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ArchitectECA2030

Trustable architectures with acceptable residual risk for the electric, connected and automated cars

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1 Executive/ Publishable summary

This documents describes the Stakeholder Management Plan for ArchitectECA2030, where 'Stakeholder' is meant to denote any organisation or individual that is (a) not a project partner, (b) active in the same technical area as ArchitectECA2030, i.e. residual risk based homologation of SAE level 3+ electric, connected and automated cars (ECAs), and (c) for whom cooperation in any form with the project would be of mutual benefit for the stakeholder and the project. We identify stakeholder groups by categorizing organisations with respect to the role that they have in the value chain for developing, testing and homologating L3+ ECAs and map concrete organizations and individuals to these groups. We also describe the different mechanisms and activities that ArchitectECA2030 offers for interaction with representatives from these groups, going from dissemination activities typically found in all publically funded projects via knowledge and information exchange actions, twinning activities, up to setting up an External Advisory Board. For each of the stakeholder groups we perform an analysis about the advantages versus the 'costs' – in terms of estimated effort and time -- of each of these cooperation forms, identifying the 'sweet spot' where the mutual benefit for both parties is maximized.

This Stakeholder Management Plan will – together with other surveys and information retrieval activities most noteworthy those done in Task 7.1. – be the basis for setting up the External Advisory Board and initiate twinning and other cooperation activities within ArchitectECA2030.

2 Introduction & Scope

2.1 Purpose and target group

This document describes the Stakeholder Management Plan for ArchitectECA2030, where 'Stakeholder' is meant to denote any organisation or individual that is (a) not a project partner, (b) active in the same technical area as ArchitectECA2030, i.e. residual risk based homologation of SAE level 3+ electric, connected and automated cars (ECAs), and (c) for whom cooperation in any form with the project would be of mutual benefit for the stakeholder and the project. The document is intended for project-internal use as a basis for setting up an External Advisory Board and identify organisations and individuals as members of this Board as well as for cooperation and twinning activities.

A major goal of ArchitectECA2030 is to 'outline a validation framework, develop key elements for this framework, and harmonize it with OEMs, regulation and certification bodies, to ultimately design safe, secure, and reliable electric, connected, automated (ECA) vehicles (cf. DoW).

Obviously, building a complete, industry usable framework including all necessary components – i.e., all software tools for requirements engineering, architectural design, Hardware- and Software design, implementation, validation and test, on all levels of the design hierarchy, for integration and integration test, including all necessary documentation – in industrial-grade technology readiness level would be impossible – and even undesirable – for any publicly funded R&D project, even if the target application would be L0 – L2 cars only. For L3+ cars, where different ideas for residual risk-based validation and test methodologies are still under discussion, this holds double. It cannot and should not be done in a single project. Therefore, ArchitectECA2030 is a part of a huge effort currently undergone in a large variety of public funded and private projects and initiatives pushed by a large group of companies and research actors in different constellations and cooperation; all of these projects and initiatives define concepts and develop solutions to different aspects of the overarching challenge of providing a consistent methodology on how to design, built, validate and test L3+ ECA vehicles that satisfy essential top level quality requirements like safety, security, reliability, and dependability. In order not neither waste effort by doubling activities and – even more important – in order to leverage synergy potentials between the solutions offered in these projects and initiatives a tight alignment and harmonisation with these initiatives is highly important.

A second major opportunity to be addressed here is related to dissemination and community building. For the same reasons as above – ArchitectECA2030 being part of a 'family' of projects and initiatives all contributing parts to the same overarching challenge –highly effective dissemination of project results as well as cross-initiative harmonised standardisation of methods, processes and tools devised in ArchitectECA203 and similar projects is even more important than it is for 'stand-alone' projects. In addition, by being able to target specific audiences – i.e. stakeholders that are already active and taking part in this effort – and by tailoring cooperation offers exactly to the needs of the respective stakeholders and of the project, ArchitectECA2030 is able to significantly support the community building process currently undergone e.g., by the ECSEL lighthouse Mobility.E and other networking platforms.

In this deliverable, we report on the work that has been done:

- To identify stakeholder groups. Stakeholder groups consists of organisations – companies, research organisations, NGOs, projects – that have the same or similar functions or roles in the homologation of vehicles and thus have similar interests and needs. Examples of those groups are the OEMs and their Tiers, standardization bodies, regulatory bodies, tool providers, insurance companies, research projects, etc.
- To describe the different forms of cooperation that ArchitectECA2030 offers for stakeholders
- To analyse the mutual benefit for stakeholders and projects for each stakeholder group and each cooperation form.

Thus, this deliverable will serve as the basis for contacting and selecting representatives of these stakeholder groups for each of the cooperation forms ArchitectECA2030 offers.

While this deliverable is complete in the description of all cooperation forms that ArchitectECA2030 offers, a strong focus is set on the setting up of the External Advisory Board (i.e. the activities of Task 7.2), while twinning activities and dissemination activities are the focus of Task 7.1 and 7.3 respectively and are described in detail in the deliverables of those tasks.

2.2 Contributions of partners

This deliverable greatly benefited from various discussions that have been undergone within the regular working meetings within SC5, most notably those in WP 1; also, very good discussion took place since the global VISION Workshop and the General Assembly in June. Many 1:1 discussions, especially with the project coordinator (IFAG), the SC coordinator (AVL), with the SC5 lead (AVL – especially about homologation procedures as summarized in Section 4) and the SC 3 lead (SINTEF), and with the task leads of Task 1.5 (VIF) and 7.5. (IFAG), substantially contributed to this Deliverable. Finally, the standardization survey conducted in SC5 (and reported on in Deliverable 7.8.) was another source of inputs for this document.

In total, all SC5 partners provided input to this document, which was then collected and written down by the task lead SafeTRANS.

2.3 Relation to other activities in the project

Stakeholder Alignment is an important part of the Vision and Objectives of ArchitectECA2030. The activity of Stakeholder Alignment, for which this Stakeholder Management Plan is the first step, is a cross-cutting activity that basically affects all Supply Chains and all work packages.

From an organizational point of view, these activities are driven by Supply Chain 5, led by AVL. Content wise these activities are strongly tied to the activities of Tasks 7.1 (Twinning, led by BUT), 7.2. (External Advisory Board, led by SAFE), Dissemination (7.3., led by TERA) and Standardization (7.5, led by IFAG and 1.5, led by VIF).

3 Terms and definitions: Stakeholder, homologation / type approval

The term 'Stakeholders' as used in this deliverable is defined as follows

> A **stakeholder** is an organisation – a company, research organisation, government or non-government organisation (NGO), or a R&D project – that (a) plays a role in resp. performs a function in the homologation process of L3+ cars and/or (b) that has a (business) interest in these processes – meaning that it needs to know these processes in order to perform its business purpose.
>
> In extension, a **stakeholder group** is a group of stakeholders that have similar/the same function and/or the same interest in homologation processes of L3+ cars.

Before we describe the identified stakeholder groups (next section), we will therefore describe shortly the homologation process as it performed now, including anticipated changes. A more extensive description of this process can be found in Deliverable 1.5.

Principles of Homologation

Homologation is a term used mostly in the automotive domain, whereas **type approval** is the more common expression in most other application domains and also synonymously used in automotive.

> **Homologation** (or type approval) refers to a certification process of a product – i.e., a car, a vehicle – demonstrating that it complies with all local standards and legal regulations applicable to this product, such as safety and environmental regulations.

Homologation is the last step of the (classical) system development process (c.f. Figure 1). A prerequisite for successful homologation is not only, that the system was developed correctly, but also that it was validated thoroughly and that all the necessary documentation – especially test and validation results – was generated.

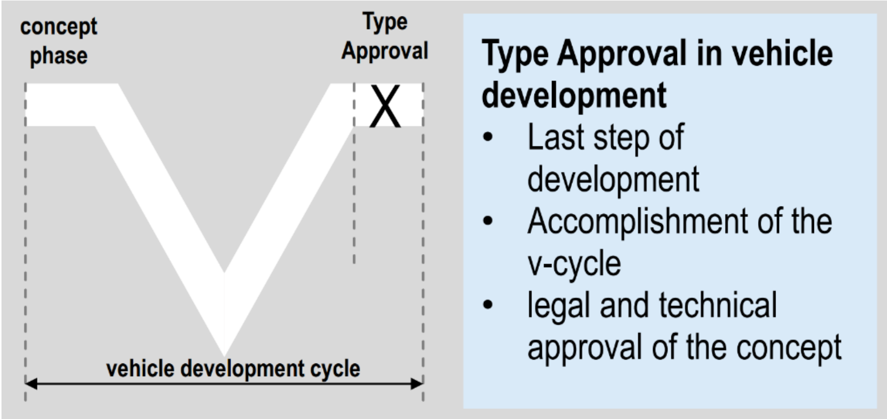


FIGURE 1: HOMOLOGATION / TYPE APPROVAL IS THE LAST STEP OF (CLASSICAL) DEVELOPMENT [ABDELLATIV 2018]

Since homologation is used to certify compliance to legal regulations (and local standards), it immediately follows that such type approval must be achieved for each judicial area in which the product – the car – is intended to be operated. This implies a major effort on behalf of the car manufacturers (OEMs – Original Equipment Manufacturers): although the overall goals in legislation are comparable in each country – at least for safety regulations, if not necessarily also for environmental regulations – the concrete regulations and especially the required tests and documentations differ considerably between countries / judicial areas.

In the European Union, legislation relevant for type approval is based upon international law and regulations, namely the Vienna Convention on Road Traffic (VC), the Geneva Convention on Road Traffic (GC), and United Nations Economic Commission for Europe (UNECE) procedures and recommendations; for homologation and type approval of vehicles, the corresponding UNECE recommendations are issued by UNECE WP 29 'World Forum for the Harmonization of Vehicle Regulations'. These, in turn, are adapted resp. concretized into EU regulations, directives and guidelines ('EU law'), which might then further influence national law of the member states, see Figure 3 on page 10. In cases where UNECE regulations are missing and/or still under discussion, the EU issues their own regulations, typically matching and/or complementing the existing UNECE procedures. Other countries mostly base their regulations upon similar international law and/or provide their own regulations, too e.g.

- North America: Federal Motor Vehicle Safety Standards (FMVSS) regulations released by the NHTSA (which also works and strongly influences UN/ECE; however, FMVSS sometimes deviate from UNECE recommendations).
- Japan follows UNECE regulations and their own Test Requirements and Instructions for Automobile Standards (TRIAS) regulations
- Australia: Australian Design Rules (ADR) regulations (partly based on UNECE regulations)
- Other countries that accept or base their own regulation on those mentioned above, following the latest release or previous versions of these regulations.

Third-party homologation vs. Self-certification

Since Homologation is a certification of compliance of a product to regulations, the obvious question is who issues such certificates. To this, two different approaches are followed throughout the world, namely self-certification and third-party certification, cf. Figure 2):

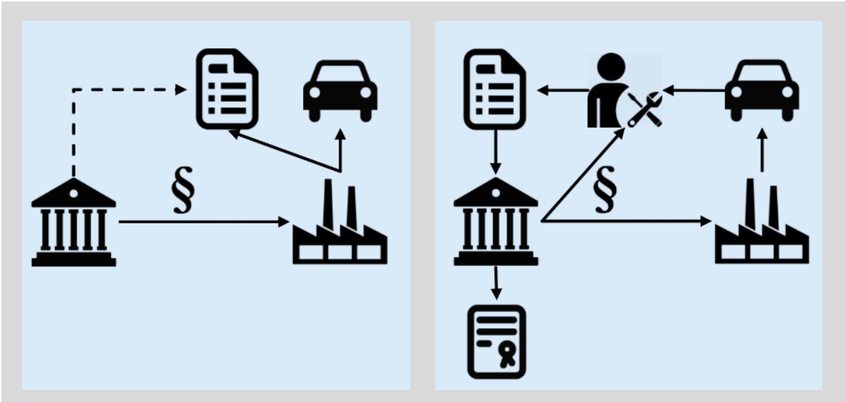


FIGURE 2: SCHEMATIC OVERVIEW OF SELF-CERTIFICATION (LEFT) AND 3RD PARTY CERTIFICATION (RIGHT) [ABDELLATIV 2018]

- **Self-certification:** With this method, the car manufacturer (OEM) is responsible itself for testing the car against all applicable regulation provided by the legislator; the OEM issues the certificate for its own products itself. It is typically not required to provide this certificate to anyone else; however, in case of damage incurred by the product resp. by the operation of the product, the OEM is liable if the damage is a direct result of a property of the product that does not conform to regulations. Concrete examples for this might be damage incurred by a car accident, where the brakes of the car failed; or environmental damage because the emissions of the car exceed the legal boundaries. In both cases the OEM would have to prove that its self-certification was indeed sufficient to show compliance with regulations.
  Self-certification is the certification method used in the US.
- **Third party certification:** Here, authorities instruct a third party for checking the certification evidence. This third party is called 'technical service provider' (TSP). More concretely: The legislator provides the regulations both for the conformance of the product as well as the requirements for testing this compliance. The OEM provides the product together with documentation about which tests and validation methods have been applied to it with what results. The TSP may require additional information and may also test structural and organisational properties of the OEM (i.e., suitability of design and test procedures, etc.). Finally, after the TSP has been satisfied that the product indeed does comply all necessary regulations, it issues a report to the legislator / governmental organisation, which in turn issues the certificate.
  Third party certification is used in the EU and many other regions. In the EU, the most commonly known TSP is the TUEV Group.

Self-certification is often seen as the more flexible instrument for homologation, providing less hindrance for innovation and experiments about best solutions ('the market will take care…'). Third-party certification suffers from the fact that rules and regulations have to be specified very concretely in order to be both suitable as well as usable in the interaction between OEM and TSP. However, although self-certification is usually accompanied by very strict liability laws, where liability fees are much higher than in countries which employ third-party certification, this approach might be problematic when (a) the product involves new technology for which appropriate regulations are missing and (b) the product opens up new business cases and markets with potentially very high profits, which might outweigh the potential liability risks.

The role of (technical) standards

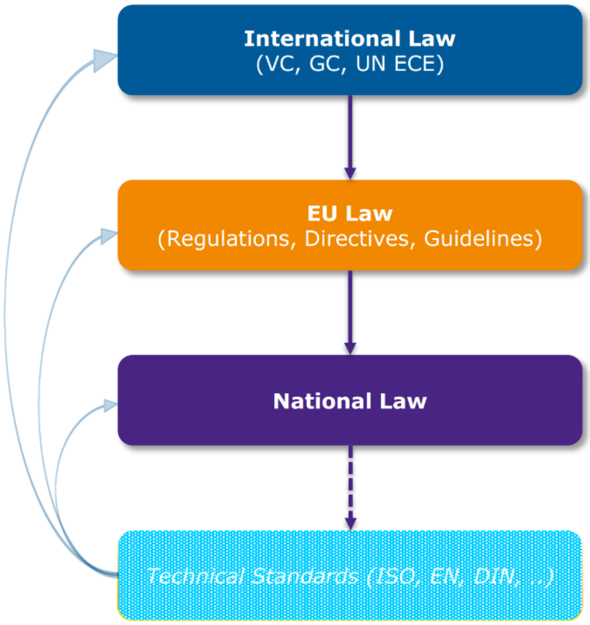


FIGURE 3: ‚HIERARCHY' OF REGULATIONS FOR HOMOLOGATION OF VEHICLES IN THE EU, AND RELATIONS TO TECHNICAL STANDARDS [PRUGGER 2021]

It is important to notice that the regulatory framework described above and shown in the upper part of Figure 3 is mostly independent of technical standard. Slightly simplifying, regulations on international, European and national level describe the 'what', i.e. they specify which properties and capabilities vehicles need to have and what proof resp. test obligations are set in place in order to demonstrate these. Regulations often deliberately don't describe the 'how', i.e. the technical means or methods that OEMs and their Tiers can or must use in order to fulfil these obligations. The reasoning behind this distinction is that regulations need to be technology neutral in order to leave enough room for innovations and technological advancement and to not promote certain companies and manufacturers.

The role of describing the 'how' is left to the appropriate technological standards. These are written by technical experts, harmonized between stakeholders, quality checked, and maintained by standardization organizations Independent of legislative progress, technical standards are developed in standardization organizations (like ISO – International Organization for Standardization, European Standardization Organisations CEN, CENELEC, and ETSI, DIN – Deutsches Institut für Normung, and many more), and regularly updated. Standards represent the agreed upon technical State-of-the-Art for methods and processes used to demonstrate compliance with certain parts of a regulation, e.g. functional safety, safety of the intended functionality, FMEA, HARA, etc. So fulfilling requirements from certain standards is a very convincing argument to the TSP that due diligence and care was exerted during the development process.

This relation between regulation and technical standards is so close, that – although regulations do not explicitly refer to concrete standards – they sometimes use the same terminology as used in the standards, in order to at least indirectly point to them.

For example, the term 'functional safety' used in a regulation strongly points towards the main standard used for demonstrating functional safety in Automotive, namely ISO 26262, whereas 'safety of the intended functionality' hints at the SOTIF standard (ISO 21448).

Liability and Insurance

It is important to notice that there is no 100% safety when operating a vehicle, and that such absolute safety cannot be guaranteed by any technical or organisational measure on part of the OEM.

Causes of accidents include user errors (both, driving errors but also misuse), errors of other traffic participants or unforeseen behaviour of objects in the environment, and unfortunately also -- to a degree that is already very small and that becomes smaller as technology and test methodology advances, but is not and probably never will be zero -- technical errors within the vehicle itself. One objective of homologation is to ensure that sufficient measures have been taken to reduce the probability of technical errors as far as possible. The risk of technical errors still being present in homologated vehicles is called the ***residual risk of operating the car***, and many technical standards used for homologation explicitly are 'residual risk'-based in the sense that they describe measures to ensure that this residual risk is minimized.

A fact that layman often find surprising is that OEMs are not necessarily liable for damage induced by technical errors in their cars. In non-juristic term, the argument here distinguishing between two cases and runs as follows:

- If the technical fault could reasonably have been detected by applying the correct standards required during homologation, then obviously the OEM has not used the standards correctly resp. to their full meaning. In this case the OEM is likely liable for the fault and its consequences..
- If, on the other hand, the standards are insufficient for detecting the specific fault that caused the damage, and since these standards represent the state-of-the-art, the OEM could not have prevented this error by any reasonable means and thus their liability is probably waived.

It should be noticed that the above is again a simplified description, in so far that not only the relevant standards are used to determine if the OEM followed state-of-the-art, but any other source of best-practices, pre-standards, research results, etc., that is resp. was relevant for the (industrial) state-of-the-art resp. state-of-practice at the time when the vehicle was launched into the market.

The task of covering the residual risk of operating a car, regardless of whether this risk is technology induced or not, is left to ***insurance companies.***

As with any other risk, they need to calculate (resp. to estimate) how often the operation of a vehicle causes damage and what the maximum (and average) monetary cost of this damage is, translate this into a fee for their policies and sell these policies to users or manufacturers of vehicles.

Specialities and expected changes in homologation for L3+ vehicles

When going to homologation of highly automated resp. autonomous cars (L3+ vehicles), we are expecting the following changes to occur in homologation processes; more precisely, while homologation will still remain to be the certification of compliance of the product to local standards and regulations, the technical means by which this compliance is shown – and which are reflected in the corresponding standards – will change considerably:

- Due to the number of test cases that need to be covered for assuring safety (and security) of the L3+ cars, much of the testing effort will switch to ***virtual testing methods***, i.e. ***simulation based methods using models of the vehicle*** (i.e., digital twins) and its environment. Standards need to take this into account, especially by setting minimum accuracy levels for simulation models and implications of virtual testing to residual risk determination.
- Future systems – e.g., L3+ vehicles – need to ***support updates and upgrades of their functionalities, preferably by Over-the-air (OTA) updates***. The reasons for this need are (a) extended lifetime of products (as for example aimed at by the European Green Deal and (b) enabling error correction as well as extensions of the Operational Domain Definition (ODD) of L3+ cars. Naturally, the updated or upgraded system should still comply with all locally applicable regulations and standards. Thus, either homologation must be done separately for each update or upgrade, or – more desirable – during homologation it needs to be shown that the update/upgrade mechanisms support only 'good updates/upgrades', i.e. updates that do not break the compliance of the product to local regulations and standards.
- ***Many functions within L3+ vehicles will rely on Artificial Intelligence***. The technical standards used will therefore need to ***define means by which properties of these AI algorithms*** – like safety, robustness, security, etc. – can be demonstrated in a way that is sufficient for homologation.

4 Groups of Stakeholder

4.1 Car Manufacturers and Tiers

The main stakeholder group to be considered here is obviously those of the car manufacturers resp. the OEMs (Original Equipment Manufacturers). We include their Suppliers, especially the large TIER 1 and TIER 2 companies, into the same group since their interests and needs are very close, if not identical, to those of the OEMS.

The main observation for this group of stakeholders is, that homologation is an extremely sensitive topic for OEMs, since it has a very high impact upon their business model and they have strong motivations for both increasing and lowering the boundary constraints for market introduction of vehicles set by homologation.

(***Nota bene***: *We restrict ourselves to purely business-related motivations here, since (a) these are more than sufficient to describe this stakeholder group for the purposes of this deliverable, and (b) we are no experts on ethical, moral or other social and socio-technical issues that might or might not influence this stakeholder group.)*

Homologation is a market entry barrier in the sense, that vehicles can only be sold (and operated) within a certain region, if a type approval for this vehicle type for that region has been obtained. During homologation, the compliance of the vehicle to all relevant regulations must be demonstrated (either to the OEM themselves, with self-certification, or to a third party, as done in Europe). For the OEM, this has two implications

- On the one hand, the OEM is interested in a thorough demonstration of compliance to regulations that do meet (or even exceed) customer expectations. Since 'safety' is a 'condition sine qua non' for customer acceptance – no user would buy a car that has not been tested and validated thoroughly for a high safety level – and since during the last two decades environmental concerns are important for more and more customers, successful homologation against high safety and environmental regulations is a quality measure for vehicles, which raises customers' acceptance considerably and thus is influencing their buying decisions.
- On the other hand, homologation is a highly costly activity; although not as expensive as in e.g., Avionics, homologation typically requires appropriate development processes (supported by appropriate development frameworks and tools), a large number of tests and validation activities – also supported by processes and tools –, and the generation of a lot of additional documentation whose only purpose is to demonstrate compliance of the product to the TSP. Thus, homologation increases the costs of the vehicles, which in turn might influence customers' buying decisions negatively.

Both of the above arguments also apply for the large supplier companies (TIERs) of OEMs: They have to supply subsystems and components to the OEM that are on the one hand compliant to all regulations and on the other hand as cost-efficient as possible.

The second of the above arguments is often known under the keywords ***'safety at affordable costs'*** or ***'green systems at affordable costs'***). It has motivated many OEMs and TIERs to participate in research projects where appropriate concepts and (prototype) tool support for the development, validation and test of their products have been researched. However, the concrete homologation processes and the regulations against which compliance are to be demonstrated have rarely been the subject of publicly funded R&D processes. In fact, because of the high business impact, these used to be discussed not even with the TIERS, but by OEMs amongst themselves and with government bodies, TSPs and regulatory organizations.

However, with the advent of autonomous driving, this 'seclusion' of the OEMs has changed, namely because it is not yet finally determined, in which way safety cases for fully autonomous cars can be demonstrated. In recent years, we therefore see

- an increased participation of OEMs to R&D projects that aim at methodologies, standards and tools for demonstrating safety of L3+ cars (starting with the German Pegasus project and the European ECSEL ENABLE-S3 project and continuing to almost all projects in the Mobility.E lighthouse and the successor project families of PEGASUS, see Section 5.4 for details
- an increased activity and cooperation of OEMs in defining standards for demonstrating safety of L3+ vehicles, and discussing these standards and their future refinement and concretization with other actors in the field. OEMs have been active in standardization before, of course (also see the discussion of liability issues in Section 4), but they have mostly been contributing to quite concrete technical standards, like ***ISO 26262*** or the (de-facto standard) ***Autosar***. Interest and contributions to such technical standards continues to be strong, also to new (de-facto) standards like ***Autosar Adaptive*** and ***SOTIF (ISO 21448)***, but in addition we now find (pre-

)standards that describe test and validation methodologies and setting up of safety cases for complete L3+ vehicles (e.g. the 'Safety first for automated driving' document, which was first published as a white paper [***SaFAD 2019***] and is now undergoing the process to become a formal ISO Standard [***ISO 4804***]. Also, in other countries and regions, one can see an increased activity in the definition of 'high level standards' – i.e., standards, that abstract from technical details but mainly describe overall methodologies for demonstrating safety of L3+ vehicles (e.g., UL 4600 [***UL 4600***] and Responsibility Sensitive Safety [***RSS 2017***] in the US).

4.2 Standardization bodies

In general, technical standards define established norms or requirements for a repeatable technical task, product or service. Typically, technical standards describe engineering or technical criteria for the task, product, or service (like e.g., quality or other properties, capabilities, intended use, etc.), and/or methods, processes, and practices for constructing or quality checking. Usually, standards are given as formal documents, maintained by specific organizations ('standardization bodies'); informal specifications, like customs, conventions, company policies, etc., which become generally accepted, are often called de-facto standards; in this section, we confine ourselves to formal standards maintained by standardization bodies.

There are at least three purposes, for which standards are established:

- ***Interoperability and comparability.*** Products or services that comply to the same standards can be combined, used together and/or work together. They are also comparable in the sense that they are exchangeable and can be used equally well.
- ***Quality assurance / Quality Gates.*** A task, product or service that complies to a certain standard has at least the quality level that this standard demand. In the context of ArchitectECA2030, i.e. the homologation of L3+ vehicles, this applies to safety and security standards as well as to other 'quality standards'. Sometimes, this purpose of standards is also used to protect markets: If the quality requirements set by a certain standard are so high, that only few companies have the means to achieve them, and if at the same time this standard is required by the regulatory environment of a certain market or region, then this construct effectively prevents less qualified companies from entering that market. However, this usage of standards is rarely, if ever, seen within the context of homologation.
- ***Definition of 'State-of-the-Art' for technical realization / fulfilment of regulatory requirements.*** As explained in Section 4, especially for homologation of vehicles, standards serve as the definition of the technical means by which homologation regulations can be achieved. In this way, they provide the technical expertise to fulfilment of regulatory requirements and thus serve as a 'blueprint' on how to fulfil these requirements as well as a description of the State-of-the-Art protecting against liability issues.

Regardless of the (main) purpose of a (formal) standard, the standard itself is typically maintained by a so-called ***Standardization body or Standardization Organization***. The purpose of these Standardization Organizations is as follows:

- They provide specific working processes for initializing, maintaining and extending formal standards and usually provide human resources and organizational support for implementing, controlling, and furthering this process.

- At least in theory, they provide a 'level playing field' for all organizations that are 'driving this specific standard', i.e. that are discussing, writing, and extended the specific standard in question. ('in theory', because although from the point of view of the standardization organization all stakeholders concerned with a specific standard are equal, there usually exist a lot of business relations between these stakeholders that provide for a 'hierarchy of decision'.)

There is a large number of ***Standardization Organizations resp. Standardization Bodies***, the most important ones from the viewpoints of 'Automotive Standards' are listed in the following paragraphs:

Official International/European/US/national standardization groups (partial list)

- ISO (International Standards Organisation) (includes national standards organizations of most industrial and developing countries as members)
- IEC (International Electro-technical Commission) (national electro-technical/electronic committees/associations)
- CEN (European Committee for Standardisation) (members are the national standardization bodies of most European countries)
- CENELEC Comité Européen de Normalisation Electro-technique (members are the national electro-technical standardization bodies of most European countries)
- IEEE (Institute of electrical and electronics engineers)
- Other national standardization organizations (like ANSI and UL in the USA, DIN in Germany, etc.)
- ETSI (European Telecommunications Standards Institute) (has official ESO status)

Industrial standardization organizations (partial list)

- SAE International (formerly Society of Automotive Engineers)
- OMG (Open Management Group)
- The Open Group (Open Source Movement)
- ISA (Instrument Society of America)
- OSGi Alliance
- OASIS (Organization for the Advancement of Structures Information Standards)
- ASAM (Association for Standardization of Automation and Measuring Systems)
- Many more

Most of the Standards used within ArchitectECA2030 are maintained by ISO and SAE, with some of them issued by IEC, IEEE or other bodies (c.f. Deliverable 7.8). Standards maintained by them that are most relevant for homologation of L3+ vehicles in Europe are ***ISO 26262 (Road Vehicles – Functional Safety), ISO PAS 21448*** (Road Vehicles – Safety of the intended functionality), ***ISO/SAE FDIS 21434*** (Road vehicles - Cybersecurity engineering) and the preliminary, yet highly relevant ***ISO TR 4804*** (System and Software Quality Requirements and Evaluation, based upon [SaFAD 2019]).

Typical workflows and responsibilities within Standardisation Organisations / Lifecycle of Standards.

Standardization Organizations typically are non-profit organisations, which offer membership for all stakeholders that want to participate in setting up and maintaining standards in a particular area resp. for a technical topic. For a specific standard, the standardization organisation offers support for organisational management, handling of the documents, invitation and organisation of meetings, and finally dissemination of the standard, while the technical expertise – and such, the technical content of each standard – is supplied by the member organisations. Standardization Organisations typically organized in a tree-like hierarchy of working groups (also called Technical Committees, etc.), where the upper levels are responsible for large sets of standards, whereas the lower levels of the hierarchy maintain subsets of these standards. For example, ISO consists of Technical Committees, e.g. TC 22 "Eve – Extended Vehicle Group" or TC 204 "ITS – Intelligent Transport Systems Group" which are each responsible for large sets of standards applicable to vehicles and road infrastructure. TC 22 in turn is composed of SC (Subcommittee) groups, e.g., SC 32 "Electrical and electronic components and general data aspects", which in turn is made up of WG (Working Groups), e.g. WG 8 "Road Vehicles". WG 8 finally is responsible for Standards like ***ISO 26262*** (Functional Safety), ***ISO 21448*** (SOTIF) and ***ISO FDIS 21434*** (Cybersecurity).

With this structure of the standardization organization a typical lifecycle of a standard works as follows:

- A group of stakeholders decides that they want to standardize a certain specification / service/ product / process / method.
- They choose a standardization organization, in which they want to install and maintain this standard. Typically, they have to become members of the chosen standardization organisation (if they aren't already).
- If the standardization organization agrees to (a) include the proposed standard into their portfolio and (b) accept the stakeholders as members, the stakeholders form a new working group or join an existing one within the hierarchy of the standardization organization. Where in this hierarchy this (new) working group is allocated, is typically also decided by the standardization organization and the members. In addition, at this time additional members are added to the working group, according to their interest in the newly proposed standard.
- Following a structured process, the proposed standard is then discussed, extended resp. completed and harmonized by an increasingly large group of stakeholders to reach different 'maturity levels'. For example, in ISO the main 'maturity levels' for a standard are
    - Preliminary Work Item PWI
    - NWIP (New Work Item Proposal)
    - WD (Working Draft)
    - CD (Committee Draft)
    - DIS (Draft International Standard)
    - FDIS (Final Draft International Standard)
    - IS (International Standard)
    - (There are several more groups notifying standards that are in the process of being updated and/or that a terminated/withdrawn)

New proposals for standards typically start at the PWI level, where they are discussed between the stakeholders (members of the appropriate Working Group and the upper levels in the organizational hierarchy of the Standardization Organization. Following specific maturity criteria, PWIs reach the next level of maturity after a certain, well defined time. The higher the maturity level of a given standard is, (a) the more complete and proven in use (typically in demonstrator and or funded R&D projects) the standard is and (b) the larger the community that has discussed this standard is (typically at each level of maturity the number of WG members increases by organizations, that become interested in working with and for this standard; also, typically, at the higher levels of maturity, more and more external experts and non-experts, up to the general public are involved in this discussion.

In addition to the above maturity levels of international standards, ***ISO offers other types of specifications:***

- TS: ***Technical Specification*** (intermediate specification, that is incomplete, but is going to be an IS (International Standard) after completion (possibly/probably first becoming a CD, DIS or FDIS first).
- TR: (***Technical Report***). Reports on first experiences with the handling of new technologies, which should be used as input for future standards regarding that technology.
- PAS (***Publicly Available Specification***). Agreement between the involved parties for handling a certain technology and/or for processes, methods, services, etc. Is meant to be publicly used and discussed, with proposals for updates typically leading to either a PAS Document again, or a IS (again: on its way to IS the PAS standard may start at lower levels like WD, CD, DIS, or FDIS).
- IWA: ***International Workshop Agreement***: Formally not a standard, but de-facto with the same impact: An Agreement between stakeholders from different countries to handle a certain technology / service / method / process in a certain way.

Although the exact names and numbers of maturity levels (and of the other type specifications) vary between Standardization Organizations, the general idea of ‘maturity levels of standards’ that are discussed and harmonized in increasingly larger groups / communities can be found in nearly all Standardization Organizations.

For the following discussions, it is important to notice the difference between the Standardization Organization and their members, which has already been mentioned several times above:

- The Standard Organization itself has mostly no interest whatsoever in the technical content of their standards (with the exception that they typically cover certain technological areas and thus request that the standard needs to be applicable to this area). They are merely the ‘keeper of books’ and the facilitator of a specific standardization process, for which they offer organizational and management support as a service to their members.
- The technical content of a standard is solely supplied by the expert members of the standardization Organizations and/or by external experts.
- Nonetheless a Standardization Organization is typically very interested in maintaining as many standards as possible (if these fit into the technical area the organization is covering), because (a) they want to completely cover the ‘standardization world’ of their technological areas in order to be recognized as ‘the place to go’ if one is interested in this area, and (b) each new standard brings new members as well as new revenues (from selling the standard documents).

4.3 Regulatory bodies, notified bodies and government organisations

Regulatory bodies provide the regulatory framework for homologation, whereas standards (at least those that are used in homologation) describe the technical means by which compliance to those regulations can be demonstrated (see Section 4).

For ArchitectECA2030, we see the regulatory side as a given fact, which can barely be influenced by the project. However, seeing how in recent years the regulatory side more and more refers to the standard side and seeing on the other hand how new standard proposals for safety and security validation of L3+ cars slowly emerge (e.g., ISO TR 4804 based on [SaFAD 2019]; [UL 4600] and [RSS 2017] in the US), ArchitectECA2030 might be able to influence regulations indirectly: By supporting and extending certain standards, the project will show what is technologically feasible in terms of residual-risk based validation and thus homologation, potentially guiding regulations to show not only what are the mandatory requirements for homologation, but also how they can be formulated in a way that makes the homologation process feasible.

Notified bodies (also called Technology Service Providers in Section 4 above) should be handled differently, however. In Europe, they are typically the 'third party' against which compliance to regulations has to be demonstrated during the homologation process (see 'third party homologation in Section 4). As such, they have a strong interest in learning and also participate in the decision as to exactly which standards are sufficient for demonstrating this compliance. Especially for new technologies, like autonomous driving, … for which this correspondence between regulations and standards has not yet been finally determined – mostly due to lack of existing standards that are sufficient expressive and technologically feasible to implement – they are in urgent need for such a correspondence and thus typically highly interested in working with research projects like ArchitectECA2030.

Regulatory bodies that are of interest to ArchitectECA2030

- UNECE
- European Commission
- National Governments
- NIST and DOT in the US

Notified bodies and technical service providers

- Most notably TÜV with its subsidiaries resp. associated organisations in the different European countries

4.4 Associations

Industry Associations are also heavily involved in standardisation activities. Here, their role is to function as a focus and point of alignment/harmonization for the needs and wishes of their member companies towards the Standardization Organisation and as a dissemination multiplier towards their members. ArchitectECA2030 could profit from cooperation with Associations since they sometimes are able to provide a unified view about certain standardization activities of the whole Automotive Industry. However, in other cases, i.e. when this unified view does not exist yet and/or if member companies decide to push their standardization activities outside of these Associations, a direct contact to the companies would be needed. In addition, and for various reasons, Associations are often very reluctant to share information about internal processes and results with non-members. In those cases, ArchitectECA2030 would need to cooperate with these Associations indirectly (i.e. via companies, that are both project or associated partners in ArchitectECA2030 as well as members of these Associations).

Relevant Industry Associations include

- ***On European Level***
    - ACEA (European Automobile Manufacturers‘ Association)
    - CLEPA (European Association of Automotive Suppliers)
- ***In the US***
    - Alliance for Automotive Innovation (merger of the former Association of Global Automakers and The Alliance of Automobile Manufacturers).
    - American Automobile Association
- ***On national/German level***
    - VDA (and, to lesser extent, BITKOM, VDE, VDI, VDMA, ZWEI).

4.5 Research projects and researchers

In this section we list projects that are currently being funded or have recently finished on European or National level, which are (a) active in the general thematic area of ArchitectECA2030 and (b) thus are potential cooperation and twinning partners for our project. For each project, we list the coordinator and the project partners, the runtime, the funding source and a summary of their activities resp. results, as given by their website or from other sources (among them discussions with or presentations of the project during events of the Mobility.E Lighthouse initiative (see Section 5.6). Projects are grouped in three sections: 5.5.1 lists project that have a focus on Validation methods for L3+ cars. These are potential candidates for close cooperation. The same may hold for the projects in 5.5.2, which also generate results towards validation methods, but do not have this as their main focus. 5.5.3, finally, lists projects that focus on advancing technologies needed for L3+ vehicles. Here, knowledge exchange activities could be beneficial for us to know about these technologies and approaches and for them to learn about appropriate validation methods.

4.5.1 Projects with Focus on Safety and Security Validation

SECREDAS (Product Security for Cross Domain Reliable Dependable Automated Systems)

Coordinator:	NXP Semiconductors
Project partners:	NXP Semiconductors Netherlands BV, Fastree3D BV, Gemeente Helmond, Royal Philips NV, Ubiqu, Stichting IMEC Nederland, Stichting Katholieke Universiteit, Radboud University, Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO, Technische Universiteit Eindhoven, Virtual Vehicle Research GmbH, AVL List GmbH, CISC Semiconductor GmbH, AIT Austrian Institute of Technology GmbH, Thales Austria GmbH, SBA Research Gemeinnützige GmbH, secinto GmbH, Interuniversitair Micro-Electronica Centrum vzw, Transport & Mobility Leuven NV, Vysoke uceni technicke v Brne, Institut Mikroelektronických Aplikací s.r.o., Agencia Estatal Consejo Superior de Investigaciones Científicas, Ficosa Adas S.L.U., Advanced Automotive Antennas S.L., Indra Sistemas S.A., Tecnologías, Servicios Telemáticos y Sistemas, S.A., Fundación Tecnalia Research & Innovation, University of Oulu, Nokia Solutions and Networks Oy, Solita Oy, Haltian Oy, Commissariat à l’Énergie Atomique et aux Energies Alternatives, Gemalto SA, Invia Semicon-ductor Security Meyreuil, Oberthur Technologies Sa, Internet of Trust SAS, Prove & Run SAS, YoGoKo SAS, iN2Car, PSA, IFSTTAR French institute of science and technology for transport, development and networks, Canon Research Centre France SAS, Commsignia KFT, Budapesti Muszaki es Gazdasagtudomanyi Egyetem, Ideas & Motion s.r.l., Magneti Marelli S.p.A., Universita degli Studi di Modena e Reggio Emilia, Evidence s.r.l., Politechnika

	Gdanska, Instituto de Telecomunicacoes, PDM e FC – Projecto Desenvolvimento Manutencao Formacao e Consultadoria Lda., Universitatea Politehnica din Bucuresti, RISE Research Institutes of Sweden, RISE SICS AB, China Euro Vehicle Technology AB, Technology Nexus Secured Business Solutions AB, National Engineering School of Tunis, Higher School of Communication of Tunis, NXP Semiconductors UK, NXP Semiconductors Germany GmbH, AVL Software and Functions GmbH, Roche PVT GmbH, Fraunhofer IESE, Giesecke+Devrient Mobile Security GmbH, ZF Friedrichshafen AG, TU Kaiserslautern, Merantix GmbH
Start date:	06/2018 (36 months)
Funding by:	ECSEL JU
Website:	https://secredas-project.eu/

Fully autonomous vehicles and robotic surgery machines have enormous potential to change society. However, the combination of safety, security & privacy of connected and automated systems is still a concern in multiple application domains for many consumers in Europe. As the trust to adopt these technologies is not yet here for many potential users, the industry and research communities need to work on an answer to ensure that these concerns are no longer roadblocks for further evolution in the transport and medical sectors.

The high-level goal of SECREDAS is to develop software for validating architecting methodologies, reference architectures, components and suitable integration, as well as verification approaches for automated systems in different domains. These will combine high security and privacy protection while preserving functional-safety and operational performance. SECREDAS will take a first important step to developing and enhancing trustworthiness, particularly for the future European transportation and medical industries. This will help to make connected and automated vehicles a reality, and ensure that European Original Equipment Manufacturers (OEM) remain competitive and can maintain their world leading position. In addition, SECREDAS addresses cross-domain cybersecurity and safety related technologies in the areas of automated systems in the medical, railway & aerospace sectors, as well as support cross-domain actions.

Within SECREDAS, a number of relevant user scenarios with specific requirements of safety, security and privacy will be studied in detail. Together with current state-of-the-art reference architectures, the user scenarios will lead to a next generation of reference architectures and common elements for multiple application domains, supported by tooling incorporating design and development methodologies. On top of common generic elements to safeguard safety, security & privacy, a number of domain-specific solutions will be designed. With the inclusion of the automotive sector in particular, and the addition of the medical, railway and aerospace spin-outs, SECREDAS will enable a wide application of its results.

VALU3S – Safety, Security, and Validation

Coordinator:	RISE Research Institutes of Sweden

Project partners:	Roboauto s.r.o., Ergünler Industry and Trade Limited Company, RGB medical devices, Otokar Otomotiv ve, Techy works, Infotiv, QR TECH, NXP, United Technologies Research Center, Berge, Camea image and signal processing, intecs group, Rule X Innovation labs, e.s.t.e srl, CAF Signalling, Siemens, ALDAKIN, Bombardier, inovasyon Mühendislik, Reuse Company, PUMACY Technologies, STAM Mastering Excellence, LieberLieber, RI.SE, Universidad de Castilla-La Mancha, vti, Maynooth University, Fraunhofer, KTH, Fondazione Bruno Kessler, AIT Austrian Institute of Technology, Universidad de Coimbra, isep INSTITUTO SUPERIOR DE ENGENHARIA DO PORTO, Università di Genova, MONDRAGON UNIBERTSITATEA Faculty of Engineering, University of L'Aquila, FACULTY OF INFORMATION TECHNOLOGY BRNO UNIVERSITY OF TECHNOLOGY, Eskişehir Osmangazi Üniversitesi, ikerlan
Start date:	05/2020 (36 months)
Funding by:	ECSEL JU
Website:	http://www.valu3s.eu

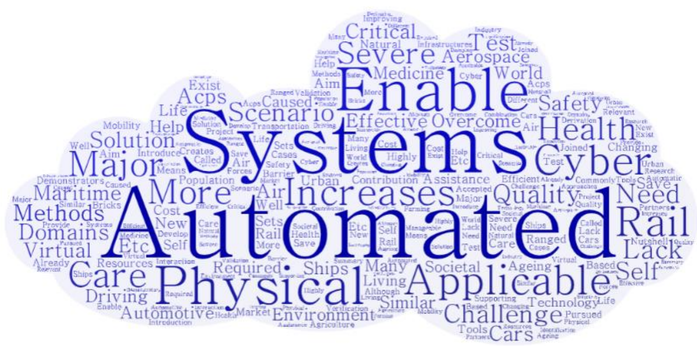
Manufacturers of automated systems and the manufacturers of the components used in these systems have been allocating an enormous amount of time and effort in the past years developing and conducting research on automated systems. The effort spent has resulted in the availability of prototypes demonstrating new capabilities as well as the introduction of such systems to the market within different domains. Manufacturers of these systems need to make sure that the systems function in the intended way and according to specifications which is not a trivial task as system complexity rises dramatically the more integrated and interconnected these systems become with the addition of automated functionality and features to them.

With rising complexity, unknown emerging properties of the system may come to the surface making it necessary to conduct thorough verification and validation (V&V) of these systems. VALU3S aims to design, implement and evaluate state-of-the-art V&V methods and tools in order to reduce the time and cost needed to verify and validate automated systems with respect to safety, cybersecurity and privacy (SCP) requirements. This will ensure that European manufacturers of automated systems remain competitive and that they remain world leaders. To this end, a multi-domain framework is designed and evaluated with the aim to create a clear structure around the components and elements needed to conduct the V&V process through identification and classification of evaluation methods, tools, environments and concepts that are needed to verify and validate automated systems with respect to SCP requirements.

The implemented V&V methods as well as improved process workflows and tools will also be evaluated in the project using a comprehensive set of demonstrators built from 13 use cases with specific SCP requirements from 6 domains of automotive, industrial robotics, agriculture, aerospace, railway and health.

ENABLE-S3

Coordinator:	AVL LIST GMBH
Project partners:	IMinds VZW, Siemens Industry Software NV, Toyota Motor Europe, Aalborg University, Danmarks Tekniske Universitet, Nabto ApS, Sky-Watch AS, Creanex Oy, Rugged Tooling Oy, Tieto Finland Oy, Teknologian tutkimuskeskus VTT Oy, Institut National de Recherche en Informatique et en Automatique, Magillem Design Services SAS, MDAL SARL, Thales SA, Valeo Comfort and Driving Assistance, IBM Ireland Limited, University College Dublin, Evidence SRL, Magneti Marelli S.P.A., Universita Degli Studi Modena e Reggio Emilia, Philips Medical Systems Nederland B.V., Reden B.V., Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek TNO, Technische Universität Eindhoven, Vector Fabrics B.V., Navitor AS, AVL List GmbH, AIT Austrian Institute of Technology GmbH, Dr. Steffan Datentechnik GmbH, Universität Linz, Linz Center of Mechatronics GmbH, Magna Steyr Engineering AG & Co KG, NM Robotic GmbH, Thales Austria GmbH, TTControl GmbH, TTTech Computertechnik AG, Technische Universität Graz, Virtual Vehicle Research GmbH, Politechnika Gdanska, GMVIS Skysoft SA, Instituto Superior de Engenharia do Porto, GMV Aerospace and Defence SA Unipersonal, Instituto Tecnologico de Informatica, Ixion Indus-try ans Aerospace SL, Microelectronica Maser SL, Thales Alenia Espana SA, Fundacion Tecnalia Re-search Centre, Universidad de Las Palmas de Gran Canaria, Universidad Politecnica de Madrid, Ceske Vysoke Uceni Technicke v Praze, Valeo Autoklimatizace k.s., University of Southampton, The Motor Insurance Repair Research Center, Airbus Defence and Space, AVL Deutschland, AVL Software and Functions, BTC Embedded Systems, Cavotec Germany, Deutsches Zentrum für Luft- und Raumfahrt, DENSO Automotive, FZI Research Center for Information Technology, HELLA Aglaia Mobile Vision, Model Engineering Solutions, NXP Semiconductors Germany, Rohde & Schwarz, Serva Transport Systems, TWT Science and Innovations, Valeo Schalter und Sensoren, VIRES, TU Darmstadt, SafeTRANS
Start date:	06/2016 (36 months)
Funding by:	ECSEL JU
Website:	https://www.ecsel.eu/projects/enable-s3



Increasing automation of cyber-physical systems – as in self-driving cars or ships, automated assistance systems in medicine and similar – is a major contribution to overcome many of the major societal challenges caused by a changing world with an ageing population, living more and more in urban environments. Increasing automation will help to save natural resources, air quality and increases efficient transportation and health care solutions, new infrastructures, etc. improving the quality of life.

The ENABLE-S3 application domains ranged from mobility (automotive, aerospace, rail, maritime) to agriculture and health-care. They all need to introduce safety-critical automated systems to overcome these challenges.

Although several technology demonstrators for highly automated systems already exist, there is a severe lack of cost-effective, commonly accepted verification & validation (V&V) methods and the need for tools supporting these methods.

This lack of effectively applicable V&V methods creates a severe barrier for the market introduction of the systems. The major challenge is the interaction of the safety-critical systems with their environment.

The aim of the ENABLE-S3 project was to provide the required means for the V&V of automated cyber-physical systems (ACPS). In a nutshell, the solution pursued in ENABLE-S3 is the identification of relevant scenarios, the automatic derivation of manageable sets of test cases from scenarios as well as the application of automated virtual V&V approaches in combination with physical tests – in summary called scenario-based V&V of ACPS. In ENABLE-S3, industry and research partners from different application domains (automotive, aerospace, rail, maritime, health and farming) joined their forces to develop the required technology bricks for the virtual V&V of automated cyber-physical systems.

Verification and validation methods for automated vehicles in urban environments Safety standards for automated driving ("V&V Methoden")

Coordinator:	Robert Bosch GmbH BMW AG
Project partners:	AUDI, AVL, BMW, BaSt, Continental, Daimler, DLR dSPACE, Ford, FhG, FZI, OFFIS, Opel, PROSTEP, Bosch, TU Braunschweig, TU Darmstadt, TÜV Süd, understand.AI, Valeo, Visteon, Volkswagen, ZF
Start date:	7/2019 (duration: 48 month)
Funding by:	German Federal Ministry of Economic Affairs and Energy
Website:	https://www.vvm-projekt.de/en/project

The VVM project aims to develop test procedures and to provide frameworks and methods for the safety verification of automated vehicles. VVM is working on the use case of Urban Intersections and focuses on driving functions up to full automation of vehicles (SAE Level 4 and 5).

The VVM project builds on the results of the PEGASUS project, which addressed the identification and description of critical scenarios and their implementation in general test cases for highly automated vehicles (Level 3), using the example of the motorway pilot. VVM extends the PEGASUS method to Level 4 and Level 5 of automated driving in an inner city environment, using the example of an urban intersection.

The VVM project is also working on integrating the verification of safety as an integral part of the development process. Already during the development of components and subsystems, the testability, verification and validation are to be considered as design goals ("design for testability"). The resulting systems can then be tested hierarchically, which has the effect that when components are updated, not the entire system has to be tested again. This approach allows test requirements to fit a wide variety of combinations of components and to be implemented and combined reliably and efficiently.

The VVM project aims to establish a seamless chain of reasoning for the proof of safety and to demonstrate its feasibility. All possible tools from digital simulation to real world test drives are used as efficiently as possible. Efforts are minimised, cost and time efficiency is increased.

SetLevel4to5

Coordinator:	German Aerospace Center (DLR) Institute of Transportation Systems
Project partners:	Ika Institut für Kraftfahrzeuge RWTH Aachen, Robert Bosch GmbH, Institut für Regelungstechnik TU Braunschweig, Audi, Continental AG, DLR, BMW, dSpace, ETAS, Ford, Volkswagen, ZF Friedrichshafen, IPG Automotive, MAN Trucks, Opel, Fraunhofer LBF, TU Darmstadt, Prostep, FZI Forschungszentrum Informatik, OFFIS,
Start date:	3/2019 (duration: 32 month)
Funding by:	German Federal Ministry of Economic Affairs and Energy
Website:	https://setlevel.de/en/project

SET Level is working on simulation technology, which is used in development and approval of such vehicles.

Motivation: To bring automated or autonomous vehicles onto the road, purely physical tests are not feasible (-> "release trap"). Therefore, simulations become an essential tool during the development and validation of such vehicles. Due to the heterogeneous group of users and their different goals, a variety of requirements arise for such a simulation platform. In order to achieve comparability between different vehicle concepts and variants, a generic platform is needed that can meet all these requirements.

Goal: The goal of the project is to develop simulation-based methods and tools for the development and validation of automated and autonomous driving functions.

KI Absicherung - Safe AI for Automated Driving

Coordinator:	Volkswagen AG
Project partners:	Volkswagen AG, AUDI AG, BMW Group, Opel Automobile GmbH, Continental Automotive GmbH, Hella Aglaia Mobile Vision GmbH, Robert Bosch GmbH, Valeo Schalter und Sensoren GmbH, Visteon Electronics Germany GmbH, ZF Friedrichshafen AG, AID Autonomous Intelligent Driving GmbH, Automotive Safety Technologies GmbH, Intel Deutschland GmbH, Mackevision Medien Design GmbH, Merantix AG, Luxoft GmbH, umlaut systems GmbH, QualityMinds GmbH, Fraunhofer IAIS, Bergische Universität Wuppertal, Deutsches Forschungszentrum für Künstliche Intelligenz, Deutsches Zentrum für Luft- und Raumfahrt, FZI Forschungszentrum Informatik, TU München, Universität Heidelberg

Start date:	01/2019 (duration: 36 month)
Funding by:	German Federal Ministry for Economic Affairs and Energy
Website:	https://www.ki-absicherung-projekt.de/en/

Goal and Challenge

KI Absicherung makes the safety of AI-based function modules for highly automated driving verifiable. An autonomous vehicle must be able to perceive its environment and react adequately to it. The solutions for such environment perception must be able to correctly interpret the movements of other road users and derive intentions for their continued behavior. In highly automated vehicles, these tasks are increasingly performed by artificial intelligence (AI). One of the greatest challenges in integrating these technologies in highly automated vehicles is to ensure the usual functional safety of previous systems. Existing and established safety processes cannot simply be transferred to machine learning methods. In the KI Absicherung project, a stringent and provable safety argumentation is being set up for the first time, with which AI-based function modules (AI-modules) can be secured and validated for highly automated driving.

Methodological approach

In the KI Absicherung project, methods and measures are developed that provide performance and safety and quality metrics. These methods, measures and metrics support the general safeguarding of an AI function in a car. On the concrete use case of the AI-based perception of pedestrians, consensual approaches to the following focal points are developed:

- Selection and further development of AI algorithms for pedestrian detection with regards to their detection performance against the backdrop of their safeguarding capability.
- Development and combination of methods and measures to identify and reduce inherent insufficiencies of the AI modules.
- Stringent development of a safety argumentation and test methodology to prove the adequate mitigation of inherent insufficiencies of an AI module
- In-process creation of synthetic training and test data sets for the analysis and evaluation of inherent insufficiencies of AI-based processes.

4.5.2 Projects with secondary focus Safety and Security Validation

AutoDrive

Coordinator:	INFINEON TECHNOLOGIES AG
Project partners:	AIT Austrian Institute of Technology GmbH, AVL List GmbH, Infineon Technologies Austria AG, Virtual Vehicle Research GmbH, Technische Universität Graz, TTTech Computertechnik AG, Flanders Make VZW, Interuniversitair Micro-Electronicacentrum IMEC VZW, ON Semiconductor Belgium BVBA, Tenneco Automotive Europe BVBA, Xenomatix N.V., NXP Semiconductors Czech Republic SRO, Vysoke uceni technicke v Brne, Murata Electronics Oy, Okmetic Oyj,

Teknologian tutkimuskeskus VTT Oy, Centro Ricerche Fiat SCPA, Ideas & Motion SRL, JAC Italy Design Center SRL, Magneti Marelli S.P.A., Politecnico di Milano, Politecnico di Torino, STMicroelectronics SRL, Universita di Pisa, VI-grade SRL, Elektronikas un datorzinatnu instituts, UAB Metis Baltic, Vilniaus Gedimino Technikos Universitetas, Heliox BV, Technische Universiteit Eindhoven, VDL Bus & Coach BV, Comlight AS, NXTECH AS, Stiftelsen Sintef, Værste AS, Ayuntamiento de Malaga, Fundacion Tecnalia Research & Innovation, Irizar S Coop, Microeletronica Maser Sl, Universidad de Alcala, Kungliga Tekniska Hoegskolan, Qrtech AB, Industrial Technology Research Institute Incorporated, AVL GmbH, Daimler AG, FEV GmbH, FZ Jülich GmbH, Fraunhofer IISB, GEORGII KOBOLD GmbH, Infineon Technologies Dresden GmbH, Kromberg & Schubert GmbH & Co. KG, Kabel-Automobiltechnik, Lange Research GmbH, OTH Amberg-Weiden, Robert Bosch GmbH, Technische Universität Dortmund, Technische Universität Dresden, ZF Friedrichshafen

Start date: 6/2017 (36 month)

Funding by: ECSEL JU

Website: http://www.autodrive-project.eu

AutoDrive will provide fail-aware, fail-safe, and fail-operational integrated electronic components, Electrical/Electronic (E/E) architectures as well as (deeply) embedded software systems for highly and fully automated driving to make future mobility safer, more efficient, affordable, and end-user acceptable. Advancing towards fail-operational systems will require increased reliability and availability of components, new redundancy schemes as well as architectures, and methodologies to appropriately manage and balance complexity, cost, robustness, and flexibility.

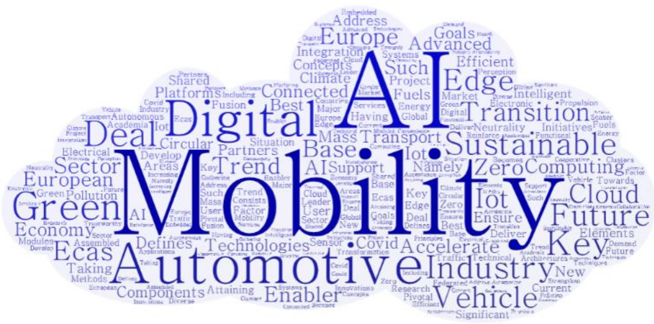
The AutoDrive project will advance the current level of safety and reliability by considerably driving forward fail-operational technologies and by making use of safety and security concepts from the aviation domain. Consequently, AutoDrive will significantly contribute to the grand societal challenge of increasing vehicle and road safety.

Overview on the key Supply Chain aims:

- Fully automated driving and flying systems targeting SAE level;
- Highly automated driving SAE Level 4;
- Cooperative active safety for automated driving;
- Fail-operational 800V automotive powertrain;
- Safe, secure and low latency communication;
- Acquisition, 360° sensing, perception, and environmental awareness;
- Embedded intelligence and systems for automated driving;
- Fail aware components and health prediction.

AI4CSM

Coordinator:	INFINEON TECHNOLOGIES AG
Project partners:	NXP SEMICONDUCTORS GERMANY GMBH, MERCEDES-BENZ AG, AI DIGITAL SOLUTIONS GMBH, FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., HOCHSCHULE OFFENBURG,INSTITUT FUR DIGITALISIERUNG DERDINGE DIGITHINX GMBH, OSTBAYERISCHE TECHNISCHE HOCHSCHULEAMBERG-WEIDEN, TECHNISCHE UNIVERSITAET DRESDEN, ZF FRIEDRICHSHAFEN AG, TECHNISCHE UNIVERSITAET DORTMUND, EMO - BIKE GMBH & CO. KG, AVL LIST GMBH, INFINEON TECHNOLOGIES AUSTRIA AG, TTTECH AUTO AG, VIRTUAL VEHICLE RESEARCH GMBH, AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH, TECHNISCHE UNIVERSITAET GRAZ, TECHNISCHE UNIVERSITAET WIEN, SINTEF AS, PAXSTER AS, NXTECH AS, INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM, VYSOKE UCENI TECHNICKE V BRNE, INSTITUT MIKROELEKTRONICKYCH APLIKACI SRO, IDEAS & MOTION SRL, INFINEON TECHNOLOGIES ITALIA SRL, VEM SOLUTIONS S.P.A., POLITECNICO DI TORINO, UNIVERSITA DEGLI STUDI DI MODENA E REGGIO EMILIA, BYLOGIX SRL,SLEEP ADVICE TECHNOLOGIES SRL
Start date:	5/2021 (36 month)
Funding by:	Horizon 2020
Website:	https://ai4csm.automotive.oth-aw.de/index.php



The European Green Deal defines 4 key elements for a sustainable mobility and automotive industry, namely: climate neutrality, zero pollution Europe, sustainable transport, and the transition to a circular economy. Digital technologies are a significant enabler for attaining the sustainability goals in mobility and transportation. The EC is taking initiatives to ensure that digital technologies such as AI, 5G, IoT and cloud/edge computing can accelerate the transition of the automotive industry to electrical, autonomous, connected, and shared vehicles. The current COVID-19 situation accelerates this trend.

The AI4CSM project will develop advanced electronic components and systems (ECS) and architectures for future mass-market ECAS vehicles. This fuels the digital transformation in the automotive sector to support the mobility trends and accelerate the transition towards a sustainable green and digital economy. Having assembled some of Europe's best partners from industry, research and academia, AI4CSM will deliver key innovations in technical areas including: sensor fusion and perception platforms; efficient propulsion and energy modules; advanced connectivity for cooperative mobility applications; vehicle/edge/cloud computing integration concepts; new digital platforms for efficient and federated computing; and intelligent components based on trustworthy AI techniques and methods. ECAS vehicles enabled by embedded intelligence and functional integration for future mobility, becomes the pivotal factor for the automotive sector to address the Green Deal principles.

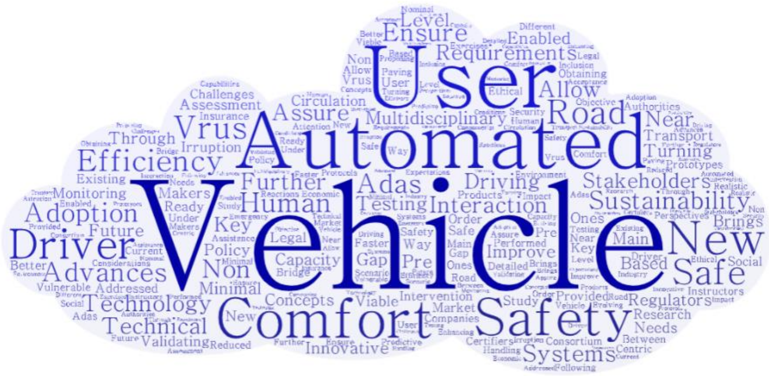
AI4CSM consists of 8 collaborative R&D clusters, gathering 41 partners from 10 countries. AI4CSM will reinforce user acceptance and affordability by convenience and services for the major transition to a diverse mobility. AI4CSM addresses the increasing demand of mobility, supporting future traffic concepts and strengthen the European automotive manufacturing base as a global industry leader.

Project Cluster BRAVE, INTERAct, and TRUST Vehicles

BRAVE

Coordinator:	VTI - Swedish National Road and Transport Research Institute
Project partners:	Swedish National Road and Transport Research Institute, Union Technique de l'Automobile, du motocycle et du Cycle, Institut fuer empirische Soziologie an der Universitaet Erlangen-Nuernberg, University of Alcalá Computer Engineering Department, Fraunhofer IAO Vehicle Interaction Lab, Mov'eo Cluster, vto-moto zveza Slovenije (Automobile and Motorcycle Association of Slovenia), Automòbil Club Assistència S.A.U., The University of California Berkeley Institute of Transportation Studies (PATH), University of Sydney Australian Centre for Field Robotics
Start date:	05/2017 (duration: 30 month)
Funding by:	Horizon 2020
Website:	http://www.brave-project.eu

New technologies in transport enabled systems with the capacity to improve safety, efficiency, sustainability and comfort. Advances in vehicle automation allow the circulation of vehicles with a minimal human intervention in the near future. However, this irruption brings new technical and non-technical challenges that are to be addressed to ensure safe adoption of level 3 automated vehicles.



Based on existing prototypes of automated vehicles (provided by the consortium), multidisciplinary research will be performed to ensure the needs of the users (drivers), other road users (other drivers and Vulnerable Road Users (VRUs)), and the perspectives of stakeholders (driving instructors, insurance companies, authorities, certifiers, policy makers and regulators), as a key for obtaining viable and market-ready products. This main objective is further detailed in the following ones:

1) Multidisciplinary (human, social, economic, security, legal and ethical considerations) study of the requirements and expectations of the drivers, VRUs, and stakeholders to assure safety and adoption of automated vehicles.
2) Turning requirements into innovative interaction and monitoring concepts for driver-vehicle interaction in order to bridge the gap between users and automation technologies while assuring safe vehicles handling with reduced driver attention.
3) Turning requirements into innovative monitoring concepts for vehicle-environment interaction, enhancing current Advanced Driving Assistance Systems (ADAS) through the inclusion of predictive capabilities for better and faster ADAS reactions (nominal and emergency).

4) Validating requirements, user acceptance and impact assessment through realistic user-centric testing exercises under different scenario conditions.
5) Paving the way for further adoption of the technology by the automation industry, by evolving in testing and pre-validation protocols, proposing advancements in the regulation and consumerist assessment.

interact

Coordinator:	Deutsches Zentrum für Luft – und Raumfahrt e.V. (DLR) Institute of Transportation Systems
Project partners:	DLR, BMW, CRF, Robert Bosch GmbH, HELLA, TU München, University of Leeds, Institute of Communications and Computer Systems (ICCS)
Start date:	05/2017 (duration: 41 month)
Funding by:	Horizon 2020
Website:	http://interact-roadautomation.eu/

There is currently a high desire by manufacturers to introduce Automated Vehicles (AVs), SAE level 3 and above, to the market. As AVs are likely to be deployed in mixed traffic, they need to interact safely and efficiently with other (non-equipped) users, including manually driven vehicles, cyclists and pedestrians. Although obstacle detection by AVs is almost flawless, these vehicles cannot communicate their intentions to other road users. This limitation currently reduces their appeal and value to the user. To ensure intuitive and cooperative interaction between the AV and others, and a smooth flow of all traffic, it is essential that there is good means of communication between all actors. The main objective of interACT is to substantially improve this communication and cooperation strategy. interACT will provide an overview of current human-machine interactions in mixed traffic, and increase chances of safe deployment of AVs by developing novel software and HMI hardware components for reliable and user-centric communication between an AV with its users.

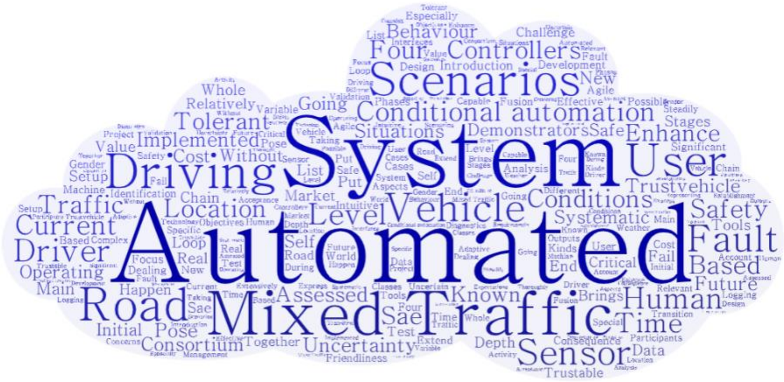
interACT will:

1) Use social-psychological models to compile a catalogue of interactions, identifying the main communication needs of road users in current and future traffic scenarios
2) Improve software algorithms and sensor capabilities for assessing intention recognition and behaviour prediction of surrounding road users
3) Use a Cooperation and Communication Planning Unit to integrate planning algorithms, providing synchronised and integrated communication protocols
4) Ensure safety of road users by developing easy-to-verify software for a safety layer, and novel methods for fail-safe trajectory planning.
5) Prototypes will be developed and evaluated in multi-actor simulators and two test vehicles, assessing ease-of-use, acceptance, safety and reliability. The impact of this successful

communication on reduction of crashes, improvement of traffic flow and acceptance of AVs by society will be investigated.

TrustVehicles

Coordinator:	Virtual Vehicle Research GmbH
Project partners:	AVL List GmbH CISC SEMICONDUCTOR GMBH Infineon Technologies Austria AG, Virtual Vehicle Research GmbH, LINKKER OY, Finland VTT Technical Research Centre of Finland Ltd., VALEO VISION SAS, IDEAS & MOTION SR, VOLVO PERSONVAGNAR AB, FORD OTOMOTIV SANAYI ANONIM SIRKETI, TOFAS TURK OTOMOBIL FABRIKASI ANONIM SIRKETI, University of Surrey
Start date:	06/2017 (duration: 30 month)
Funding by:	Horizon 2020
Website:	http://www.trustvehicle.eu//



Automated driving can be implemented with relatively simple controllers if the current location of the ego vehicle and the current and future locations of other road users are known without uncertainty. However, this is not going to happen in the initial stages of the introduction of automated driving systems into the market. As a consequence, system and human driver uncertainty pose a significant challenge in the development of trustable and fault-tolerant automated driving controllers, especially for conditional automation (SAE level 3) in mixed traffic scenarios. The TrustVehicle consortium brings together participants from the whole vehicle value chain to enhance safety and user-friendliness of level 3 automated driving systems.

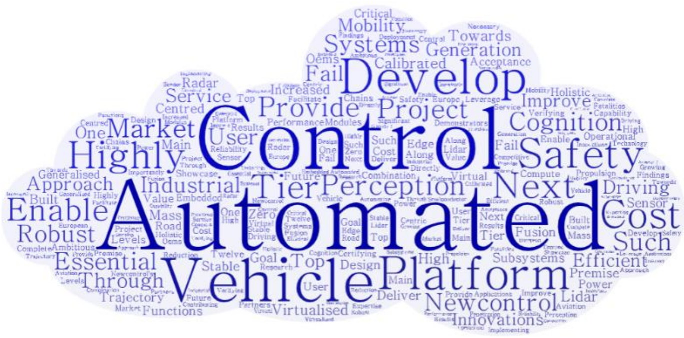
The main objectives are:

1) the systematic identification of critical road scenarios based on in-depth analysis of possible traffic situations and human behaviour;
2) the setup of new tools for the cost- and time-effective assessment of driver-in/off-the-loop situations;
3) design of controllers and sensor fusion systems capable of dealing with complex, uncertain and variable road scenarios to enhance road safety;
4) the implementation of intuitive human-machine interfaces for the safe management of the transition phases taking into account user acceptance and gender-specific aspects; and
5) the establishment of an adaptive and agile vehicle validation based on self-diagnostics and data logging to steadily extend the list of relevant scenarios and test cases.

The outputs of the TrustVehicle project will be extensively assessed in real-world operating conditions on four demonstrators representing four vehicle classes. End users of the technology will systematically and thoroughly express their requirements, expectations, and concerns during the consortium activity. Special focus will be put on the demonstration of the fault-tolerant and fail-operational system behaviour at any time and for different kinds of weather conditions.

NewControl – Intelligence on Board

Coordinator:	AVL List GmbH
Project partners:	INFINEON TECHNOLOGIES AG, FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., NXP SEMICONDUCTORS GERMANY GMBH, TU MUENCHEN, AVIONTEK GMBH, AVL LIST GMBH, INFINEON TECHNOLOGIES AUSTRIA AG, Virtual Vehicle Research GmbH, TTTECH COMPUTERTECHNIK AG, VYSOKE UCENI TECHNICKE V BRNE, INSTITUT MIKROELEKTRONICKYCH, APLIKACI S.R.O., IDEAS & MOTION SRL, MAGNETI MARELLI S.P.A., UNIVERSITA DI PISA, UNIVERSITA DEGLI STUDI DI MODENA E REGGIO EMILIA, DANISI ENGINEERING SRL, 4S-SISTEMI SICURI E SOSTENIBILI SRL, TECHNISCHE UNIVERSITEIT DELFT, TU EINDHOVEN, SMART PHOTONICS BV, NXP SEMICONDUCTORS, NETHERLANDS BV, INNOLUCE BV, AMBER NEDERLAND BV, IDNEO TECHNOLOGIES SAU, KNOWLEDGE CENTRIC SOLUTIONS SL, UNIVERSIDAD CARLOS III DE MADRID, AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS, FORD OTOMOTIV SANAYI ANONIM SIRKETI, HABITUS ARASTIRMA VE DANISMANLIK LIMITED SIRKETI, XENOMATIX, VRIJE UNIVERSITEIT BRUSSEL, BiFAST, UAB Teraglobus, THALES SA, PSA ID, Internet of Things applications and Multi-Layer development, Valossa Labs Oy, TAMPEREEN KORKEAKOULUSAATIO SR, Teknologian tutkimuskeskus VTT Oy, AALTO KORKEAKOULUSAATIO SR, OKMETIC OY, MURATA ELECTRONICS OY, UNIKIE OY
Start date:	04/2019 (duration: 36 month)
Funding by:	ECSEL JU
Website:	http://www.newcontrol-project.eu



NewControl will develop virtualised platforms for vehicle subsystems that are essential to highly automated driving (such as perception, cognition and control), so as to enable mobility-as-a-service for next generation highly automated vehicles. It will provide an industrially calibrated trajectory towards increased user-acceptance of automated control functions, through an approach that is centred on the premise of safety by design.

NewControl will deliver a fail-operational platform for robust, holistic perception through a combination of Lidar, Radar, and sensor fusion. The project will also develop a generalised virtual platform for stable and efficient control of propulsion systems, on top of cost- and power-efficient, high-performance embedded compute-platforms for in-vehicle perception, cognition, and control. Robust approaches for implementing, verifying, and certifying automated control for safety-critical applications will be one of the main results of this ambitious project.

Twelve (12) demonstrators will be built to showcase the project's findings and their capability to facilitate perception, cognition and control of next generation highly automated vehicles. The developments in NewControl will enable significant cost reduction for essential modules of future automated vehicles. These developments will improve the safety and reliability of automated systems to the levels necessary for mass-market deployment. These innovations will leverage the expertise of industrial (OEMs, Tier-1, Tier-2 and technology providers) and research partners along the complete semiconductor, automotive, and aviation value chains, providing Europe with a competitive edge in a growing market. Importantly, NewControl's innovations will improve the market penetration of safety-centric automation systems, contributing directly to the European goal of zero road fatalities by 2050.

PRYSTINE – Sensors and Senor Fusion

Coordinator:	Infineon Technologies Austria AG
Project partners:	CISC SEMICONDUCTOR GMBH, TU GRAZ, Virtual Vehicle Research Center GmbH, AVL LIST GMBH, DICE DANUBE INTEGRATED CIRCUIT ENGINEERING GMBH & CO KG, INFINEON TECHNOLOGIES AUSTRIA AG, TTTECH COMPUTERTECHNIK AG, INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM, TENNECO AUTOMOTIVE EUROPE BVBA, MATTERSOFT OY, NOKIA SOLUTIONS AND NETWORKS OY, TTY-SAATIO, TURUN YLIOPISTO, TTS KEHITYS OY, MURATA ELECTRONICS OY, OKMETIC OYJ, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, INFINEON TECHNOLOGIES AG, VIDEANTIS GMBH, FRIEDRICH-ALEXANDER-UNIVERSITAET ERLANGEN NUERNBERG, EPOS EMBEDDED CORE & POWER SYSTEMS GMBH & CO. KG, TTTECH GERMANY GMBH, OSTBAYERISCHE TECHNISCHE HOCHSCHULEAMBERG-WEIDEN, BAYERISCHE MOTOREN WERKE AG, HOCHSCHULE OFFENBURG, G.N.T. SYSTIMATA PLIROFORIKIS AE, AUTOCAR MEDIA GROUP LTD. STARHOME, AITEK SOCIETA' PER AZIONI, IDEAS & MOTION SRL, MASERATI S.P.A., POLITECNICO DI TORINO, RE:LAB S.R.L., UNIVERSITA DEGLI STUDI DI MODENA E, REGGIO EMILIA, CENTRO RICERCHE FIAT SCPA, UAB METIS BALTIC, ELEKTRONIKAS UN, DATORZINATNU INSTITUTS, ANYWI TECHNOLOGY BV, DAT.MOBLITY BV, NXP SEMICONDUCTORS NETHERLANDS BV, NEDERLANDSE ORGANISATIE VOOR, TOEGEPAST NATUURWETENSCHAPPELIJK, ONDERZOEK TNO, TU DELFT, TU EINDHOVEN, INNOLUCE BV, NOORD-BRABANT PROVINCIE, UNIVERSITATEA POLITEHNICA DIN BUCURESTI, AGENCIA ESTATAL CONSEJO SUPERIOR, DEINVESTIGACIONES CIENTIFICAS FICOSA ADAS S.L., IDIADA AUTOMOTIVE TECHNOLOGY SA, INSTITUTO TECNOLOGICO DE INFORMATICA ROVIMATICA SL, FUNDACION TECNALIA RESEARCH & INNOVATION, IRIZAR S COOP, KUNGLIGA TEKNISKA HOEGSKOLAN, SCANIA CV AB, FORD OTOMOTIV SANAYI ANONIM SIRKETI, AVL ARASTIRMA VE MUHENDISLIK, SANAYI VE TICARET LIMITED SIRKETI, HABITUS ARASTIRMA VE, DANISMANLIK LIMITED SIRKETI
Start date:	05/2018 (duration: 36 month)
Funding by:	ECSEL JU
Website:	https://prystine.automotive.oth-aw.de/

Programmable Systems for Intelligence in Automobiles

Fully automated driving is one major enabler to master the Grand Societal Challenges of safe, clean and efficient mobility, and autonomous driving will affect society and most disruptively change the automotive industry as we know it today. Consequently, it will also greatly impact the semiconductor industry and open new market opportunities, since semiconductors play an indispensable role as enablers for automated vehicles.

Fail-operational behaviour is essential in the automation chain, in order to handle safety-critical situations on its own. State-of-the-art approaches cannot reach this, in part due to a lack of reliable environment perception and sensor fusion.

PRYSTINE will realise Fail-operational Urban Surround Perception (FUSION) which is based on robust Radar and LiDAR sensor fusion and control functions, to enable safe automated driving in urban and rural environments. It will strengthen and extend traditional core competencies of the European industry, research and universities in smart mobility and in particular the electronic components and cyber-physical systems domains.

Technically, project targets are to develop and validate new, fail-operational HW/SW platforms, high performance and dependable perception (sensor fusion on different levels) and AI-based decision-making algorithms – the functional safety methodologies are applied from the chip to the system level.

PRYSTINE will deliver:

- fail-operational sensor-fusion framework on component level;
- dependable embedded E/E architectures, and
- safety compliant integration of Artificial Intelligence (AI) approaches for object recognition, scene understanding, and decision making within automotive applications.

The resulting reference FUSION architectures and reliable components for autonomous systems will be validated in 22 industrial demonstrators, including an electrical and highly automated commercial truck equipped with new FUSION components (such as LiDAR, Radar, camera systems, safety controlers) for advanced perception and a highly connected passenger car anticipating traffic situations.

PRYSTINE's well-balanced, value chain oriented consortium, is composed of 60 project partners from 14 different European and non-European countries, including leading car manufacturers, Tier-1 suppliers, engineering and semiconductor suppliers as well as supply chain partners, technology integrators, universities and research institutes. The project will also have significant impact on smart regions. High-tech jobs in the area of innovation toward automated driving which are expressed core competences of the participating countries such as Austria, Germany, Italy, Spain and the Netherlands.

PEGASUS - SECURING AUTOMATED DRIVING EFFECTIVELY

Coordinator:	German Aerospace Center (DLR) Volkswagen AG
Project partners:	Audi AG, ADC Automotive Distance Control Systems GmbH, BMW Group, Continental Teves AG & Co. oHG, Daimler AG, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Forschungsgesellschaft Kraftfahrwesen mbH Aachen (fka), iMAR Gesellschaft für inertiale Mess-, Automatisierungs- und Regelsysteme mbH, IPG Automotive GmbH, Opel Automobile GmbH, QTronic GmbH, Robert Bosch GmbH, Technische Universität Darmstadt – FZD, TraceTronic GmbH, TÜV SÜD Auto Service GmbH, VIRES Simulationstechnologie GmbH, Volkswagen AG
Start date:	01/2016 (duration: 42 month)

Funding by: German Federal Ministry for Economic Affairs and Energy

Website: https://www.pegasusprojekt.de/en/home

PEGASUS delivers the standards for automated driving. With the PEGASUS joint project, promoted by the Federal Ministry for Economic Affairs and Energy (BMWi), key gaps in the field of testing will be concluded by the middle of 2019, up to the release of the highly-automated driving functions.

The dream of many car drivers appears like this: while driving, one simply switches to the autopilot, sits back, reads, etc. The technical requirements have already been met at the present moment. However, until these automation systems can actually be used on the roads, a million times, there are still many questions that have to be clarified. In particular: what are the requirements for self-propelled vehicles? How can the safety and reliability of these systems be proven?

And not to forget: as nice as the future vision of self-driving cars might be – without people behind the wheel, it will not work. In particular, the transfer of responsibility from the driver to the automated system comes with high demands, since the humans no longer have to continuously monitor their driving task and can devote themselves to other activities. But what role will the human factor play in the future? What does technology have to guarantee? And how can optimally shape the interplay between humans and technology? In such situations, there is an enormous demand for research, when it comes to bringing highly-automated vehicles, quickly and safely on the market.

Standards for the safeguarding of highly-automated vehicles

In order for such functions to be approved, new and standardized quality standards and methods must be developed in the coming years – through the close cooperation between the research and industry fields. This is what the PEGASUS joint project stands for: project for the establishment of generally accepted quality criteria, tools and methods as well as scenarios and situations for the release of highly-automated driving functions. The objective is to develop a procedure for the testing of automated driving functions, in order to facilitate the rapid implementation of automated driving into practice.

The German automotive industry maintains the opinion that a standardized procedure in the field of testing and experimenting is necessary, for the securing and approval of higher levels of automation. For this reason, the PEGASUS project has brought together automotive companies, suppliers, small and medium-sized companies as well as research facilities. PEGASUS will develop, until 2019, a generally accepted and standardized procedure, for the testing and approval of automated driving functions. The 17 project partners from the science and industry fields define hereby a state-of-the-art technology for the safeguarding of highly-automated driving and demonstrate the development in a practical manner, using the example application of the highway chauffeur, which takes over the highly-automated driving on the highway.

Overview of the main goals:

- Definition of a standardized procedure for the testing and experimenting of automated vehicle systems in simulation, on test stands and in real environments.
- Development of a continuous and flexible tool chain to safeguard the automated driving.
- Integration of the tests in the development processes at an early stage.
- Creation of a cross-manufacturer method for the safeguarding of highly automated driving functions.

KI-Daten Tooling (AI Data Tooling)

Coordinator:	BMW Group
Project partners:	BMW Group, Bosch Group, Continental AG, Valeo, ZF Friedrichshafen, Ansys, AVL List, dSpace, DLR, FKFS, FZI Forschungszentrum Informatik, Bergische Universität Wuppertal, TH Aschaffenburg, TU Braunschweig, TU München, Universität Kassel, Universität Passau
Start date:	04/2020 (duration: 36 month)
Funding by	German Federal Ministry for Economic Affairs and Energy
Website:	https://www.ki-datatooling.de/

Goal and Challenge

The research project KI Data Tooling develops and investigates methods and tools for the provisioning of data of different sensor modalities (camera, lidar, radar) for AI-based automated driving functions. Through the integrated consideration of real data and synthetic data as well as the use of efficiency potentials in their combination, the project is the first to develop a comprehensive data solution for the training and validation of AI-based automated driving functions.

A sound data base comprising various sensor modalities is essential for the successful implementation of AI-based functions in vehicles. So far, however, only isolated solutions exist for the data of individual sensor types, highly restricted scenarios or parts of the training and evaluation chain.

Approach

In the project KI Data Tooling, real, synthetic and augmented data of different sensor modalities will be generated. Methods for analysis, quality assessment, and efficient and resource-saving storage and transmission of this data will be developed. Based on these methods and data, an optimized AI training strategy will be created. Specifically, the following core innovations will be developed:

- Methods for automatic labelling of real data and improvement of the efficient recording as well as processing of this real data
- Methods for generating synthetic radar sensor signals
- Validation of synthetic sensor data and extension of existing toolchains to generate such data

- Training process for AI functions based on synthetic, real, and augmented data, taking into account requirements of real-world applications
- Methods for context identification and exploitation, and compression of training data •
- Methods for corner case detection and synthesis

L3 Pilot

Coordinator:	Volkswagen AG
Project partners:	Audi Aktiengesellschaft, BMW AG, CENTRO RICERCHE FIAT SCPA, Daimler AG, Ford-Werke GmbH, Honda R&D Europe, Jaguar Land Rovers Ltd., Adam Opel AG, PSA Auotmobiles, Renault, Toyota Motors Europe, Volvo, Aptive Services, FEV Europe, Bundesanstallt für Straßenwesen, DIENST WEGVERKEER (RDW), FEDERATION INTERNATIONALE DE L'AUTOMOBILE, AZT AUTOMOTIVE GMBH, SCHWEIZERISCHE RUCKVERSICHERUNGS-GESELLSCHAFT AG, DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV, RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, CHALMERS TEKNISKA HOEGSKOLA AB SAMFUNNS-OG NAERINGSLIVSFORSKNING AS, UNIVERSITY OF LEEDS, INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS, WIVW WUERZBURGER INSTITUT FUR VERKEHRSWISSENSCHAFTEN GMBH, UNIVERSITA DEGLI STUDI DI GENOVA, NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO, UNIVERSITY OF SURREY, HAGLEITNER WALTER, EUROPEAN CENTER FOR INFORMATION AND COMMUNICATION TECHNOLOGIES GMBH, OPEL AUTOMOBILE GMBH, THE UNIVERSITY OF WARWICK, VEONEER SWEDEN AB
Start date:	09/2017 (duration: 48 month)
Funding by	EU, Horizon 2020
Website:	https://l3pilot.eu/

The overall objective of the L3Pilot project is to test the viability of automated driving (AD) as a safe and efficient means of transportation, exploring and promoting new service concepts to provide inclusive mobility. This high-level objective is detailed as four major technical objectives: (i) create a standardized Europe-wide piloting environment for automated driving (ii) coordinate activities across the piloting community to acquire the required data (iii) pilot, test, and evaluate automated driving functions and connected automation (iv) innovate and promote AD for wider awareness and market introduction. The European automotive sector must remain competitive in vehicle automation in the face of increasing competition from the US and Asia. Only by joining forces in pilot testing and evaluation of AD systems with real users will European industry meet the challenge coming from overseas. The project will focus on large-scale piloting of SAE Level 3 functions, with additional assessment of some Level 4 functions. The functionality of the systems used is exposed to variable conditions in 11 European countries, 100 vehicles and 1000 test drivers. The approach will be to adapt the FESTA methodology for testing automated driving needs. The tested functions cover a wide range from parking to overtaking, and urban intersection driving. Due to its large coverage of driving situations, L3Pilot is unique, and the first project which will demonstrate and test such a comprehensive menu of automated driving functions. The data collected will also be made available for third parties outside the consortium, for further use. The evaluation of the data will focus on technical, user acceptance, driving and travel behavior, impact on traffic and society. The project promotion will include user outreach campaigns with four showcases, and the creation of a comprehensive guideline - a Code of Practice - with best practices for the development of automated driving functions.

4.5.3 Projects with focus on relevant technologies

COREnect

Coordinator:	Technical University Dresden
Project partners:	Technische Universität Dresden/Barkhausen Institut, 5G IA,III-V Lab/Nokia, AENEAS, Australo, Bosch Group, CEA-Leti, Ericsson AB, imec, Infineon Technologies, NXP Semiconductors Netherlands BV, STMicroelectronics
Start date:	07/2020 (duration: 24 month)
Funding by:	Horizon 2020
Website:	http://www.corenect.eu

In view of the importance of core technologies both for European sovereignty and for decreasing the dependence of European industry on American and Asian technologies in the smart networks and services domains, it is vital that Europe reinvents its strategy for developing core technologies for 5G and beyond. This requires concrete and coordinated actions from both the European telecommunications industry and the European microelectronics industry.

COREnect brings together the most prominent European industrial and academia players as well as industry associations in the network, microelectronics and verticals domains to jointly design a core technology roadmap. The goal is to establish a sustainable European technology sovereignty in 5G and beyond, promote innovation and business opportunities, e.g. for small and medium-sized businesses (SMEs), pave the way for one or more future European champions in this area, and lay a solid foundation for the long-term success of both industries. A new COREnect community will emerge from the close collaboration between Smart Networks and Services (SNS) and Key Digital Technologies (KDT) communities as well as with other related communities, e.g. on High-Performance Computing (HPC), artificial intelligence (AI), Photonics, IoT and Cloud. Through outreach activities via its extensive industry and academia network, COREnect will have the potential to significantly impact the European R&I and industry landscape of future connectivity systems over the next ten years.

Main objectives of COREnect are to:

- Bring European major players in microelectronics and telecommunications together, developing a strategic roadmap of core technologies for future connectivity systems, decreasing European dependence on other continents and building technological sovereignty in 5G and beyond 5G;

- Establish a connection and collaboration between the Smart Networks and Services (SNS) community and the Key Digital Technologies (KDT) community at the strategic research & innovation agenda level;
- Promote COREnect results to stakeholders in both private and public sectors and create the conditions for one or more European champion(s) in the domain of core technology for attaining goals.

1000kmPlus

Coordinator:	INFINEON TECHNOLOGIE AG
Project partners:	Infineon Technologies AG, AVL List, Brno University of Technology, Daimler AG, Fraunhofer IISB, OTH Amberg – Weiden, TU Dresden, Valeo Siemens eAutomotive Germany, Hutchinson S.A., IONITY GmbH
Start date:	01/2019 (duration: 42 month)
Funding by:	Horizon 2020
Website:	https://1000kmplus.automotive.oth-aw.de/

The electric vehicles (EV) market is progressively developing worldwide: in only 10 years, Europe has developed cutting-edge technologies. It must now speed up to enter early mass production, thus ensuring large market shares and a wide adoption of the products provided. The need for scalable and brand-independent technology platforms for the key EV elements, like the inverter-motor-transmission/gearbox (powertrain) and the battery, is evident. The project 1000kmPLUS addresses this point globally, to ensure the superiority of European automotive key technologies in terms of performance, scalability and costs for the 2nd and 3rd generation of EV.

The 1000kmPLUS project is organised in a matrix structure: Work Packages (WP) versus Supply Chains (SC) to ensure a smooth and continuous follow-up of the Key Performance Indicators (KPI: see Table 4), an on-time delivery, and a high-quality outcome. The WP represent the development process in general and the SC represent the different systems and components developed in the project to achieve the 100kmPLUS project objectives. Each major demonstrator developed in the project is covered by an SC. This structure facilitates a clear separation between the research and development work carried out in the WPs on one side, and the actual implementation, testing and benchmarking performed on the demonstrators on the other side. Each SC is led by a highly competent partner in the respective application domain to ensure a perfect outcome. To do so, the 1000kmPLUS project brings together the following SCs:

- Supply Chain 1: Scalable and highly efficient powertrain technology platform: common inverter-motor making use of highly efficient SiC MOSFET power modules offering scalability in power (40-120 kW) and in voltage (400-800 V), thus enhancing the driving range.
- Supply Chain 2: Fast-charging capable and weight optimized battery system: 800 V modular battery system with reduced mechanical structure weight, improved thermal management performance, and using battery cells optimised for fast charging.
- Supply Chain 3: Vehicle integration and energy management, including demonstration: integrated thermal management with advanced insulating materials and new road routing algorithms coupling the fast charging infrastructure with short charging times, thus lowering the overall travelling time. The demonstration challenges (1000 km, 2000 km, 4500 km) will also take place in this Supply Chain.
-

InSeCTT

Coordinator:	Virtual Vehicle Research GmbH
Project partners:	VIRTUAL VEHICLE RESEARCH CENTER, ABB AB, ACCIONA CONSTRUCCION SA, AEROPORTI DI PUGLIA S.P.A., AKEO PLUS, Capgemini Engineering, ARCELIK A.S., AVL LIST GMBH, CISC SEMICONDUCTOR GMBH, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, CONSORZIO INTERUNIVERSITARIO NAZIONALE PER L'INFORTATICA, CORK INSTITUTE OF TECHNOLOGY, EUROTECH SPA, F-SECURE OYJ, IDEMIA IDENTITY & SECURITY FRANCE, INDRA SISTEMAS S.A., INSTITUT JOZEF STEFAN, INSTITUTO SUPERIOR DE ENGENHARIA DO PORTO, ISS RFID SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA, J.I.G INTERNET CONSULTING SL, JOHANNES KEPLER UNIVERSITÄT LINZ, KAITOTEK OY, KLAS LIMITED, KUNGLIGA TEKNISKA HOEGSKOLAN, LEONARDO S.P.A, LIEBHERR CONTAINER CRANES LTD, LINZ CENTER OF MECHATRONICS GMBH, MAELARDALENS HOEGSKOLA, MARMARA UNIVERSITY, MONDRAGON GOI ESKOLA POLITEKNIKOA JOSE MARIA ARIZMENDIARRIETA S COOP, NURD YAZILIM A.S., NXP SEMICONDUCTORS AUSTRIA GMBH, NXP SEMICONDUCTORS NETHERLANDS BV, PAVO TASARIM URETIM ELEKTRONIK TICARET ANONIM SIRKETI, PHILIPS ELECTRONICS NEDERLAND B.V., POLITECHNIKA GDANSKA, REALTIME EMBEDDED AB, RISE RESEARCH INSTITUTES OF SWEDEN AB, SILICON AUSTRIA LABS GMBH, SOCIETÀ EMILIANA TRASPORTI AUTOFILOVIARI S.P.A., STMICROELECTRONICS ROUSSET SAS, TECHNISCHE UNIVERSITEIT DELFT, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, TIETO FINLAND OY, TIETO SWEDEN AB, UNIVERSIDAD POLITÉCNICA DE MADRID, UNIVERSITEIT TWENTE, UNIVERSITY COLLEGE CORK - NATIONAL UNIVERSITY OF IRELAND, CORK, VEMCO SP ZOO, VORTEX - ASSOCIAÇÃO PARA O LABORATÓRIO COLABORATIVO EM SISTEMAS CÍBER-FÍSICOS E CÍBER-SEGURANÇA, WAPICE LTD WAPICE AB, WESTERMO TELEINDUSTRI AB
Start date:	06/2020 (duration: 36 month)
Funding by:	ECSEL JU
Website:	https://www.insectt.eu/

Artificial Intelligence of Things (AIoT) is the natural evolution for both Artificial Intelligence (AI) and Internet of Things (IoT) because they are mutually beneficial. AI increases the value of the IoT through machine learning by transforming the data into useful information, while the IoT increases the value of AI through connectivity and data exchange. The ECSEL JU project InSecTT – Intelligent Secure Trustable Things, a pan-European effort with 54 key partners from 12 countries, will provide intelligent, secure and trustworthy systems for industrial applications to provide comprehensive cost-efficient solutions of intelligent, end-to-end secure, trustworthy connectivity and interoperability to bring the Internet of Things and Artificial Intelligence together. InSecTT aims at creating trust in AI-based intelligent systems and solutions as a major part of the AIoT.

InSecTT will enable cooperation between big industrial players from various domains, a number of highly innovative SMEs distributed all over Europe and cutting-edge research organisations and universities. The project features a big variety of industry-driven use cases embedded into various application domains where Europe is in a leading position, i.e. smart infrastructure, building, manufacturing, automotive, aeronautics, railway, urban public transport, maritime as well as health. The demonstration of InSecTT solutions in well-known real-world environments like airports, trains, ports, and the health sector will generate a massive impact on both high and broad level, going from citizens up to European stakeholders. InSecTT will bring intelligent solutions into the market by conclusive showcases all over Europe, hence strengthening Europe's industry and once more make European solutions a frontrunner in cutting-edge technology.

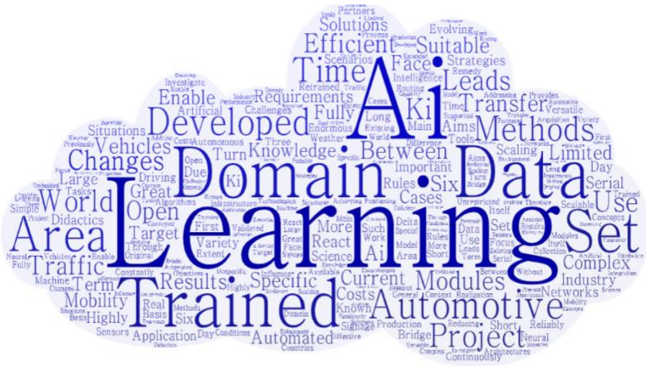
InSecTT will open up new market opportunities for the European industry, will significantly reduce time to market and decrease costs for trustable AIoT solutions on the market, in particular by using new designs and technical building blocks. InSecTT is aiming to achieve the full potential of the "Artificial Intelligence of Things" - it will establish the EU as a centre of intelligent, secure and trustworthy systems for industrial applications enabled by a strong industry with a strong reputation and an informed society, in order to enable products and services based on AI compliancy to European values and "Made in Europe".

KI-Delta Learning - Scalable AI for Automated Driving

Coordinator:	Mercedes-Benz AG
Project partner:	Mercedes-Benz AG, BMW Group, Porsche Engineering Group GmbH, Robert Bosch GmbH, Valeo Schalter und Sensoren GmbH, Volkswagen car.SW Org Wolfsburg AG, ZF Friedrichshafen AG, CMORE Automotive GmbH, InnoSenT GmbH, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), FZI Forschungszentrum Informatik, OFFIS e.V., Albert-Ludwigs-Universität Freiburg, Bergische Universität Wuppertal, Hochschule Reutlingen, TU München, Universität Stuttgart, Eberhard Karls Universität Tübingen,
Start date:	01/2020 (duration: 36 month)

Funding by: German Federal Ministry for Economic Affairs and Energy
Website: https://www.ki-deltalearning.de/en/

Highly and fully automated vehicles face a large variety of complex situations in a continuously evolving world of mobility. This leads to great challenges in scaling AI (artificial intelligence) modules for serial production of autonomous vehicles. Currently, automotive AI solutions react reliably only in limited scenarios and algorithms must be constantly retrained for new domains, resulting in enormous development costs. In KI Delta Learning, leading partners from science and industry investigate versatile machine learning solutions that enable a more efficient training of AI modules and, in turn, the unrestricted realization of automated driving in the Open World. Through new methods for efficiently transferring existing knowledge to new application areas the project aims to bridge deltas – the difference in requirements between a known domain and a new target domain – addressing six important use cases.



Delta Learning – 6 use cases

- Sensors: Changes in positioning and technologies
- Countries: Changes in infrastructure, signage and traffic rules
- Traffic areas: From simple to complex traffic routing
- Short-term changes: Day time, weather conditions
- Long-term changes: New mobility concepts
- Networks: Developments in training strategies and neural networks architectures

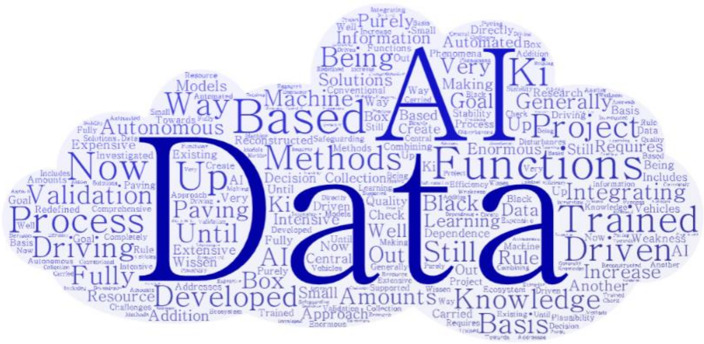
New methods for a scalable AI

To remedy these deltas, new methods are developed and validated supported by a project-specific delta data set in three main areas: transfer learning, didactics and automotive suitability. Data acquisition – the delta between general training data sets and specific Delta Learning data Available training data sets are often unspecific to delta learning and only suitable to a limited extent for achieving the project objectives. For the first time, the collection of a comprehensive project-specific data set provides the basis for the efficient development of Delta Learning methods. Transfer learning – the delta between previously trained and new domains New tools and methods will be developed to enable AI modules to be extended and transferred to new domains and new tasks without significantly reducing their performance in their original application area. Didactics – the delta in the learning process Not only the knowledge itself, but also how the knowledge is conveyed, has an influence on the learning results. Therefore, project work will focus on targeted learning strategies and model structures for effective and efficient training. Automotive suitability – the delta between special requirements in the automotive industry and current AI approaches of other research areas AI modules must have important properties such as robustness and real-time capability in the automotive context. New domains due to changes in the open world represent deltas in addition to new hardware requirements for the integration into the embedded environment.

KI Wissen – Automotive AI powered by Knowledge

Coordinator:	Continental AG
Project partners:	Continental AG, Bosch Group, Valeo, Altran, Alexander Thamm GmbH, AVL List, BTC AG, EFS, Elektronische Fahrwerksysteme GmbH, DFKI, DLR, fortiss, Fraunhofer IAIS, Fraunhofer Fokus, FZI Forschungszentrum Informatik, OFFIS, Universität des Saarlandes, bast
Start date:	01/2021 (duration: 36 month)
Funding by:	German Federal Ministry for Economic Affairs and Energy
Website:	https://www.kiwissen.de/

Development of methods for integrating knowledge into machine learning



AI-based processes are paving the way to fully automated driving. Up until now, the development of AI solutions has been purely driven by data. This data driven approach requires enormous amounts of data for the training and validation of AI functions, with the collection and processing of this data being very resource-intensive and expensive. In addition to the dependence on extensive amounts of data, data-based AI processes have another weakness: they are still generally black-box models for which the decision-making process cannot be directly reconstructed.

In the research project KI Wissen, methods for integrating existing knowledge into the data-driven AI functions of autonomous vehicles are being developed and investigated. The goal of the project is to create a comprehensive ecosystem for the integration of knowledge into the training and safeguarding of AI functions. By combining conventional data-based AI methods with the knowledge- or rule-based methods developed in the project, the basis for training and validating of AI functions will be completely redefined: This basis now includes not only data, but information, i.e., data and knowledge. The development from data- to information-based AI carried out in the project addresses the central challenges towards autonomous driving: the generalization of AI to phenomena with small data bases, the increase of the stability of the trained AI to disturbances in the data, the data efficiency, the plausibility check and the validation of AI-supported functions as well as the increase of the functional quality.

4.6 EXCEL Lighthouse Mobility.E

The EXCEL Joint Undertaking introduced the concept of "Lighthouse Initiatives" to provide a meeting and cooperation platform to all actors within specific subjects of common European interest. Lighthouses initiate, facilitate, and coordinate various activities of these actors, like cooperation between projects (funded by the JU itself and/or within other H2020, Eureka, national or even regional initiatives), standardisation activities and assist in technology transfer and uptake. In this way, Lighthouse Initiatives provide a “container” resp. an “umbrella” for a set of well-coordinated activities.

The first lighthouse to be initiated was the Lighthouse Mobility.E initiative. It focusses its attention on the considerable technological, legislative and infrastructure difficulties facing large-scale deployment of safe, electrically powered, intelligent vehicles. In addition, it also serves as a “hub” and knowledge exchange platform for many of the European projects funded in this technology area; ArchitectECA2030 is one of these projects, with consortium members playing significant roles in the setup and continued work of Mobility.E. Last, but not least, Mobility.E also serves as an incubator for new projects, by identifying open research challenges and providing these as an input to e.g., the ECSEL SRIA.

In a way, Lighthouses play an equivalent role for projects as Industry Associations do for companies. However, Lighthouses are much more open to external stakeholders and even more so for projects like ArchitectECA2030 which is already part of the Lighthouse.

4.7 Tool providers

Electronic Components and Systems and thus, in turn, also L3+ vehicles, are designed, developed, implemented, tested and validated, and integrated into larger components resp. into the complete product using structured development processes supported and enabled by a large variety of software tools. These tools enable Engineers to do their job efficiently, and exchange data and artefact across process step borders as well as between different sub-organisations within their own company (like between Engineering and Marketing and Sales) and even across company borders. Thus, such tools also enable the relation between OEMs and TIERs resp. between TIERs and their suppliers. Although the number of software tools needed for these tasks is typically smaller than e.g. in Avionics (where typically more than 1000 such SW tools are employed), still also in Automotive the number of necessary tools often exceeds 100. These engineering tools are available from so called Tool Providers, of which there a lot of companies in Europe. Depending on the size of the companies, such Tool Providers may provide complete frameworks (or tool chains) that different steps in the development process, or they might provide only few tools that are optimized for executing a very specialized task during this process. The resulting engineering framework and its engineering tools that are used at the OEM or TIER for a specific task varies, and is often a mixture of tool chains enhanced by specialized tools.

Many of the standards that are used for demonstrating compliance of the product to regulations during homologation, require the assessment of system properties, which in turn are – at least in part – based upon properties of its components, which in turn depend upon properties of simple devices or other parts of that component. Demonstrating that these properties hold, therefore affects all levels of the design hierarchy and thus many, if not all, of the tools that are used for engineering such systems; it often requires the use of engineering tools that are specialized in exactly this task.

With this motivation, it becomes immediately clear that Tool Providers do have an immediate need to know about new methods and tools for demonstrating systems compliance to regulations during homologation, since these either influence the requirements set to the functionality of their existing tools or might open up new business opportunities by implementing additional tools able to fulfil these requirements efficiently.

However, Tool Providers are typically not very interested in defining the regulations or standards used for homologation. Plainly speaking, as long as they can implement the necessary tests or validation methods within their tools, they do not care that much about the concrete reasons for those tests.

4.8 Test Fields and Test Field Operators

Test fields and proving grounds provide an important infrastructure for testing and validation of L3+ vehicles. With them, many of the features and capabilities of new vehicle types can be tested in real-life-like environments. Tests in proving grounds are thus an important part of demonstrating functionality and safety of L3+ cars and thus of demonstrating their compliance with regulations.

Test fields are usually operated by independent organisations: Their set-up and maintenance are too expensive for single organisation like OEMs or Tiers; on the other hand, since test fields are used to validate features of vehicle types – instead of for each produced vehicle – no single car manufacturer would need the whole testing capacity that a test field provides. Test field Operators are usually consortia that include members of OEMs, Tiers, Research Organisation, local government and other actors. They typically sell testing time, (parts of) their test fields as well as accompanying services (like, e.g., electronic maps of the proving ground, storage capacity for the test data that is recorded, etc.) to all customers (i.e., OEMs and TIERs) that want to use it.

Test field operators need to ensure that their test fields provide exactly those services and capabilities that are needed for the operators to test their cars. Therefore, they are naturally interested in gaining knowledge about changes in homologation requirements and procedures, as well as in the appropriate standards. On the other hand, test field operators rarely have an interest in defining those regulations or standards. Much like Tool Providers, they will provide the necessary services and test infrastructure regardless of the concrete regulatory or standard environment.

The following paragraphs lists some existing test fields resp. proving grounds, their operators and a short summary of their capabilities. Members of the consortium are already cooperating with these test field operators in a variety of contexts, or are even involved as test field operators themselves.

AlpLab

Operators: Consortium with shareholders AVL LIST GmbH, Magna Steyr vehicle technology AG & Co KG, Joanneum Ressearch Forschungsgesellschaft mbH, Graz University of Technology, Virtual Vehicle Research GmbH.

Location Graz, Austria, and surrounding area

Website https://www.alp-lab.at/

The Austrian test region offers a unique and holistic infrastructure for developing and testing automated and connected vehicles and functions. The test region covers comprehensive testing opportunities on private and public test tracks. The in-house data management and data broker systems link the individual phases of our test chain covering ADAS/AD active safety test equipment, mobile HiL platforms, driving demonstrators and traffic monitoring systems. Our clients and customer network includes OEMs, TIER suppliers and many worldwide operating and leading technology companies. The test region offers

- Proving Ground

The test region is offering private proving grounds for a wide scope of application. ALP.Lab offers all-season ice-free testing, NCAP-conform testing, harsh condition & tunnel testing as well as winter testing possibilities. The region also cooperates with various additional proving grounds, e.g. with Zalazone (Hungary; see next section).

- A2/A9 Public Road Test
  ALP.Lab offers public road tests and UHD-maps of public primary roads, toll stations as well as private proving grounds focusing the Austrian road-characteristics.
- A2 Highway as Sensor
  The highway test track is located along the A2 (south motorway) between Laßnitzhöhe and Graz West. The concentrated section equipped with radar sensors is located between the “Airport Graz” entrance and exit and the “Graz-West” intersection.
- City of Graz (Urban Road Test)
  Public road tests with excessive road infrastructure like C-ITS units and different sensor-technologies for traffic monitoring are available.

Zalazone

Operators: Automotive Proving Ground Zala Ltd.

Location: Zala, Hungary

Website: https://zalazone.hu/

The Zalazone test track is unique, the traditional test track features focusing on driving and driving stability are implemented together with the research and development infrastructure elements connection with future vehicles on multi-level system for validation. The proving ground provides not only dynamics tests for conventional vehicle, but it also allows validation tests for autonomous vehicles and electric vehicles.

Zalazone is built in three different phases, where each phase adds additional testing features:

- Phase 1 (2017-2018)
  - Dynamic Platform
  - Braking Platform
  - Handling course
  - Roeadway
  - Smart City Zone
  - Buildings
- Phase 2 (2018-2020)
  - High-spped oval
  - Smart City Zone II
  - Bad roads
  - Slopes
  - Buildings II
- Phase 3 (from 2022)
  - Extensions for and development of Smart City Zones

Digitales Testfeld Autobahn (DTA, Digital Motorway Test Bed)

Operators: German Federl Ministry of Transport and Digital Infrastructure (BMVi) and state of Bavaria, supported by VDA and Bitkom.

Location: Part of Highway A9, Bavaria, Germany

Website https://www.bast.de/EN/Traffic_Engineering/Subjects/V5-digital-test-bed.html

DTA consist of a part of highway A9, which has been enhanced with infrastructure for highspeed LTE mobile connections, 5G communication, and data recording, storing and sharing capabilities within a so called Mobile Data Marketplace. The test field also offers UHD maps of the area. Additional infrastructure enhancements already have been or will be implemented.

Testfeld Autonomes Fahren Baden-Württemberg (TAF, Testfield Autonomous Driving, Baden-Württemberg)

Operators: Karlsruher Verkehrsverbund, cooperating with FZI Forschungszentrum Informatik, City of Karlsruhe, Karlsruher Institut für Technologie (KIT), Die Hochschule Karlsruhe – Technik und Wirtschaft, Fraunhofer IOSB, Stadt und Region Bruchsal, Hochschule Heilbronn

Location: Karlsruhe and surrounding areas, state of Baden-Württemberg, Germany.

Website: https://taf-bw.de/en/

TAF provides a full featured test field covering (parts of) highways, federal and country roads, city roads including bycicle lanes and pedestrian areas as well as tram and bus lines, parking garages and similar. These roads have been instrumented with communication and sensor facilities, maps, data storage capabilities and similar infrastructure. Within this environment, customers – industry as well as research organisations – can test autonomous driving vehicles. The operator company KVV itself uses this facilities for testing autonomous shuttles, busses and trams.

Test field Autonomous Driving Lower Saxony

Operators: DLR e.V., Volkswagen AG, Continental AG, Siemens AG, Wolfsburg AG, IAV GmbH, NordSys GmbH, Oecon Products & Services GmbH und ADAC Niedersachsen / Sachsen-Anhalt e.V

Location: Brunswick and surrounding areas, state of Lower-Saxony, Germany

Website: https://verkehrsforschung.dlr.de/en/projects/test-bed-lower-saxony-automated-and-connected-mobility

The test field autonomous Driving Lower Saxony offers an effective and flexible test infrastructure for the efficient development of automated and networked vehicles. This open research platform provides a unique and comprehensive combination of testing options, ranging from simulations through to test routes on public roads. In addition to offering highly accurate maps of traffic routes, the test field offers sections of motorway with state-of-the-art tracking and communications technologies. Upon completion, the test field in Lower Saxony will comprise approximately 280 kilometers on the A 2, A 7, A 39, and A 391 motorways, as well as several federal highways and state roads in the areas around Hanover, Wolfsburg, Braunschweig and Salzgitter. It integrates the established routes from the Application Platform for Intelligent Mobility (AIM), which has been fully operational since 2014 and has been deployed in Braunschweig City Centre. Road tests can be conducted across Lower Saxony in a variety of traffic environments and situations.

4.9 Insurance Companies

In the context of highly automated and autonomous driving, the task of insurance companies is to provide insurance coverage to vehicle operators for potential damage caused by operating the vehicle. To do this – or, more specifically, to assign a premium / cost for their policies – they need to do a risk assessment estimating the frequency of such damage occurring and the typical and maximal amount of damage that can be caused by operation of these vehicles. The ability to correctly assess the associated risk is vital to Insurance Companies: If they overestimate this risk, premiums would be accordingly high, which might prevent operators for buying them (since, on the other hand, insurance coverage is mandatory to have, this might prevent customers from buying L3+ cars at all). Even worse is the case where they underestimate the risk. The total amount needed to cover the actual occurring damage would be higher than the income generated from selling the policies, which might lead to bankruptcy of the company and – worse from a societal perspective – would leave all other insurance holders without coverage.

For the past, i.e. for cars with automation grades up to SAE Level 2, there is a large amount of data available which can be used to calculate this risk (i.e., accident statistics, but also the accident data collected by the insurance companies themselves), for L3+ vehicles no such statistics exists.

For the purpose of testing and validation of L3+ cars – and especially for residual risk-based homologation as done in ArchitectECA2030 – it is therefore important to harmonize with insurance companies about the way in which residual risk is estimated resp. computed during homologation and to what level these estimations need to be validated in order to enable a sufficiently accurate risk assessment for issuing their policies.

5 Forms of cooperation and mutual benefits

This section describes the forms of cooperation and interactions with stakeholders that ArchitectECA2030 offers. For each such cooperation mechanism we describe the way it works and the benefits that this form of cooperation offers to the stakeholder and to the project.

5.1 External Advisory Board

The closest form of cooperation that ArchitectECA2030 will offer to stakeholders is for them to become member of the External Advisory Board (EAB) that ArchitectECA203 will set up.

The EAB will comprise external partners from the stakeholder groups identified in Section 5. They are invited by the projects Steering Board resp. by the Project Coordinator and will be required to sign a Non-disclosure agreement protecting confidential information that they might receive during their activities. The operational procedures for installing and managing this EAB, including the agreement of all project partners to set up and cooperate with external partners as members of the EAB are included in the Project Consortium Agreement, which also includes a template for the PCA.

The purpose of setting up the EAB and cooperating with its members is to enable an extensive knowledge exchange between the project and external experts' writ. Homologation and standardisation activities. Especially, EAB members are expected to provide strategic advice and recommendations to the project and the work undergone within it, taking into account their expertise about homologation and standardization procedures, industry activities in this area, results and expected results from other projects, the concrete needs and activities of the stakeholder group they belong to and so on. This advice and recommendations are non-binding for the project or project partners, but will of course be of great value and thus be taken into account and at least be considered for the implementation of the work programme by the partners.

On an operational level, EAB members will provide their expert knowledge and advice by participating in EAB Workshops organized by the project as well as in General Assembly Meetings (if invited). Here, the work programme as well as generated results will be presented to EAB members who are expected to comment on it, and evaluate the results from their point of view resp. from the point of view of the stakeholder group they belong to (i.e. OEMs might evaluate the results with respect to their own plans and activities for homologation processes, standardisation organisations will advise upon standardization processes and content of standards, and so on.). In addition, EAB members will receive (drafts of) project deliverables, if the corresponding project partners wishes to do so, and be asked for review.

Last, but not least, EAB members are also first targets and multipliers for dissemination activities. They are expected to disseminate and advocate ArchitectECA2030 results within their respective stakeholder groups, thus on the one hand increasing the credibility of the results as well as their reach out and impact, and, on the other hand further harmonization and alignment of these results with their respective stakeholder group and beyond.

Mutual benefits

The benefits of installing an EAB and cooperating with its members for the project are manifold; the main benefit is to have the opportunity to exchange information and get experts advice upon the various technical and organizational topics that Architect is involved in. From OEMs and TIERs, the most valuable information would be about homologation processes and their plans and activities on how to homologate future L3+ cars. This could be achieved by either involving representatives of the OEMs and TIERs directly, or via involving the Automotive driven projects in that area (c.f. ‘KI family projects’ or ‘Pegasus family projects’ from Section 5.4). From standardization organisations the most useful information would be about how to integrate the extensions to standards that ArchitectECA2030 will propose, Insurance companies should provide information about detailed requirements for their risk assessment procedures, etc. The ability of being able to discuss these matters in a closed group protected by an NDA is highly valuable to ArchitectECA2030, and also serves the community by furthering knowledge exchange and harmonization of activities, avoiding double work (‘re-inventing the wheel’ and furthering community building, cooperation and incubation of ideas for follow-up projects. Last, but not least, the project benefits from the ‘ambassador role’ that EAB members will have in dissemination.

The advantages for stakeholders to become members of the EAB are also quite clear: They would be able to guide the project in directions that are (both compatible with the project objective and work plan and) aligned with their own activities and projects. They will gain early knowledge about the project results as well as to the deliverables, and thus propose further directions for work within the project, for dissemination, for exploitation, for standardization and for follow-up activities.

The benefits mentioned above of discussions of these matters in a closed group protected by NDAs, the harmonization of activities and avoidance of double work, community building and follow-up project incubation do apply to the members of the EAB as well as to the project itself.

5.2 Standardisation activities

ArchitectECA2030 will participate actively in the definition of emerging and the extensions of existing standards used for homologation of L3+ vehicles. Currently, the foreseen participations are to the revision of the main technical standards used currently for homologation: the revision of ISO 26262 (Functional Safety), ISO PAS 21448 V2 (SOTIF), and EuroNCAP Roadmap 2025, as well as to the ISO 21434 and SAE J3061 ("automotive cybersecurity"), c.f. KT 5, target 5 and 6 in the project proposal. To this, the main contributions foreseen are extensions to the residual risk-based methods proposed in these standards, the framework developed within the project, and the monitor device related activities. Several members of the ArchitectECA2030 project are already actively involved in the further development of these standards.

However, the selection of standards and the exact contributions that ArchitectECA2030 will make are of course dependent on the analysis and development work done in the project itself. More concretely, we will

- Identify the standards related to the work done in ArchtiectECA2030 itself (c.f. Deliverable D 7.8.)
- Select from those the ones that are most important for homologation activities.
- Compare the content of these standards with the requirements and regulations set for homologation of L3+ cars as well as with the residual risk method developed in the project ('Gap Analysis', c.f. Deliverables D7.8, D 1.5 and follow-up activities.) and select the ones with the 'closest fit'.
- Actively participate in extending the 'closest fit' standards with the results from ArchitectECA2030.

These activities require close cooperation with external stakeholders from all the stakeholder groups identified in Section 5, especially with the 'content providers' for standards – OEMs and TIERs that actively push these standards and develop new ideas for extending them to match existing and emerging regulations, with research projects that work in similar areas as ArchitectECA2030 (i.e., that are also active in homologation processes and/or standardization for homologation activities for L3+ vehicles) – as well as with organisations that define the needs and thus the requirements to such standards – regulatory and government bodies, technical service providers and insurance companies. Last, but not least also the organizational issues of how to extend existing resp. add new standards must be discussed with standardization bodies.

Mutual benefits

For the project, successful standardization activities will result in ensuring sustainability of the respective project results, which will in turn further dissemination and exploitation of these results. Cooperation partners' benefit differs between 'content providers' for standards, who will be able to include these results into 'their' standards, thus advancing the state of the art and ultimately leading to the ability to successfully homologate L3+ vehicles. On the other hand, standardization organisations will benefit from hosting the respective standards, both in terms of 'portfolio completeness' as well as in terms of size of their memberships (c.f. Section 5.2).

5.3 Twinning

ArchitectECA2030 will offer Twinning Activities targeted at specific stakeholders selected from the stakeholder groups identified in Section 5. These activities cover, amongst others, hosting common events (like thematic workshops, seminars, etc.), short term staff exchanges, expert visits (both at the stakeholder from the project and vice versa), on-site and virtual training, and similar. Twinning activities will also provide links between EU and US partners. These activities will benefit from participation of US partner in ArchitectECA2030 with possible extension to other institutes in US.

Main target group of these activities are other research projects that are active in similar areas as ArchitectECA2030 (c.f. Section 5.5), but also tool providers and test field operators. Other stakeholder groups could also be targeted after assessing their willingness and the mutual benefits of twinning with them.

Twinning activities are conducted within Task 7.1 of the project and will be reported on in detail within their deliverables. As the twinning activities are strongly dependent on travel possibilities, they were and probably will be impacted by restrictions related to COVID-19 pandemic situation.

Mutual benefits

The main benefit for the project of twinning is knowledge exchange and harmonization of activities. This will help the project to deliver results that are compatible with those of other projects in the sense that no work is repeated and that the same – or at least very similar – concepts for homologation of L3+ cars are followed. Twinning is also an important part of general dissemination activities and thus will also further exploitation of results.

These benefits are reciprocal: Twinning partners will benefit in exactly the same ways as ArchitectECA2030 partners.

5.4 Information and Knowledge Sharing

In addition to the ‘usual dissemination activities’ done in every funded project – in ArchitectECA2030 these are collected within Task 7.3 and will be reported on in the corresponding deliverables. – The project will also offer thematic workshops, seminars, and trainings to a non-targeted audience. For ArchitectECA2030 partners and the project, these are advanced dissemination activities, supporting sustainability and take-up of project results and also furthering exploitation.

6 Stakeholder Management Plan

Matching the needs and interests of the various Stakeholder Groups identified in Section 5 and the objectives of the project to the benefits achievable by the various forms of cooperation ArchitectECA2030 offers, we derive the following table as a basis for our external stakeholder strategy:

TABLE 1: MATCHING STAKEHOLDER GROUPS TO FORMS OF COOPERATION

Stakeholder Group	External Advisory Board	Standardization Activities	Twinning	Information and Knowledge Sharing
OEMs and TIERs	XX / X	XX / X		XX / XX
Standardization bodies	X / X	XX / XX		X / XX
Regulatory Bodies, notified bodies, government organizations	X / X	XX / XX		X / XX
Associations		X/X		X / X
Research projects…				
with a focus on Safety and Security Validation		X / X	XX / XX	XX / XX
with secondary focus on Safety and Security Validation			XX / XX	XX / XX
with focus on relevant technologies		X / X		XX / XX
Lighthouse Mobility.E	X / X	X / X		XX / XX
Tool providers			X / X	XX / XX
Test Field operators	X / X		X / X	X / XX
Insurance Companies	X / X	X / -		XX / XX

Each entry in the above table is either empty (denoting a non-match, i.e., the performing this form of cooperation with participants from that specific stakeholder group would provide no special benefits, neither for the project nor for the external partner), or it is of the form “a/b” where ‘a’ denotes the benefit for the project (either ‘X’ – beneficial or ‘XX’ – highly beneficial) and ‘b’ denotes the benefit for the external partner.

OEMs and TIERs are the central players resp. main actors behind all technical (i.e., non-regulatory) homologation and standardization related activities. ArchitectECA2030 has some partners out of this group, however, a stronger involvement of more members of this group – ideally as members of the EAB and for standardization activities – would be highly beneficial for the project. The main challenge to get their involvement is to increase their knowledge about the project and increase their awareness about the mutual benefits that cooperation with ArchitectECA2030 involves. Many project partners of ArchitectECA2030 maintain good connections both with the large OEMs as well as with the TIERs, but rarely with the organisational units that handle homologation and certification within these companies. Some information campaigns have already been started, but have been slow due to the pandemic situation. These contacts will be intensified and extended at the beginning of Year 2, as indicated in the DoW.

Standardization bodies Cooperation with standardization bodies are instrumental for all standardization activities planned by ArchitectECA2030. Contacting them and aligning our activities is part of the standardization activities as briefly sketched in Section 3.2. It remains to be seen whether for some specific standardization organisations the mutual benefit of including their representatives in the External Advisory Board is high enough.

Regulatory Bodies, notified bodies, government organizations With the exception of TSPs (Technical Service Providers) that implement the 'third party' in the third-party homologation process (cf. Section 4), cooperation with regulatory bodies and government organisations will be on the knowledge exchange level mostly. For TSPs it would be highly beneficial to include them into our standardization activities and probably even in the EAB. Preliminary discussions with various TÜV organisations have already been started and will be continued in Year 2.

Associations provide an – ideally aligned and harmonized – version of the views and activities of their members. Thus, with all of the cooperation forms offered by ArchitectECA2030, the receiving part of information exchange would be eased considerably for the project. However, in terms of knowledge dissemination, Associations provide both, a potential multiplier as well as a filter. We will contact various industrial associations during the second year of the project to find a sweet spot for both sides for cooperation measures.

Research projects, especially those focusing on validation methodology for L3+ vehicles and cars, are perfect twinning partners for ArchitectECA2030. For ArchitectECA2030 the benefit of twinning with them increases in proportion to the number of OEM and large supplier companies they have and with the closeness of the methods and technologies that they work on to those of ArchitecECA2030.

Lighthouse Mobility.E As the Excel Lighthouse, Mobility.E is an excellent information hub, point of contact, cooperation platform, and dissemination multiplier; ArchitectECA2030 will make heavy use this platform up to discussing and potentially offering membership in the EAB with / to them.

Tool providers will be takin into account for specialised information exchange activities, especially regarding the framework developed by ArchitectECA2030 and the methods behind it.

Test Field operators, too, are ideal partners for information and knowledge exchange activities as well as potential twinning partners. Because of their detailed knowledge about feasibility of test procedures within real world test tracks, it might even be worthwhile to include them into the External Advisory Board. Many project partners already have established cooperation with test fields and their operators, upon which we will build when contacting them during Year 2.

Insurance Companies have to insure the residual risk inherent in operating L3+ vehicles and therefore have to assess this risk in order to be able to define premiums. Knowledge about their concrete needs and requirements to any residual risk-based validation method – so also to the methods and framework developed in ArchitectECA2030 – would be of high importance to ArchitectECA2030; They, on the other hand, will benefit from detailed knowledge about our methodology, which might enable them to do their risk assessment at all. Project partner already are in contact with at least one

Insurance Company. At the beginning of Year 2, we will discuss the exact form of their cooperation with ArchitectECA2030.

Setting the plan into action

As envisioned in the DoW, after having undergone this stakeholder analysis and strategy setup, ArchitectECA2030 will now start to initialize and set up the External Advisory Board, with a first meeting of their members planned as 'back-to-back' with the next general assembly at the end of 2021. With respect to standardization activities, the next steps are to select the most relevant standards for homologation in L3+ cars and performing the gap analysis there. In parallel, we will start to contact the respective standardization organisations in order to prepare our contributions to those standards. Both, setting up the EAB as well as the standardization activities will involve intensifying our contacts to OEMs and large TIERs, increasing their awareness of the project and the various forms of cooperation that we offer with the goal of increasing their involvement. Twinning, information and knowledge sharing and 'usual' dissemination activities have already started and will be continued as laid out in the DoW and reported on in the deliverables of WP 7.1 and 7.3.

7 Conclusion

7.1 Contribution to overall picture

This Deliverable described the "Stakeholder Management Plan" for ArchitectECA2030, where Stakeholders are any project-external organization that has a role/function and/or a business interest in homologation of L3+ vehicles. We have presented a high-level overview of vehicle homologation in Section 4; based on this we identified Stakeholder Groups – consisting of stakeholders that have similar resp. the same function or the same business interest in homologation -- and detailed their concrete roles and interests. Next, we have detailed the forms of cooperation – External Advisory Board, Standardisation Activities, Twinning, Information and Knowledge Sharing – and identified the mutual benefits for external partners and the project to cooperate in this way. Finally, we have matched the interests of the external partners to the benefits of the different cooperation forms, which then gives our priorities for which external partners should be approached with which offer for cooperation.

This Stakeholder Management Plan is now the basis for the next steps as planned in the DoW, which will be (a) to set up the External Advisory Board and initiate interaction and alignment with their members, (b) to perform standard selection and gap analysis for these standards as a preparation for our standardization activities, and (c) continue and increase twinning and information and knowledge exchange activities.

8 References

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9 List of figures

10 List of tables

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