

TENDER DOCUMENTATION TO PUBLIC CONTRACT COMMISSIONED IN COMPLIANCE WITH ACT NO. 137/2006 COLL., ON PUBLIC CONTRACTS, AS AMENDED (HEREINAFTER REFERRED TO AS “APC”)

PUBLIC CONTRACT TITLE

Public contract title:	VR 67B:Purchase of Driving Simulator for Transport R&D Centre
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REQUIREMENTS FOR TECHNICAL SPECIFICATIONS OF DRIVING SIMULATOR OF TRUCK AND BUS

CONTRACTING AUTHORITY IDENTIFICATION DATA

Trade name or title / trade name or name and surname:	Centrum dopravního výzkumu, v. v. i.
Registered Office / Seat / permanent address of individual (or forwarding address):	Líšeňská 2657/33a, 636 00 Brno - Líšeň
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General information

Introduction

This document specifies requirements on technical equipment to be procured by CDV.

The basic function of the delivered equipment is the Truck driving simulator with the potential modification to Bus driving simulator. CDV is going to use the simulator for **research and development** purposes, e.g. in the field of drivers' distraction and their mental stress, when performing secondary activities while driving. The device will also be used for **education and training** purposes. Last but not least, the simulator technology is to be used in **commercial** domain, e.g. potential cooperation in the automotive industry for designing and testing of driver's assistance systems. The delivered equipment will be installed at CDV workplace.

Any deviations from the requirements in this specification must be stated clearly in the tenderer's quotation.

Definitions and abbreviations

The following definitions and abbreviations are used in this document:

Term	Description
ABS	Anti-lock braking system
EEG	Electroencephalography
EMG	Electromyography
ESC	Electronic Stability Control
FOV	Field Of View
GSR	Galvanic Skin Response
HMI	Human Machine Interaction
ms	milliseconds
μ	coefficient of friction between tyre and road
SDDRM	System Development Design Review Meeting
TBS	Test Before Shipment
TN-S	Cable with separate neutral and ground conductor
UPS	Uninterrupted Power Supply
SIM	Simulator

Notes on requirements:

[only applicable for Truck SIM] – requirement is only applicable to truck simulator (Truck)

[only applicable for Bus SIM] – requirement is only applicable to bus simulator (Bus)

“**MUST**” – this note is mentioned with every requirement which must be fulfilled by tenderer

“**SHOULD**” – this note is mentioned with every requirement which does not have to be unconditionally fulfilled, but it improves the comfort and quality of the use of the simulator for the needs of CDV, and therefore, the number and solution of requirements “**SHOULD**” shall be taken into account when awarding the tender.

Scope of work

- Delivery of a fully operational driving simulator according to technical specification parameters, including equipment to log data from experiments.
- Installation of all delivered equipment at CDV premises
- Transportation, loading and unloading to the CDV site, including crating.
- Training of operating and maintenance personnel in the scope required for the operation and maintenance of simulator
 - servicing, maintenance, spare parts delivery and other services specified in the contract
 - delivery must include operating manuals from mechanical and electrical viewpoint, and a list of recommended spare parts. All documentation must be delivered in two (2) paper copies. The documentation must also be delivered in electronic form.

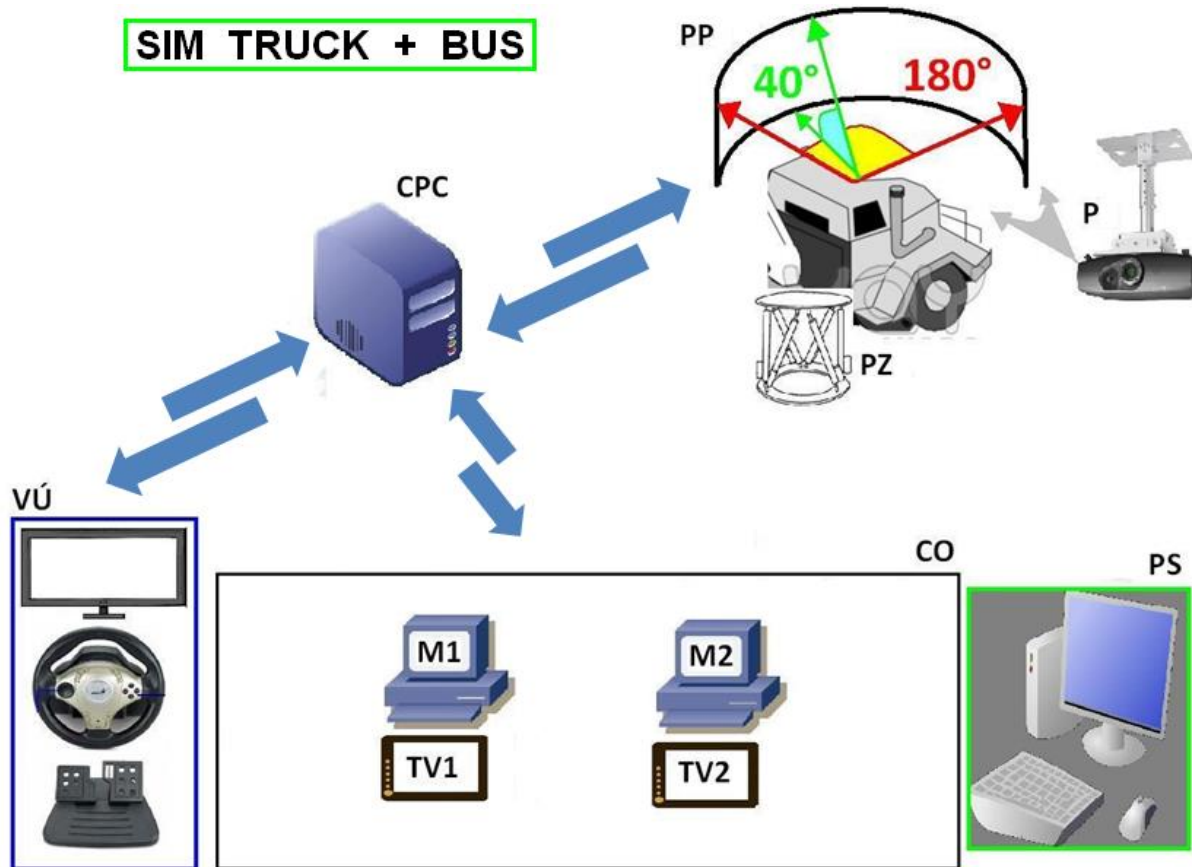
Items not included in the supplier’s Scope of work

The following equipment and services will be supplied by CDV:

- Electrical power supply, three phase 400V, 50 Hz, TN-S and single phase 230V, 50 Hz.
- Ventilation
- Installation of cable ducts forming part of the building structure
- Safety system to assure unauthorised personnel does not enters the facility during operation

Simulator specification

Model scheme of simulator environment



SIM laboratory shall contain **1 moving base** specified below in the requirements

SIM TRUCK+BUS – cabin of vehicle Truck and Bus, which is placed at the moving base platform (PZ), a truck cabin with potential modification to bus cabin is placed at this platform

PP – Projection system of virtual traffic environment of Truck and Bus

PZ – Moving base of Truck and Bus (3 or 6 degrees of freedom)

CPC – Central system of PC stations which control all simulator functions

P – System of projectors displaying a traffic situation of Truck and Bus

VÚ – Virtual user who participates in a traffic situation in the interaction with the simulator driver. The virtual user has a steering wheel, pedals, and a screen with a simulator traffic situation available, therefore becoming a road user.

CO – Operator's centre, a workstation with the use of which the operator communicates with simulator drivers. The operator has available the current traffic situation from driver's point of view (system of monitors designated as M1), maps and other relevant data on the traffic environment of a current situation (system of monitors designated as M2). In addition, the operator verbally

communicates with a driver and has available two broadcasts from driver's cabin. At the screen (TV1) the operator can see the situation from a camera pointed at the driver, and at the screen (TV2) the operator can see the situation from a camera recording the situation in front of the driver

PS – Workstation, workstation for production and adjustment of terrains (CO workstation can be used for this purpose)

Basic components of simulator environment

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>Requirement CDV 1: "MUST"</p> <p>SIM laboratory must contain:</p> <p>SIM TRUCK+BUS – simulator of vehicles Truck and Bus which are placed at a moving base (PZ)</p>		
<p>Requirement CDV 2: "MUST"</p> <p>SIM laboratory must contain:</p> <p>PP – Projection system of virtual traffic environment of vehicles Truck a Bus with the parameters of simulated view of 180° x 40° (horizontally x vertically).</p> <p>Vertical angle of display must be maintained by the technical display tools of the display system, i.e. in the stable position of the cabin without vehicle inclination and displacement of driver's view against horizontal level.</p>		
<p>Requirement CDV 3: "MUST"</p> <p>SIM laboratory must contain:</p> <p>PZ – Moving base of vehicles Truck and Bus (3 or 6 degrees of freedom) see Chapter "Moving base"</p>		
<p>Requirement CDV 4: "MUST"</p> <p>SIM laboratory must contain:</p> <p>CPC – Central system of PC stations which control all simulator functions</p>		

<p>Requirement CDV 5: “MUST”</p> <p>SIM laboratory must contain:</p> <p>P – Projection system displaying a traffic situation of vehicles Truck and Bus</p> <p>Possible alternatives:</p> <ul style="list-style-type: none"> • front/rear projection on cylindrical curved wall • front/rear projection to flat segments of projection screen • rear projection to projection screens, installed on the windscreen, right and left side windows 		
<p>Requirement CDV 6: “MUST”</p> <p>SIM laboratory must contain:</p> <p>VÚ – Virtual user who participates in a traffic situation in the interaction with the simulator driver. The virtual user has a steering wheel, pedals, and a screen with a simulator traffic situation available, therefore becoming a road user.</p>		
<p>Requirement CDV 7: “MUST”</p> <p>SIM laboratory must contain:</p> <p>CO – Operator’s centre, a workstation with the use of which the operator communicates with simulator drivers. The operator has available the current traffic situation from driver’s point of view (system of monitors designated as M1), maps and other relevant data on the traffic environment of a current situation (system of monitors designated as M2). In addition, the operator verbally communicates with a driver and has available two broadcasts from driver’s cabin. At the screen (TV1) the operator can see the situation from a camera pointed at the driver, and at the screen (TV2) the operator can see the situation</p>		

<p>from a camera recording the situation in front of the driver.</p> <p>Note: all furniture (tables, chairs, drawers, cabinets, etc.) necessary to furnish Operator’s Centre is not a part of the requirements and shall be provided by Contracting Authority (CDV).</p>		
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Operator’s workplace (CO – Operator’s centre)

Requirement	Fulfil Yes/No	Tenderer’s answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>Requirement CDV 8: “MUST”</p> <p>must include a workstation for the creation of scenarios PS (Workstation)</p>		
<p>Requirement CDV 9: “MUST”</p> <p>must contain training control (at least start, stop, replay, moving base blocking); operator must be able to see currently progressing scenes from driver’s view and from virtual cameras, which allow to observe vehicle in the context of current traffic environment</p>		
<p>Requirement CDV 10: “MUST”</p> <p>must contain a recording of the whole practice (recording of a driver in the cabin, logging of control components status). It must be possible for instructor to play the current ride scenario immediately after its end with an option to replay the ride and corresponding variables (speed, ride trajectory, changing gears, pedals, etc.). It must also be possible to change angles of view of the played scene. The instructor will have the complex data of the recorded scene available.</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>Requirement CDV 12: “MUST”</p> <p>must contain the evaluation of relevant physical variables describing vehicle behaviour while driving, corresponding with the behaviour of a given vehicle in the real traffic environment. The recorded data must allow to evaluate the style and characteristics of driving in the context of the traffic environment the vehicle moves in. They concern at least:</p> <ul style="list-style-type: none"> • Vehicle trajectory • Vehicle speed • Vehicle acceleration • Vehicle deceleration • Critical events (skid, collision, leaving the road, etc.) • Critical manoeuvres (hazardous overtaking, driving through hazardous road segments in improper speed, etc.) • Other relevant variables 		
<p>Requirement CDV 13: “MUST”</p> <p>must contain a workstation for production and adjustment of terrains</p> <p>see PS – Workstation, workstation for production and adjustment of terrains</p>		
<p>Requirement CDV 14: “MUST”</p> <p>colour printer intended for printing output data of simulator experiments and other related information, at least A4</p>		

Function and operation

Software, Scenarios

The facility should be delivered with some predefined environments and scenarios. It shall be possible for CDV to design custom scenarios and road environments. Necessary tools for this shall be included in the delivery. A description of work process and support agreement of how to handle development/support of new scenarios for CDV shall be included in the offer.

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>Requirement CDV 15: "MUST"</p> <p>must include at least 100 km of motorway database, which must contain road connections to motorway – at least 10 slip roads for exit and 10 ramps for entry motorway. All road signs and road marking must be applicable and valid in the Czech Republic.</p>		
<p>Requirement CDV 16: "MUST"</p> <p>must include at least 50 km of road database (excluding motorways) of different speed limits and road segments through urban areas. All road signs and road marking must be applicable and valid in the Czech Republic.</p>		
<p>Requirement CDV 17: "MUST"</p> <p>must include at least 10 km of virtual terrain database in urban area, including one-way roads, roundabouts, different types of pedestrian crossings, level crossings. All road signs and road marking must be applicable and valid in the Czech Republic.</p>		
<p>Requirement CDV 18: "MUST"</p> <p>The library for the preparation of a scenario must contain be at least 50 different moving vehicles, pedestrians, animals (3d models); 20 pedestrians (men, women, children), 5 animals (cat, dog, roe deer,), 20 passenger vehicles, 5 trucks, 5 coaches, 5</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>motorcycles, 5 cyclists,</p> <p>[5 police vehicles, 5 ambulance vehicles, 5 fire brigade vehicles, 5 trams, 5 city buses] => vehicles for the Czech Republic</p> <p>Furthermore, the database must contain at least 150 static models, e.g. vegetation, dustbins, poles, containers, road signs, buildings and other relevant structures typical to the real environment.</p>		
<p>Requirement CDV 19: "MUST"</p> <p>during runtime, the simulator control system must be able to generate at least 100 models – road users (controlled subjects), such as pedestrians, vehicles, etc. These models move automatically.</p>		
<p>Requirement CDV 20: "MUST"</p> <p>must allow for setting of different weather types, at least: fog, rain, snow, rain intensity, speed and direction of wind.</p>		
<p>Requirement CDV 21: "MUST"</p> <p>a scenario of driving in rainy conditions should be included. This includes changes in Computer graphics, vehicle dynamics, sound, haptic feedback, and relevant reception modalities.</p>		
<p>Requirement CDV 22: "MUST"</p> <p>a scenario of driving in snow conditions (road covered by snow, plus snowing) must be included. This includes changes in computer graphics, vehicle dynamics, sound, haptic feedback, and relevant reception modalities.</p>		
<p>Requirement CDV 23: "MUST"</p> <p>a scenario driving on icy conditions must be</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
included. This includes changes in computer graphics, vehicle dynamics, sound, haptic feedback, and relevant reception modalities.		
Requirement CDV 24: "MUST" a scenario of driving in wet road conditions must be included. This includes changes in computer graphics, vehicle dynamics, sound, haptic feedback, and relevant reception modalities.		
Requirement CDV 25: "MUST" a scenario of driving with strong side wind must be included. This includes changes in computer graphics, vehicle dynamics, sound, haptic feedback, and relevant reception modalities.		
Requirement CDV 26: "MUST" a scenario with a sudden tyre blow-out must be included. This includes changes in computer graphics, vehicle dynamics, sound, haptic feedback, and relevant reception modalities		
Requirement CDV 27: "MUST" a scenario with a sudden side impact must be included. This includes changes in computer graphics, vehicle dynamics, sound, haptic feedback, and relevant reception modalities.		
Requirement CDV 28: "MUST" activation of hazardous scenarios (e.g. puncture, fire in the engine, etc.) must be possible to be programmed in advance, randomly generated and started up directly from operator's user interface. These hazardous scenarios could be created in the scenario editor or by another way in the		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>user interface.</p> <p>Two basic scenarios must be supplied:</p> <ol style="list-style-type: none"> 1. hazardous behaviour of pedestrians on road. 2. hazardous behaviour of vehicles on road. 		
<p>Requirement CDV 29: "MUST"</p> <p>it must be possible to simulate poor visibility conditions, including driving at night.</p>		
<p>Requirement CDV 31: "MUST"</p> <p><i>[only applicable for Truck SIM]</i></p> <p>visualisation of fixed- and articulated trailer in the visual system must be included</p>		
<p>Requirement CDV 32: "MUST"</p> <p>simulation of high and low beam from the own vehicle should be included</p>		
<p>Requirement CDV 33: "MUST"</p> <p>it must be possible to replace road signs (at least add, remove and move, select from road database) on an existing road</p>		
<p>Requirement CDV 34: "MUST"</p> <p>it must be possible to modify billboards (at least content, add, remove and move) on an existing road.</p>		
<p>Requirement CDV 35: "MUST"</p> <p>must include so-called variable road signs and traffic information signstraffic signals, level crossing traffic signals</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>Requirement CDV 36: “MUST”</p> <p>the simulator software must include the possibility to use autonomous traffic, i.e. the behaviour does not have to be specified by scenario programming software and also must allow manually adjustable traffic in the so-called scenario editor</p>		
<p>Requirement CDV 37: “MUST”</p> <p>it must be possible to choose density and composition of the autonomous traffic.</p>		
<p>Requirement CDV 38: “MUST”</p> <p>It should be possible to generate random scenarios by selecting some predefined events to be executed during autonomous traffic while driving.</p>		
<p>Requirement CDV 40: “MUST”</p> <p>In order to create a 3D situation, it must be possible to use a standard format, e.g. “OpenFlight” or some of formats supported by “3D studio Max”</p>		
<p>Requirement CDV 41: “SHOULD”</p> <p>In order to support automatic traffic, it should be possible to use “OpenDrive format” as the input data</p>		
<p>Requirement CDV 42: “MUST”</p> <p>must include a terrain database designed for creating any road network including the below mentioned modules (components) or it must be possible to create these modules (components) and integrate them into the road network through a graphic user's interface. The graphic user's interface shall be controlled by a keyboard and a mouse.</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>REQUIRED MODULES (COMPONENTS):</p> <p>At-grade junctions: (see Annex P1)</p> <p>Types:</p> <p>without signed right of way with signed right of way signalled</p> <ul style="list-style-type: none"> • X-junction • T-junction • Y-junction • Staggered junction • Multi-leg junction • Roundabout <p>According to location:</p> <ul style="list-style-type: none"> • with a traffic island on a minor road • with a left turning lane • with a right turning lane • with a merging lane • with a central island <p>Grade separated junctions: (see Annex P1)</p> <ul style="list-style-type: none"> • cross-over points <ul style="list-style-type: none"> ○ diamond (more information) ○ Four-leg Interchange – ramps in one quadrant ○ four ramp partial cloverleaf (more information) ○ folded diamond (more information) • with weaving segments <ul style="list-style-type: none"> ○ half-clover 		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<ul style="list-style-type: none"> ○ cloverleaf (more information) ○ Partial cloverleaf (more information) ○ roundabout ● without weaving segments <ul style="list-style-type: none"> ○ trumpet (more information) ● directional interchange (obrázek) <ul style="list-style-type: none"> ○ semi-directional T ○ windmill ○ three-level turbine ○ four-level stack 		
<p>Requirement CDV 43: “SHOULD”</p> <p>Modification of basic terrain formations</p> <ul style="list-style-type: none"> ● straight ● convex ● concave <p>possible definition of angles of road terrain gradient and other basic variables describing traffic topography</p>		

Data

Simulation data shall be logged to a file. The file shall include metadata specified below. Supplier shall describe the general process from raw data to processed data in the offer to CDV. Metadata shall be included, i.e. project name, test stand name, date and time, comment. It should be possible to define which data should be logged.

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>Requirement CDV 44: “MUST”</p> <p>It must be possible to log data from the simulated environment; all data must be logged time synchronous. All events in the data recording must be possible to logged at at least 30 Hz. The collected</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
data need to be in such format to be easily exportable into some of commonly used software (e.g. Excel and MatLab)		

Graphic system

The graphics system comprises software for image generation and hardware for displaying the image. It should provide a realistic view of the surrounding environment to the driver. The graphic system is expected to include high quality computer graphics of the environment and other actors.

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
Requirement CDV 45: "MUST" the visualization must include internal rear-view mirror (for BUS), two separate left side mirrors on the left side and two separate right side mirrors on the right side.		
Requirement CDV 46: "MUST" Graphic system must include a set of graphic generators including SW, in case of a projection on a "curved wall", it must support the functions of picture non-linear deformation and perfect connection of images from neighbouring projectors		
Requirement CDV 47: "MUST" the update frequency of the image should be at least 60 Hz.		
Requirement CDV 48: "MUST" the resolution in front of the drivers face must be 0.5 pixels/arc minute or higher		
Requirement CDV 49: "MUST" Road signs and road equipment must be		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>of a sufficient contrast and resolution, so that they could be readable for at least 5 seconds, when a driver drives past respecting the speed limit for a given road. For example, at daylight under clear visibility conditions, the following apply:</p> <ul style="list-style-type: none"> • on roads with speed limit 50 km / h (= 13.9 m / s) roads signs must be readable from the distance of at least $5 \times 13.9 = 69.5$ m • on roads with speed limit 130 km / h (= 36.1 m / s) roads signs must be readable from the distance of at least $5 \times 36.1 = 180.5$ metres 		
<p>Requirement CDV 50: “MUST”</p> <p>maximum latency of the visual system must be below 50 ms.</p>		
<p>Requirement CDV 51: “MUST”</p> <p>[only applicable for Bus SIM]</p> <p>the internal rear-view mirror must be possible to adequately display video sequences recorded by a video camera in the real time from the rear parts of vehicle interiors</p>		
<p>Requirement CDV 52: “MUST”</p> <p>the visualisation of a navigation system, and voice navigation must be included</p>		
<p>Requirement CDV 54: “SHOULD”</p> <p>the visualisation of ice on the windscreen should be included.</p>		

Audio

The simulator's audio system should provide the driver with a realistic sensation of the sound of the own vehicle (road, engine and wind). It should also provide the sound of surrounding vehicles and internal and external warning sounds and other effects. The system should be able to provide directional sound e.g. like in 5.1 sound systems

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
Requirement CDV 55: "MUST" the sound software must produce sound of the own vehicles road, engine and wind noise.		
Requirement CDV 56: "MUST" the sound software must produce directional sound coming from surrounding vehicles.		
Requirement CDV 57: "MUST" the sound software must be able to replay warning signals and other sounds added by the user.		
Requirement CDV 58: "MUST" the sound hardware must be able to replay directional sound.		

Vehicle dynamics

The vehicle dynamical model describes how the vehicle itself behaves based on the inputs from the driver and the surrounding.

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
Requirement CDV 59: "MUST" must include a dynamic model of truck and bus while allowing the setting of basic parameters, such as tyre pressure, loading of vehicle by passengers or goods, acceleration, braking, running		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>resistances, dry cargo, liquid cargo etc.</p> <p>The offer of specific vehicle types – truck and bus – will be marked by tenderer in the box “comments – tenderer’s answers” including the reasons why these vehicle types are selected.</p>		
<p>Requirement CDV 60: “MUST”</p> <p><i>[only applicable for Truck SIM]</i></p> <p>A vehicle dynamic model of an articulated HGV (truck-semitrailer) and a truck with a tank container must be included.</p>		
<p>Requirement CDV 61: “MUST”</p> <p>the provided vehicle dynamics model must be able to simulate the skidding of one or several wheels</p>		
<p>Requirement CDV 62: “MUST”</p> <p>in the provided vehicle dynamics model it must be possible to change the μ-value, to simulate different levels of adhesion between road and tyre.</p>		
<p>Requirement CDV 63: “MUST”</p> <p>the provided vehicle dynamics model must be able to simulate different levels of tyre pressure, while it must be adjustable</p>		
<p>Requirement CDV 64: “MUST”</p> <p>the provided vehicle dynamics model must provide data on the cab inclination when cornering, braking and accelerating and other specific variables defining behaviour of a given type of a vehicle in the real environment.</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
Requirement CDV 65: "MUST" the provided vehicle dynamics model must take road unevenness as an input and be affected by it.		
Requirement CDV 66: "MUST" in the provided vehicle dynamics model it must be possible to change between manual and automatic transmission.		
Requirement CDV 67: "MUST" the provided vehicle dynamics model must include ABS and ESC functions.		
Requirement CDV 68: "MUST" an interface must be available to integrate another vehicle dynamic model into the simulator environment.		

Moving base

The simulator should include a motion system. The motion system will be used to actuate the truck (bus) cabin. The moving base is used to generate motion cues that give that driver a sensation of lateral and longitudinal jerks and accelerations and road unevenness.

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
Requirement CDV 69: "MUST" The moving base must be activated on the basis of electric actuators		
Requirement CDV 70: "MUST" The moving base must allow movement in at least 3 degrees of freedom and must comply with the		

Requirement	Fulfils Yes/No	Tenderer’s answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>following criteria:</p> <ul style="list-style-type: none"> · base movement: <ul style="list-style-type: none"> o Rotation around axis X ± 15 degrees o Rotation around axis Y ± 15 degrees · moving base acceleration: <ul style="list-style-type: none"> o Rotation around axis X 200 degrees / s² o Rotation around axis Y 200 degrees / s² 		
<p>Requirement CDV 71: “SHOULD”</p> <p>The moving base should allow, alternatively to requirement 70, movement in 6 degrees of freedom and must comply with the following criteria:</p> <ul style="list-style-type: none"> · base movement: <ul style="list-style-type: none"> o Rotation around axis X ± 8degrees o Rotation around axis Y ± 8 degrees o Rotation around axis Z ± 8 degrees · moving base acceleration: <ul style="list-style-type: none"> o Rotation around axis X 200 degrees / s² o Rotation around axis Y 200 degrees / s² o Rotation around axis Z 200 degrees / s² 		
<p>Requirement CDV 72: “MUST”</p> <p>The moving base must be able to carry extra 200 kg more than the minimum load necessary for the operation of the fully equipped cabin.</p>		
<p>Requirement CDV 74: “SHOULD”</p> <p>Acceleration noise transient peak values for the linear degrees of freedom should be lower than $0.2 [m/s^2]$ for the given payload. Using a 0.5 Hz sinusoidal signal with amplitudes within the allowed operational space - actual acceleration of the moving base may never deviate more than $0.2 [m/s^2]$ from the commanded</p>		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
value during a transient manoeuvre.		
<p>Requirement CDV 75: "MUST"</p> <p>The simulation must be able to create a sufficient motion, auditive, and visual effect in the moving base at a head-on collision.</p> <p>The requirements defines that these audio-visual motion feedback must be as real as possible even under a head-on collision of the vehicle with a stationary or moving object, and in the scene in progress may not be a situation when the vehicle "gets stuck" (software and hardware stops) without appropriate audio-visual motion impression immediately after the collision.</p>		

Driver's environment/cabin

Driving simulator must be designed so that the simulator sickness is eliminated in the maximum degree. The driver's environment should be designed to give a realistic impression of driving. The aim is to have a complete heavy vehicle cabin with a possible modification to a cabin of bus (PZ), which would enclose the driver for an immersive feeling. The steering wheel, brake and gas pedal should provide as realistic haptic feed-back as possible.

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
<p>Requirement CDV 76: "MUST"</p> <ul style="list-style-type: none"> • a generic truck cabin modifiable to a bus cabin must be a replica of an original cabin of a selected vehicle containing: <ul style="list-style-type: none"> ○ dashboard with clocks, indicators, switches located as in a real vehicle ○ active steering wheel ○ manual transmission 		

<ul style="list-style-type: none"> ○ automatic transmission ○ pedals ○ driver and front passenger seat ○ communication device ○ cabin sound distribution ○ interface for devices specified in requirements: 90, 91, 92, 93, 94, 95, 96 <p>The offer of specific vehicle types – truck and bus – will be marked by tenderer in the box “comments – tenderer’s answers” including the reasons why these vehicle types are selected.</p>		
<p>Requirement CDV 77: “SHOULD”</p> <ul style="list-style-type: none"> ● truck cabin modifiable to a bus cabin should be alternatively to requirement 76 an original cabin of a selected vehicle containing: <ul style="list-style-type: none"> ○ dashboard with clocks, indicators, switches located as in a real vehicle ○ active steering wheel ○ manual transmission ○ automatic transmission ○ pedals ○ driver and front passenger seat ○ communication device ○ cabin sound distribution ○ interface for devices specified in requirements: 90, 91, 92, 93, 94, 95, 96 <p>The offer of specific vehicle types – truck and bus – will be marked by tenderer in the box “comments – tenderer’s answers” including the reasons why these vehicle types are selected.</p>		
<p>Requirement CDV 78: “MUST”</p> <p>Cabin (original CDV 77 or generic CDV 76) must be generically equipped with a dashboard with clocks, indicators, switches, etc. Speedometer, tachometer and other gauges and indicators of the dashboard will be displayed on an integrated monitor, so that it could be possible to modify them for research purposes. An alternative may be real components on the dashboard, where the dashboard indicators and components are completely identical to the dashboard of a real vehicle and a monitor replacing the real indicators is not used. It is possible to combine the equipment of the dashboard with real as well as generic indicators,</p>		

such as an integrated monitor.		
Requirement CDV 79: “MUST” The cabin (generic and original) must include a passenger seat.		
Requirement CDV 80: “MUST” The cabin (generic and original) must have pedals and gear levers for manual transmission modifiable to automatic transmission		
Requirement CDV 82: “MUST” the position/state of all driver inputs required to drive the vehicle must be available and logged. It concerns recording of activity of all pedals, hand brake, gear changing, indicators low and high beam, wipers activation, horn use, and other relevant controls. Signals must be recorded synchronized with other simulation data.		
Requirement CDV 83: “MUST” The simulator must include a high performance force feedback steering wheel, which uses input from the vehicle dynamics model to reproduce the torque felt by the driver in the steering wheel. The maximum torques of the feed-back motor must be larger than 15 Nm.		
Requirement CDV 84: “MUST” the cabin must include the simulation of seatbelt		
Requirement CDV 87: “MUST” an audio-visual system for the communication between driver and operator must be installed. There must a one-way visual system from driver to operator. Operator must have visual information from two cameras. One records the driver, one records the area in front of the driver. Video		

records must be in some of the standard video formats (.avi or .wmv)		
Requirement CDV 88: “SHOULD” CAN bus line should be used for the communication of all controlling and information elements in the cabin interior. CAN signals from the cabin network should be readable and writeable.		

Physiological measurement and monitoring of driver

The device must contain an interface for the measurement of physiological quantities of driver/test participant. The data from this equipment will be collected synchronized with other recordings from the simulation.

Requirement	Fulfils Yes/No	Tenderer’s answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
Requirement CDV 89: “MUST” it must be possible to synchronise log data from device for physiology measurements (e.g. eye-tracking, EEG, GSR, EMG, EKG etc.) with other signals from the simulator log.		
Requirement CDV 90: “MUST” the facility must include an interface which allows to connect the equipment for eye-tracking		
Requirement CDV 91: “MUST” the facility must include an interface which allows to connect the equipment for pulse measurements (R – R intervals).		
Requirement CDV 92: “MUST” the facility must include an interface which allows to connect the equipment for GSR (galvanic skin response)		

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
measurements.		
Requirement CDV 93: "MUST" the facility must include an interface which allows to connect the equipment EEG (ElectroEncephaloGram) measurements		
Requirement CDV 94: "MUST" the facility must include an interface which allows to connect the equipment for blood pressure measurements.		
Requirement CDV 95: "MUST" the facility must include an interface which allows to connect the equipment for EMG (ElectroMyoGraph) measurements.		
Requirement CDV 96: "MUST" the facility must include an interface which allows to connect the equipment for EKG (Electrocardiogram) measurements.		

Computer system

Computers

- Shall have effective cooling, adjusted to a temperature between 20-26 °C.
- Noise of computers and projectors shall be minimized as much as possible.
- Standard computer components must be used.

Licence

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)

Requirement	Fulfils Yes/No	Tenderer's answer (Tenderer needs to specify clearly how they meet the given requirement, e.g. technical parameters, links to specifications / tests, other possible solutions, etc.)
Requirement CDV 97: "SHOULD" The source code of the simulator software should be made available for CDV.		
Requirement CDV 98: "SHOULD" The source code should have an open license approved by OSI (open source innovative).		

GUI

The GUI language including all error messages must be English.

Technical requirements for maintenance

The following requirements apply for maintenance:

- The supplier must be able to provide a procedure for a complete new installation of the system.
- There must be a backup procedure for each computer in the delivery to perform a backup of the computer configurations and settings.

Documentation

General requirements

The documentation must clearly describe the equipment supporting service and maintenance work. This includes drawings, manuals, spare parts lists, etc.

The system hardware must be described in engineering drawings, service documentation and manuals. Engineering drawings of all the systems are to be supplied. This includes all mechanics drawings with dimensions and component lists, and all electrical documentation, including circuit diagrams down to components.

Training

On-site training must be included for all installed systems. The training shall be available at least for 2 researchers and one operation and maintenance person.

The total extent of the training is divided into the following areas:

- Operator training
- Scenario development

- Maintenance

The training program and training documents shall be delivered 2 weeks prior the beginning of the training.

Service and maintenance

Supplier shall propose a plan for service and maintenance.

Additional information required from tenderer

Tenderer is requested to provide the following additional information:

- Tenderer shall specify the total equipment power consumption during typical operation.
- Machinery emitting more than 70 dBA, if any, must be stated in the tender, together with the estimated noise level 1 m from the equipment.