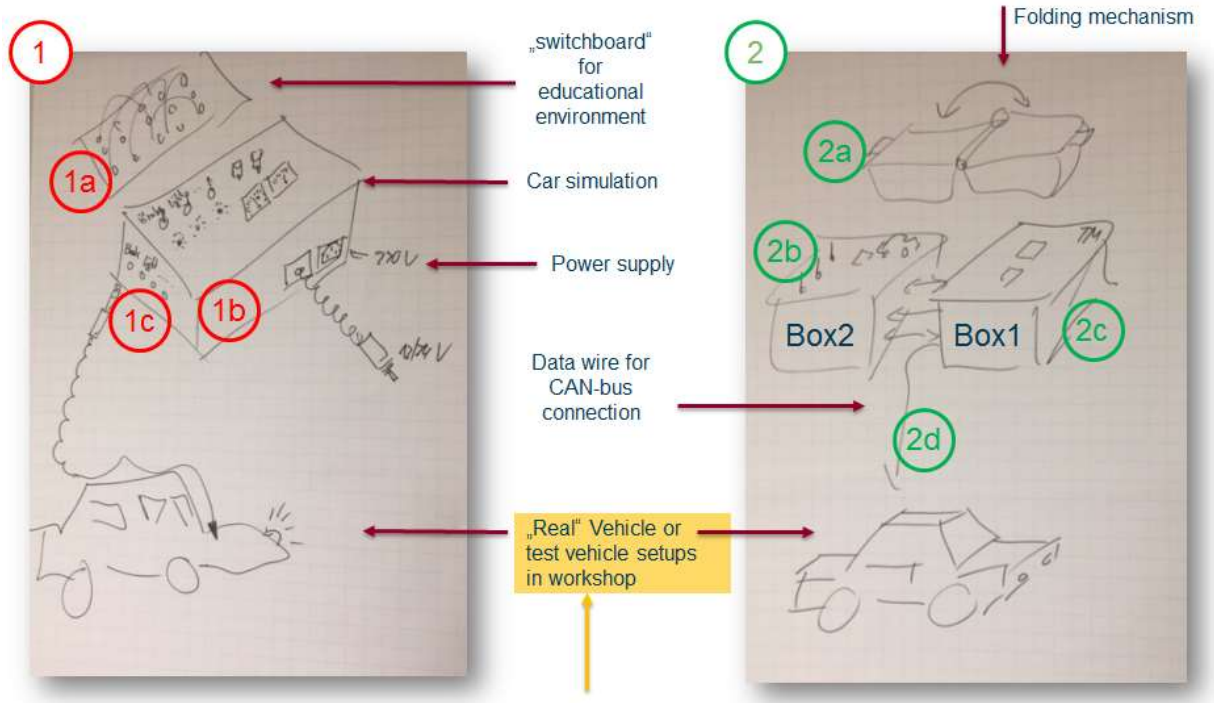

Fig. 0.2: General Layout of the Telematics Box

The following table summarizes the elementary parts of the telematics box.

Tab. 0.4: Elementary Parts oft he Telematics Box

No.	Description
1	Usage of telematics box using real vehicle or both simulated and real vehicle w/o field bus connection
1a	Switchbox: Breakout panels at Box 1 and 2 to interconnect Telematics Box (Box 1) and Car-Sim box (Box 2) / Example: 4-mm plugs and sockets
1b	Signal Simulator (Car-Sim Box 2) for defining simulated signals. Sockets for real vehicle signals available.
1c	Sockets for real vehicle signals (brake, lights, wipers, etc.) 4 mm connectors
2	Usage of telematic box using real vehicle or both simulated and real vehicle with field bus connection
2a	Folding mechanism: Bottom part and cover are separable. Solution 1: Cover represents Box 1 and bottom part is Box 2 (or vice versa) Solution 2: The case itself is not separable but contains the two separable boxes 1 and 2

2b	Signal Simulator (Car-Sim Box 2) for defining simulated signals. Box 2 is supplied by Box 1 (power supply)
2c	Telematics box (Box 1) containing storage, CAN, OBD, GPS, FM transmitter and breakout panel (for interconnection with Box 2)
2d	Field bus access: Bus data from vehicle (like CAN or OBD) are applied directly to Box 1. Box 1 should provide suitable connectors

The box itself should be foldable. The box is divided into two parts. One part contains the telematic items, the other part contains the simulation accssories (see. **Fehler! Verweisquelle konnte nicht gefunden werden.**)

Fig. 0.3: Telematics Box Unfolded (Left) and Folded (Right)

The following requirements are defined fort he partition layout:

Tab. 0.5: Requirements for the Partition Layout

No.	Requirement
1	BOX 1 serves as the telematics container and provides • power supply, • FM-Box • CAN-Box • LED-Indicators, and • external connectors
2	BOX 2 serves as car simulator containing • switches, • controls, • LED-Indicators, • external connectors, • OBD-II Simulator, and • wiring options for educational purpose
3	In unfolded state both parts can be completely disconnected. For use in vehicle only BOX1 is needed
4	In folded state both parts are joint for transport purposes

Hardware

The hardware provides all necessary interfaces for simulation and in-vehicle-use. The following figures **Fehler! Verweisquelle konnte nicht gefunden werden.** to **Fehler! Verweisquelle konnte nicht gefunden werden.** give an overview of the hardware sturucture of the system.

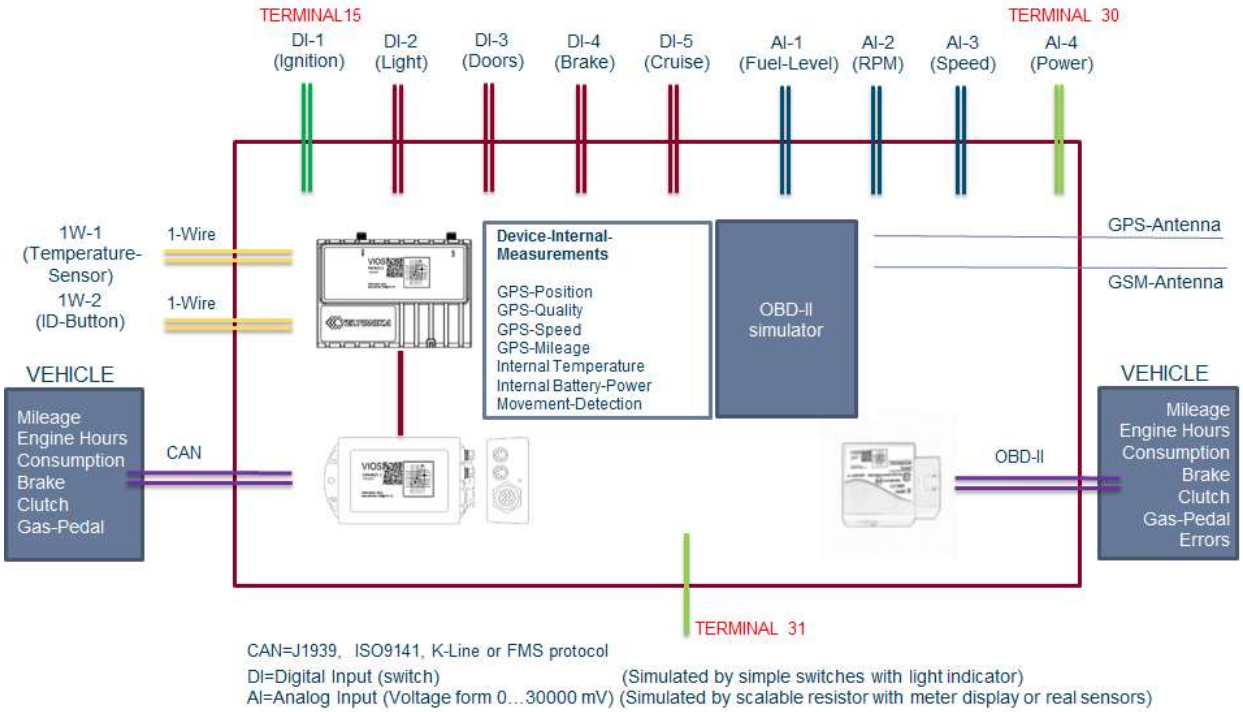

Fig. 0.4: Technical Overview and Components

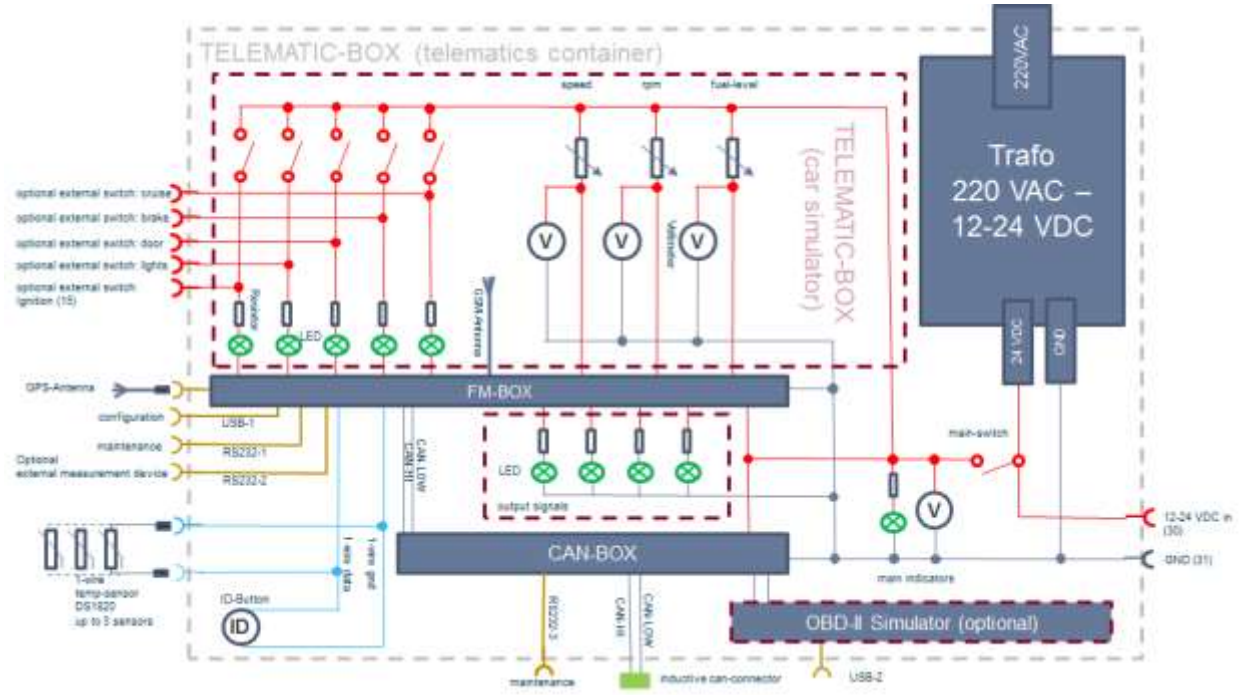

Fig. 0.5: Schematic Wiring, Switchboard and External Connectors

It should be stated out here clearly, that both diagrams combine elements of the Telematics Box (Box 1) and the Simulation Box (Box 2).

For the used components the following requirements should hold:

Tab. 0.6: Layout Requirements

No.	Requirement
1	The components should be integrated into box/trolley
2	The Switchboard should be equipped with • controls (to visualise measurements and dash displays), • switches (to simulate vehicle operations), • plugs and sockets for box setup (educational environment), and • LED indicators for operational control
3	There should be a holder for FM-Box and other parts
4	There should be a mount for antennas
5	There should be sufficient storage room for needed external cables and adapters
6	The following sockets for external wiring should be available • power supply (110-230 VAC/12-24 VDC) • switch connectors • CAN connector • RS232 connectors • USB connectors

For interfaces and functions the hardware is required to comply with the following requirements:

Tab. 0.7: Requirements for Interfaces and Functions

No.	Requirement
1	One USB interface (USB-1) should be used for maintenance of FM-BOX (not for end-user)
2	One USB interface (USB-2) should be used for maintenance of OBD-II-Simulator (not for end-user)
3	One RS232 interface (RS232-1) should be used for maintenance of FM-BOX (not for end-user)
4	One RS232 interface (RS232-2) should be used for maintenance of CAN-BOX (not for end-user)
5	One RS232 interface (RS232-3) should be used for optional connection of external measurement devices/future extensions)
6	A 1-wire-bus interface should be used for connecting up to 3 separate temperature sensors which can be applied to • ambient temperature • coolant temperature • battery temperature

7	A CAN interface (CAN-click) is used with inductive connector to CAN-HI/CAN-LO connection in vehicle
8	Digital input interfaces (DIN 1-5) are used for external connection to digital inputs (work in parallel to internal switches)
9	A GPS antenna (GPS-Ant) is used for external connection for GPS-Antenna
10	A 12 VDC in socket is used for external connection to power supply from vehicle (ex.: via car cigar lighter socket)

For analogue and digital input signals the box provides the following interfaces which should comply with the following requirements:

Tab. 0.8: Requirements for Signal Inputs

No.	Requirement
1	**Digital Inputs (DI-x)** • The box should provide at least 5 digital inputs: Ignition, light, doors, brake, and cruise-control (simulated by switches in Car-Sim-Box) • Logic states: ≤ 0.8 V: „0“ (Low) ≥ 2.4 V: „1“ (High) • Additional IO-channels could be added when needed by connecting external measurement devices
2	**Analog Inputs (AI-x)** • The box should provide at least 3 analogue inputs: Fuel level, engine speed, and vehicle speed (simulated by scalable resistors in Car-Sim-Box) • Input voltage specification: Range: 0 … 30,000 mV Resolution: 16 bits Sample rate: 1 kHz max
3	**Additional Inputs:** • The box should provide a 1-wire-bus-interface for • 1W1 – Temperature Sensor: DS18x20 (Example: DS18S20) • 1W2 – ID-Button: iButton and iButton-Probe (Example: iButton DS1990 F5 / iButton Probe A-TENA

The following devices with the given features are recommended to be used for the telematics box so that all devices will have to be configured by VIOM prior to assembly in telematics BOX.

Tab. 0.9: Recommended Hardware Device Components

No.	Component
1	**FM-BOX:** Telematics base device incl. GPS positioning and GMS Data-Transfer CAN-Interface, K-Line-Interface, Digital IO, Analog IO, 1-Wire IO • Brand: Teltonika (www.teltonika.lt) • Device: FM6320
2	**OBD-II-Adapter:** Telematics base device incl. GPS positioning and GMS Data-Transfer OBD-II-Interface • Brand: Teltonika (www.teltonika.lt) • Device FM1000
3	**CAN-Adapter**: Interface to Vehicle CAN-Bus, configured for VAG*-Vehicles (Optional configurations for all major vehicle brands are available and can be applied if needed**) • Brand: SQUARELL (www.squarell.com) • Device FELX 12 • * Volkswagen Audi Group (incl. Seat, Skoda, …) ** The required configuration has to be specified prior to assembly in telematics BOX
4	**OBD-II-Simulator**: Programmable simulation*** of vehicle operation and ODB-II error conditions for two ECUs J-1850 PWM, ISO-9141, KWP2000, CAN 11/500, CAN 29/500, CAN 11/250,CAN 29/250 • Brand: DIAMEX (www.diamex.de) • Device: Diamex-OBD-Simulator 7105 *** Preprogrammed for educational use; For reprogramming an external PC is needed

Sample Layout

The following figure illustrates the sample layout of the telematics box (BOX1). This is not a wiring plan.

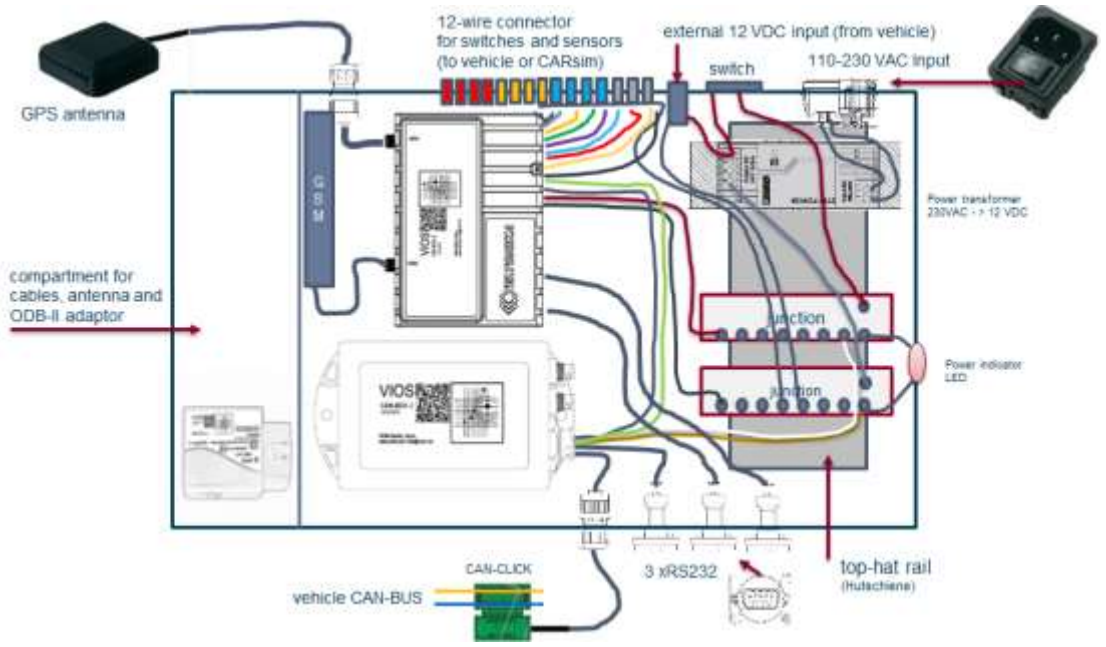

Fig. 0.6: Sample Layout

The following figure illustrates the sample layout of the car simulator (BOX2).

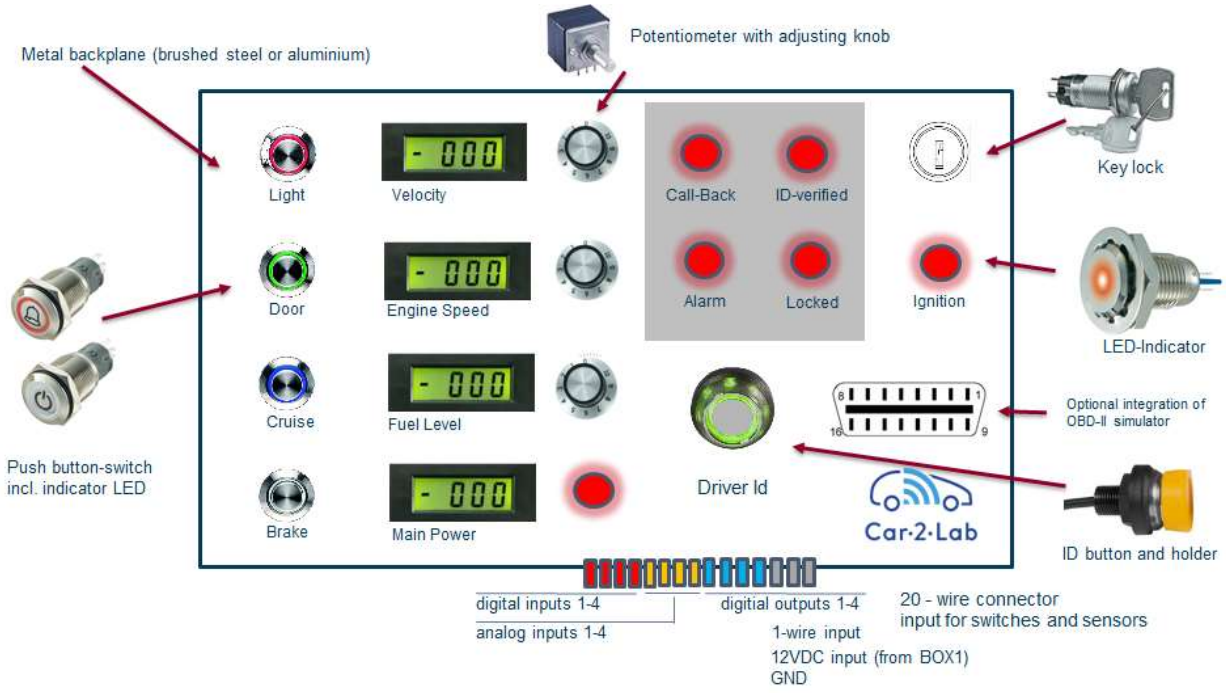

Fig. 0.7: Sample Layout of the Car Simulator

1 University Entrance Qualification

The German/Berlin education system offers three ways to enable VET students to entrance the university. These possibilities are described in §11 of the Berlin Law on Higher Education.

1.1 "Meister" Education

The so called "Meister" degree can be passed after a usually three-year lasting vocational training. The first vocational training is passed with a journey-level status. This education is mostly practical and only basics in theory are imparted.

To gain the "Meister" degree a further vocational training is required with focus on four main items: Technical and practical skills, theoretical skills, business knowledge, and pedagogy.

The grade of the "Meister" is comparable to the Bachelor degree, and enables the students to enter a university and to start with a technically related Bachelor program. Nonetheless it is not possible to apply for a Master program.

1.2 Technical College

The technical college provides a professional education in a more theoretical way. The double qualified education gives the opportunity to get both a vocational training and an entrance qualification for university of applied sciences.

Another way is to visit a sixth form centre that also gives an entrance qualification for universities.

1.3 Professional Qualification

Even the professional qualification enables students with a journey-level status to access a university of applied sciences. An additional requirement is that the bachelor program technically relates to the vocational training and the student shows at least three years of practice. These students have to prove a certain number of successfully passed exams (credit points) during their first two terms.

2 Permeability in the Educational System

A single module (just like telematics) is not sufficient to provide all the basic knowledge necessary to get the university entrance qualification. Nonetheless such kind of modules can help to teach elementary skills like mathematics and physics.

Usually students tend to be successful in their studies if they meet the following requirements:

- They have a deep interest in technology, i.e. mechanics, electrics, electronics, and informatics
- They have mathematical skills
- They have an affinity to physics

These requirements are needed to be able to pass all the modules that are offered in a Bachelor program like automotive engineering. Nonetheless not every module in a Bachelor program requires basic mathematical knowledge.

And here our research project may help to provide additional capacities to vocational students and to gain credit points for a likely further study at a university:

Typically the Bachelor programs in automotive engineering in Germany have election modules in higher terms. These modules usually deal with specific automotive contents giving a broad overview over a certain topic.

Another branch of alternative modules (let us call them training modules with a higher practical relation) can be implemented as an adequate substitute for the standard election modules. This branch may for example consist of

- Basics in Telematics
- High Voltage Training in Vehicles
- Engine Diagnostics
- …

If theses training modules are offered in cooperation with vocational education institutes and universities both vocational and higher education students can attend these courses. They can gain credit points, and especially vocational students get the chance to get in contact with universities and HE students in advance.

If the vocational student continues its education on a university these courses (assumed that they are successfully passed) are fully eligible as election modules. Ideally all universities in Germany (e.g. all Bachelor programs in automotive engineering) offer such kind of alternative branch.

The benefit for the students is also that they may need to spend less time at the universities as they passed these courses already before having begun with their studies.

3 Cooperation HE-VET

It is highly recommended that both universities and vocational schools cooperate offering additional training courses for vocational students. Cooperation between universities and vocational schools (in the following called "partners") can be established in these issues:

3.1 Course Definition

As a result of this project it could be seen that the learning units for the telematics module for the vocational and the university students are quite comparable. The partners can work together on different curriculums for different applications (e.g. telematics, or alternative drives) with a high practical part.

3.2 Laboratories

The partners have different kinds of laboratory equipment: At the university the more theoretical/programming/software parts can be handled whereas at the vocational schools the hands-on practice can be performed.

3.3 Virtual Classrooms

On many even theoretical parts can be worked on in virtual classrooms. Both pure theory and also theoretical project development in work groups can be done in a virtual classroom. Furthermore e.g. for the telematics unit an evaluation of measurements data takes a certain capacity of the course. This also can be done in a virtual way with data evaluation software.

3.4 Course Timing

Both university and vocational students and teachers as well just have room for working on additional topics after their obligatory training. Thus it is recommended that these additional modules are performed in the afternoon/evening or at weekends.

Project partnership

Germany

BGZ Berliner Gesellschaft für internationale Zusammenarbeit mbH
Pohlstraße 67
DE – 10785 Berlin
Telefon: +49 (30) 80 99 41 11
Telefax: +49 (30) 80 99 41 20
info@bgz-berlin.de
www.bgz-berlin.de
www.car2lab.eu

www.kfz-innung-berlin.de www.htw-berlin.de www.viom.de

Denmark

www.aarhustech.dk www.teknologisk.dk

Italy

www.confartigianatovicenza.it www.sangaetano.org

Poland

www.mechatronika.pl www.samochodowka.edu.pl