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The DESERVE Project: Towards Future ADAS Functions

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1.1 Project Aim

This book aims to outline the major innovations introduced by the DESERVE (DEvelopment platform for Safe and Efficient dRiVe) project. The project started in September 2012 and finished on February 2015 after 3,5 years heavy working and was coordinated by VTT Technical Research Centre of Finland Ltd. The project was co-funded by the European Commission under the ECSEL EU-Horizon 2020 programme. The project was a joint effort of major vehicle manufacturers (Volvo, Daimler, Fiat), component suppliers (Continental, Ficosa, AVL, Bosch, NXP, Infineon, dSPACE, ASL Vision, Ramboll, TTS, Technolution), research institutes (VTT, ICOOR, ReLab, INRIA, CTAG) and universities (VisLab, IRSEEM, ARMENIS, IKA, INTEMPORA, Leibniz Universität Hannover).

> **VISION**
> DESERVE will design and build an ARTEMIS Tool Platform based on the standardisation of the interfaces, software (SW) reuse, development of common non-competitive SW modules, and easy and safety-compliant integration of standardised hardware (HW) or SW from different suppliers

The main research question was to identify the optimal sensor solutions for the DESERVE platform which are required by the selected ADAS functions

for supporting transition to automated vehicles. 22 different modules were selected to be implemented to 11 driver support applications according to user needs when starting development process:

- Lane change assistance system
- Pedestrian safety systems
- Forward/rearward looking system (distant range)
- Adaptive light control
- Park assistance
- Night vision system
- Cruise control system
- Traffic sign and traffic light recognition
- Map-supported systems
- Vehicle interior observation
- Driver monitoring

The project created the methodology framework for integrating embedded hardware and software modules was created which enables better interoperability of automotive industry products and third party aftersales components. This approach is also beneficial to comprise the problem for guaranteeing safety and security problems when new components are added to the complex software and hardware stacks.

The initial project objective has been defined in the Table 1.1 with having measurable verification of the expected results.

Table 1.1   Scientific and technical objectives

Scientific and Technical Objectives	Measurable and Verifiable Form
The definition and implementation of a model-driven process for the compositional development of safety critical systems that allows the smooth integration of existing components and functions in a new framework.	By defining an analysis methodology to establish an industrially applicable process for exploration of design spaces and multi-criteria constraint satisfaction, with particular regard to safety properties. **Verification: 90% or more of the applications identified could be developed with the proposed platform.**
The development of an innovative embedded vehicle platform capable of supporting the fast and reliable development of ADAS and efficient Eco-driving functions.	By implementing demonstrators for active and passive safety of drivers and all road users in the three macro-areas in the automotive domain such as:

Table 1.1 Continued

	• Technical, safety and efficiency impact assessment of resulting prototypes following the evaluation methodologies identified in project PREVAL and in line with INTERACTIVE evaluation methodologies. • Cost-Benefits analysis. • Evaluation of cost reduction in comparison with conventional Driver Assistance Systems.
	Verification: 90% or more of the developed applications showed more than 15% of reduction in development time and cost.
The integration of existing vehicle sensors and actuators in a unified SW framework for multiple safety and Eco-driving applications.	Existence of a cost-effective and flexible SW platform, able to be used with available sensors/actuators.
	Verification: 90% or more of the developed applications show more than 15% reduction in development duration and cost.
The adaptation of the current data fusion, HMI and driver's behaviour modules to provide suitable and harmonised middleware for the different safety and Eco-driving functions.	By applying the V-model and developing high level services and Application Protocol Interface (API) that can be used in a wide range of safety-related use cases. Via multi-modal HMI with user related and driver behaviour assessment through tests in driving simulator and in prototype vehicles.
	Verification: Statistical evidence of improvement of driver acceptance between existing (on the market) and DESERVE-developed functions. Subjective evaluation through questionnaires.
The implementation of a new method and relative tools for ADAS functions development.	Existence of new tools for development of Driver Assistance Systems, including data fusion visualisation, algorithm development, actuation simulation, etc.
	Verification: Evidence that the method is suitable for effective ADAS developments: • **Results of the test case development** • **Results of workshops with main stakeholders, OEMs and automotive suppliers.**

The developed applications are tested and validated in different demonstration vehicles for showing that DESERVE methodology is not limited to one single vehicle type. The project demonstration vehicles are:

- two medium class passenger cars from Fiat
- research passenger car from VTT
- luxury passenger car from Daimler
- heavy goods vehicle from Volvo
- driver training truck from TTS

Additionally, tests will also be conducted in simulators, e.g. a simulator for driver monitoring functions and a simulator for cruise control systems.

1.2 Project Structure

The project was divided into 8 sub-projects (see Figure 1.1) in order to keep the whole development chain manageable and taking different automotive orientated technical challenges into account.

This project workflow also enabled professional development process starting from the requirements and finishing to the validation phase. One sub-project was engaged with specifying and designing the DESERVE platform and three sub-projects for doing implementation.
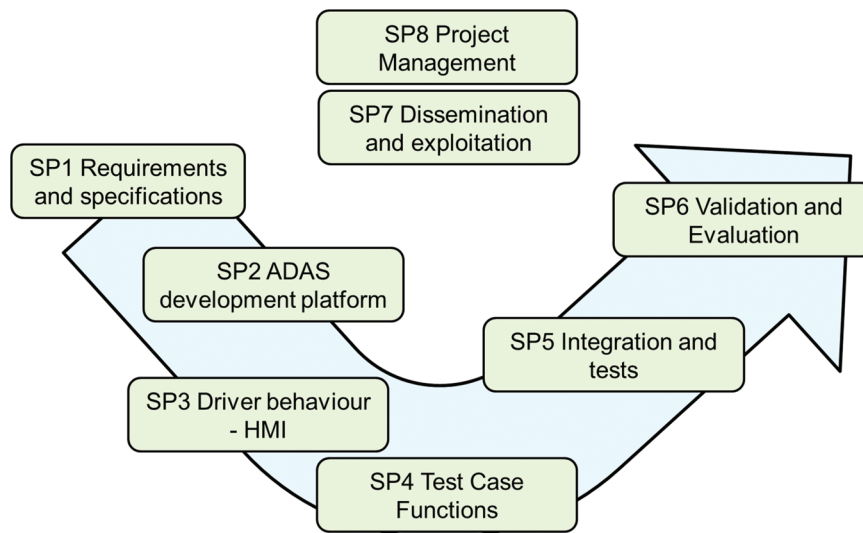
Figure 1.1   The DESERVE V-shape development process.

1.3 DESERVE Platform Design

The project developed the framework methodology (see Figure 1.2) to integrate new software components to car environment. In practise, the methodology verified with implementing two alternative solutions which were adapted to fit to the project framework design. The one bases on ADTF which is mainly utilised by the German automotive industry and RTMaps which is implemented by the other demonstrators. Since the aim is to introduce a solution which will be exploited in real vehicles both solutions this gives good bases to bring the specified framework to cars in future within next 5 years.

1.4 The Project Innovation Summary

The project was not limited to the framework design but was also further developing the current in-vehicle technology. The specific areas where steps were taken forward are:
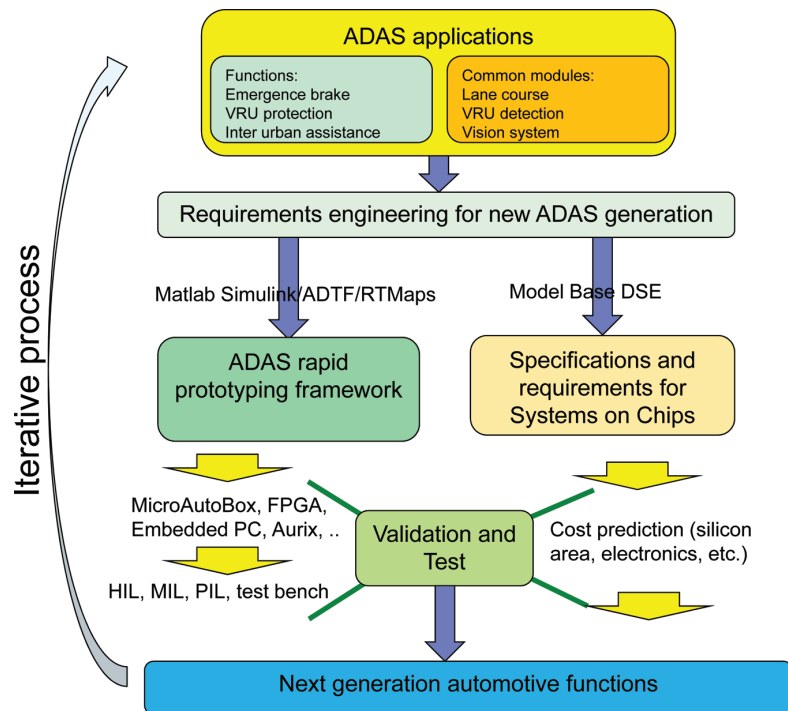

Figure 1.2 DESERVE platform concept for speeding up the ADAS function development time.

- Night time environment perception
- Driver monitoring topics: Drowsiness and distraction detection
- Embedded in-vehicle computing system: Setting up FPGA based automotive CPUs
- Vehicle blind spot detection
- Vehicle surrounding awareness
- New human-machine interface concept

However, these are kind of by-products since main intention was to develop common methodology for automotive software implementation. The project therefore, took steps forward in developing common framework (i.e. methodology) to bring new functions to the vehicles. These are not limited to above functionalities but they are the first steps.

The one DESERVE platform allows the co-design of software and hardware for applications and algorithms. The whole application or algorithm can be implemented in software using for example ADTF, RTMaps or Simulink interfaces which allows reusability, flexibility and fast verification of the implemented hardware modules.

1.5 Conclusions

The original project target was to develop a common software platform for modern vehicles. The expected outcome is that the platform fits up to 90 % of all new applications introduced in the new cars. The novel ADAS functions are becoming more and more complex and the new features are software-based instead of mechanical solutions like they were 10 to15 years ago. However, software is always prone to errors which may have serious consequences if e.g. the vehicle accelerates when emergency braking is expected. Therefore, a proper evaluation procedure is needed by using proper performance indicators, in order to verify the correct functionality of the platform.

As the final concluding remark, the DESERVE methodology pushes forward the situation compared to the current approaches in the automotive industry. The used architecture for the DESERVE platform is flexible and modular and enables to add new software components, devices, modules and functions even if the set of vehicle sensors, actuators and HMI remains.