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FOT-Net 2

Field Operational Tests Networking and Methodology Promotion

Tools for FOT

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Executive Summary

Conducting a FOT or NDS in a scientific manner as proposed in the FESTA methodology requires a coordination effort during the different stages of FESTA (preparing, using and analysing). Generic tools (such as document and project management tools, databases, or evaluation tools) as well as dedicated tools specific to a FOT are necessary to cope with the demands of planning a FOT, operationalizing abstract use-cases, collecting and holding the test data and finally evaluating the hypotheses.

In previous projects these tools were developed each time a FOT or NDS was conducted by the FOT/NDS partners taking into account the specific needs and requirements of their FOT/NDS. This led to a considerable amount of work, which partly could have been avoided, if existing tools would have been used and additionally if these tools would have been developed in a more general way considering a broader field of application and not only the projects these have been developed for. A reason for non-reuse of FOT/NDS tools is that project partners are often not aware of what is already available and accessible.

Therefore FOT-Net 2 is aiming for an inventory of FOT and NDS tools, which can be used by all parties interested in conducting a FOT/NDS. The inventory aims to list all tools and specify these tools as far as the specifications are accessible and public.

In this deliverable the process for compiling the inventory of FOT/NDS tools is described starting from tool collection and ending by the dissemination of the tools on the FOT-Net Wiki.

The collected tools are clustered into the following categories:

- Inventory of tools for data acquisition (considers all tools which can be used for data collection in the field and its storage in the vehicle). These can be distinguished between tools for CAN data collection and tools for “other” data collection.
- Inventory of tools for data management (considers all tools which can be used for data management, which starts at storage of the data in the vehicle and ends when the data is stored in a database on a server).
- Inventory of tools for data analysis (all processing aiding the data analysis, which starts after the data is put in the database).
- Inventory of tools for test planning, test monitoring and test control (considers all tools which are used especially for controller FOT/NDS e.g. cooperative driving scenarios, which require some test control).

All tools are listed in the Annex.

Introduction

Field Operational Tests (FOT) are large-scale test programmes aiming at a comprehensive assessment of the efficiency, quality, robustness and acceptance of ICT solutions used for smarter, safer, cleaner and more comfortable transport solutions. There are many FOTs within Europe in the form of European and national projects, and many more FOTs in North America and Japan. The FOT-Net project was set up to facilitate networking between these projects in view of sharing approaches, experiences and findings and fostering the comparability of results.

The prime goal of FOT-Net 2 is to increase the momentum of the network achieved in FOT-Net 1 by further developing the strategic networking of existing and future National, European and Global FOTs.

FOT-Net 2 also focuses on methodology based on recent FOT experiences. Through a series of targeted meetings, it gathers the relevant experts to revise and adapt the FESTA methodology for FOTs on ADAS, Nomadic devices, Cooperative systems, and in addition, addresses Naturalistic Driving Studies.

Next to other work packages FOT-Net 2 is analysing the tools utilized in existing FOTs and to make an inventory of these tools. This is the content and objective of WP5. Furthermore the tool chain will consider all steps of the FOT starting form data acquisition systems, database structure, data management and analysis. As far as possible the experience of the FOT parties which utilized the corresponding tools is collected and considered in the inventory. Also the suitability of a specific tool for a specific type of FOT will be treated in the inventory.

This deliverable provides an overview and results of the work done in work package 5. It shows the collected tools, the collection method and finally the presentation of the tools to the FOT-Net community and the general public.

FOT-Net Contractual References

FOT-Net 2 is a Support Action submitted for the call FP7-ICT-2009.6. It stands for *Field Operational Tests Networking and Methodology Promotion.*

The Grant Agreement number is 269983 and project duration is 39 months, effective from 01 June 2011 until 31 March 2014. It is a contract with the European Commission (EC), Directorate General Communication Networks, Content and Technology (DG CONNECT).

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Project Objectives

The prime goal of FOT-Net 2 is to increase the momentum of the network achieved in FOT-Net 1 by further developing the strategic networking of existing and future National, European and Global FOTs i.e. US and Japan. During 39 months, the FOT Network has met trough six bi-annual FOT stakeholders meetings and three international FOT meetings.

FOT-Net 2 also focuses on methodology based on recent FOT experiences. Through a series of targeted meetings, it gathers the relevant experts to revise and adapt the FESTA methodology for FOTs on ADAS, Nomadic devices, Cooperative systems, and, in addition, address Naturalistic Driving Studies.

Five new expert working groups have been created in order to clarify critical topics related to the legal and ethical issues, data analysis, incident definition, impact assessment, and data sharing. The revised FESTA methodology is promoted through six seminars supported by webinars.

FOT-Net 2 creates a new web-based inventory of existing tools for data acquisition, database structure, data analysis to facilitate the setup of new FOTs.

FOT-Net 2 continues to act as a multiplier for the dissemination and awareness of FOT activities especially in terms of inter-activities support and outreach.

Finally, FOT-Net 2 evaluates contributions of FOTs to policy goals and market deployment using an improved methodology for stakeholders' analysis.

1 Tool inventory

The conduction of a FOT or NDS requires specific tools. In previous projects these tools were developed each time a FOT or NDS was conducted by the FOT/NDS partners taking into account the specific needs and requirements of their FOT/NDS. This leads to a considerable amount of work, which partly could have been avoided, if existing tools would have been used and additionally if these tools would have been developed in a more general way considering a broader field of application and not only the projects these have been developed for. A reason besides the missing general tools for non-reuse of FOT/NDS tools is that project partners are often not aware of what is already available and accessible.

In order to provide an overview of available FOT/NDS tools an inventory was created, which can be used by all parties interested in conducting a FOT/NDS. The inventory aims to list all tools and specify these tools as far as the tool specification are accessible and public.

The inventory was created and available tools have been collected. In order to collect the tools, they are clustered into different categories. The main categories are:

- Inventory of tools for data acquisition (considers all tools which can be used for data collection in the field and its storage in the vehicle). These can be distinguished between tools for CAN data collection and tools for “other” data collection.
- Inventory of tools for data management (considers all tools which can be used for data management, which starts at storage of the data in the vehicle and ends when the data is stored in a database on a server).
- Inventory of tools for data analysis (all processing aiding the data analysis, which starts after the data is put on the database).
- Inventory of tools for test planning, test monitoring and test control (considers all tools which are used especially for controller FOT/NDS e.g. cooperative driving scenarios, which require some test control).

1.1 Tool collection

In a first step all collected tools are stored in an xls-file for further data processing. Therefore a template was created. This template considers all relevant technical information on the respective inventory category as well as common information on the tool, e.g. manufacturer, contact data, date of release etc. (see following figure as an example).

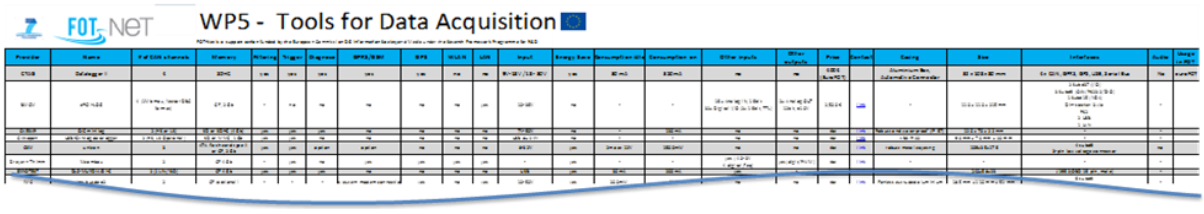

Figure 1: Example of data acquisition inventory

1.2 Dissemination process

One the tools are identified and the necessary information on the tools is collected the goal is to disseminate this information to the FOT/NDS community on the FOT-Net Wiki (see section 3.2 for details).

Therefore a process was established, which considers the following steps:

1. Identification of tool
2. Acquire all relevant information on tool
3. Contact manufacturer in order to complete information and check on latest release or further tools from the same manufacturer
4. Add tool to tool section of FOT-Net Wiki

This process was applied to all collected tools.

2 Inventory of Tools for FOT

2.1 Data acquisition systems

This section deals with the inventory of data acquisition systems (DAS). Principally two different main instances of a DAS have to be distinguished. The first instance focuses on the collection of the data that is necessary for the analysis of the defined research questions and hypotheses. This can be the vehicle ego-data (generally, CAN bus) with all existing in-built sensors but also additional sensors for the monitoring of the vehicle surrounding (radar, laser and camera based sensors). The camera based sensors can process the images and generate additional data (e.g. position of vehicle in lane, distance and relative velocity to objects, view direction of the driver etc.) or provide just the videos in their raw format which need to be processed afterwards manually or automatically. The second instance of the DAS takes all the collected data, synchronizes and stores it in a specific format (data logger). Additionally the data can be transmitted via UMTS/GPRS to a server depending on the amount of data that is given.

2.2 Database structure and data management

The data management starts with the setup of test campaigns. To allow proper analysis and evaluation the requirements, hypothesises, and test scenarios have to be connected with the data collected in the vehicle.

During the FOT all incoming data needs to be stored in a specific format taking into account functional aspects like fast and proper access for analysis tools as well as non-functional aspect like security aspects by e.g. encryption of the data. Generally the following steps are considered:

- Data transfer and upload procedure (manual data pick up, automatic via GPRS/UMTS)
- Online (in the vehicle) and offline (after transfer to server) data quality check with corresponding data monitoring tools
- Procedure and tools for data enrichment and pre-processing (signal filtering, enrichment with map data and data from external databases, calculation of performance indicators etc.)
- Database structure and database tools

Also corresponding measures (backups, data mirroring etc.) in order to avoid data losses need to be taken into account.

2.3 Analysis tools

The analysis of the data starts as soon as it is put on the database. The analysis can be divided into two main steps:

- Analysis of hypotheses and research questions
- Impact Assessment

For both types specific tools are used in existing FOTs/NDS which are listed in the inventory. For hypotheses analysis these are mainly statistical tools and tools which link different types of data with each other (e.g. video and CAN data for verification of critical situations).

For the impact assessment first of all the FOT data need to be translated into performance indicators for safety, traffic efficiency and environment (e.g. frequency of incidents or accident risk). These indicators are then translated in a next step into impacts (e.g. accident reduction). For this different methods exist, which are considered in the inventory. For scaling up the identified impacts micro-simulation tools are needed. These tools are added to the inventory list in order to cover the complete chain of data analysis.

2.4 Test control tools

For specific FOT/NDS test control tools are necessary in order to monitor and control a test scenario. Although the definition of FOT and NDS does not foresee nor allow external control, it can become useful and even necessary for cooperative systems with very low penetration rates. If a tested function of human behaviour can only be recorded and monitored during a short time window, in which cooperative vehicles are at the same time in close distance, test planning, monitoring and control becomes necessary.

3 FOT-Net Wiki on Tools for FOT

3.1 FOT-Net website

FOT-Net's website www.fot-net.eu is an important tool for disseminating information about the FOTs, including progress and findings, and the activities of FOT-Net. The website offers also a link to the FOT-Net Wiki (see figure 2).

Figure 2: FOT-Net website

3.2 FOT-Net Wiki - Encyclopaedia of FOTs

The FOT-Net Wiki (http://wiki.fot-net.eu) is an open platform of information about FOTs, which can be accessed and modified freely by members of the FOT community (see following figure).

The main section of the Wiki is the FOT catalogue, which provides an extensive list of past and present FOTs from around the world, with dedicated pages on the identified FOTs, and classification of the FOTs by theme (e.g., autonomous systems, cooperative systems), by location (European, North American, Asia-Pacific), by type of project (e.g. FOT, methodology) and by year of activity.

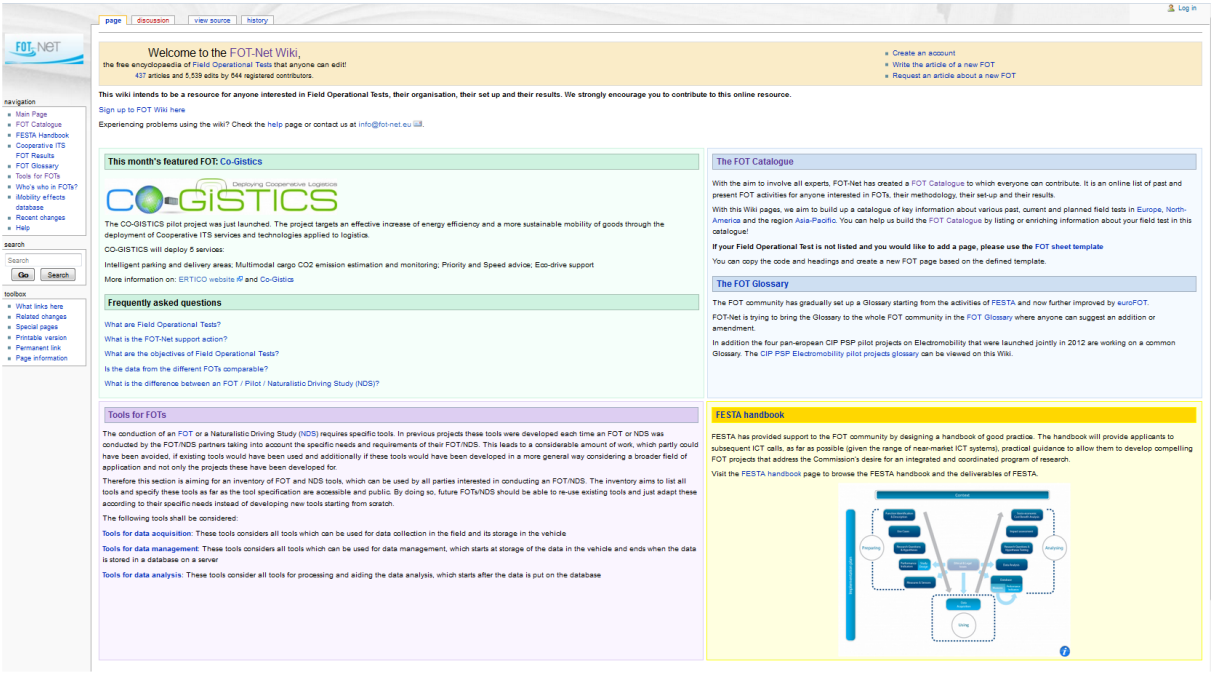

Figure 3: FOT-Net Wiki

Within the FOT-Net Wiki a section on tools is provided in the navigation menu on the left hand side. This navigates the user to the tools section, shown in the following figure (Figure 4).

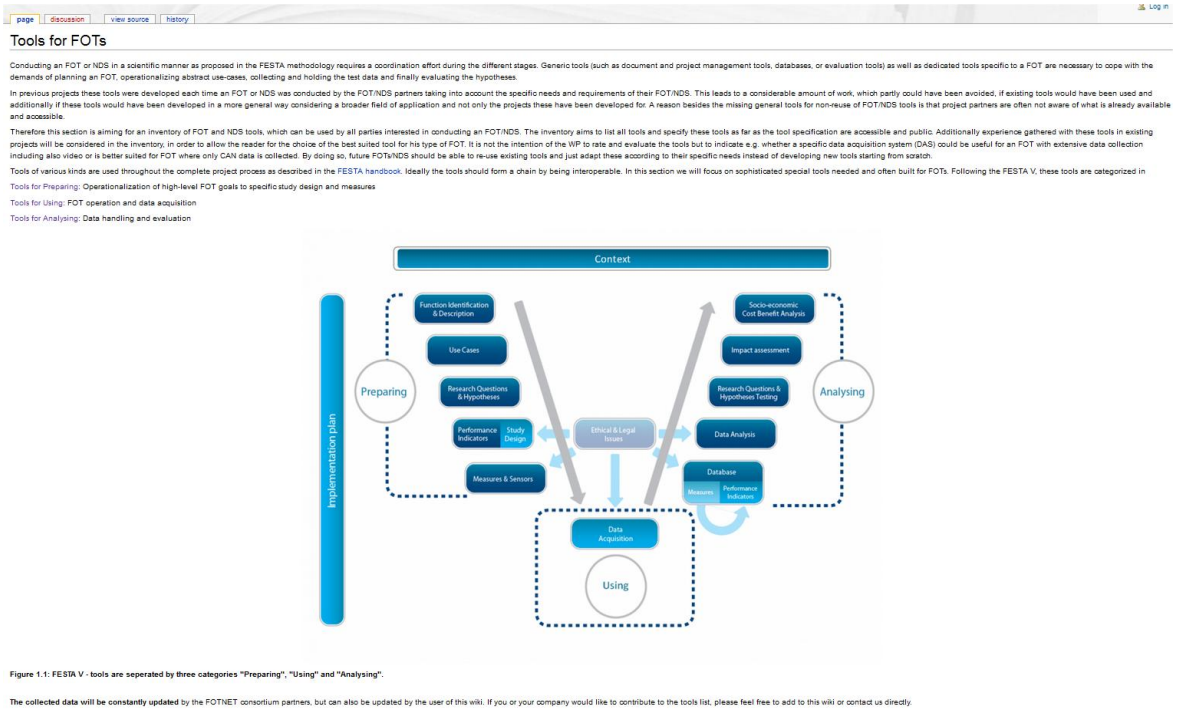

Figure 4: Tool section in the FOT-Net Wiki

The tools are sorted in categories according to their usage. These categories list all collected tools used in FOTs. Currently the following 8 subcategories are identified (see Annex for tool names in each subcategory):

- Commonly used databases
- Data acquisition tools
- Data analysis tools
- Data transfer tools
- Date processing frameworks
- Test control tools
- Test monitoring tools
- Test planning tools

In each category a list of available tools is available. The information for each of the tools is provided on a separate page (see following figure).

For each tool different information is shown. These are:

- Purpose: Common purpose of the presented tool
- Usage in FOTs: If this tool was used in a known FOT/NDS the name of the project is given and a link to the FOT catalogue is provided
- Experiences: Experience with the tool is provided (if available)
- Contact: Contact company or person for this specific tool
- Specific information: tool specific information on software, hardware and other

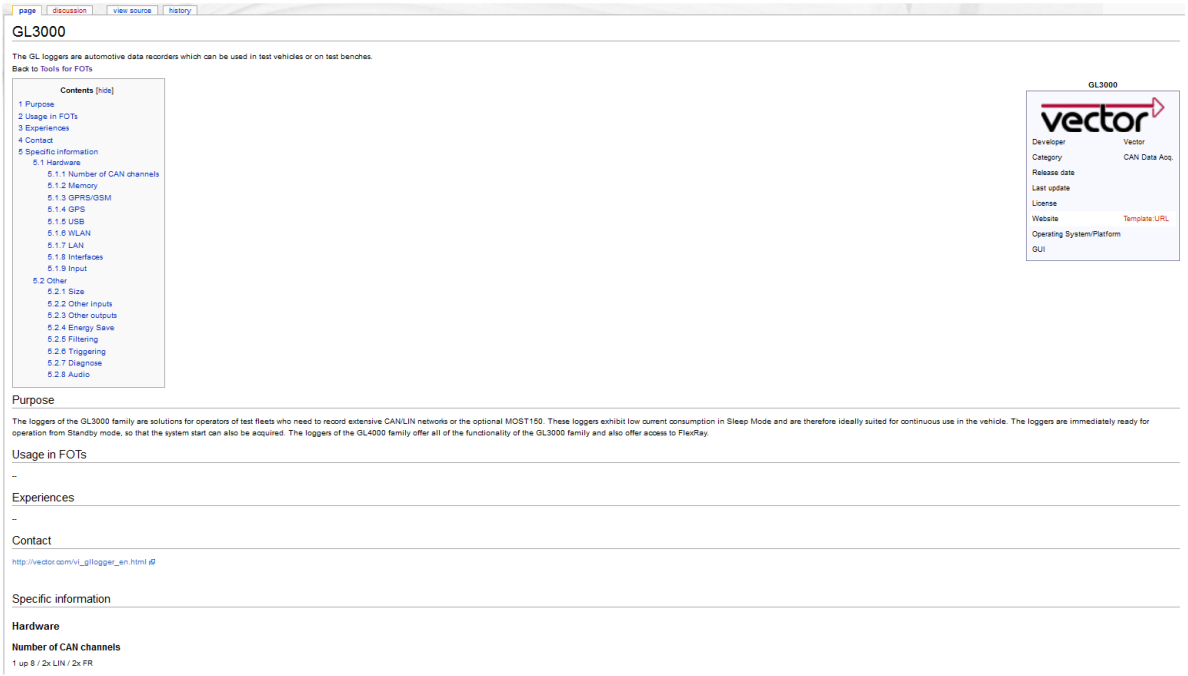

Figure 5: Tool overview example

All identified tools are online and can be accessed by visitors of the Wiki.

Conclusions

The deliverable presents the collected inventory on tools for FOTs/NDS of the FOT-Net 2 project. Over 90 tools were collected and presented on the FOT-Net Wiki in the tools section. The tools and relevant information on the tools are available on the Wiki.

In the FOT-Net Data follow-up project the tools section will be further populated with tools on data sharing and data analysis.

List of Figures

Annex Inventory of tools

The following tools are online:

CAN data acquisition tools

- CAN CASE XL LOG
- CANcorder MMC
- CANlog
- Datalogger II
- DLC-MUXDIAGII-C
- DL1
- DL2
- ePCII-LOG
- Exxotest USB-MUX-6C6L
- FMS-500
- FLEETlog2
- GL1010
- GL3000
- imc busdaq2
- imc busdaqX
- imc busLOG
- imc C1
- IPElog
- Kvaser memorator Professional
- MAHTechS M5X-PRO Data logger
- Mcombox
- M-LOG
- M-TRAS
- Multilog
- Muxlog R
- MUXy fleet
- OBD minilogger
- QIC minilog
- Rebel xt
- S-LOG
- unican
- UniCAN 2 Professional
- USB-CANlog datalogger
- USB-CANmodul2
- VarioPRO
- VBOX 3i
- VDL-1000
- VideoBox
- Vector GL-2000

Other data acquisition tools

- BLOM
- BroadBit data logger

- CAA
- CANGPS
- CCP
- Danew data logger
- DL1 data logger
- DRIVECO
- faceLAB
- ITS Testing Unit
- LATIS FSD
- MetaSat TVM 5.0
- Performance Box
- QIC-CAN-WLAN
- QICGPS
- Swedish LFOT1 Logger
- Telenavis data logger
- VoCAN

Data transfer tools

- DataLoggerII
- Logstation

Generic transferal methods

- Generic usb transfer
- Generic Wifi transfer
- Generic cellular transfer

Test planning tools

- WebScenarioEditor
- simTD Test Planning

Test control tool

- WebScenarioEditor
- Test Driver Communication Unit
- Webscetest

Test monitoring tools

- WebScenarioEditor
- Codar Viewer
- simTD Testueberwachung

Database tools

Commonly used Databases

- Oracle DB
- MySQL
- PostGreSQL

- NoSQL

Date processing frameworks

- Hadoop
- Matlab
- EB Assist ADTF

Data analysis tools

- Agez (Integration of Communication Security into Advanced Simulation Environments)
- CanOE
- ECA
- Jist/SWANS with extensions by Ulm University
- OMNeT++
- PELOPS
- PreScan
- Sumo
- VISSIM
- VSimRTI
- VSimRTI (V2X Simulation Runtime Infrastructure)
- VSimRTI_App_Native (V2X Application Simulator for native Applications)
- VSimRTI_App_OSGi (V2X Application Simulator for OSGi Applications)