

## 6. Publishable Summary



European Initiative  
to Enable Validation for Highly Automated Safe and Secure  
Systems

### Project Objectives

ENABLE-S3 will pave the way for accelerated application of highly automated and autonomous systems in the mobility domains automotive, aerospace, rail, maritime and health, through provision of highly effective test and validation methodology and platforms that will save significant fractions of field tests. Virtual testing and verification and coverage-oriented test selection methods will enable certification of these systems with reasonable efforts and project results will be considered for standardization of such systems.

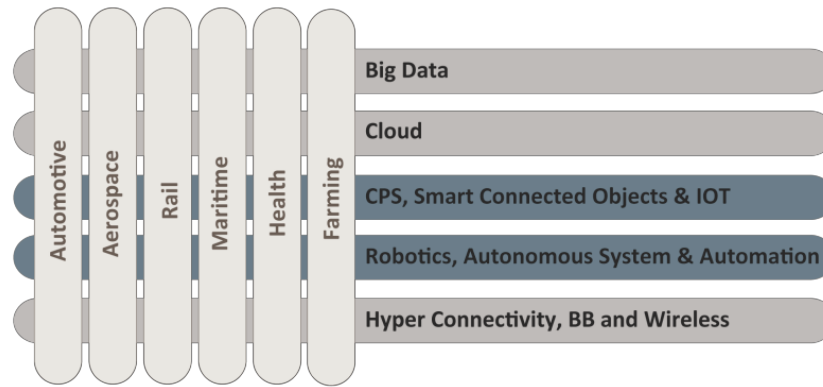
This overall goal is founded on following technical Objectives:

1. ENABLE-S3 will provide a **modular verification and validation framework** that proves the **functionality, safety and security** of ACPS.
2. ENABLE-S3 promotes a new technique for testing sensor-based ACPS with **physical sensor signal stimuli generators**, which will be demonstrated within the use-cases.
3. ENABLE-S3 aims to **significantly raise the level of dependability** of automated systems and minimizing the risk of design or implementation faults by the provision of a **modular comprehensive verification and validation platform** and systematic **coverage measures**.
4. ENABLE-S3 will provide a validation environment for **rapid re-qualification**, which will allow **reuse of validation scenarios** in at least 3 development stages.
5. ENABLE-S3 will **promote and extend existing standards** as well as **establish new open standards** to speed up the adoption of the new verification and validation methods and tools for ACPS.
6. ENABLE-S3 aims at developing validation and verification bricks applicable **across 6 industrial domains (Automotive, Aerospace, Rail, Maritime, Health, Farming)**.
7. ENABLE-S3 aims for the **creation of an eco-system** (incl. LEs, SMEs, NGOs and academia) for the validation and verification of automated systems **within the European industry**.

### Concept and Approach

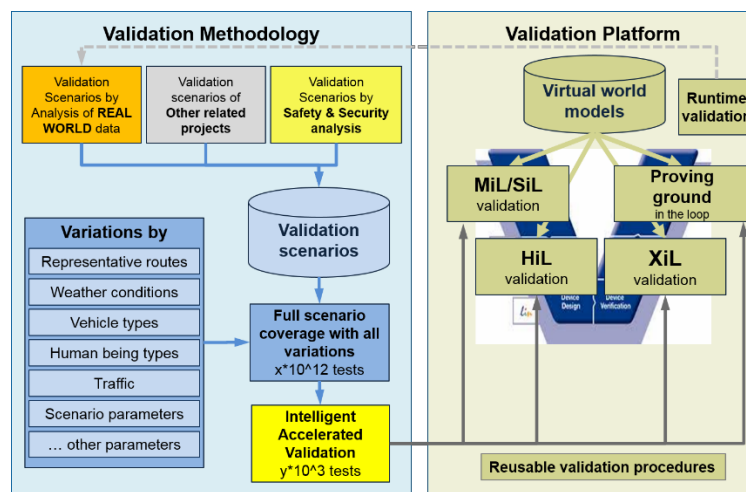
ENABLE-S3 is **strongly industry-driven**. **Several representative use-cases** from **smart mobility** and **smart health** will define the requirements to be addressed in the project and will assess the benefits of the technological progress achieved in the project. ENABLE-S3 addresses all five main innovation tracks stated by the commission within their presentation “Digitizing Europe's economy”<sup>49</sup> with a special focus on “CPS, Smart connected objects and IOT”, and “Robotics, Autonomous systems and automation”.

<sup>49</sup>ARTEMIS ITEA Co-summit, Berlin, 10.-11.March 2015



ENABLE-S3 will extend the established conventional development processes. The V&V processes used in the various domains will be complemented by methods that respects the different focus and capabilities of the validation platform bricks. This will be achieved by **focusing on virtualization** using modelling and simulation, which enables both **frontloading of V&V activities** and their directing towards relevant situations and aspects (i.e. for significantly reducing redundant testing efforts of traditional road testing). This is complemented with security testing methods adapted for ACPS throughout the development process. The emphasis is on early security validation and verification.

The following picture illustrates the approach envisioned by the ENABLE-S3 consortium. Basically, we distinguish between the **Validation Methodology** (a) and the **Validation Platform** (b). Both are of course dependent from each other.



## Results

Manifold project outcomes are expected:

- **Validation methodology** that will provide the overall work- and data-flow for selection of test data and coverage criteria, as well as guidelines for modelling, simulation, application of formal and testing methods/tools, and use-case specific tailoring of the validation platform. The validation methodology of this project will enable the affordable validation of highly automated systems in the transport and healthcare domain.
- **Validation platform** that will allow to carry out most of all required V&V activities for highly automated and autonomous CPS and SoS in a virtual or semi-virtual environment, thus minimizing the need for expensive, dangerous and limited controllable field tests. This will include models,

model-platforms and interfaces for sensors, components, humans, traffic, environment, etc., as well as stimulators for sensors in XiL-environments.

- **Open standards** for efficient reuse of validation methodology and platform outside and after the project, including e.g. protocols for safety and security testing. ENABLE-S3 aims for setting the de-facto standard for validation methodology of highly automated cyber physical systems.
- The project is strictly **use case oriented**, therefore all validation methods and tools will be developed to fulfill the requirements of real, relevant industrial use cases. The implementations and methods will be evaluated with demonstrators of the use-cases in industrial environments.

## Impact

The **market potential** of highly automated and autonomous systems is high. For instance, <sup>50</sup>, <sup>51</sup> predict **42bn\$** for automated vehicles of level 3, conditional automation, and more in 2025, and a potential annual market value of 265 Billion Pounds for the UK alone is identified by <sup>52</sup>. Technological giants such as Google and Apple or large industrial conglomerates like Rio Tinto are investing heavily in the ACPS domain which could lead to the development of disruptive technologies that represent a threat to well established industries<sup>53</sup>.

It is **imperative for Europe to compete strongly** in front of such technological and vastly funded competitors. A key factor in this competition for European ACPS leadership resides on its ability to manufacture **highest quality products at competitive costs**.

ENABLE-S3 will add **important missing technology bricks** which are required to **validate the dependability (safety and security) of ACPS at affordable costs**. Thus ENABLE-S3 results shall help to enable the market introduction of this new and for Europe's industry very important technology of automated systems.

The **societal impact** of this enabled technology of highly automated and autonomous systems is very high. In transport, they can significantly **increase safety by avoiding human errors, to improve efficiency**, and especially to **significantly reduce emissions** in mobility applications. In addition, automated driving can also **enable handicapped or elderly people to participate in social life** self-determined. In the health domain, they not only can support **high quality medical diagnostics and surgery**, but also assist in long-term patient care.

Diagnosis or treatment in the **health care domain** will be cheaper and allow for faster and higher quality. This will enable the access of emerging markets and generate additional revenue and market share. Large populations can be screened with minimum interruption of working life and productivity in hospital increases by improved up-time and faster and higher quality of follow-up of field complaints.

ENABLE-S3 will help the European industry to gain **leadership in the strategic field of autonomous systems** due to faster development and test of new products, fewer call-backs and faster follow-up of call-backs with higher quality, which allows to step into and to create new markets. Finally it will set the basis for future **standards for validation of highly automated systems**.

<sup>50</sup>Boston Consulting Group: The Road to Autonomous Driving, <http://de.slideshare.net/TheBostonConsultingGroup/the-road-to-autonomous-driving>, January 8 2015

<sup>51</sup><https://connect.innovateuk.org/documents/3299324/6049173/Autonomous+Systems+Report.pdf/d05a4cd6-fa91-4f4c-99b3-08b672dd967c>

<sup>52</sup> Trotta, F., Autonomous Systems : Opportunities and Challenges for the UK, Knowledge Transfer Network, April 2014, Available at <https://connect.innovateuk.org/documents/3299324/6049173/Autonomous+Systems+Report.pdf/d05a4cd6-fa91-4f4c-99b3-08b672dd967c>; Visited on March 2015.

<sup>53</sup> Hotten, R., Fiat boss : Google and Applie may disrupt car industry, BBC News, 3 March 2015, Available at <http://www.bbc.com/news/business-31714178>, Accessed on 10 April 2015.

Cooperation with validation competence centers for automated systems will **increase the impact** of ENABLE-S3 **even after the project end**. It will especially help SMEs to take advantage of the fast growing new market of ACPS.

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