

VR-Drive

3D Virtual Reality Driver Training Solutions



- Fully Interactive 3D Virtual Reality Software
- Pre-configured and Customizable Scenarios
- Urban & Rural Road Networks
- Full Range of Environmental Effects & Road Surfaces
- Range of 3rd Party Plugin Options
- Range of Static and Motion based Drive Simulators
- Multiple Networked Simulators
- Driver Training & Vehicle Research

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1 Introduction

VR-Drive, FORUM8's Driver Safety Training and Simulation software enables driver training and vehicle research organisations to deliver an extensive programme of approved and custom designed teaching modules compatible with a wide range of drive simulators from entry level, low-cost static systems through to the most advanced motion-based drive platforms capable of incorporating different production vehicles.

Based on FORUM8's multi-award-winning, real-time, interactive 3D VR Driving Simulation and Modeling Software **VR-Design Studio** (aka UC-win/Road), **VR-Drive** creates a fully immersive and highly realistic driving experience for both novice and experienced drivers, operated under safe and controlled classroom and laboratory conditions. VR-Design Studio is one of the world's most functional and flexible modeling and simulation software products that in addition to driver training is used throughout the world by architects, universities and urban planners in the design of new roads, buildings, traffic-planning and cityscapes. It is also used extensively by leading vehicle manufacturers including Toyota, Nissan, Honda, Renault and Denso for research into vehicle dynamics and the development of the latest driverless, V2X and ADAS technologies.

A critical component of many University research projects into distracted driving and other road safety related human factors. FORUM8's technology is being used by customers in the USA, Europe, China, Korea, Australia and the Middle East.

The standard features of VR-Design Studio enable users to learn and test their latest safe driving skills within a fully interactive 3D VR urban or rural environment, on or off road, while reacting to multiple different driving scenarios and emergency events to provide an enhanced and realistic driving experience.

In addition, optional features and 3rd party software plugins can be incorporated into the initial VR Drive system or added when required. Examples include the ability to cluster multiple drive simulators within the same overall network, enabling multiple drivers to interact in real-time within the same road network.



1.1 Pricing

The price for an individual driving simulator system consists of a number of elements, with the total price being dependent upon: the particular hardware simulator, the type of 3D VR driving environment required, the complexity of the various training scenarios and the driver performance reporting systems. Contact brendan@forum.com for an accurate quotation.

2 VR Design Studio - Interactive Simulation & Modeling Software

VR-Design Studio is multi-award-winning driving simulation software, designed and developed by FORUM8 Co Ltd., one of Japan's foremost software engineering companies over the past 33 years. While the hardware platform is the obvious visible element of any driving simulation (DS) system, it is the photo-realistic quality, functionality and flexibility of the software that is the most critical element within any high-quality driving simulation installation.

It is the software that provides the user with the ability to both reproduce the 'real world' driving experience within the confines of a virtual environment, whilst at the same time controlling and reporting on every aspect of the driving experience, safely and cost-effectively, and in a way that is not practical or possible in the real world. VR Drive solutions are used extensively by many emergency services organisation driver training departments including the Taiwanese Central Police University, the main Police Driver Training Centre of Taiwan. It has also recently been certified for use within the Japanese National Driver Training Schools.

Case Study: The Taiwanese Central Police University

The Taiwanese Central Police University has installed of an additional FORUM8 drive simulator at its investigation and training facility located in the city of Taoyuan. The Central Police University is the only educational institute of its type dedicated to training the future leaders of the Taiwan police in the latest "traffic science" with the primary role of maintaining security and traffic safety throughout the country. Students' studies include latest traffic rules, how to treat and investigate accidents, traffic process management, and traffic safety management, with lecturers involved in researching as well as teaching in these fields.

The Taiwan Police have to regularly deal with a number of specific traffic and driver related situations particularly motorcycles frequently changing lanes and drivers of parked cars suddenly opening their doors without considering other road users or pedestrians. The FORUM8 drive simulators enables students to learn how to react to these and other common scenarios without leaving the classroom and under safely controlled conditions.

The addition of the new simulator means that the University now has three of the FORUM8 systems, which are networked together to enable students to train in groups managed from a central control desk.

Associate Professor Pi-Chang Chuang, the director of the Traffic faculty at the University explained the choice of the FORUM8 simulators "we had previously tried other solutions but found that they were like toys and did not give the realistic driving experience we need and the FORUM8 technology could give us."



FORUM8's on-going software development philosophy has two parallel paths.

2.1 Environmental & Lighting Effects

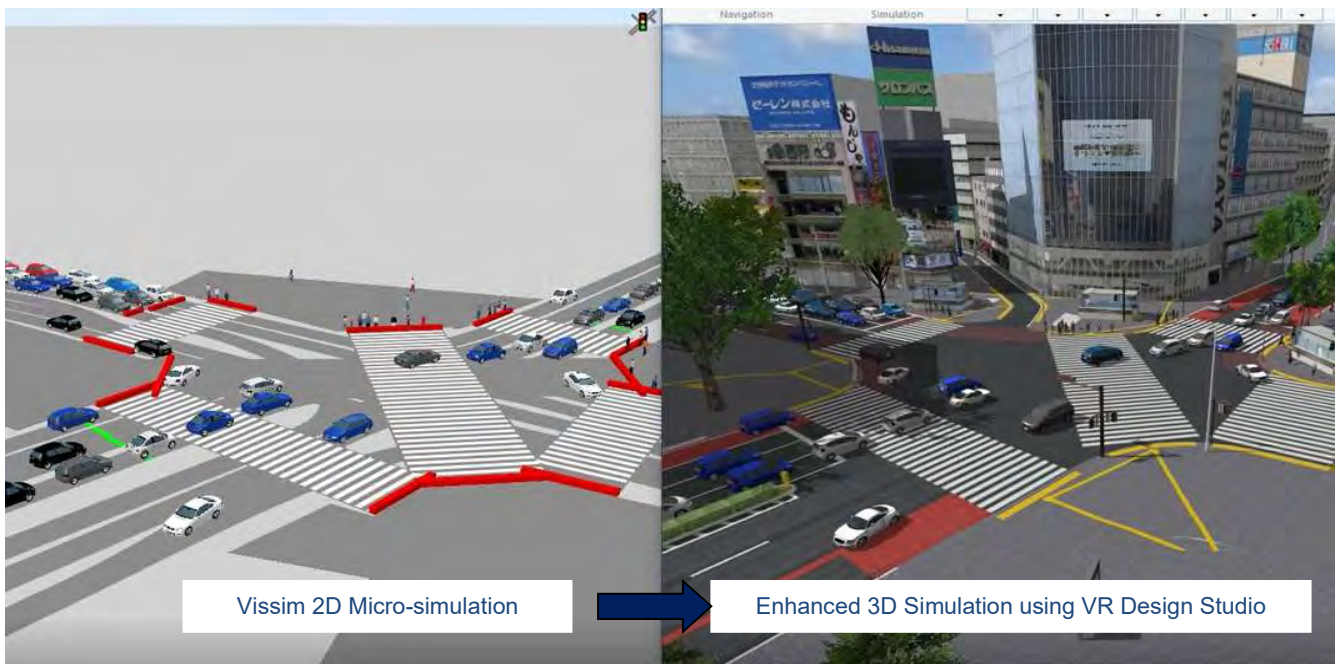
The first is to enable VR-Design Studio to simulate the real world as accurately as technically possible. This includes being able to reproduce and control every conceivable environmental effect from rain, wind, snow etc., including time of day and geographic location. The software also allows the user to depict shadows and lighting in a realistic way, including traffic, buildings and streetlights, as well as the standard vehicle car lights.

Road traffic can be set and managed including vehicle speed, volume and direction, on or off road, plus a scenario editor enables users to perform and analyze an infinite number of what-if driving situations and events. The data log export feature enables the user to design bespoke driver performance reports. Realistic pedestrian movement can also be simulated either individually or in crowds.



2.2 3rd Party Plugins

The second aim of the development team is to enable VR-Design Studio to add and gain value, via software interfaces (plug-ins), to and from 3rd party industry standard software and other data sources. These include head mounted displays (HMD), eye-tracking systems, pedestrian, traffic, & flood modelling software, as well as tsunami, earthquake & emergency evacuation systems. The VR-Design Studio portfolio of plug-ins also enable a range of other data sources such as: photogrammetry, LiDAR and Photo-logs to be utilised in the development of the most highly realistic 3D VR immersive real-world environments possible. In addition, there are software plug-ins available for 2D micro-simulation traffic and pedestrian systems, such as the market leading software PTV VISSIM, enabling users to drive within realistic VISSIM data





VR-Design Studio Software Overview

A comprehensive overview of VR-Design Studio (aka UC-win/Road)'s functionality can be obtained by studying the latest brochure available here: <https://www.dropbox.com/s/8yr51mh9n5rvs0w/V14%20Brochure.pdf?dl=0>

2.3 VR-Drive Simulation Features and Functions

- 3D Photo-Realistic Immersive Driving Simulation (DS), left or right hand
- Control the type of vehicles, volumes, congestion, speed, traffic signals & ITS systems
- Traffic signals can be controlled according to traffic rules which can be pre-set
- Simulate driving on a variety of road surfaces including off-road
- Multiple drivers can interact within the same road network using the multi-user plug-in
- Digital cockpit dashboard including all gauges, mirrors & navigation systems
- 2D horizontal plane views of the vehicle's movement within the road network
- Vehicle control system enables the maintenance of constant distance, acceleration or speed
- Advanced audio using OpenAL provides realistic sounds, tyres, wind, road and tunnel reflections
- Control pedestrian numbers, type and motion
- The Scenario Editor enables multiple driving scenarios to be pre-set or activated remotely
- Waypoints can be pre-set throughout the drive to trigger emergency driving events
- Control vehicle dynamics / physics, noise simulation & force feedback
- Calculate engine transmission, vehicle weight, centre of gravity, tyre friction coefficient and ABS breaking
- Import more comprehensive vehicle dynamics data from specialist 3rd party products like CarSim or CarMaker
- Eco-Drive / Carbon footprint calculations
- Monitor driver performance and produce customized reports by means of the Log-Export module
- Replay the drive through the use of the Replay plug-in, sound and vision
- Hear the sounds from their actual positions within the 3D VR Space
- Maximise the simulation frame rate by clustering multiple PCs within the overall DS system
- Cluster system can transmit camera data from master to client enabling eye direction reporting
- Side mirrors, rear-view mirror and car navigation system displayed in 3D in real-time
- Import real traffic data from PTV VISSIM 2D micro-simulation software and convert to 3D VR
- Interact with the imported VISSIM traffic data as a driver or pedestrian
- Interaction function used in ADAS and Autonomous Driving R&D

Additional customized features can be produced using the Software Development Kit (SDK).



3 VR-Drive 3D Driving Environment

3.1 Standard Features & Functions

- Use the pre-built hypothetical 16km road network including numerous pre-set scenarios
- Alternatively import terrain data, satellite photos, DXF – XML conversion, GIS tiles etc.
- Build real-world or hypothetical 3D photo-realistic rural & urban environments
- Include roundabouts, complex junctions, flyovers, bike lanes, tunnels, bridges, etc.
- Freely insert and delete carriageways, white lines, zebra crossings as required
- 64bit native mode supported enabling road networks of several hundred kilometres
- Generate forests, up to several thousand trees in predetermined locations
- Import 3D models and textures in various formats from the free database of over 8000 items
- Create country specific infrastructure and signage to add to existing FORUM8 database
- Semi-automatic generation of different road textures
- Import commercially available 3D models in FBX, DWG, DXF and 3DS formats
- Import LiDAR point cloud data to help build real-world urban environments and road networks
- Import jpeg image data from drones (UAVs) to aid in 3D environment creation
- Import OpenStreetMap data & GIS maps, Photo-logs. OpenFlight data supported
- Semi-automatically produce 'real' road networks using GPS points
- Simple 3D modelling of buildings with SfM plug-in generating 3D models from jpegs
- Convert coordinates to latitude and longitude to create more precise VR data
- Advanced lighting throughout, including all individual vehicle lights, wipers, hazards etc.
- Control all weather effects: rain, snow, wind, fog, fire, smoke, puddles etc.,
- Including smoke & fire in tunnels, alter particle size and hence intensity
- Simulate different road surfaces, splashing, rain ripple of windscreen, road mirage & wipers
- Control the viewing range e.g., set the distance of mist or fog and Level of Detail (LOD)
- Control the sound of rain and its intensity heightening the realism of the simulation
- Control the time of day, geo-location, cloud and sun glare plus thunder and lightning
- Add animated video walls to 3D cityscapes as well as live CCTV

3.2 Visual Options

- Multi-projector systems with edge blending capability
- Single or multiple curved LCD High Resolution screens
- 360° Cave like Dome Systems
- Head mounted displays (HMDs) such as Oculus Rift, HTC VIVE & FOVE

3.3 Additional & Customized Functions

- Simulate Autonomous & Connected Vehicle driving
- Advanced Driver Assistance Systems (ADAS) Simulation, V2V, V2I & V2P (Pedestrians)
- Compatible with Eye Tracking & Biometric systems
- Variety of data linkages through numerous FORUM8 plug-ins
- Parametric 3D modelling feature supported
- A Software Development Kit (SDK) is available for users to customize their own systems

4 Drive Simulators

VR Drive is compatible with an extensive range of hardware platforms that can be configured for a variety of training or research applications. These include static or motion-based systems offering 3,6 or 8 degrees of freedom (DOF) motion generated by D-BOX actuators or electric or pneumatic hexapod platforms customized using real cars and trucks. In addition, VR Drive is also available to operate train and ship simulators.

4.1 FORUM8 Mini Drive Simulator

The FORUM8 mini drive simulator is an ideal hardware platform for a basic Driver Training system where no more than a 125° viewing angle is required and with no requirement to add, either initially or later, a motion capability to the DS.



Standard Mini Drive Simulator Features

- 3 x 42" LCS high resolution screens
- Real car parts plus all dashboard gauges
- Steering wheel, accelerator / brake pedal system
- Right hand or Left hand steering available
- Automatic transmission (Manual transmission is an option)
- Active Steering as standard & Optional extra LCD instrument panel

Forum8 Mini Drive Simulator mounted on 6DOF platform



4.2 FORUM8 Compact Drive Simulator

The FORUM8 Compact Drive Simulator is an Open Cockpit system with a number of optional configurations depending upon customer requirements. This compact simulator comes with full digital instrumentation and a comprehensive sound system. It can either be static or motion based and can accommodate a range of driver viewing systems.

This FORUM8 DS meets all the requirements of a modern Driver Training organization and is available in three hardware configurations: Static, 4DOF and 6DOF



Compact Drive Simulator Standard Features

- Real Car Parts: Driver Seat, Steering Wheel, Multi-function Switch
- Shift Lever, Parking Brake, Seat Belt all dashboard gauges
- PC (Windows 10) installed inside Cockpit
- 12" monitor for Instrument Panel, 8" Additional Touch Monitor
- 4.1 Channel Surround Audio System
- Adjustable Casters for Easy Moving and Installation
- L: 1,800mm, W: 790mm, H: 1,050mm
- AC 100V ~ 220V, Max 800W (For 3 Monitors, PC & Cockpit PC)

4.3 Real-Car based Drive Simulators

FORUM8 can not only meet individual customer requirements through the provision of mini and compact drive simulators, we can also provide customized simulators based on real vehicles.

These could be ordinary cars or specific vehicles such as police cars or other emergency vehicles.

Case Study – The Lebanese American University Beirut

The Lebanese American University in Beirut contracted FORUM8 to build and install a 6DOF drive simulator based on a fully functional production Mercedes Smart Car to carry out research into driver behaviours specific to the country.

To meet the needs of the research team the car was linked to FORUM8' VR Drive software incorporating a significant library of pre-built road networks, vehicles, pedestrians and additional road infrastructure, street furniture and associated 3D objects with the ability to monitor, collect and record the driving data.

The software was also configured to enable 3rd party plug-ins to be added to expand the capabilities of the overall system at a later stage. These included the addition of driver's eye and head motion sensors to enable the monitoring of such things as fatigue and driver distraction as well as vehicle to vehicle and vehicle to infrastructure communication and autonomous driving systems. Three degrees of motion (3DOF) was achieved through the incorporation of 4 x D- BOX actuators with a three-projector system delivering a 180° driver viewing angle.



4.4 Customized Toyota 3-wheel Car on a 6 DOF hexapod motion platform with a 5 screen, 4K Dome viewing system



5 Driver Training Instructor Control Station

5.1 Instructor Station Software

The FORUM8 Instructor Control Station enables the driving instructor to interact with each individual driver via tablet to tablet and / or via their headphones. In addition, the instructor can control the activation of the various pre-built driving scenarios, as well as remotely controlling other aspects of the 3D environment, vehicle dynamics and drive, dynamically.

The following are just some examples of how the instructor can interact with the trainees:

- The remote selection and activation of scenarios and driving hazards (crashes, near-misses, etc.)
- Recording, Monitoring & Reporting of driver performance including playback of the individual drive
- Control of the environmental and driving effects:
 - Time of Day: day, early dusk, early evening, night
 - Visibility & Viewing distance: clear day, haze, fog, and heavyfog
 - Precipitation & Wind: none, rain & snow (control particle size and intensity)
 - Road Traction: dry, wet, snow & ice
 - Traffic Density: city, highway and rural traffic controlled independently
 - Track the driven vehicle using an overhead 2D view

The FORUM8 Instructor Station Software includes a large number of **free pre-built driving scenarios**:



A typical Multi-Driving Simulation & Instructor Control System

5.2 Instructor Control Station Development

The Instructor Control Station - Functionality

The Central Instructor Computer center running the VR-Design Studio cluster software linked to the DS(s) via an appropriate Local Area Network (LAN)

- If a multi-DS system is required each of the hardware simulators (DSs) will run the VR-Design Studio Run-Time software including its PC cluster client, plus the log export plug-in etc., to facilitate the monitoring & reporting of driver performance
- The Instructor will be able to communicate with each driver via both screen, tablet and voice
- The Instructor will also have full dynamic control of all scenarios and emergency events that have been pre-designed, plus dynamic control of the individual vehicle dynamics as well as all environmental effects
- All aspects of individual driver performance can be monitored and reported on in accordance with the customer's specification. Note that these reports can be updated and changed as required by the customer

In addition, VR-Design Studio enables the Instructor to:

- Control of Traffic Density: city, highway, rural traffic controlled independently
- Track the driver's progress and location of the driven vehicle using an overhead 2D view
- Control Traffic flow via traffic light sequences
- Control of each drive simulator's vehicle dynamics:
 - Vehicle settings (engine power, gearbox efficiency, acceleration, etc.).
 - Vehicle dynamic parameters (load, tyre pressure, fuel level, ...)

6 Hardware Specifications

FORUM8 DS computing systems are in compliance with the Driving Simulator recommendations as detailed on the FORUM8 web site: <https://www.forum8.com/wp-content/uploads/2019/07/System-Requirements-2018.pdf>

The Instructor Station can support suitable clustered PCs via an appropriate LAN that will enable the Instructor to control and monitor all aspects of the driver's experience.

The individual drive simulator (DS) requires a suitable clustered computer processing system that enables the best possible frame rate considering the physical size of the interactive 3D road network, the 3D VR environment and the type of visual projection or LCD system utilized

6.1 Simulation and Utility PC Specifications

- PC Be Quiet! Silent Base 601 Window Black- BGW26
- Motherboard MSI Z390 GAMING PRO CARBON - LGA1151(2017)/DDR4/ATX
- Processor Intel Core i9-9900K - 3,6GHz/16M/LGA1151(2017)
- Water-cooling Cooler Liquid ML120R RGB MLX-D12M-A20PC-R1
- Memory PC Ballistix BLT16G4D30BET4 RGB (64Go DDR4 3000 PC24000)
- Master Disk SSD Samsung 500Go SSD M.2 - 860 EVO
- Internal Data Disk 3.5" Seagate 4To SATA III IronWolf ST4000VN008
- Graphic card MSI RTX 2080Ti - 2080Ti/11Go/DP/HDMI/USB-C
- Power Supply Be Quiet! ATX 700W Pure Power 11 - 80+ **Gold**

7 FORUM8 Services

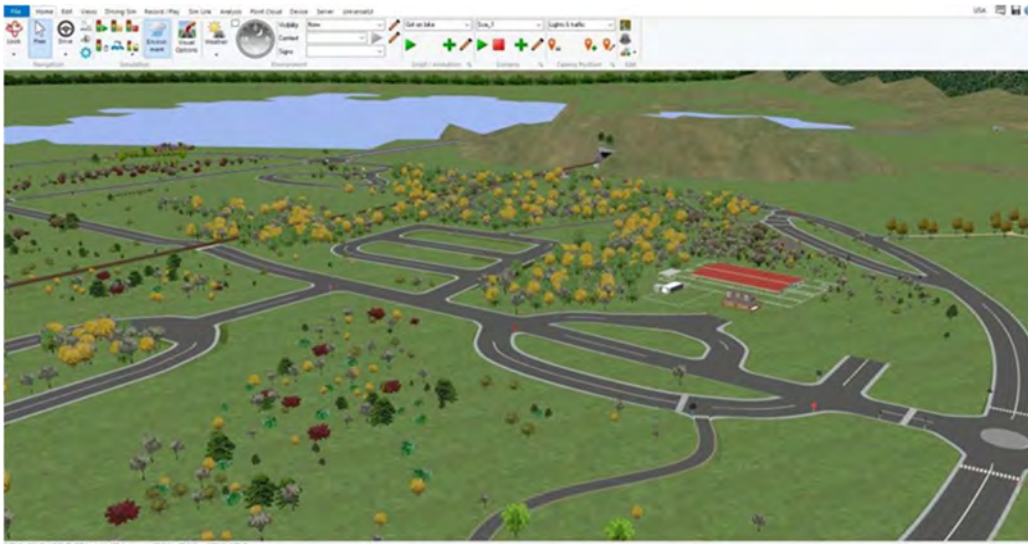
7.1 Development of a 3D VR Road Network & Infrastructure

FORUM8 offers customers the option to build either hypothetical or real 3D road networks. These 3D environments could be produced by FORUM8 based on the customer's specification (LHD or RHD). Alternatively, the customer could build their own road networks and 3D buildings etc., following suitable training.

There are a number of options open for the production of the driver training road network as shown below. In addition, the FORUM8 Instructor Control Station software includes a number of pre-built driver training scenarios along with the appropriate 3D environment and infrastructure.

a) Pre-built hypothetical FORUM8 driver training environment

FORUM8 offer customers a pre-built driver training road network (LHD). This model could be used as the initial starting point of a customized driving environment that accurately meets the customer's local requirements.



b) Build a customer specific hypothetical 3D Road Network with surrounding Infrastructure

Using the standard digital terrain model within VR-Design Studio a customized road network including the urban / rural infrastructure could be produced by FORUM8, or by the customer.



c) Build a real 3D Road Network with surrounding Infrastructure

A real 3D cityscape and / or rural landscape could be produced using a number of different modelling techniques available with the VR-Design Studio software including OpenStreetMap data. The time and hence the cost of building a real 3D environment is dependent upon the level of detail the customer requires. If the initial budget did not allow for this option, it could always be added to the overall FORUM8 VR-Drive system in the future.



Irrespective of what type of 3D Driving Environment is initially chosen by the customer, it is possible to upgrade the driving network, or indeed build totally new ones, without having to change the basic VR-Design Studio software.

d) The fourth way to build a real-world driving environment would be to purchase commercially available 3D City Models or terrain / aerial ortho-photographs and import them into VR-Design Studio. OpenStreetMap data could be used to populate the environment along with accurate 3D models of the various street furniture and other elements of the overall infrastructure.

FORUM8 customers have access to the 3D model and textures database which currently contains over 8000 models all available to download. These models range from vehicles, street furniture, signage, vegetation, trees, people and buildings as well as every conceivable road and soil texture. 4.2 Development of the Driving Training Scenarios & Reporting System

7.2 Development of the Driving Training Scenarios & Reporting System

As with the road network, the various driving scenarios required to train the drivers can be produced by FORUM8 or by the customer following suitable training.

i. Scenario Production

- VR-Design Studio contains an easy to use scenario editor which allows the customer to produce as many driver training scenarios as required
- This specific software (REM) is used to prepare the scenarios graphically and launch them from the instructor station onto the target drive simulator
- Any real-life event that could occur during the drive can be reproduced using REM and controlled by the Instructor from the Control Station
- Driving scenarios that are pre-built into the driver training programs can be altered or added to at will
- All scenarios are designed as a workflow of actions and conditions
- The whole Driver Training system can be automatically backed-up as require

ii. Driver Reporting System Production

- VR-Design Studio contains a data logging system as standard. This software enables the monitoring of all aspects of the driver performance and the production of individual reports as required
- This monitoring and reporting feature is highly flexible and suits all driver training requirements
- VR-Design Studio also has a replay feature which enables the Instructor to replay the drive to highlight areas of concern with the individual driver immediately following the conclusion of the training session
- Driver performance reports can be produced by FORUM8 or by CUSTOMER staff following training



7.3 Software Maintenance & Hardware Warranty

FORUM8 software is sold on a subscription basis. The initial subscription fee is as per the current price list and includes software maintenance and technical support free of charge.

FORUM8 software is available either as a regular web activated license tied to specific PC, or as an annually web activated license which can 'float' across multiple PCs. This type of license is useful if work, such as new scenario development, was to be performed off-site.

The second and subsequent years' subscription fees are based on approximately 15% of the initial fee and once again include software maintenance and technical support free of charge. These fees are listed in the software price list.

The standard warranty on hardware is for one year. During this year. Any software issues will be fixed remotely. During this warranty period, any defective equipment will be replaced free of charge. In case of misuse or malice, the equipment will be charge at its cost plus a handling / shipping fee.

If required, an engineer will travel to replace the defective equipment. If this travel is out of the warranty coverage, expenses and time will be charged at cost, plus a handling fee. Intervention delay is in a 24 open hour range after receiving the replacement equipment.

If required additional software and hardware warranty can be purchased as required.

7.4 Delivery

Delivery includes factory to ship and ship to site delivery. Customs release and taxes are not included in our quotations. The site must be clean and ready for the delivery, including all required power supply outlets and internet connections.

Delivery time scales are subject to the final order.

7.5 Set-up and Commissioning per site

Setup would be realized by our team of FORUM8 engineers. The time and cost of this will depend upon the number and location of the drive simulators and Instructor Station.

We recommend that the local system administrator is available on-site during this period for pre-training. An internet connection must be provided during all setup and commissioning phase.

7.6 Training

Local instructor training will be held on-site during a 2 day period. Basic training is based on the following sessions:

- VR Design Studio and Simulators presentation
- Building a VR, using the model library, setting up traffic, Building a scenario
- Using the Instructor Station

Final documentation of the site with all settings recorded will be delivered at the end of the training session.

Training sessions should take place in a separate room with a video projection facility and a maximum of 5 attendees, all with their own PC to practice the required exercises. Time-limited software licenses will be provided.

8 FORUM8 Company Mission Statement

“FORUM8 will continue to pursue and realize the goal of "The Era of Virtual Reality" by continuing the research and development of the latest system integration services, as well as incorporating the most current technologies to provide our customers with the most up-to-date products.

“The VR-Design Studio (aka UC-win/Road) was first released in the year 2000 and sees its 14th iteration in 2020. Ver. 14 features an improved rendering engine, the new SfM (point-cloud generation through normal photos) jointly developed with Tokyo Institute of Technology, 4D and OpenStreetMap support and a real-time plug-in for PTV VISSIM as well as CAVE systems, and head / eye tracking technologies.”

Yuji Ito, Chief Executive Officer, FORUM 8 Co., Ltd.



Company Profile

The infographic features the FORUM8 logo and a 30th anniversary badge. It includes a Venn diagram with three overlapping circles: '先進性 Up & Coming' (top-left), '社会性 Sociality' (top-right), and '協調性 Forum Spirit' (bottom). A hot air balloon is depicted on the right side.

Company profile

FORUM8[®]

FORUM8. Co., Ltd

Established: May 1987 Capital stock: 50 million yen

Authorized: Construction consultant

Activities: Civil engineering software design, support, and related solutions

Staff: 260 (As of 1st Oct. 2019) [Practical IT Business Theory Course](#)

History: Foundation - Reconstruction: [\(Kansai Graduate School Lecture Materials\)](#)

- ① Established as the developer and distributor of specialized civil engineering design & support software UC-1, in 1981.
- ② Number of clients: **128,201** (as of June 17th, 2019), highest market share in civil engineering software.
- ③ Client composition: Construction consultants (60%), public sector, automobile manufacturers, universities, and research institutes.
- ④ Employing 6 Doctors of Engineering, 5 certified professional engineers (construction/information technology), and 51 certified IT technicians
- ⑤ Offices: 11 in Japan with 5 overseas. Accepts overseas orders of UC-win/Road as well as large-scale simulator systems.
- ⑥ Wholly owned offices / subsidiaries: FORUM8 Shanghai / FORUM8 Qingdao / FORUM8 Taiwan / FORUM8 Vietnam / FORUM8 Yangon
- ⑦ Achieved peak sales in the 33th period (September 2019) of 4.27 billion yen (1.1% increase since previous period, all time high), with a net profit of 739 million yen.
- ⑧ Registered Certification: ISMS, Privacy Mark, QMS(ISO9001), BCMS (BCP), EMS(ISO14001). PSQ certification (UC-win/Road ver.12, UC-1 products)
- ⑨ Obtained basic patent of Data Transmission Technology "a3S Cloud Transmission Library" / Cloud Management System / VR-Cloud® Driving Simulation / Architecture of Cloud Computing

Midyear plan "FORUM8 - 3 x 3 = 32" The 33rd Sales Report Technological Sales Performance

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