HORIZON 2020 - ICT-14-2016-1

# AEGIS

Advanced Big Data Value Chains for Public Safety and Personal Security

**WP5 – AEGIS Data Value Chain**
**Early Community Demonstrators**

# D5.1 – Demonstrators and Project Evaluation Framework

Version 1.0

**Due date:** 31.12.2017 **Delivery Date**: 29.12.2017

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**Dissemination level**: Public **Nature of the Deliverable:** Report

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**AEGIS KEY FACTS**

| | |
|---|---|
| **Topic:** | ICT-14-2016 - Big Data PPP: cross-sectorial and cross-lingual data integration and experimentation |
| **Type of Action:** | Innovation Action |
| **Project start:** | 1 January 2017 |
| **Duration:** | 30 months from **01.01.2017** to **30.06.2019** (Article 3 GA) |
| **Project Coordinator:** | Fraunhofer |
| **Consortium:** | 10 organizations from 8 EU member states |

**AEGIS PARTNERS**

| | |
|---|---|
| **Fraunhofer** | Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. |
| **GFT** | GFT Italia SRL |
| **KTH** | Kungliga Tekniska högskolan |
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| **SUITE5** | SUITE5 Limited |
| **HYPERTECH** | HYPERTECH (CHAIPERTEK) ANONYMOS VIOMICHANIKI EMPORIKI ETAIREIA PLIROFORIKIS KAI NEON TECHNOLOGION |
| **HDIA** | HDI Assicurazioni S.P.A |

**Disclaimer:** AEGIS is a project co-funded by the European Commission under the Horizon 2020 Programme (H2020-ICT-2016) under Grant Agreement No. 732189 and is contributing to the BDV-PPP of the European Commission.

## EXECUTIVE SUMMARY

The success of the AEGIS project depends on effectively evaluating the AEGIS platform and then providing constant feedback to the AEGIS platform developers to further improve it.

Therefore the AEGIS project plans, executes, and evaluates AEGIS Data Value Chain Early Community Demonstrators from three different Public Safety & Personal Security (PSPS) domains, namely (1) Automotive, (2) Smart Home & Assisted Living, and (3) Insurance within WP5. These three AEGIS demonstrators will be complemented by further activities running independently to facilitate the generalisation of the AEGIS platform to be utilized within other domains for different application scenarios, too.

This document at hand is the first deliverable of *WP5 – AEGIS Data Value Chain Early Community Demonstrators* and the codified result of the first running task *T5.1- Project Validation and Evaluation Framework Design*. Hence, this deliverable D5.1 sets the baseline for all further activities of WP5 including the managed execution of the three demonstrators and obviously also their systematic evaluation.

D5.1 presents in its core an inclusive AEGIS evaluation framework (focusing on qualitative evaluation techniques) as well as a four steps methodology for the AEGIS platform & demonstrator evaluators on how to implement the framework in the project. The proposed AEGIS evaluation framework has its roots in information systems research, treating the AEGIS platform as an information system. To meet its goal, D5.1 presents a set of test cases detailed through the descriptions of the three AEGIS demonstrators and established by the three demonstrator owners. To meet its goal, D5.1 presents detailed descriptions of the three AEGIS demonstrators including preliminary evaluation cases established by the three demonstrator owners.

Rigorously evaluating the AEGIS platform is expected to lead to many valuable (and potentially new) remarks, conclusions, knowledge, and learnings about the AEGIS platform's usefulness, usability, quality, viability, effectiveness, trustworthiness, and sustainability. A sound evaluation will moreover facilitate the (continuous) improvement of the AEGIS platform and increase its success in the commercialisation phase following the project. During the development of the evaluation framework, scientific rigor and practical application feasibility have been well balanced.

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## ABBREVIATIONS

| | |
|---|---|
| CO | Confidential, only for members of the Consortium (including the Commission Services) |
| D | Deliverable |
| DoW | Description of Work |
| H2020 | Horizon 2020 Programme |
| FLOSS | Free/Libre Open Source Software |
| GUI | Graphical User Interface |
| IPR | Intellectual Property Rights |
| MGT | Management |
| MS | Milestone |
| OS | Open Source |
| OSS | Open Source Software |
| O | Other |
| P | Prototype |
| PPP | Public Private Partnership |
| PSPS | Public Safety and Personal Security |
| PU | Public |
| PM | Person Month |
| R | Report |
| RTD | Research and Development |
| WP | Work Package |
| Y1 | Year 1 |

# 1. INTRODUCTION, MOTIVATION AND OBJECTIVES OF THIS DELIVERABLE

## 1.1. Introduction and Motivation

This deliverable presents an inclusive evaluation framework for the AEGIS platform as well as a four steps methodology a general guideline to be used to monitor and align the phases and progress of three different AEGIS Data Value Chain Early Community Demonstrators. D5.1 is the direct result of the first running task in WP5, *T5.1-Project Validation and Evaluation Framework Design*, and has been mutually developed by the WP5 team starting in M7 of the project. The AEGIS evaluation framework is perceived as a working document and as such it should facilitate all further activities in WP5.

It is a general principle to monitor the performance of a project against its project objectives. Whoever 'examines and judges accomplishments and effectiveness [of an approach] is engaged in evaluation' (Patton, 1990). Hence it is the overall goal of any research project to define a suitable evaluation framework to judge the goal achievement with respect to scientific rigor as well as to practical applicability. As a research project in the Big Data Value Public Private Partnership PPP, AEGIS is obviously based on solving big data related challenges. The AEGIS challenge as outlined in the proposal is therefore a valid starting point for an evaluation framework to develop:

*The overall challenge to be solved by the AEGIS platform is to bring together the data, the network and the technologies to create a curated, semantically enhanced, interlinked and multilingual repository for "Public Safety and Personal Security - PSPS"- related Big Data. (AEGIS Challenge)*

Hence it is of utmost importance for any evaluation framework to assess if the data, the technologies, and the partner network has been brought together to realize the AEGIS vision. To master this challenge, AEGIS will offer novel services and applications that will allow data scientists from PSPS-related industries to generate (a) more factual and evidence-based analytics, (b) improved decision support models, and (c) new business services focused on real-time data collaboration, knowledge sharing and notifications amongst the key stakeholders.

*AEGIS aims to drive a data-driven innovation that expands over multiple business sectors and takes into consideration structured, unstructured, and multilingual datasets, rejuvenate the existing models and facilitate all companies and organisations in the PSPS linked sectors to provide better and personalized services to their users. (AEGIS Mission)*

*Hence AEGIS aims to develop a curated, semantically enhanced, interlinked and multilingual data platform for PSPS - to allow businesses and developers to provide better and personalized services to users. (Preliminary AEGIS Value Proposition)*

Through the AEGIS Platform, the PSPS Data Value Chain Analysis is conducted at multiple levels including: (I) Data Privacy Enhancement, (II) Data Pre-Processing, (III) Big Data Analysis, and (IV) Data Intelligence Sharing. Hence the AEGIS platform has to support a data-based value chain, starting with gathering data from various resources, enabling a data-

analytics workflow and then delivering a tangible result for various PSPS stakeholders as shown in the figure below.

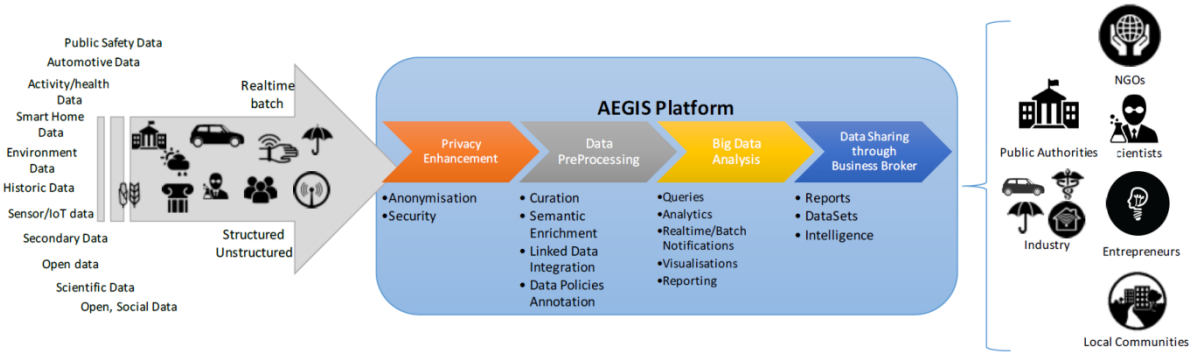


Figure 1: AEGIS High Level Approach

The AEGIS platform is a technological artefact based on a particular methodology, which is highly relevant for the evaluation framework development.

*The overall approach of AEGIS is to (a) deliver a refined, proven methodology for bringing data together and foster uninterrupted changes and analytics, (b) developing and integrating the tools needed to compose the overall platform, and (c) testing the projects results towards fine-tuning the platform to accelerate market entry. (AEGIS APPROACH)*

As such it is the AEGIS principle to serve as a data platform with embedded data processing and analytical functionality which can be enhanced by the platform users to finally enable the provision of data-driven services for PSPS end users.

*The envisioned platform of the AEGIS project will facilitate and accelerate the provision of applications and services in a number of sectors that can contribute to and offer services for Public Safety and Personal Security. For the evaluation of the Project, AEGIS will set up three different demonstrators as well as associated test cases detailed through descriptions of the three AEGIS demonstrators established by the three demonstrator owners. (AEGIS Evaluation)*

So how is the AEGIS platform going to be used within the AEGIS project? The data, functionality, and workflows of the AEGIS platform will be utilized by three long-lasting demonstrators in the course of the AEGIS project, which are going to be 'developed' by PSPS data scientist by using the AEGIS platform and stemming from three different PSPS-related sectors (1) automotive, (2) smart home & assisted living, and (3) insurance to develop data-driven services.

The AEGIS services (enabled through data and functionality) will then be used by various stakeholders from these three PSPS domains, which have been defined in the pilot scenarios. The following figure summarized the role of the AEGIS big data platform to enable the development of three data-driven services from three different domains in the course of the project.

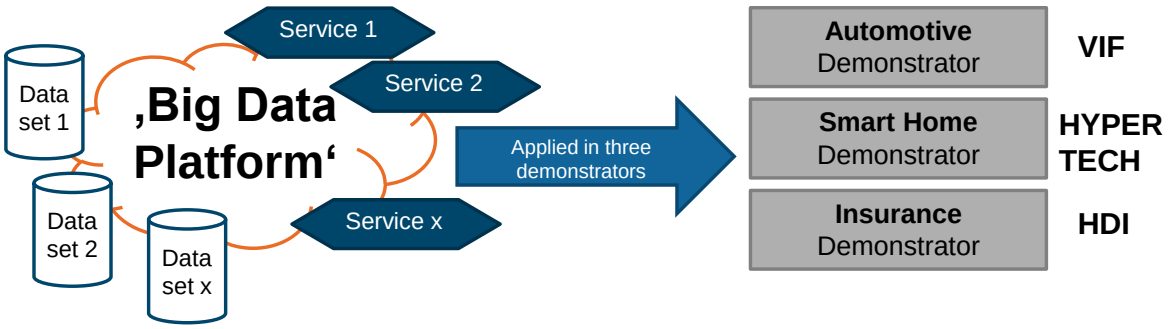


Figure 2: AEGIS – the platform & the demonstrators

The main direct beneficiaries of the AEGIS platform are - in a more general perspective - the PSPS data scientists from three different sectors as the developers of the data-driven AEGIS PSPS services, as well as the various stakeholders as PSPS users from three different sectors, who consume the AEGIS PSPS services in the three domains of the demonstrators. Hence, their satisfaction with the AEGIS platform has to be evaluated in a holistic way. The demonstrator-specific participants as well as their expectations are concretized in section 3 of this deliverable.

### 1.2. Objectives of this Deliverable

The overall goal of D5.1 ‘AEGIS Project Validation and Evaluation Framework’ is first to allow and facilitate an extensive study of how the three concrete AEGIS Data Value Chain Early Community Demonstrators have been developed as test cases by the PSPS data scientists by using the data and the functionality of the AEGIS platform, thus, capturing their particular experiences with the platform during demonstrator development as well as their (implicit) needs in this service development process. This will finally allow identifying valuable remarks, conclusions, and learnings about how to facilitate viability and sustainability of the AEGIS platform. Second the experiences of the various PSPS related end users who consume the developed data-driven services linked to the scope of the three demonstrators have to be integrated into the evaluation. Furthermore it is to elaborate by this deliverable, what else is required for a sufficient evaluation of the AEGIS approach.

It is NOT an objective of this deliverable to validate, whether the AEGIS software application is (technically) free of bugs, which would be the goal of classical software test cases. Functional tests of the AEGIS platform have to be conducted within the technical work packages and especially within the integration work package. However, it is the major objective of this deliverable to evaluate the success of the AEGIS platform in terms of how it contributes to meeting the requirements and expectations of the AEGIS PSPS stakeholders of the three demonstrators and beyond.

The following guiding questions have been developed together with the consortium to frame the evaluation concept for the AEGIS Platform. They have established the baseline (besides the descriptions in the DoW) to develop the evaluation framework in D5.1:

- What is the difference between the successfully validated AEGIS project to the successfully validated AEGIS Platform?

- What is a successful AEGIS platform, one that can satisfy a large number of service requests within acceptable response time; one that brings together large data sources, regardless of their demonstrated use; one that provides the expected functionality, one that has a commercially-successful future, …?
- What is the difference between the AEGIS platform and the AEGIS demonstrator, i.e. in what relationship is the AEGIS platform bigger in scope then the demonstrated applications?
- What are the main PSPS stakeholders of AEGIS which have to be considered in the evaluation of the project?
- What is the expected process/practice to use the AEGIS platform from the perspective of the different user groups?
- What are the expectations and requirements of data scientists from PSPS domains in utilizing a big data (analytics) platform & data marketplace such as AEGIS for developing PSPS services?
- What are the expectations and requirements of the ends users of PSPS data-driven services regarding the consumption of data-driven AEGIS services?
- How many PSPS data scientists (developers) and how other PSPS stakeholders (e.g. end users) are required to evaluate usability and usefulness of the AEGIS platform?

It can be said that the (commercial) success of the AEGIS project heavily depends on effectively evaluating the AEGIS solution together with the intended stakeholders of the AEGIS platform solution, and then providing the necessary feedback to the platform developers to further improve the platform. Initiating such a feedback processes heavily relies on the execution and the evaluation of three concrete AEGIS demonstrators – (1) automotive, (2) smart home & assisted living, and (3) insurance – in a coordinated and unified manner. However, this is intended not to be sufficient for validating the success of the AEGIS platform. Hence further approaches are to be designed, which are independent from the three demonstrators, and which can be independently evaluated. This will assure that the AEGIS platform fulfils a broader scope than just serving the pure requirements of three AEGIS Data Value Chain Early Community Demonstrators.

To summarize, this deliverable has

- to provide an inclusive evaluation framework including a set of demonstrator-specific test cases for the AEGIS platform, as well as
- a four steps procedure to be used to monitor and align the demonstrator's phases and progress.

Furthermore this deliverable has to provide sufficient space, so that three demonstrators can be defined in detail. The evaluation framework to be developed and documented in this deliverable is intended to serve as a tool to support the evaluators in evaluating the platform. The evaluation framework foresees (1) a series of qualitative methods and (2) a set of test cases, which have been developed in cooperation with all AEGIS project partners. The test cases have especially found their roots based on the business cases, use cases and requirements identified within WP1-4 of the AEGIS project.

### 1.3. Insights and Contributions from/to other tasks and deliverables

The AEGIS project is divided into eight different work packages, four technical work packages for the development of the AEGIS platform (WP1-4), one WP responsible for using, testing and evaluating the AEGIS platform (WP5), one work package for dissemination and communication (WP6), one work package for exploitation and business case development (WP7), as well as one work package for project management (WP8). Hence, WP5 deals with testing and evaluating the AEGIS platform, mainly through planning and operating three dedicated long-lasting AEGIS Data Value Chain Early Community Demonstrators. These will demonstrate both the scientific innovations and the business value preposition of the overall AEGIS approach. The main objectives of WP5 are in a nutshell:

- To define the evaluation framework that will assess the actual added value of the AEGIS methodology and platform against the objectives targeted.
- To prepare and coordinate the pilot applications by setting and executing a set of scenarios in the different domains selected.
- To create guidelines for all the demonstrators in order to run smoothly and in line with the project's needs and goals.
- To execute the demonstration scenarios, collect and evaluate results.

Hence evaluation is closely connected to the AEGIS Data Value Chain Early Community Demonstrators. This deliverable *D5.1 Demonstrators and Project Evaluation Framework* is the first deliverable in a series of deliverables in *WP5 AEGIS Data Value Chain Early Community Demonstrators* thereby setting the baseline for all demonstrator-specific activities as shown in the figure below.

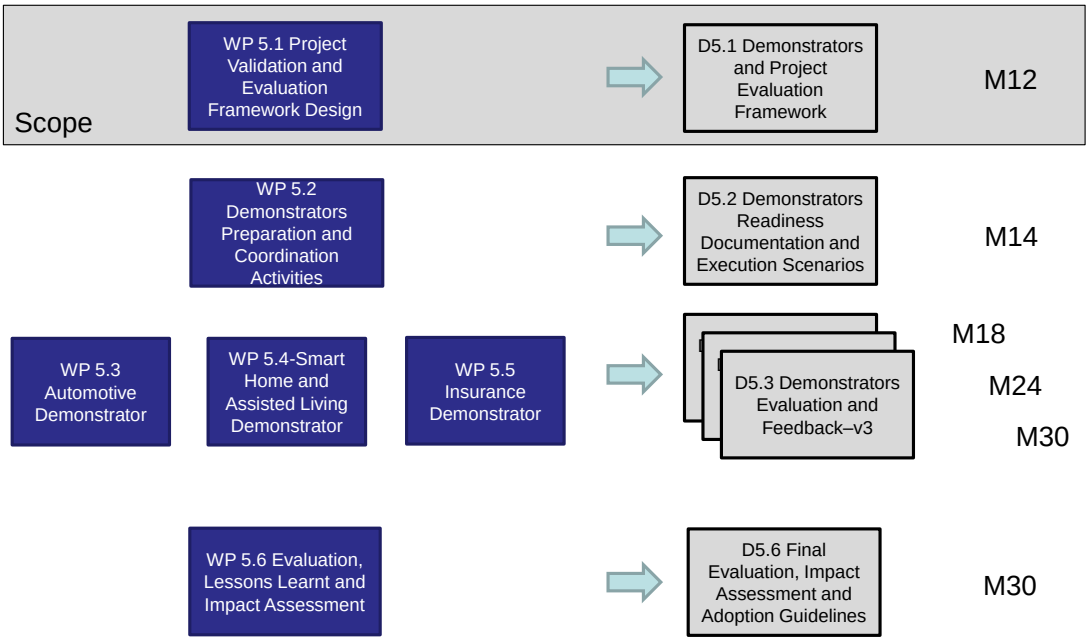


Figure 3: Scope of WP5

This deliverable is strongly related to a number of AEGIS tasks and deliverables from WP1-4, from which it receives/provides relevant inputs. It facilitates and ensures a process of

(continues) platform improvement through qualitative stakeholder feedback, especially also to WP1 to close the loop as shown by the red link in the figure below.

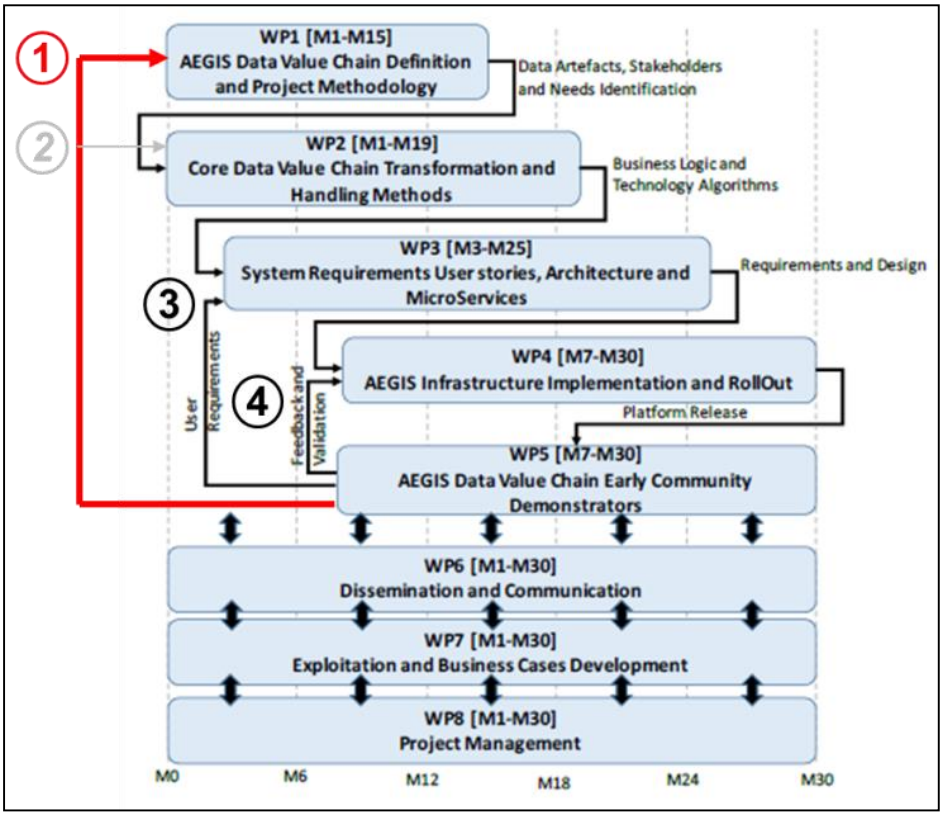


Figure 4: Relation of WP5 to WP1-4

A very relevant input for D5.1 is *D1.2-AEGIS Methodology and High Level Usage Scenarios* from WP1, which provides five high-level usages scenarios of the AEGIS platform to define and refine the concept of the project. Each Scenario is structured into the elements Actor/Alternative Actor/Actors interested in the outcome/Overview/Scenario and provides a plain-text description of what is to achieve by applying the AEGIS platform. Each scenario further describes how one or more PSPS-related data analysts apply/ies the AEGIS platform to develop a data-driven service. While four scenarios are directly related to one of the three AEGIS Data Value Chain Early Community Demonstrators, one scenario is more open to solve a series of PSPS-related data-driven challenges.

- **Scenario 1:** Advanced time series analytics in the automotive sector (link to automotive demonstrator)
- **Scenario 2**: Data-enabled services for enriched real-time navigation system (link to automotive demonstrator)
- **Scenario 3:** Data-driven monitoring and Alert Services for impaired or High Risk Groups Individuals (link to smart home & assisted living demonstrator)
- **Scenario 4:** Personal early warning system for asset protection and commercial offering (link to insurance demonstrator)
- **Scenario 5:** Open Innovation Platform for Data Experimentation and Service Offering (no direct link to one of the three AEGIS demonstrators)

### 1.4. Structure and content of this deliverable

After this introduction, motivation, and presentation of the objective and scope of this deliverable in section 1, the next sections are to read as follows:

In section 2 this deliverable presents the evaluation framework. It first reviews a series of approaches and methodologies that are relevant for a comprehensive evaluation framework. The presented AEGIS evaluation framework has its roots in information systems research (treating the AEGIS platform as a type of information system) and therefore heavily relies on instruments of qualitative data collection (most notably interviews) to find out more about how users (stakeholders) of the AEGIS big data platform perceived its usefulness to help them in their tasks as well as the usability and quality of the platform.

Demonstrators are at the core of evaluating the AEGIS platform. Therefore section 3 of this deliverable provides a comprehensive description of the three different AEGIS demonstrators, automotive, smart home, and insurance, as well as respective operational scenarios and a set of evaluation cases per demonstrator, too. Section three also provides the preliminary evaluation cases from the perspectives of the particular demonstrators.

Finally, section 4 describes the implementation of the AEGIS evaluation framework within the project, following a 4 step procedure. The framework can be applied two times in the project, while the results of two evaluations can directly be fed back into the project. The results of the third evaluation will support the commercial exploitation following the successful completion of the AEGIS project.

In section 5 this deliverable concludes with a summary and an outlook on further activities in WP5 related to this deliverable.

# 2. TOWARDS A COMPREHENSIVE AEGIS EVALUATION FRAMEWORK

## 2.1. Setting the Scope of this Evaluation Framework

The overall goal of the *D5.1 Demonstrators and Project Validation and Evaluation Framework* is to enable coordinated evaluation actions in order to maximise the future success of the AEGIS platform. The evaluation framework should help the AEGIS project to demonstrate and evaluate the benefits generated for designing data-driven applications by using the AEGIS methodology (and the AEGIS platform).

Obviously, the AEGIS methodology has been developed and will continuously be implemented within an AEGIS big data platform to enable three different AEGIS Data Value Chain Early Community Demonstrators. These three AEGIS Data Value Chain Early Community Demonstrators will be developed by PSPS data scientists on the AEGIS platform, processing the (big) data available on the AEGIS platform, thereby creating workflows by applying the functionality provided by the AEGIS platform to transform (big) data into consumable digital services with added value for PSPS end users.

One prerequisite for the successful evaluation of the AEGIS platform is that all required functionality for the execution of the three AEGIS Data Value Chain Community Demonstrators and beyond is provided through the AEGIS platform. External services are only then acceptable, if they are directly provided through the AEGIS platform. Thereby it is required to capture the experiences of the stakeholders who have been using the AEGIS platform accordingly to develop the demonstrators.

The AEGIS methodology implemented in the AEGIS platform has been derived from the AEGIS data value chain. The AEGIS Data Value Chain has been strongly motivated by the Big Data Value Chain developed by Curry et al. (2016). The AEGIS Data Value Chain is the foundation for enabling an AEGIS data to services process.

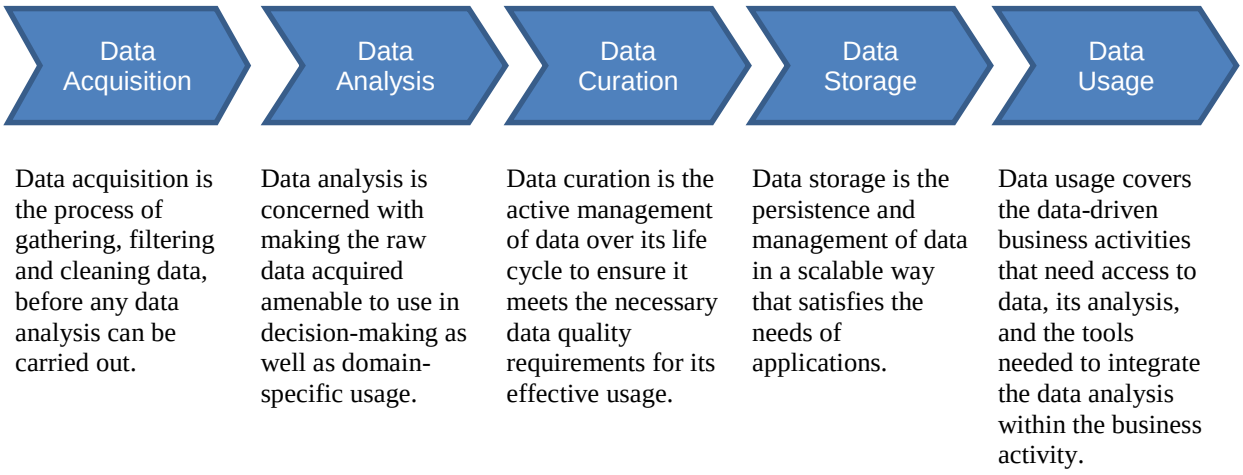


Figure 5: The Big Data Value Chain (Curry et al. 2016, AEGIS Deliverable D1.1)

It is also required to capture the experiences of the stakeholders performing activities in these steps while developing their demonstrators. Hence it has to be evaluated, if the relevant functionality per data value transformation step is available in the AEGIS platform, from the perspective of real AEGIS platform users.

So how is the AEGIS platform going to be used in the AEGIS project for establishing the demonstrators – and by what kind of users? To elaborate on this question, five AEGIS high level usage scenarios linked to the three AEGIS demonstrators have been already defined so far (in deliverable D1.2). They include a series of actors, which are relevant within a particular scenario. All these actors can be reduced to two different roles, PSPS data scientists (the ones who contribute in enabling/developing the demonstrator) as well as PSPS end users (the one who are consuming the services created in the demonstrator).

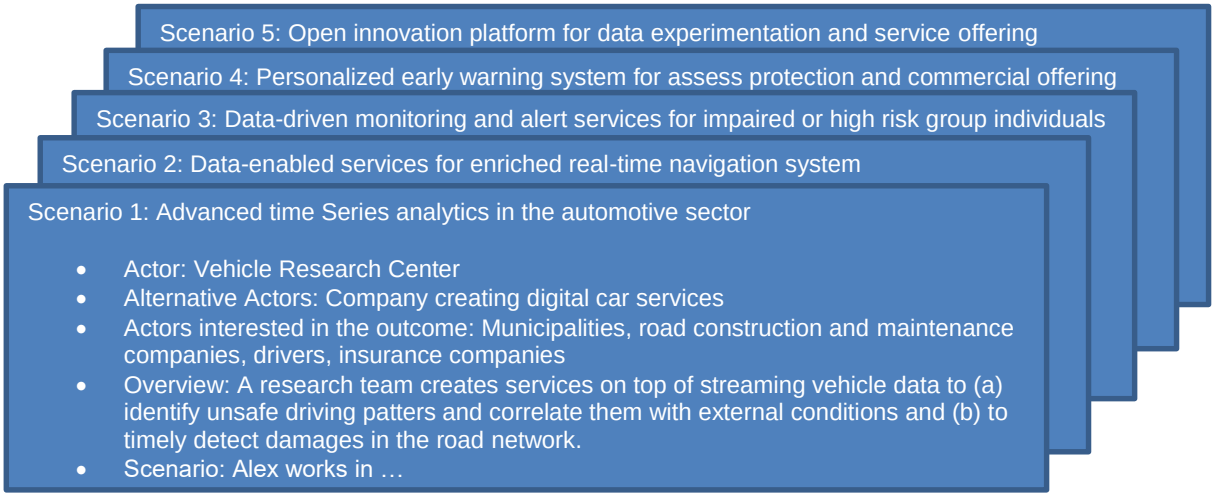


Figure 6: AEGIS High level usage scenarios (AEGIS Deliverable D1.2)

Having this said, it seems appropriate to evaluate the AEGIS platform from at least two different perspectives:

- The success of the AEGIS platform is directly linked towards its application for creating PSPS demonstrators: Taking a demonstrator-specific-perspective in the evaluation will assure that the expectations and requirements of the demonstrator-specific stakeholders (actors like the PSPS data-scientist creating the service(s), and the PSPS users consuming the service) are met. This is assured by modelling scenarios 1-4 into the demonstrators along with involving the related stakeholders within evaluation.
- However, the success of the AEGIS platform must not be limited to the scope of the three demonstrators, only. Taking a general PSPS-specific-perspective will assure that expectations and requirements of non-demonstrator-specific stakeholders in creating different digital services for PSPS users are evenly met, too. Therefore a further scenario 5 has to be modelled into a demonstrator and also these stakeholders have to be involved in evaluation.

The following figure is a very simplified visualisation of the AEGIS big data to data-driven service process focusing on (1) the two primary stakeholder roles (PSPS data scientists and PSPS end users), (2) the data-driven services to develop for three concrete long-term PSPS domains as well as (3) a number of small-scale services for the PSPS domain utilizing the AEGIS platform, which are all relevant for the evaluation framework to develop.

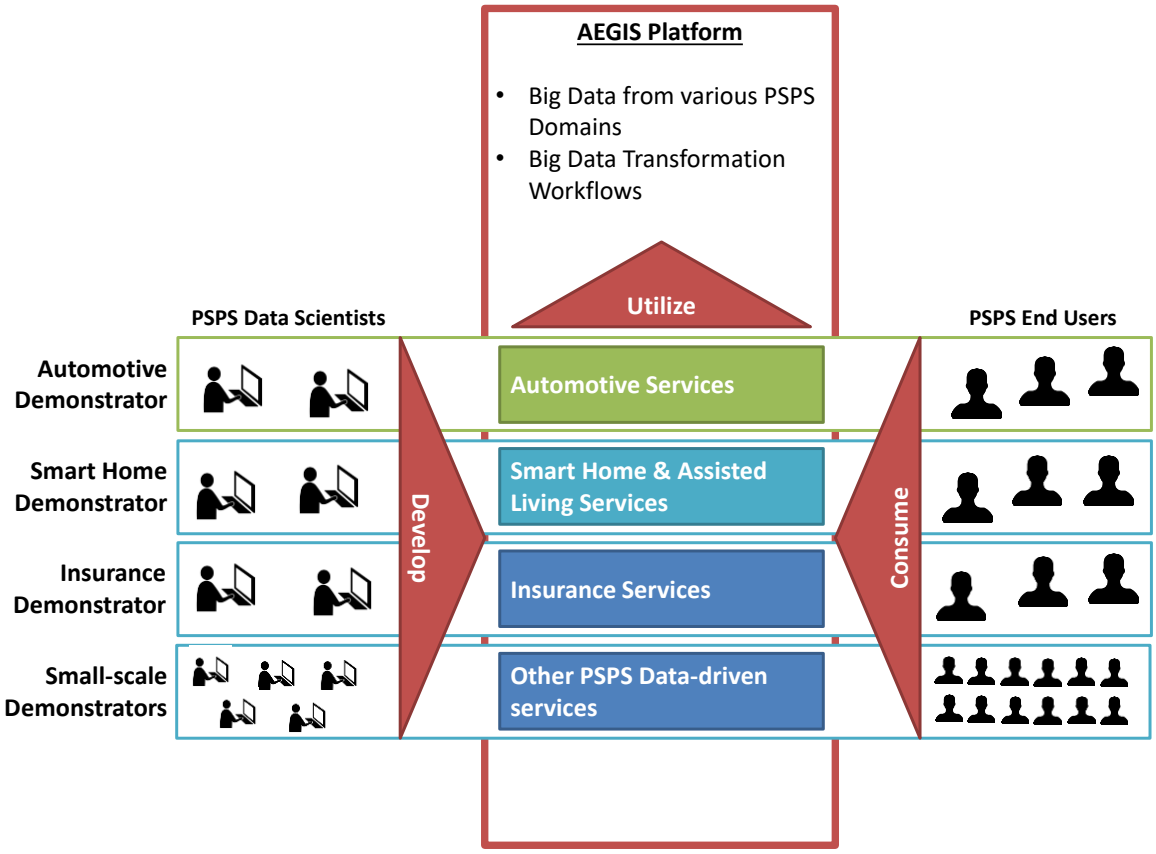


Figure 7: How stakeholders will directly benefit from the AEGIS platform (simplified)

To bring this into action, the following tasks have to be carried out on the AEGIS platform by the respective PSPS stakeholder groups.

- PSPS data scientists from the automotive domain have to develop data-driven Automotive Services for PSPS end users from the automotive domain using the PSPS-relevant data from the AEGIS platform for creating data-driven workflows on the AEGIS platform based upon. (Demonstrator 1)
- PSPS data scientists from the Smart Home and Assisted Living Domain have to develop data-driven Smart Home and Assisted Living services for PSPS end users from the Smart Home and Assisted Living domain using the PSPS-relevant data from the AEGIS platform and then creating data-driven workflows on the AEGIS platform based upon. (Demonstrator 2)
- PSPS data scientists from the Insurance domain have to develop data-driven Insurance services for PSPS end users form the Insurance domain using the PSPS-relevant data from the AEGIS platform and then creating data-driven workflows on the AEGIS platform based upon. (Demonstrator 3)
- Other PSPS data scientists have to use the PSPS-relevant data from the AEGIS platform, eventually complementing it with own data, and then have to develop other PSPS Data-driven services for any other domain.

Moreover, the evaluation of the AEGIS platform should be related to the following three different questions:

- *Does the operation of the AEGIS platform meet the defined objectives from the perspective of its users*? This question has to be answered by involving PSPS data

scientists, PSPS end users, and test/evaluation cases. Usefulness of the platform, user acceptance, user satisfaction, and ease of use are key evaluation aspects. It should be a major goal of the evaluation framework to propose a qualitative evaluation approach to shed light on these aspects and feed the gained knowledge back to the software developers.

- *How can the AEGIS platform be further improved beyond the originally defined objectives*? This question has to be answered by including additional perspectives into the platform evaluation. Interviews with PSPS data scientists as well as with PSPS platform users seem to be an appropriate technique to generate additional insights and requirements to feed back to the software developers. It should be a major goal of the evaluation framework to generate requirements for platform improvement.
- *Is the AEGIS platform operating according to its specifications*? This question has to be answered by conducting a (quantitative, technical) evaluation, testing technical parameters of system availability, functionality, and performance. However, this should not be the goal of this evaluation framework; such foundational issues have to be handled in the technical work packages WP1-4.

The AEGIS evaluation framework suggests an evaluation method mix to enable the success of the AEGIS platform and to learn as much as possible from platform users.

- AEGIS demonstrator-specific evaluation cases will be used to evaluate the required functionality of the platform required by the demonstrators from the perspective of PSPS data scientists.
- Guided interviews with the PSPS data scientists will be conducted to evaluate the perceived usefulness and usability of the service design process.
- Guided interviews with PSPS end users (and eventually user surveys, if feasible) will be conducted to evaluate the perceived usefulness, usability, and business relevance of the digital services created with the platform.

## 2.2. Background: Models and Theories on Information Systems Acceptance and Success

This section reviews theories, models, and approaches, which are relevant to the AEGIS evaluation framework and which have been widely accepted in evaluating information systems (IS) in the past. While many of these models and theories cannot directly be applied in practice as an evaluation instrument, they provide sound knowledge to develop the concrete evaluation instruments to be applied within the AEGIS evaluation framework.

Researchers from the Information Systems domain have created a number of models and theories to better explain and finally measure information systems acceptance as well as information systems success.

One of the most prominent models is the technology acceptance model (TAM) by Davis, (1989), which explains why some information systems are more accepted by their users than others. The underlying assumption of the model is that ‘perceived usefulness’ and ‘perceived ease of use’ determine an individual’s attitude to use an information system, which serves as a mediator of actual system usage. A direct relationship between perceived usefulness and behavioural intention to use is also proposed by the model. The model also suggests a direct relationship between perceived ease of use and perceived usefulness.

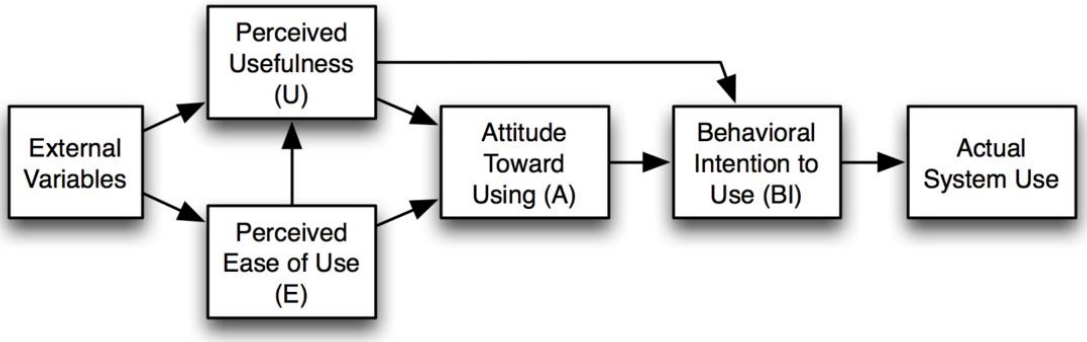


Figure 8: The Technology Acceptance Model (Davis 1989)

The TAM model has been applied in many domains including management information systems (MIS). The questionnaires used by Davis (1989) to develop and test the model already included a series of questions on perceived usefulness (PU) and perceived ease of use (PE).

- Perceived usefulness (PU)
  - Using 'Information system (IS) name' in my job would enable me to accomplish tasks more quickly. (PU)
  - Using 'IS name' in my job would improve my job performance. (PU)
  - Using 'IS name' in my job would increase my productivity. (PU)
  - Using 'IS name' would enhance my effectiveness on the job. (PU)
  - Using 'IS name' would make it easier to do my job. (PU)
  - I would find 'IS name' useful in my job. (PU)
- Perceived ease of use (PE)
  - Learning to operate 'IS name' would be easy for me. (PE)
  - I would find it easy to get 'IS name' to do what I want to do. (PE)
  - My interaction with 'IS name' would be clear and understandable. (PE)
  - I would find 'IS name' to be flexible to interact with. (PE)
  - It would be easy for me to become skilful at using 'IS name'. (PE)
  - I would find 'IS name' easy to use. (PE)

The TAM has been continuously refined and expanded, with one of the most significant adaptations being the unified theory of acceptance and use of technology (UTAUT) by Venkatesh et al. (2003). The UTAUT posits the four constructs, performance expectancy, effort expectancy, social influence, and facilitating conditions as direct determinants of information systems' usage intention and usage behaviour.

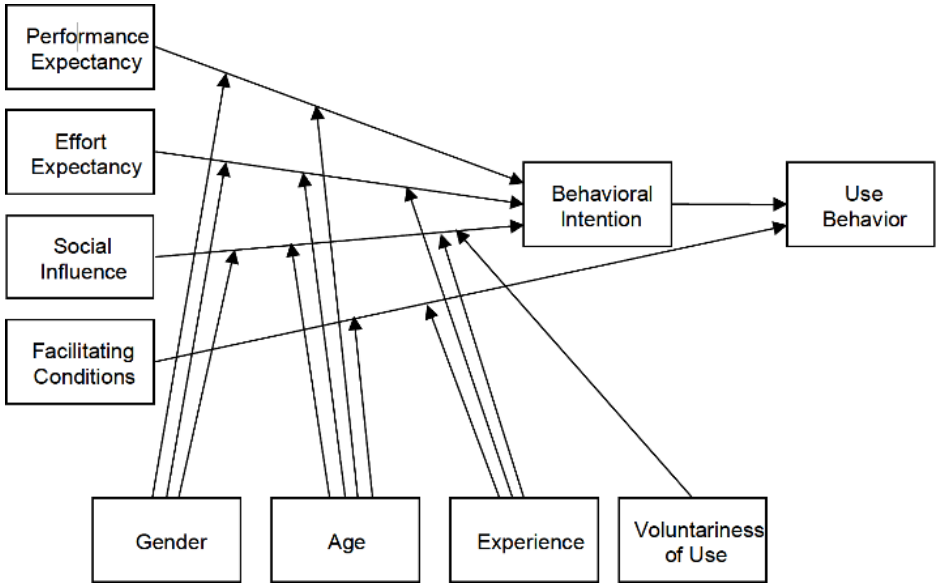


Figure 9: The Unified Theory of Acceptance and Use of technology (Venkatesh et al. 2003)

Another very popular model to measure the success of IS success measurement is the IS success model (DeLone and McLean, 1992). The model provides a taxonomy of IS success originally consisting of six variables: system quality, information quality, use, user satisfaction, individual impact and organizational impact. In a follow-up work, the authors revised the original model and added service quality as another construct (DeLone and McLean, 2003).

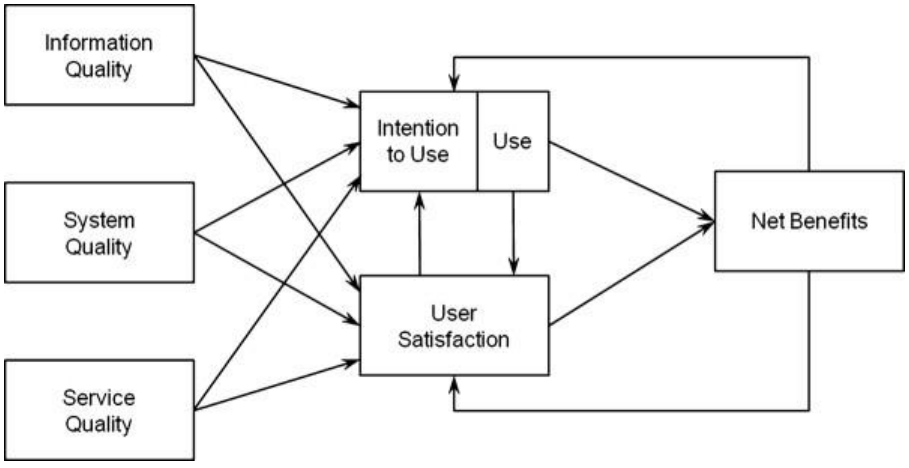


Figure 10: The Information Systems Success Model (DeLone and McLean, 2003)

Among the different models developed over the last thirty years (Petter, DeLone, & McLean, 2012) for considering the evaluation of IS "success" and effectiveness (for example in terms of organizational effectiveness, information quality and/or user satisfaction), the User Information Satisfaction (UIS) has been one of the options used to measure it (Baroudi & Orlikowski, 1988; Ives, Olson, & Baroudi, 1983) as well as eventually as a predictor of IS 'implementability' (Iivari & Ervasti, 1994).

| External variables | Instrument characteristics | Bailey and Pearson (1983) | Ives et al. (1983) | Baroudi and Orlikowski (1988) | Doll and Torkzadeh (1988) |
|---|---|---|---|---|---|
| *System quality* | Accessibility | X | X | | |
| | Timeliness | X | X | | X |
| | Language | X | X | | |
| | Flexibility | X | X | | |
| | Integration | X | X | | |
| | Efficient | | | | X |
| *Information quality* | Accuracy | X | X | X | X |
| | Precision | X | X | X | X |
| | Reliability | X | X | X | X |
| | Currency | X | X | | X |
| | Completeness | X | X | X | X |
| | Format | X | X | | X |
| | Volume | X | X | | |
| *Service quality* | Relationship with EDP staff | X | X | X | |
| | Communication with EDP staff | X | X | X | |
| | Technical competence of EDP staff | X | X | | |
| | Attitude of EDP staff | X | X | X | |
| | Schedule of products or services | X | X | | |
| | Time required for new development | X | X | X | |
| | Processing of change requests | X | X | X | |
| | Vendor support | X | | | |
| | Response time | X | X | | |
| | Means of input with EDP center | X | | | |
| *Usefulness* | Usefulness | X | X | | X |
| | Relevancy | X | X | X | X |
| *Ease of use* | User friendly | | | | X |
| | Easy to use | | | | X |
| *Outcome expectations* | Expectations | X | X | | |
| | Understanding of systems | X | X | X | |
| | Confidence in the system | X | X | | |
| | Feelings of participation | X | X | X | |
| | Feelings of control | X | X | | |
| | Degree of training | X | X | X | |
| | Job effects | X | X | | |
| *Organizational factors* | Top management involvement | X | X | | |
| | Organizational competition with EDP | X | | | |
| | Priorities determination | X | X | | |

| | | | | | |
|---|---|---|---|---|---|
| | Charge-back method | X | | | |
| | Error recovery | X | X | | |
| | Security of data | X | | | |
| | Documentation | X | X | | |
| | Organizational position of EDP | X | X | | |

Table 1 User satisfaction external variable and instrument characteristics, adapted from Wixom & Todd (2005, p. 88).

Table 1 shows a summary of the constructs identified by Wixom & Todd (2005, p.88) from the literature on UIS, in order to propose an integrated model of user satisfaction and technology acceptance (shown in Figure 11), where object based beliefs about the information and system quality (with the level of satisfaction with the system being likely to influence the sense of satisfaction with the information produced by the system) play a role in behavioural beliefs about usefulness (of information) and ease of use (of system) respectively, these latter influencing behavioural attitude and finally have an impact on the intention to use of the use.

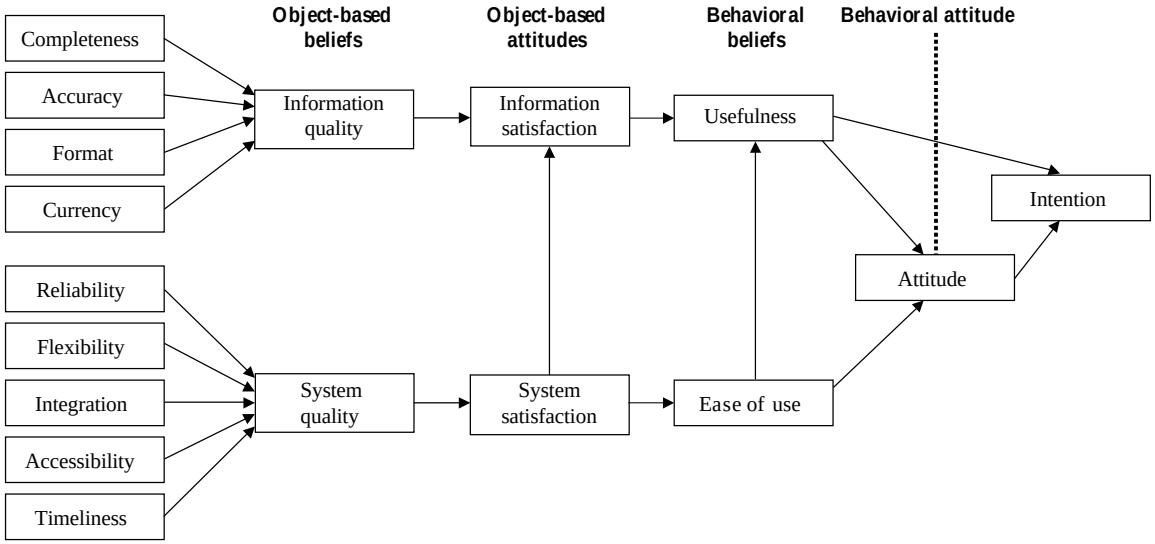


Figure 11: An integrated model of user satisfaction and technology acceptance, source Wixom & Todd (2005, p. 90).

Considering information value, Ahituv (1980) identified three utility attributes (*timeliness*, *contents*, and *format*) for a utility function suitable to assess the value of an Information System (IS). Also, Ahituv (1989) considered these attributes as arguments for information value as a function, adding *cost* as further attribute; then Ahituv (1989) identified at theoretical level three types of value of information: the *normative value* (purely analytical, based on axioms and assumptions for settings where a system can be modeled and the impact of various attributes of information on the decision maker can be calculated, p. 318 – see Figure 12); the *realistic value* (based on the measurement of different performances of a decision maker using different information assets, p. 319) the *perceived value* (subjective evaluation by the users p. 320).

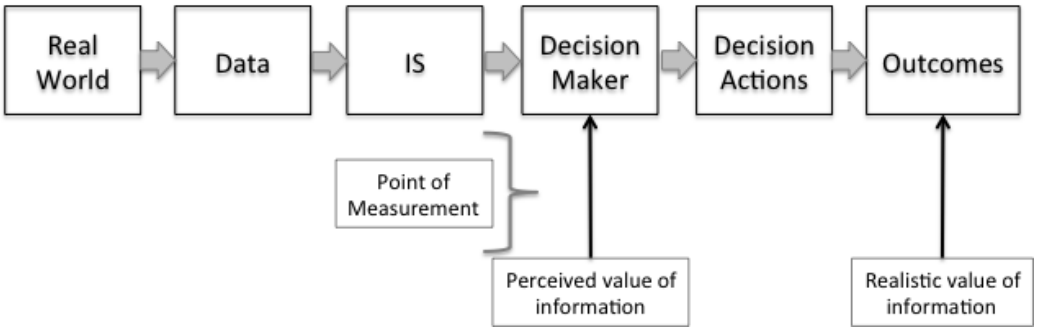


Figure 12: Point of measurement of perceived and realistic value of information, adapted from Ahituv (1989, pp. 320 -321).

Finally, Viscusi and Batini (2014) have developed a model for digital information asset evaluation (see Figure 13) based on an analysis of the literature on information value. The model considers information value as determined by costs and information utility. This latter is influenced by the information diffusion and by the information capacity of an organization or a user mediated by its/his/her set of information capabilities.

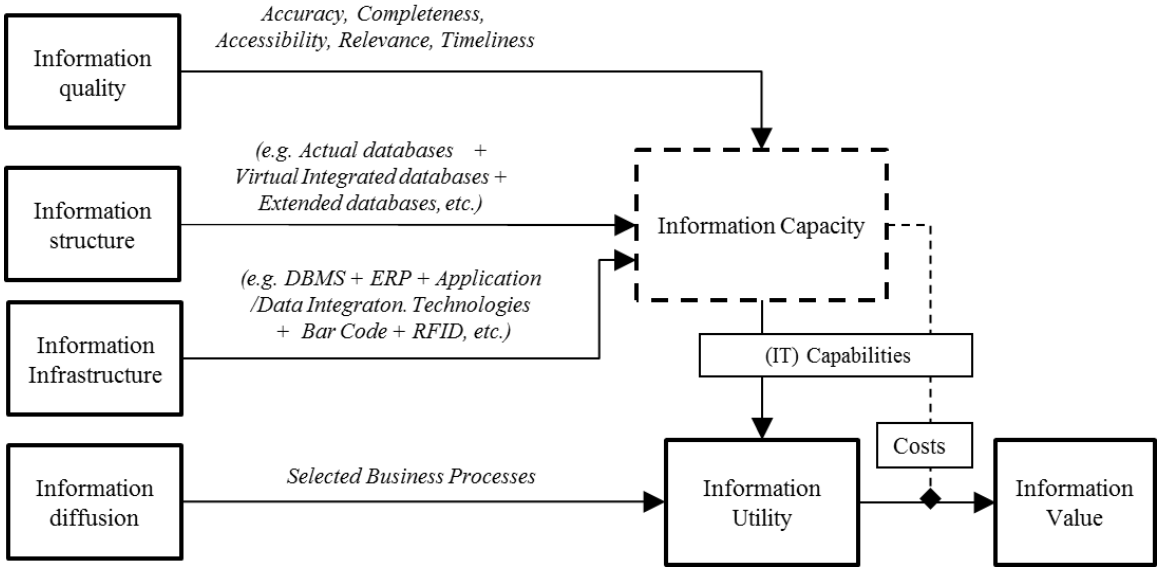


Figure 13: A model for digital information asset evaluation, source Viscusi and Batini (2014).

As for the model, it is worth noting the elaboration there and further development by Viscusi and Batini (2014) of the concept of *information capacity* as influenced by information quality, information structure, information infrastructure and defined as "*the current stock of understandings informed by a given installed base*" (p. 81) representing "*the potential of a digital information asset that can be defined and evaluated independently from the usage*" (p. 81).

Another popular model in IS contributes to better understanding information systems continuance, i.e. the cognitive believes and affect influencing one's intention to continue using information systems. Bhattacherjee (2001) adapts the expectation-confirmation theory from consumer behaviour literature and integrates findings from IS usage research to theorize a *model for IS continuance*, an *expectation-confirmation model*. In its core, IS users' continuance intention is determined by their level of satisfaction with IS use and perceived

usefulness of continued IS use. User satisfaction, in turn, is influenced by the user's confirmation of expectation from prior IS use and perceived usefulness.

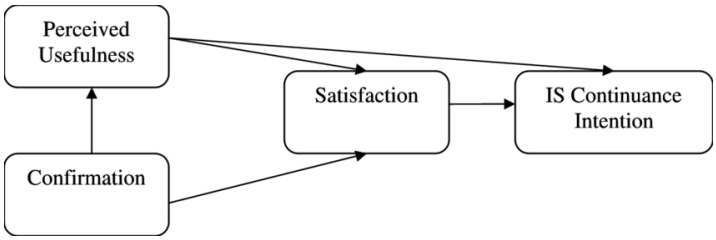


Figure 14: Expectation-Confirmation Model, source Bhattacherjee (2001).

## 2.3. The AEGIS Evaluation Framework

### *2.3.1. Evaluation goals, stakeholder groups and evaluation methods*

Due to the complexity of the AEGIS platform, the evaluation framework to develop envisages the application of a mix of methods. Depending on a particular application goal, and a stakeholder group in focus of evaluating the goal achievement, a particular evaluation approach is suggested. A mix of semi-structured interviews, user surveys and evaluation cases is foreseen. The evaluation framework envisages the application of qualitative methods, due to the complexity of the AEGIS platform and the expected platform evaluation feedback. Some of the constructs derived from the state of the art analysis (e.g. quality dimensions, information systems success, system usefulness and usability to name three of them) will be used within the evaluation framework.

Practically developing the three AEGIS demonstrators is a continuous process. However each AEGIS demonstrator is expected to show progress throughout the three defined phases early, medium, and advanced. The tangible results of these phases constitute the demonstrator-specific milestones. The three AEGIS demonstrators are created by several PSPS data scientists in charge (from different applications domains) through executing demonstrator-specific evaluation cases. To capture the satisfaction of the users with the AEGIS platform, the evaluation framework suggests conducting ex-post interviews with the PSPS data scientists in charge of creating the demonstrators as well as ex-post interviews with PSPS demonstrator users.

The following table provides a summary of evaluation approaches, goals, and stakeholder groups.

| Evaluation goal | Stakeholder group | Suggested method |
|---|---|---|
| Evaluate the AEGIS platform in general: Technical and functional assessment | PSPS data scientists involved in creating the three AEGIS demonstrators | Execute test cases for platform evaluation. Provide qualitative user feedback. |
| Evaluate the three AEGIS demonstrators: Demonstrator-specific technical and functional assessment | PSPS data scientists involved in creating the three AEGIS demonstrators | Execute test cases for platform evaluation. Provide qualitative user feedback. |
| Evaluate non-functional aspects including usability and usefulness of AEGIS platform & service design process | PSPS data scientists who are involved in creating the three AEGIS demonstrators | Guided (semi-structured) interviews.<br>Provide qualitative user feedback |
| Evaluate non-functional aspects including usability and usefulness of AEGIS platform & service design process | PSPS data scientists who are not involved creating the three AEGIS demonstrators | Conduct Hackathon<br>Provide qualitative user feedback. |
| Evaluate non-functional aspects including usability and usefulness of AEGIS demonstrator-specific services | PSPS end users of the three AEGIS demonstrators<br>Other PSPS end users | Guided (semi-structured) interviews<br>User surveys (depending on the number of users) |

Table 2: AEGIS Evaluation Framework - Method Mix

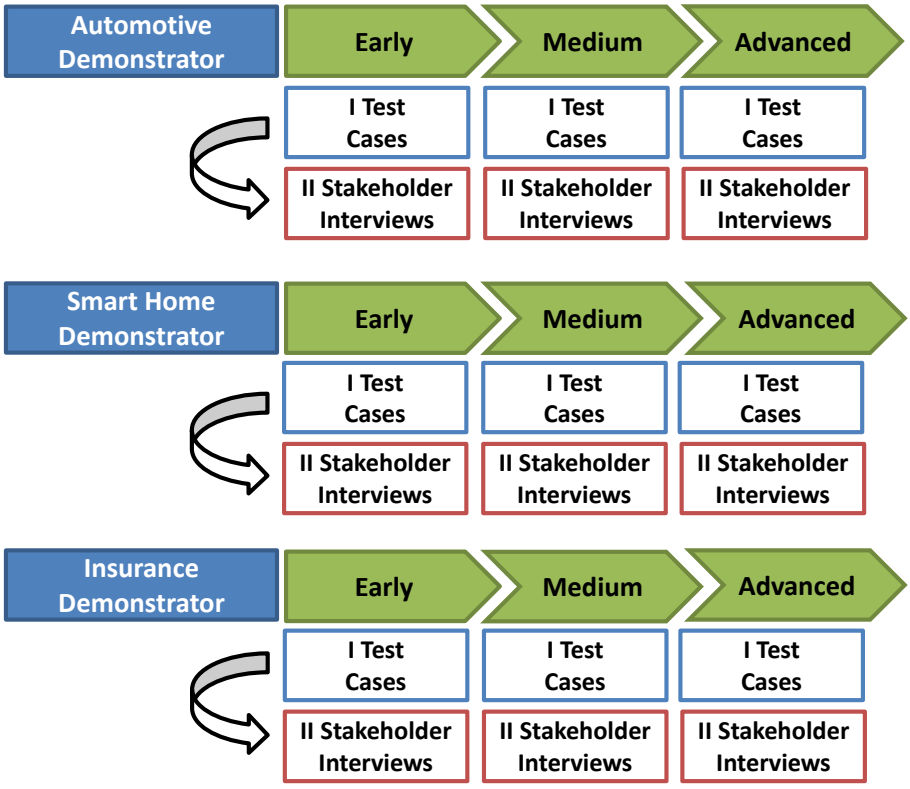


Figure 15: AEGIS Evaluation Framework: Test cases and stakeholder interviews

### *2.3.2. Part I: Executing AEGIS test cases for platform evaluation*

One main instrument of evaluating the AEGIS platform is based on concrete evaluation cases, which have been defined by the three demonstrator owners and which have subsequently to be executed by the data scientists in charge for developing the respective demonstrators. The AEGIS platform has therefore to provide all required functionality (according to the AEGIS data value chain) to allow the PSPS data scientists executing these evaluation cases, resulting in the creation of the three AEGIS demonstrators.

To keep it practical, test cases are in its core short user stories (narratives) developed by the demonstrator owners, describing how a PSPS data scientist (intends) to use the functionality as well as the data of the AEGIS platform to finally develop the AEGIS demonstrator based on his or her concrete requirements. For each of the three AEGIS demonstrators a set of such test cases is defined within this evaluation framework.

The **AEGIS test cases** are **described within the AEGIS demonstrator-specific section** in this deliverable. Test cases are short stories for capturing the expectations of the demonstrator-specific PSPS data scientists on how to create the AEGIS demonstrator on the AEGIS platform with the data available. They are crucial for AEGIS platform evaluation.

### *2.3.3. Part II: Conducting guided interviews with key stakeholders*

Interviews are a popular instrument within qualitative research (see e.g. Myers 1997; Myers and Newman, 2007) and suitable for the qualitative evaluation of complex technical artefacts, which also holds for the AEGIS platform. Two general stakeholder groups are especially relevant to be interviewed in the context of this evaluation, (1) the PSPS data-scientist 'developing' the AEGIS demonstrators and (2) the PSPS (end) users 'using' the provided demonstrators within their tasks or practices.

Derived from the presented IS models, it is highly relevant for the evaluation framework to

1. capture the prior knowledge and experiences of the data scientists in charge,
2. capture the data scientists' expectations and perceptions of the AEGIS platform in general, and finally
3. capture the data scientists' expectations and perceptions of the AEGIS demonstrator specific development process in particular as the figure below suggests.


Figure 16: Capturing the experiences, expectations and perceptions of PSPS data scientists

The following questions are appropriate to shed light on how PSPS data-scientists experienced the use of the AEGIS platform within the AEGIS project, taking also their prior experiences into account.

| **Target** | **Example questions for guided interviews with PSPS data scientists** |
|---|---|
| Capturing the **knowledge and experiences** of the PSPS data scientist | What knowledge and experiences have you already gained in (big) data-related activities and projects?<br><br>• How do you see your personal role in the AEGIS project?<br>• What are your previous experiences with data analytics, Big Data, and data-based applications?<br>• What concrete tools/applications have you previously used for creating data-based applications?<br>• Are you already familiar with the tools integrated in / made available via the AEGIS platform? |
| Capturing the expectations of the data scientists as well as how the data scientist in charge perceived the **AEGIS platform in general** | From what you have so far learned in the application of the AEGIS platform, how useful do you perceive the AEGIS platform in general?<br><br>• How does the AEGIS platform meet your requirements? What did you like? What didn't you like?<br>• How comfortable was it for you, using the AEGIS platform? How do you rate its usability? How satisfied are you with the aesthetics of the AEGIS platform?<br>• In what way may using the AEGIS platform improve your work/tasks? How useful is the AEGIS platform for your job?<br>• What would you like to change on the AEGIS platform? Do you have suggestions for general improvements of the AEGIS platform?<br>• How much do you trust the AEGIS platform, the information and data therein, and the services created with it? How would you relate to aspects including privacy protection and security?<br>• How would you rate the flexibility of the platform, its innovativeness, as well as its generated value?<br>• How satisfied are you with the quality of the AEGIS platform? How satisfied are you with its performance?<br>• Under what conditions would you use the AEGIS platform regularly (also for other projects)? Under what conditions would you use the AEGIS platform with pleasure?<br>• How is your overall impression of the AEGIS platform? How helpful do you perceive the AEGIS Platform? Does the AEGIS platform improve the performance of your job? |
| Capturing the expectations of the data scientists as | How did you perceive the technical process of developing your AEGIS demonstrator with the AEGIS platform? |

| | |
|---|---|
| well as how the data scientist in charge perceived the **AEGIS demonstrator development process** using the AEGIS platform | • How easy was it for you to develop the AEGIS demonstrator? Have you dedicated a lot of time on using the AEGIS platform?<br>• How long did it take you finally to create the AEGIS demonstrator through the support of the AEGIS platform and the data?<br>• Can you explicate the concrete advantages, which the AEGIS platform provides for you (in generating data-based applications) compared to previous approaches you have already taken and/or know? Can you explicate the concrete disadvantages, too?<br>• How did the AEGIS platform meet your demonstrator-specific requirements? What would you change on the AEGIS platform? Do you have any suggestions for platform improvement from the perspective of your demonstrator?<br>• How is your overall impression of the current technical AEGIS demonstrator development process? What did you like especially? What didn't you like at all? |

Table 3: General example questions for PSPS data scientists on the AEGIS platform

The following example questions are appropriate to shed light on how PSPS users experience the use/consumption of the services provided by the AEGIS platform.

| **Target** | **Example questions for guided interviews with PSPS users** |
|---|---|
| Capturing the expectations of PSPS users as well as how they perceive the **AEGIS demonstrator** use phase | How do the services created by the AEGIS platform meet your specific needs?<br>• How satisfied are you with the data-driven services created/enabled by the AEGIS platform?<br>• How usable do you perceive the services created in your domain?<br>• Do the services solve a particular problem or challenge, which is vital to you?<br>• Are the services created useful to support a certain task, process, or goal?<br>• What could be further improved with regard to the provided services?<br>• What is your overall impression of the AEGIS services? |

Table 4: General example questions for PSPS users on the developed services

The AEGIS platform is intended to enable a big data value chain (for public safety and personal security - PSPS), as defined in deliverable D1.1. Hence it should be a further goal of the evaluation framework to shed light on how successful this enabling process is from the perspective of PSPS data scientists as well as how satisfied involved PSPS data are with the support or the AEGIS platform for developing big data driven applications are, respectively.

The following questions are dedicated to be answered by PSPS data scientists, too. They are related to the *AEGIS data value chain* (as defined in D1.1, derived from Curry et al. 2016),

while relevant functionality is implemented in the AEGIS platform. For each step of this big data value chain, a set of example questions is listed. The AEGIS platform can be seen as a tool targeted at data scientists to support all steps of the data value chain accordingly.

| **Data value chain** | **Example questions for interviews with data scientists** |
|---|---|
| **Data acquisition** is the process of gathering, filtering and cleaning data, before any data analysis can be carried out (D1.1).<br>  | Does the AEGIS platform's functionality intended for data acquisition meet your needs and expectations? If yes, how? If no, why not?<br>• How satisfied are you with the interface of the platform to upload/ make your data available? How satisfied are you with the platform's interfaces to relevant (open, third party) data sources that you eventually need in your pilot?<br>• How satisfied are you with the upload/streaming functionality suitable for the size/amount of your data? Is the data relevant for your pilot scenario available on the platform? Is the data available in sufficient quantities?<br>• How satisfied are you with the provision of structured and unstructured data to the platform?<br>• How satisfied are you with the platform's semantic annotation functionality? How satisfied are you with the AEGIS ontology and vocabulary?<br>• How satisfied are you with the anonymization functionality of the AEGIS platform?<br>• How satisfied are you with the data harvester?<br>• How satisfied are you with data cleansing functionality?<br>• How satisfied are you with data access control, security, privacy and trust aspects/rules in place?<br>• What functionality is missing from your perspective? What would you like to have added to the platform? |
| **Data analysis** is concerned with making the raw data acquired amenable to use in decision-making as well as domain-specific usage (D1.1).<br>  | Does the AEGIS platform's functionality intended for data analysis meet your needs and expectations? If yes, how? If no, why not?<br>• How satisfied are you with functionality for data exploration? How satisfied are you with functionality for modelling the data for extracting interesting (hidden) information?<br>• How satisfied are you with the available data mining methods? How satisfied are you with functionality for correlation mining?<br>• How satisfied are you with functionality for data transformation?<br>• How satisfied are you with the structure of provided data per third party? How satisfied are you with available and agreed schemas and data standards of the platform? |

| | |
|---|---|
| | • Is the data available in the correct sampling rate, and – if not – do you have the feasibility to adjust it accordingly? Is the relevant data available?<br>• Are you satisfied with the available algorithms for data analysis? Are you satisfied with the algorithm parameterisation functionality?<br>• Does the performance for data analysis meet your needs and expectations? If no, why not?<br>• What functionality is missing from your perspective? What would you like to have added to the platform? |
| **Data curation** is the active management of data over its life cycle to ensure it meets the necessary data quality requirements for its effective usage (D1.1).<br>  | Does the AEGIS platform's functionality intended for data curation meet your needs and expectations? If yes, how? If no, why not?<br>• How satisfied are you with the functionality for, content creation, selection, classification, transformation, validation, and preservation?<br>• How satisfied are you in general with functionality for data management and organisation?<br>• How satisfied are you with functionality for data quality validation?<br>• How satisfied are you finally with the (improved) quality of data?<br>• What functionality is missing from your perspective? What would you like to have added to the platform? |
| **Data storage** is the persistence and management of data in a scalable way that satisfies the needs of applications (D1.1).<br>  | Does the AEGIS platform's functionality intended for data storage meet your needs and expectations? If yes, how? If no, why not?<br>• How satisfied are you with functionality regarding persistence and management of data?<br>• How satisfied are you with the performance of the data storage system (e.g. latency, throughput-rate)?<br>• How satisfied are you with the security of data storage?<br>• How satisfied are you with the provision of (own) APIs for others to use your data?<br>• What functionality is missing from your perspective? What would you like to have added to the platform? |
| **Data usage** covers the data-driven business activities that need access to data, its analysis, and the tools needed to integrate the data analysis within the business | Does the AEGIS platform's functionality intended for data usage meet your needs and expectations? If yes, how? If no, why not?<br>• How satisfied are you with restricting access to your data regarding usage?<br>• How satisfied are you with the (envisaged) data |

| | |
|---|---|
| activity (D1.1).<br>  | marketplace in general?<br>• How satisfied are you with the (business) brokerage function of the platform?<br>• How satisfied are you with the interfaces the platform provides to you for own business applications?<br>• What functionality is missing from your perspective? What would you like to have added to the platform? |

Table 5: General example questions for PSPS data scientists on the AEGIS platform

# 3. AEGIS DEMONSTRATOR DESCRIPTIONS & PRELIMINARY EVALUATION CASES

## 3.1. Overview and scope of the AEGIS demonstrators

The AEGIS project envisages three different long-term demonstrators, each of them available in three different versions with different functionality required, to be implemented in M18, M24, and M30. The success of these demonstrators is a main quality criterion for the success of the AEGIS platform and the whole AEGIS project.

The evaluation framework suggests conducting three different evaluations, i.e. an evaluation of the early demonstrator, the medium demonstrators, and finally of the advanced demonstrator. This will ensure a threefold feedback to the development team as well as that all requirements of the demonstrators towards the AEGIS platform are successfully met. Furthermore this will ensure that many fresh ideas and further requirements are elicited and transferred to the development team, which can even increase the value of the AEGIS platform once more. The figure below summarizes the three versions of AEGIS demonstrators and their demonstrator due dates.

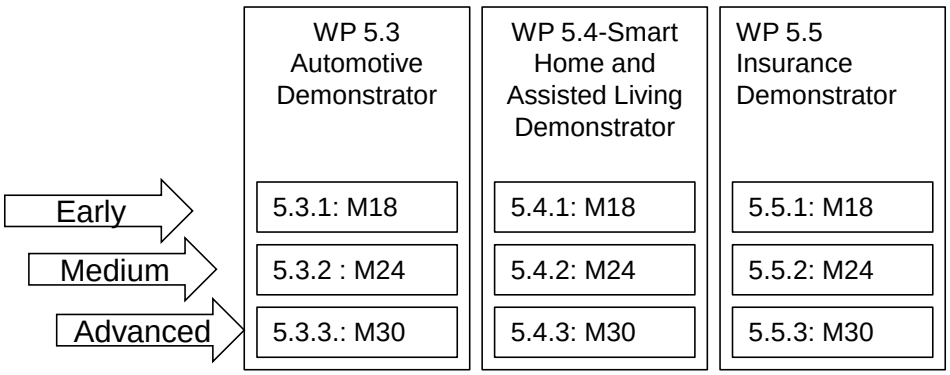


Figure 17: AEGIS demonstrators and due dates

Functional tests of the AEGIS architecture as well as implementing the AEGIS approach are part of the software development and integration work of WP1-4. This section is concerned with demonstrator-specific explanations, operational scenarios and test cases for evaluation. There are no quantitative measures envisaged in the AEGIS evaluation framework.

## 3.2. AEGIS Automotive Demonstrator

### *3.2.1. Overview and goal*

The overall goal of the **AEGIS Automotive Demonstrator** is to explore how vehicle driving data and other road safety related data including e.g. weather data can be meshed and modelled, aggregated and semantically annotated in order to extract meaningful, safety-relevant information. For this, various combinations of vehicle driving datasets and datasets from other domains will be investigated to determine which of them provides the most valuable insights into driving styles and driving behavior. Beneficiaries including drivers and other stakeholders will enhance their (business) value by using the AEGIS platform to create services for safer driving and safer roads.

### *3.2.2. Operational Demonstrator Scenario & Solution Approach*

The automotive demonstrator will be located in Greater Graz area in Austria as the majority of vehicle trips will be recorded in this area. Data scientists from VIF will use the AEGIS platform to model the service workflows for the three versions of the demonstrators.

The automotive and road safety demonstrator will involve a reasonable number of human participants as volunteering vehicle drivers for generating driving data in the field (vehicle usage data) as well as in laboratory settings using a driving simulator (vehicle simulator data), as well as evaluating usefulness and usability of the developed services & applications running in a browser and/or on a mobile phone.

The automotive and road safety demonstrator will be developed in three different versions, Broken Road Indicator, Safe Driving Indicator, and Regional Driving Style Risk Estimator. These three versions of the automotive demonstrator are aimed to provide the following benefits to the users of the services.

- Provide insights into road conditions based on exploiting individual vehicle sensor data, traffic data, and map data (Broken Road Indicator).
- Infer the driver's safety style and then calculate a safety index, through utilising vehicle sensor data along with environmental information and other content (Safe Driving Indicator).
- Calculate a regional driving safety risk metric for certain regions including intersections, streets, cities or countries (Regional Driving Style Risk Estimator).

| |
|---|
| The automotive demonstrator is perceived successful, if the expectations of the involved stakeholders in developing the demonstrator as well as the ones using the services are met. |

The table below lists the main stakeholders of the automotive demonstrator.

| **General stakeholders** | **Role in the project & involvement in evaluation** |
|---|---|
| PSPS Data Scientists (Researchers from VIF) | Defining the service workflows on the AEGIS platform for all three versions of the automotive demonstrator.<br><br>Evaluation of the service design process. Does the AEGIS platform provide the required data and functionality for the envisaged services? Is the AEGIS platform useful and usable? |
| PSPS end users (Drivers from VIF) | Generating trip data to be uploaded to the AEGIS platform. Evaluation of the AEGIS services targeted at drivers.<br><br>Are the services provided by the AEGIS platform perceived as useful and useable for drives? Would such services motivate drivers to share their driving data in return? |

Table 6: AEGIS Automotive Demonstrator stakeholders and related AEGIS actor roles.

The following sections reveal insights into the automotive demonstrator versions.

**Broken Road Indicator Service (early demonstrator)**

The goal of this service is to provide insights into road conditions based on exploiting individual vehicle sensor data, traffic data, and map data. Quantified information on road conditions is relevant for various stakeholders including vehicle drivers, road maintenance authorities, transportation companies, online content providers and public traffic authorities to name a few. Knowledge on road conditions can contribute to significantly increasing driving safety. The following aspects are relevant for this particular version of the demonstrator.

- Individual vehicle data such as X-Y-Z acceleration, speed, and location are processed in combination with historic traffic data to detect and classify road damage.
- To assist individual drivers, navigation systems can be enabled to suggest routes based on a road safety prioritization complementary to fastest route or shortest route.
- Maintenance departments can analyze roads with their reported damage level visualized on a map and can thus better plan and budget their maintenance work.
- Public traffic authorities from cities, districts or countries can use the data generated to facilitate informed decision making.

**Safe Driving Indicator Service (medium demonstrator)**

The goal of this service is to utilize vehicle sensor data along with environmental information and other content to infer the driver's safety style and then calculate a safety index for stakeholders such as vehicle drivers, ride sharing services, driving schools, insurance companies, online content providers, automotive developers and suppliers or automotive manufacturers to name a few. The application developed will aim to detect unsafe driving behavior such as speeding, hard accelerations, bad steering or hard brakes and deliver actionable insights taking into account environmental information. The following aspects are relevant for this particular version of the demonstrator.

- Vehicle data such as X-Y-Z acceleration, X-Y-Z rotation, speed, RPM, fuel consumption, and location are processed in combination with historic traffic data, weather data, news data and data on accident types and frequency to calculate a safety index for individual drivers.
- Individual vehicle drivers can benefit from a mobile app, which will encourage them to drive more safely, while comparing their own safety score with the safety score of their peers in their social community.
- Ride sharing services may incorporate a driver safety indicator as another selection criterion for ride seekers in their online portals.
- Automotive developers and suppliers may want to use the generated and aggregated data to improve the accuracy of driver models and testing for advanced driver assistance systems.

**Regional Driving Style Risk Estimation Service (advanced demonstrator)**

The goal of this service is to calculate a regional driving safety risk metric for certain regions including intersections, streets, cities or countries for stakeholders such as vehicle drivers, smart city planners, local and federal governments, insurance companies, online content

providers or automotive engineers to name a few. The regional driving safety risk metric is an aggregation of all individual driving styles meshed up with related events extracted from public social media, traffic messages and the content of regional and national newspapers. The following aspects are relevant for this particular version of the demonstrator.

- Smart city planners can get an overview on relevant traffic safety challenges of their city, pulling safety-related data from individual drivers, incidents and accidents onto a map, thereby creating a prioritized list of traffic safety infrastructure interventions.
- The interactive application will also allow drivers to compare their region's driving dominant driving style with others
- Insurance companies can better assess regional risk through having access to a driving safety risk metric and therefore better estimate appropriate insurances premium baselines.
- Automotive engineers will benefit by getting quantified vehicle information, which will help them to better customize vehicles and powertrains according to the requirements of a specific region.

**The 'field data visualizer' - a tool for requirements communication**

The following figure shows the **field data visualizer**, a Web Application developed in R, running on a virtual machine at VIF.

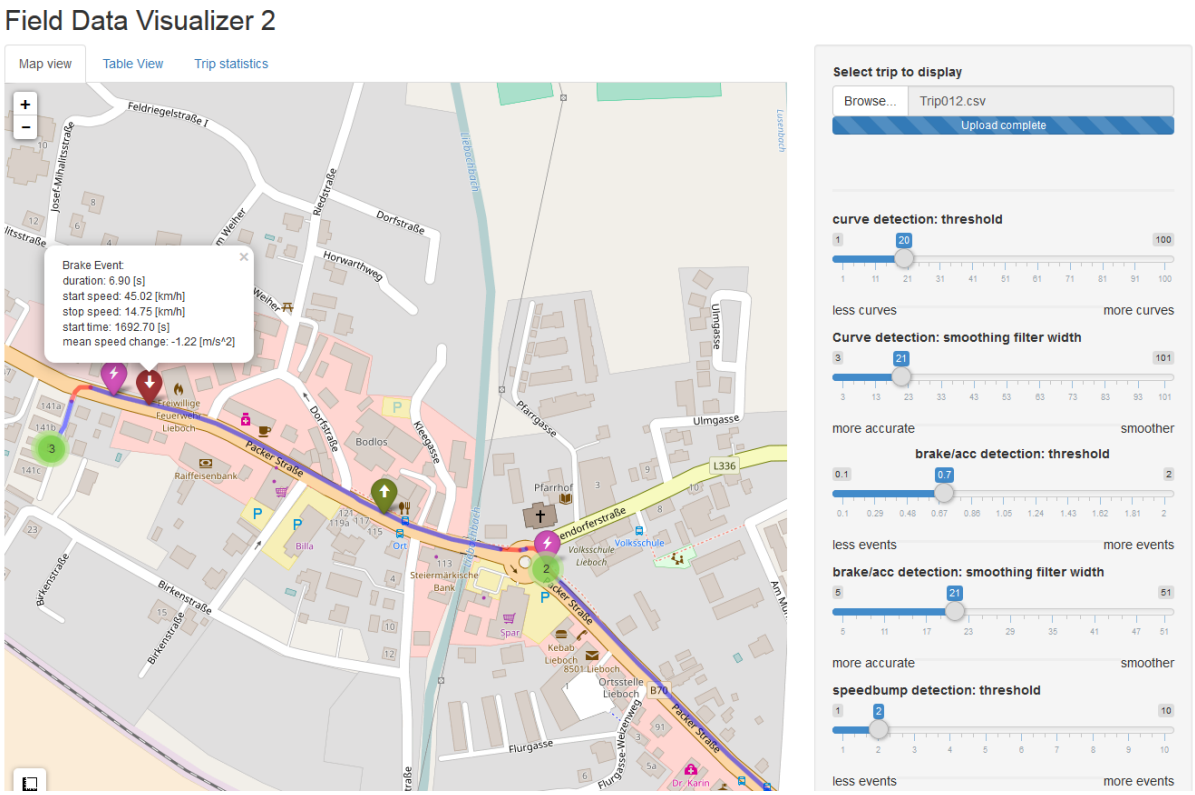


Figure 18: The field data visualizer: Detecting safety-relevant events within one single trip

To ease the requirements elicitation process, VIF has developed this application to visualize safety-relevant events (harsh acceleration, harsh breaking, stopping, as well as pot holes & speed bumps) on a map. This application is used to provide insights on how automotive

stakeholders can benefit from the data analysis conducted by applying the AEGIS platform within a demonstrator. VIF has already conducted several meetings with automotive stakeholders to showcase this application. Developing preliminary algorithms for detecting safe and unsafe driving behavior from vehicle operation data in R was based on collected simulator data as well as collected real driving data from the field.

Both the development of these algorithms as well as the visualization of the results have been conducted in the early phase of the project to have a demonstrator at hand, as well as to derive user requirements from additional stakeholders. Automotive stakeholders may experience the application and this will enable them to better understand the technical capabilities and benefits of the future AEGIS platform, which is crucial for the exploitation phase.

The Field Data Visualizer only supports a simple workflow: It is intended for evaluating developed algorithms for the AEGIS services to develop. The final AEGIS demonstrators (early, medium, final) will provide a data workflow as proposed in D1.2. The algorithms will be finally implemented on the AEGIS Platform during the demonstrator development process.

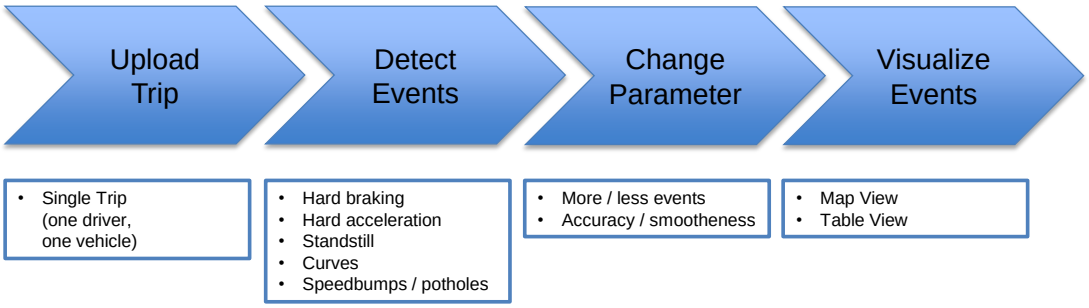


Figure 19: The field data visualizer (data workflow)

While the field data analyzer serves as a useful tool to detect interesting safety-relevant events on the level of a single trip, the AEGIS platform is intended to enable large-scale digital services based on multi-trips, multi-drivers, and multi-datasets.

### *3.2.3. Preliminary Demonstrator-specific Test Cases*

Besides usefulness & usability a series of properties of the AEGIS platform are evaluated by executing demonstrator-specific evaluation cases involving both data scientists and service users into the evaluation process. Data Scientists from VIF have to define the data workflow on the AEGIS platform in a reasonable amount of time without needing extensive training efforts and programming knowledge.

| **Test case** | **Preliminary test cases for the automotive demonstrator** |
|---|---|
| #1<br><br>**Broken Road Indicator:**<br><br>Road damage application | A data scientist wants to create a broken road identification service to be used by others, too. The service should be based on vehicle data and identify areas of road surface damage thereby.<br><br>The data scientist logs into the AEGIS platform and creates a new project there. He then uploads raw vehicle data (time series data) collected from different vehicles driving in Greater Graz area to the project. (In this case |

| | |
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| | the data scientist is also the owner of the raw vehicle data).<br><br>He already has developed the appropriate statistical procedures previously offline (implemented in R) and then re-implements the algorithms to be executed on the platform using the provided mechanisms of the platform.<br><br>He then develops an API on the platform, which can provide the results of the algorithms (i.e.) road damage values for a given areas. Inputs are coordinates of a rectangle for the map as well as a resolution value for the road damage positions. Output is a JSON-formatted list of coordinates plus the detected road damage per coordinate.<br><br>The data scientist then creates a web page, which visualizes the output of the AEGIS platform (JSON file) on the client's browser within a map, showing road damage on a map. |
| #2<br><br>**Broken Road Indicator:**<br><br>Buying data for Road damage application | A data scientist wants to create a broken road identification service to be used by others, too. The service should be based on vehicle data and identify areas of road surface damage thereby.<br><br>The data scientist logs into the AEGIS platform and creates a new project there. He browses the data market for vehicle data (raw data), which is suitable for assessing road damage. At least acceleration, GPS, speed, and rotation have to be included in data suitable for such an undertaking.<br><br>He was able to identify a number of suitable datasets owned by a third party collected from different vehicles driving in Greater Graz area. He purchases the data, downloads the data and performs an offline analysis. |
| #3<br><br>**Safe Driving Indicator**<br><br>Safe driving application | A data scientist wants to create a safe driving indicator service. The service should be based on historical vehicle data and weather data and identify areas of risky driving thereby. Risky driving includes harsh breakings and harsh accelerations as relevant patterns determining it.<br><br>The data scientist logs into the AEGIS platform and creates a new project. He then uploads raw vehicle data (time series data) collected from different vehicles driving in Greater Graz area to the project. (In this case the data scientist is also the owner of the raw vehicle data).<br><br>He already has developed the appropriate statistical procedures for identifying safe/unsafe driving patterns in vehicle data (including corresponding weather data) previously offline (implemented in R) and then re-implements the algorithms to be executed on the platform using the provided mechanisms of the platform.<br><br>He then develops an API on the platform, which can provide the results of the algorithms (i.e.) values of unsafe driving events (e.g. harsh breakings & harsh accelerations) for a given areas. Inputs are coordinates of a rectangle for the map as well as a resolution value for the road damage positions. Output is a JSON-formatted list of coordinates plus the detected event of |

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| | unsafe driving per coordinate.<br><br>The data scientist then creates a web page, which visualizes the output of the AEGIS platform (JSON file) on the client's browser within a map, showing patterns of unsafe driving on a map. |
| # 4<br><br>**Regional driving safety risk estimator**<br><br>Driving safety risk application | A data scientist wants to create a safe driving identification service for regions. The service should be based on historical vehicle data as well as weather data and identify areas of risky driving thereby.<br><br>The data scientist logs into the AEGIS platform and creates a new project there. He then uploads a bulk of raw vehicle data datasets (time series data) collected from different vehicles driving in Greater Graz area to the project. (In this case the data scientist is also the owner of the raw vehicle data).<br><br>He browses the platform for weather data (raw data) collected from the same region as the vehicle data. He finds a suitable set of weather data for the safe driving service.<br><br>He already has developed the appropriate statistical procedures to identify events of unsafe driving in combined data (vehicle data & weather data) offline (implemented in R) and then re-implements the algorithms to be executed on the platform using the provided mechanisms of the platform.<br><br>He then develops the API on the platform, which can provide the results of the algorithms (i.e. sections of unsafe driving depending on weather & driving style). Inputs are coordinates of a rectangle for the map as well as a resolution value for the road damage positions. Output is a JSON-formatted list of coordinates plus the detected unsafe driving event per coordinate.<br><br>The data scientist then creates a web page, which visualizes the output of the AEGIS platform (JSON file) on the client's browser within a map.<br><br>Alternatively – using the snap2road feature of the AEGIS platform – inputs are a location (e.g. a city). Output is a JSON-formatted list of the most dangerous street sections including their particular safety risk in this city.<br><br>The data scientist then creates a web page, which visualizes this list of the most dangerous street sections in a table form. |

Table 7: Preliminary evaluation cases for the automotive demonstrator

## 3.3. AEGIS Smart Home and Assisted Living Demonstrator

### *3.3.1. Overview and goal*

The combined objective of the **AEGIS Smart Home and Assisted Living Demonstrator** is to illustrate and implement a services bundle towards advanced holistic monitoring and assisted living management, aiming to improve everyday living and enhance the wellbeing of

people belonging to vulnerable groups. The services pertain, in particular, three main functionalities, namely:

1. Monitoring and analysis of physical health, physical activity, positioning and wearable information and weather data, towards provision of an application, through which care providers can remotely monitor their patients and be alerted for signs of patients' ill health and risks for the physical well-being of the individuals monitored.
2. Monitoring and analysis of an individual's well-being conditions, in conjunction with health-related data, indoor environmental data, as well as external environment data (e.g. weather, crime, news, social media) towards the provision of a recommendation and notification issuing application for at-risk individuals.
3. Monitoring and analysis of weather, indoor environmental conditions, energy and operational device data towards the provision of a smart home application, which can be offered by care providers to at-risk people for increased indoor comfort and welfare.

### *3.3.2. Operational Demonstrator Scenario & Solution Approach*

The demonstrator will be developed in Athens from Hypertech, Ubitech and Suite5, Information and Technology (IT) companies which adopt the AEGIS role of the provider and developer of the services (data scientists). In particular, the envisaged stakeholders for the demonstrator, along with their roles in the AEGIS project and evaluation process, are summarized in Table 8.

| **General stakeholders** | **Role in the project & involvement in evaluation** |
|---|---|
| PSPS Data Scientists (Researchers from Suite5, Ubitech and Hypertech) | Data scientists adopt the multifaceted role of service providers and developers, as well as data providers, curators and analysts, within the AEGIS platform. As such they are responsible for defining the service workflows of the demonstrator.<br><br>Evaluation Queries: Does the AEGIS platform provide suitable infrastructure for easy anonymization, uploading and managing of data? Can the platform address equally well the analysis of both numerical and text data? Are suitable algorithmic procedures in the platform? If not, is it easy to create new ones? |
| PSPS end users (Care Providers/Doctors) | The first non-expert users involved in the demonstrator are the care providers/doctors, who, apart from using the respective services, also provide data to the data scientists.<br><br>Evaluation Queries: Are the services provided by the providers and created using the AEGIS platform useful and easily useable by non-expert users? Do the services achieve the goal for better monitoring at-risk individuals and |

| | |
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| | patients? |
| PSPS end users (At-risk individuals/ patients) | The second non-expert users are the at-risk individuals/patients, who utilize the respective developed applications to assist them in their everyday lives.<br><br>Evaluation Queries: Are the services useful, easily useable and non-intrusive to the non-expert users? |

Table 8: AEGIS Smart Home and Assisted Living Demonstrator stakeholders and related AEGIS actor roles.

At a high level, a social care service provider, for example a care centre for elderly individuals or a nursing home, desires to exploit big data-driven insights, in order to provide added value services to vulnerable individuals. The services pertain *proactive* and *reactive security*, *protection through smart notifications* and *personalised recommendations*, as well as *comfort* and indoor air *quality preservation*. Proactivity and reactivity of the aspired services aim at prolonging self-sufficiency and independence of the at-risk individuals, boosting safety, and facilitating informed decision making, either by the individuals themselves, or by their (in)formal carers. The case service provider employs a data scientist to process and analyse the data and develop the required services and end-user applications.

The system will have to analyse and process domain specific data coming from various sources, including, yet not limited to, (anonymised) health data, smart home sensor data, wearable devices, and other proprietary or external open sources (e.g. weather, social media, health or crime statistics). The demonstrator architecture is graphically illustrated in the following schematic. As per the illustration, the core module responsible for the aggregation of the information from the various sources is the AEGIS platform, which is fed data from the open sources as well as from the platform end users.

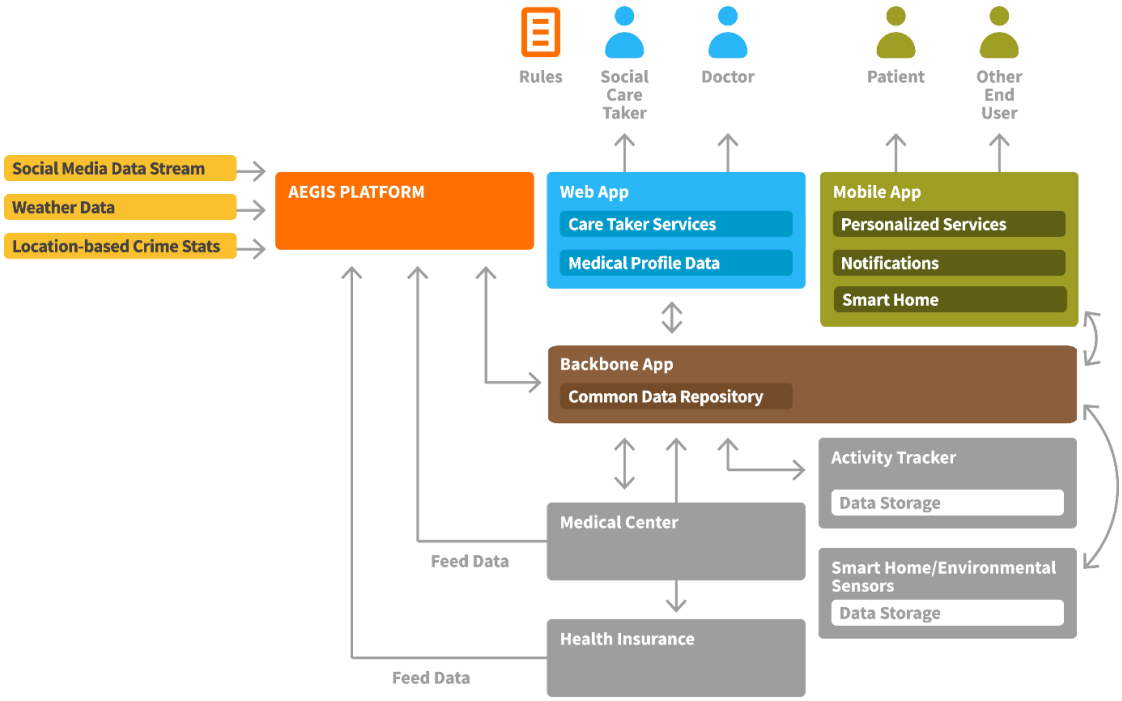


Figure 20: Hospitals, Insurance companies, doctors and social carers can employ this system to offer advanced personalized services to their patients.

The AEGIS web application serves as the main interface for the interaction of the carers with the AEGIS platform. The AEGIS platform is assigned the role of the primary processing unit where data from various sources are gathered, evaluated and processed. Data analysis produces sets of general rules and conditions for safety, security, indoor comfort and environmental quality. The web interface provides a supervisory picture of the monitored individuals to the medical personnel so as to facilitate personalised, informed decision making. In particular, the aforementioned rules are fed to the web application, which acts as a server to the end-user's mobile app, transmitting and receiving personalized data. The rules from the first step become tailored to each individual and/or its living environment, offering, on the one hand, personalized notifications and alerts, and, on the other hand, individualized control actions for the unobtrusive preservation of indoor health and well-being conditions.

Apart from the web interface, the services bundle includes dedicated mobile applications for informal carers and vulnerable or at-risk individuals. The apps are responsible for communicating the personalised notifications, alerts and ambient indoor conditions. In tandem, the apps undertake the job of aggregating personal information (e.g. information from wearable devices and sensory equipment), which is fed to the web app and mapped to the extracted rules, leading, thus, to the identification of personalised service offerings. In this context, the web interface acts as a data monitoring system for the shareholders and other core actors, sending alerts and notifications when a high-risk incident is happening, or is predicted to happen with high confidence.

The criteria for success of the demonstrator vary depending on the concerned stakeholder. For a data scientist, criteria will be concentrated on the provision of the required software components and services from the AEGIS platform, that allow easy and convenient processing and exploration of the data, as well as creation of workflows for analysis and

extraction of patterns/rules through learned models, which can then be utilized by standalone applications tailored to the respective end-users. Furthermore, the usefulness of the AEGIS platform for the data scientist will be increased if a number of relevant datasets can be located in the AEGIS platform. Regarding the end-users, a care provider should be provided by appropriate a user interface/dashboard to allow monitoring of the at-risk individuals. Furthermore, additional value for this stakeholder constitutes the provision of easy-to-use services for convenient anonymization of personal data, and a respective framework for uploading datasets to the platform. Finally, at-risk individuals have an AEGIS-agnostic role, and thus the success, from their perspective, is detangled completely from the platform and relates to the usefulness of the provided services/functionalities from the end-user applications.

Quantification of user satisfaction/whether the success criteria were met will be based on targeted interviews and online surveys/questionnaires for the various stakeholders. The evaluation material will comprise of a combination of generic questions, mainly targeting the overall usefulness of the AEGIS platform, as well as focused queries regarding the particular demonstrator and evaluation scenarios (see below).

As prescribed beforehand, the demonstrator will be assessed within a three-stage framework (early, mid and late-stage assessment). Thus, an incremental approach will be adopted with respect to the evaluation of the functionalities offered by the developed demonstrator applications.

### *3.3.3. Preliminary Demonstrator-specific Test Cases*

The usefulness of the AEGIS platform with respect to the smart home and assisted living demonstrator is to be assessed through a sequence of demonstrator-specific evaluation cases, pertaining the described functionalities and the identified stakeholders. There are presented below.

| **Test case** | **Preliminary test cases for the Smart Home and Assisted Living Demonstrator** |
|---|---|
| #1<br><br>**All considered services**<br><br>Data acquisition, and anonymization, project initiation and preliminary data analysis | A data scientist wants to provide a bundled service to a care provider, which the latter will offer to at-risk patients. The first goal is to identify daily activity patterns and behaviours, in association with health, as well as other demographic parameters, towards collecting useful profile data to be used for outlining suggested activities for individuals to the care providers.<br><br>The service capitalises on various personal activity monitoring devices and social media data from individuals, to extract the necessary data and compose activity profile for each user. Furthermore, anonymized physical health data are provided by the care provider.<br><br>Batches of data are anonymized at the backbone app layer. The data scientist logs into the AEGIS platform and creates a new project. He |

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| | uploads the anonymized health and activity data.<br><br>He then employs off-the-self clustering and pattern recognition algorithms in order to create clusters of at-risk individuals/patients, based on various aspects, such as age range, location and daily activity routines. Each cluster is associated with typical/average activity, comfort and health risk profiles.<br><br>These profiles are then digested by the service and are offered in an anonymised manner to the care provider, who can then utilise such information to identify abnormal health and environmental conditions, and outline activities of certain groups who are at-risk. |
| #2<br><br>**All considered services**<br><br>Advanced Analytics for 360º monitoring of at-risk individuals | The data scientist goes one step further to help the care provider identify other data which could affect the well-being of the at-risk groups. For this, he is willing to perform analyses with the already acquired profile data and other data sources that describe the environment where an individual may reside.<br><br>The analyst logs into the AEGIS portal and selects datasets that are relevant to the individuals at risk from a location perspective, such as weather data or air pollution data, as well as social media data that hinder to events which may have an impact on people's wellbeing. Furthermore, the data scientist establishes the required channels for acquisition of indoor air quality measurements (VOC, CO2), occupancy, indoor and outdoor temperature and humidity, through appropriate in-home instrumentation.<br><br>For the aforementioned data streams, aggregated data, linked to anonymous users, are uploaded to the platform and are subjected to correlation analysis to identify relationships between indoor conditions and physical activities. These allow the data analyst, together with a care provider expert to train the system to identify comfort and wellbeing zones. |
| #3<br><br>**Remote Monitoring and care provider services**<br><br>Personalized Notifications and Recommendations to at-risk individuals | The data scientist wants to offer to the care provider a recommendation and notification service to send useful information to individuals at-risk regarding their wellbeing and safety.<br><br>A Developer creates a smart notification application that performs close to real-time mentoring of data regarding the individual at-risk and its environment. For this, the data analyst is providing a trained model which allows classification of individuals to different groups and provides also rules for notifications, as identified collaboratively with the care provider expert.<br><br>The App to be developed receives data streams from the pilot's backbone service (such as events of interest for the pilot, and weather conditions) and combines it with data measured by the different |

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| | sensors aggregated on the user's device (wearable/smart home/etc), and pushes the correct notifications. |
| #4<br><br>**Remote Monitoring and care provider services**<br><br>Environmental and air condition personalized risk identification | A data scientist wants to create a service for the care provider that identifies signs of health deterioration of the individuals monitored in correlation with external weather conditions (e.g. individuals suffering from COPD in case of increased humidity over a specific percentage) and provides proactive notifications to care providers and personalized simplified alerts to patients.<br><br>The service should be based on anonymized physical health data and physical activity data obtained mainly from wearable devices and smartphones in addition to external weather data and external VOC data as provided by the AEGIS platform for the specified area.<br><br>The data scientist logs into the AEGIS platform and creates a new project. He uploads the anonymized physical health and activity data as provided by the care provider. In addition to the data provided, he browses the datasets available on the AEGIS platform for external weather data and external VOC data suitable for analysis on extreme weather conditions identification. At least temperature, humidity and wind speed have to be included.<br><br>The data scientist would like to utilize machine learning techniques (e.g. feature extraction) already trained with historical data, to be executed within the AEGIS platform in order to identify any risk posing weather conditions, and machine learning models (e.g. regression and /or classification models) also trained with historical data to identify possible correlations between the weather conditions and possible health risks. |
| #5<br><br>**Remote Monitoring and care provider services**<br><br>Alert Notification Service for irregular health and behavioural patterns | A data scientist wants to create a service for the care provider that identifies risks for the health and well-being of individuals and provides proactive notifications to care providers and personalized simplified alerts to patients.<br><br>The data scientist logs into the AEGIS platform and creates a new project. He uploads the anonymized physical health and activity data and the positional information data as provided by the care provider.<br><br>The data scientist would like to develop machine learning models (e.g. regression and /or classification models) already trained with historical data, to be executed within the AEGIS platform. The models are developed in order to extract behavioural routines towards the identification of pattern irregularity or deviations from behavioural routines which could signify cognitive deterioration. The models are also able to detect physical wellbeing deterioration and frailty status (like detection of falls or taking the individual more time to complete typical physical routines) by analysing historical physical health and |

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| | activity data of the individual and by training the model to classify the individual's activities and distinguish the events indicating possible health risk. |
| #6<br><br>**Smart Home**<br><br>Automated smart home control for health and comfort preservation | A care provider wants to offer an added-value service to at-risk individuals through a smart home application, targeting at preservation of comfort and safe indoor environmental conditions.<br><br>To achieve that, the data scientist needs to establish additional streams of data regarding energy use, tariff information and device control patterns, which are integrated into the service data model.<br><br>The identified comfort profiles, along with standard limits regarding indoor air quality, are transmitted to the mobile smart home app, which processes real-time sensor data and alerts the user in cases that indoor air conditions/quality fall outside the comfort and safety limits.<br><br>In addition, the data scientist develops a stochastic optimization algorithm that performs mid-term optimization of HVAC operational status, which utilizes as inputs current and future estimates of indoor/outdoor temperature and humidity, as well as energy-usage, cost and comfort profiles.<br><br>Initial model parameter estimation is performed on the AEGIS platform utilizing location-based aggregated historical data. The learnt model is passed on to the mobile app. In-home data streams are then employed to continuously update the model based on the specific occupant characteristics.<br><br>The fully fledged smart home app monitors the real-time sensor data streams and sends control signals to the HVAC equipment, alleviating thus the user from the need of continuous manual control, which can be a tedious and difficult process for patients and impaired individuals. |

Table 9: Preliminary evaluation cases for the smart home and assisted living demonstrator

## 3.4. AEGIS Insurance Demonstrator

### *3.4.1. Overview and goal*

The overall goal of the AEGIS insurance demonstrator is to exploit the AEGIS platform big data technologies in order to access and analyse information coming from diverse and heterogeneous data sources including the in-house data (e.g. customer location, insured/uninsured asset types, …). Exploring with the AEGIS tools weather, news and crime open data, the HDI data scientists would be able to manage in an efficient way events (to be happen or just happened), while the use of the AEGIS analytic tools would allow the company to set a strategy to minimise the impact of the event on the company itself, while offering a support to the customers.

Summarizing, the expected benefits of the AEGIS adoption by HDI Assicurazioni include the possibility to rapidly analyse and process huge volumes of cross domain data, an improvement of the customer's satisfaction through personalised offering and information about natural or social events of interest. Moreover, AEGIS services would constitute a key for the development of an accurate and successful business plan through the pricing analysis and the analysis of the trend of the Company.

### *3.4.2. Operational Demonstrator Scenario & Solution Approach*

The insurance demonstrator will be focused in Italy, in particular in the area of the Metropolitan City of Rome and in Lazio as the majority of the HDI customers are located in this area and in the meanwhile, it offers a wide range of possible events both natural and social.

The insurance demonstrator will be developed in three different versions:

- ***Financial impact, customer support and services***
- ***Personalised early warning services for asset protection***
- ***Marketing strategy and pricing support services***

The first and the second versions, arisen from the detection of an event that has already happened (close to real time notification) or is expected, will include the analysis of the financial impact for the company, the pricing strategy and support and services to the customer possibly involved.

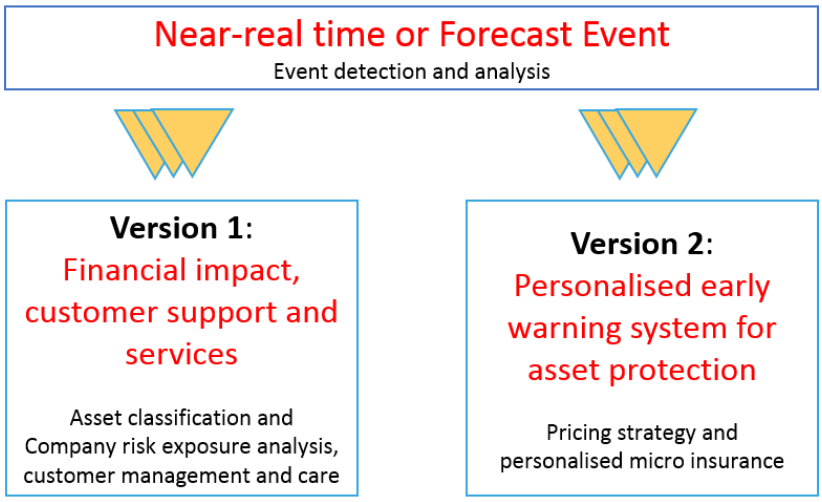


Figure 21: Main features of the version 1 and 2 of the insurance demonstrator

The third version will exploit the analysis related to the previous versions in order to better understand the HDI market: historical in-house datasets and open data (mainly from Public Italian Registers) will be analysed, providing to the Company models to enhance and ease the business planning and advertising campaigns.


Figure 22: Main features of the version 3 of the Insurance Demonstrator

The insurance demonstrator aims to:

- Support the HDI customers affected by natural events;
- Support HDI employees/Company managing claims related to extraordinary events;
- Evaluate the financial impact for the Company (risk exposure);
- Improve the cross selling and up selling strategy;
- Inform HDI customers about forecast events
- Ad-hoc marketing campaigns and specific offers to selected customers
- Improve HDI presence on the national territory

The table below shows the involvement of the HDI employees with the AEGIS platform.

| General stakeholders | Role in the project & involvement in evaluation |
|---|---|
| Management Department Team | It is involved in:<br>• AEGIS requirements identification and description;<br>• Significant AEGIS data sources detection;<br>• Definition of internal procedures/rules, to react to AEGIS outputs;<br>• Evaluation of the benefits achieved using the AEGIS functionalities. |
| Developers (both internal and external) | They are involved in:<br>• Definition of the service workflow on the AEGIS platform for the insurance demonstrator;<br>• Satisfaction of the requirements elicited by the Management Department. |
| Data Scientists | They are the first beneficiaries of the AEGIS platform. Their work is expected to be facilitated, while their evaluation more accurate and complete.<br>They are responsible of the evaluation of the service design process: does the AEGIS platform provide the required functionality and data for the envisaged services? Is the platform easily usable? Is the platform time of response |

| | |
|---|---|
| | acceptable? Does the platform really provide a set of innovative tools to ease the data analysis? |
| Operators (both internal and external) | They receive as input the outputs of the AEGIS algorithm analysis and are involved in contacting the HDI customers.<br>They are responsible of the evaluation of the legibility of the AEGIS reports. |
| HDI Customers | They are the final beneficiaries of the demonstrator; they will not use directly the AEGIS platform.<br>The AEGIS evaluation will be based also on the customers' feedback. |

Table 10: AEGIS Insurance Demonstrator stakeholders and related AEGIS actor roles.

**Insurance demonstrator version 1 and 2 – *Background***

Through AEGIS, HDI would like to contact its customers in case of natural (for instance, a *hailstorm*, a *whirlwind* or a *flood*) or social event (i.e. a *strike*, a *concert* or a *sport event*). For the Insurance Company identifying and contacting customers that could be involved in the event can result into a considerable improvement in customer relationships and performance. However, such services could also lead to reliable and efficient evaluation of the risks of exposed assets for the company.

The Company will provide to the AEGIS platform:

- customer position, gained from the HDI Mobile App and a set of pre-signed terms and conditions about data policy; customer position could be also gained from data in the insurance contracts (especially for non-movable assets), but also for movable, it would be possible from the "registered" address to assume, in case no real-time geolocation is possible, if the area is of interest for the person under observation.
- a set of "significant sources" to monitor: the HDI data scientists in agreement with the HDI Management Department pre-selected a list of data sets; the AEGIS event detection tool notifies the HDI Data Scientist almost in real time if a set of events marked with one or more keywords (defined by the data scientists) happens, scanning the pre-selected datasets. While a new event is detected, the AEGIS platform automatically associates its risk level following a default classification that implements the HDI internal criteria. Nevertheless the HDI Data Scientist can change manually the default risk.

**Financial impact, customer support and services (early demonstrator)**

The development of the early demonstrator could be summarized as follows:

- The AEGIS Platform correlates the event happened with the HDI in-house datasets: customers (registry data, geo referenced addresses, contacts), portfolio and insured assets (type of assets and risk insurance coverage, georeferenced locations). It is highly important to note that the company databases have to be previously anonymized hiding personal data and policy numbers by an offline tool provided by AEGIS.

- Customers resident in the area, that have an asset or a real estate secured registered in the area or are actually been (through HDI Mobile App geolocalization feature) in the area are shown on a map of the area with a pin (Figure 23).
- It would be useful if the algorithm distinguishes with different colours of the location pin marker the policy type hold by each customer (Figure 24).

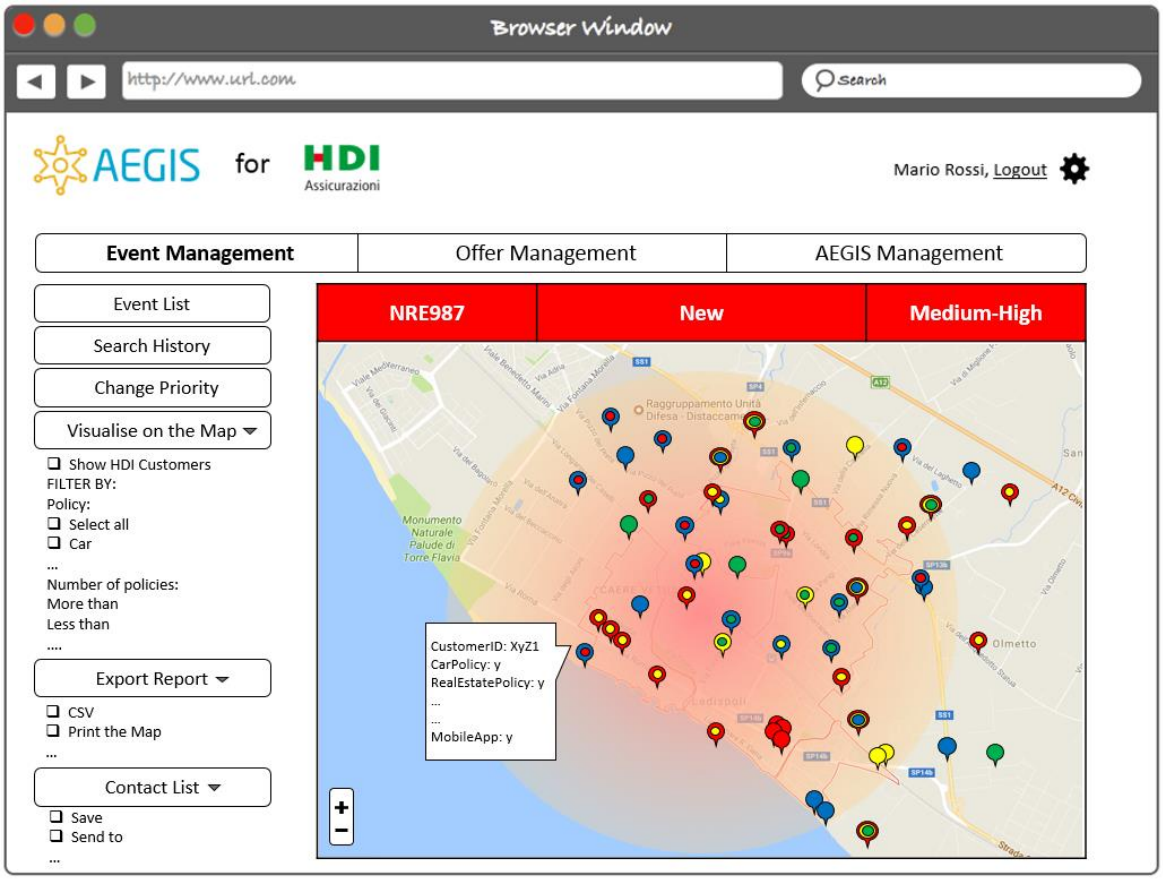


Figure 23: Example of the AEGIS Demonstrator Platform with the visualisation of the HDI customers in the impact area of a whirlwind (version 1 and 2)

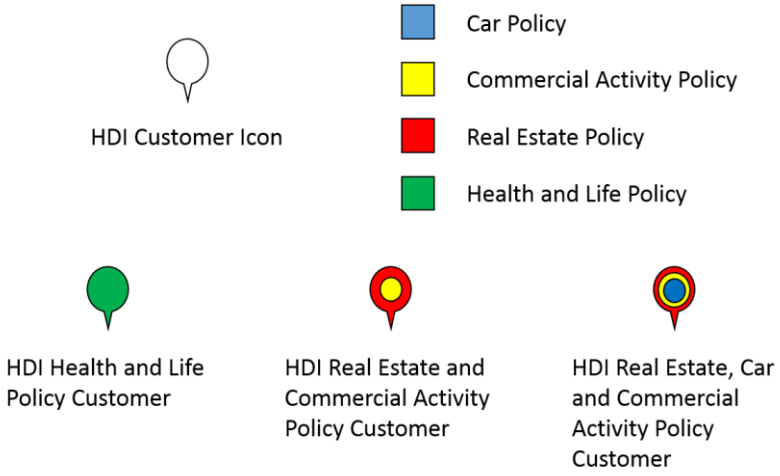


Figure 24: Meanings of the marker pins on the map

A key feature would be the possibility to filter the search asking to highlight on the map, for instance, only the customers that have a car policy. This kind of search helps in the near-real time use case to prioritise the call order.

- Through queries across datasets (private and public) the AEGIS Analytics tool will estimate the financial impact for the Company of the event.
- The HDI Data Scientist runs a clustering algorithm that extracts the list of the possibly involved customers as a priority list of the customers that have to be contacted. The priority rules (dependent on the type of natural event and on the type of policies held) have been defined by the HDI Management Department and they were entered in AEGIS.
- Such list can be sent to internal/external operators allowing them to call, send a notification or email to the customers on the list. The aim is to assist the customer, understanding if the event has caused consequences to insured goods. The content of the communication will be highly dependent on the event and on the customer, a general guide shall include:
    - The reference number to contact both of the emergency team and the Insurance Company;
    - Further steps after the emergency event to claim for damages.

***Personalised early warning services for asset protection* (<u>medium demonstrator</u>)**

The second version of the demonstrator comes out from the need to provide a customer-oriented service. As aforementioned, the main idea is to focus analysis through the AEGIS platform on some events of interest, such as natural and 'social' events, in order to inform customers of the event, providing them general indications, support (how to behave in case of danger and specific policies even for a short time period) and offering micro-insurances (cross-selling and up-selling).

Considering the AEGIS platform involvement, the '*Personalised early warning systems for asset protection'* evaluation case could be split in two main steps:

- The first step of that scenario includes a warning to the possible involved customer, through HDI Mobile App, email, SMS or a call. The AEGIS platform monitoring news and weather forecasts websites notifies to the HDI Data Scientist the foreseen event. The Data Scientist can evaluate the event and send automatically an alert to the HDI customers possibly interested on it. The AEGIS tools that will be involved in that scenario are the same of the first evaluation case.
- That scenario is suitable both for weather and crime data. In fact, another key point to reach through AEGIS, would be the analysis of crime data, and the identification of the HDI customers that live, work or have an insured good in the high-risk areas (leading to 'on-site based strategy'). A tool that notifies possible Public Security Issues events to HDI operators, would allow them to have the time to contact the HDI customers that may be affected, depending on the type of insured assets and on the event, the already-insured could be alerted, while for the not covered customers it would be possible to propose new policies (cross selling and up-selling) specific for the event.

**Marketing strategy and pricing support services (advanced demonstrator)**

The third demonstrator version focuses on the HDI Business Intelligence, in order to better understand the trend of the Company, the presence of the commercial agents in the territory and the type of the policies sold in relation to the events that mainly hit the area.

The data that will be analysed are:

- Customer data (in-house data), both historical and actual;
- Public Registries Data, related to particular meteorological situations and natural events in specific areas, where HDI customers are located (leading to 'seasonal strategy').

The analysis of historical weather data and eventually its correlation with the seasonal forecasts will be useful in order to lead a marketing strategy based on the risk evaluation and the customer policy analysis. Through these AEGIS features, HDI will be able to plan focused advertisement campaign while measuring the effect of adjustments on pricing, which is crucial to tuning on models.

In that view the visualisation tool that best fits the purpose could include some graphs such as histograms or scatter plots, with customizable features (see figure below).

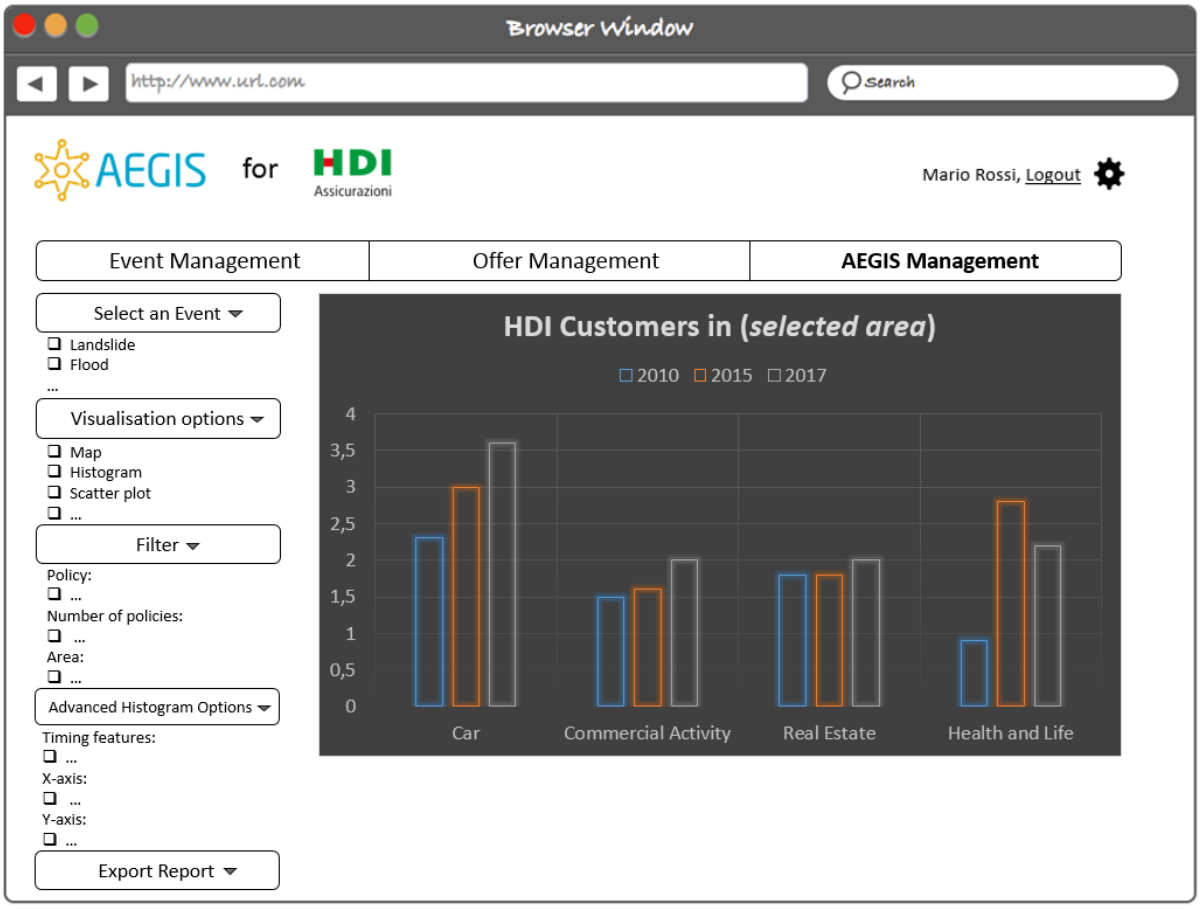


Figure 25: Example of the AEGIS Demonstrator graph

### *3.4.3. Preliminary Demonstrator-specific Test Cases*

The usefulness & usability of the AEGIS platform applied to the insurance demonstrator will be evaluated by demonstrator-specific evaluation cases involving both HDI data scientists and operators in the evaluation process.

The high level descriptions of the evaluation cases provided in the previous section (section 3.4.2) was written in cooperation with both of the HDI Data Scientists and the HDI Management Department members, in order to take into account the needs of the main actors that will exploit the benefits provided by the AEGIS platform.

It is important to note that evaluation cases 1, 2 and 3 will be probably evaluated through the simulation of an event, to ensure that these are applicable regardless if an event of interests happens within the project's evaluation period.

| **Test case** | **Preliminary test cases for the insurance demonstrator** |
|---|---|
| #1<br><br>**Financial** | The AEGIS Demonstrator platform provides an alert service that notifies to the HDI data scientist that a natural or a so called social event is happening or is foreseen. The data scientist can visualise the main features |

| | |
|---|---|
| **impact, customer support and services:**<br><br>Asset classification and Company risk exposure analysis | of the event (i.e. the preview of the news with photos, titles and the link(s) to the web page where the article has been published). The alert service takes into account if the event could be of interest for HDI, in other worlds if in the area of interest there are customers' assets insured with HDI.<br><br>Once the data scientist has verified the event features, he/she creates a project and runs the Emergency Rules tool that automatically associates to the event a risk value, dependent on the event and on the exposure of the Company to the risk (through an asset classification). |
| #2<br><br>**Financial impact, customer support and services:**<br><br>Customer management and care | Once an event of interest for HDI is detected, the data scientist opens a project and asks AEGIS to visualise on a map the customers that should be associated to the area, in particular the main data related to each customer will be:<br><br>• Personal data (registry data, geo referenced addresses, contacts);<br>• Portfolio and insured assets (type of assets and risk insurance coverage, georeferenced locations).<br><br>The algorithm distinguishes with different colours of the location pin marker the policy type hold by each customer as described in Figure 23.<br><br>The data scientist running a clustering algorithm receives a priority list of the customers that have to be contacted. The priority rules have been defined by the HDI Management Department and they were entered in AEGIS. The priority rules will be highly dependent on the type of natural event and on the assets insured by the customer. Through the 'Share with' functionality the HDI data scientist is enabled to send the list to an outsourcing contact centre. The customers, depending on the prioritisation shall be contacted by a call, an email, a SMS or through the HDI Mobile App notification or chatbot. |
| #3<br><br>**Personalised early warning systems for asset protection:**<br><br>Pricing strategy and personalised micro insurance | Once a foreseen event is detected, the data scientist could visualise on the map of the interested area the HDI customers (leading to 'on-site based strategy').<br><br>The data scientist opens a project and imports the HDI in-house datasets. Through AEGIS the HDI data scientist could obtain a list of the customers not insured for the specific event, hence he/she could share the list with the HDI operator allowing them to sell personalised offering on the basis of the type of risk and of the policies already held (cross selling and up-selling) specific for the event. |
| #4 | For the Management Department team, the planning of the marketing campaign and the business plan are a high effort activities. A tool that |

| | |
|---|---|
| **Business plan and marketing strategy**<br><br>Marketing strategy and pricing tool | helps in such fundamental and critical activities would ease and improve the Company results. Hence AEGIS Analytics analysing particular meteorological situations and natural events in specific areas, where HDI customers are located (leading to a 'seasonal strategy') would be a key point of the new HDI marketing strategy method. It that view, the analysis of historical weather data and their correlation with the seasonal forecasts and the HDI customer data both actual and historical could mean an innovation to focus the business model. With such technologies, AEGIS could help to adapt HDI marketing strategy and policy pricing through decision support models. |

Table 11: Preliminary evaluation cases for the insurance demonstrator

## 3.5. Non Demonstrator specific Evaluation Cases

### *3.5.1. Open Innovation Platform for Data Experimentation and Service Offering*

#### 3.5.1.1. Overview and goal

The scope of the AEGIS platform is not restricted to the concrete requirements of the three defined AEGIS demonstrators, only. In fact the AEGIS platform should enable PSPS data scientists from various domains to design appropriate services (including domains beyond those of the three demonstrators).

Hence a non-demonstrator-specific scenario has been envisaged treating the AEGIS platform as an open innovation platform for data experimentation and services offering, too.

#### 3.5.1.2. Solution Approach & Operational Scenario

A data analyst is using the AEGIS platform to experiment with data owned by him or discovered on the platform, resulting in the generation of analyses, reports, visualisations as well as data streams, which he can then offer as a service through the AEGIS infrastructure to any interested stakeholder.

#### 3.5.1.3. Preliminary Test Cases

In order to evaluate if the AEGIS platform also satisfies this goal, a series of evaluation actions are envisioned. After executing the evaluation case all participating data scientists will be surveyed on usefulness and usability of the platform as well as on their additional ideas on how to improve the platform revealing additional insights on how the platform can be improved, too.

| **Test case** | **Preliminary non demonstrator specific test cases** |
|---|---|
| #1<br><br>**Open innovation** | The project conducts an AEGIS data science hackathon with university students, e.g. from the participating university partners.<br><br>During this hackathon, the students have to solve a pre-defined data-driven |

| | |
|---|---|
| **platform**<br><br>Data science hackathon with university students | challenge using the data and the functionality of the AEGIS platform.<br><br>According to a given scenario description provided to them, they have to design a specific data-workflow on the AEGIS platform in a reasonable amount of time (1-2 days) to meet the accepted formal criteria of a hackathon. |

## 4. APPLICATION OF THE EVALUATION FRAMEWORK

In its core the AEGIS platform can be reduced to an information system. Data scientists are interacting with this information system to finally develop data-driven services by using it. WP5 understands information systems as *socio-technical systems, supporting information system users in their tasks through providing them with task-relevant functionality, task-relevant information, and data*. The AEGIS platform has to enable and support the data scientists in their tasks of developing a PSPS demonstrator. As previously outlined, the proposed evaluation framework has its roots in qualitative research, highlighting interviews with key stakeholders as main data collection techniques. Qualitative approaches are supposed to better help AEGIS platform developers to understand what satisfies the explicit and implicit needs, expectations, and wants of platform users.

The successful implementation of the evaluation framework relies on a four step procedure as shown in the visualisation below:

- In a first step the data collection procedure will be started through involving key stakeholders from the AEGIS demonstrators into platform evaluation, by conducting interviews with PSPS data scientists who have executed their evaluation cases on how they perceived their use of the AEGIS platform.
- In a second step, the collected qualitative data will be analysed and then evaluation results will be derived, by performing a qualitative content analysis followed-up by summarizing and quantifying main statements from transcribed interviews.
- In a third step, the AEGIS platform developers will receive the evaluation results to help them to improve the quality, usability, and usefulness of the AEGIS platform, leading to a better meeting of needs, expectations and wants of the demonstrator users.
- In a fourth and final step, the evaluation input will be implemented into the AEGIS platform by the platform development team in a best possible way, if feasible.

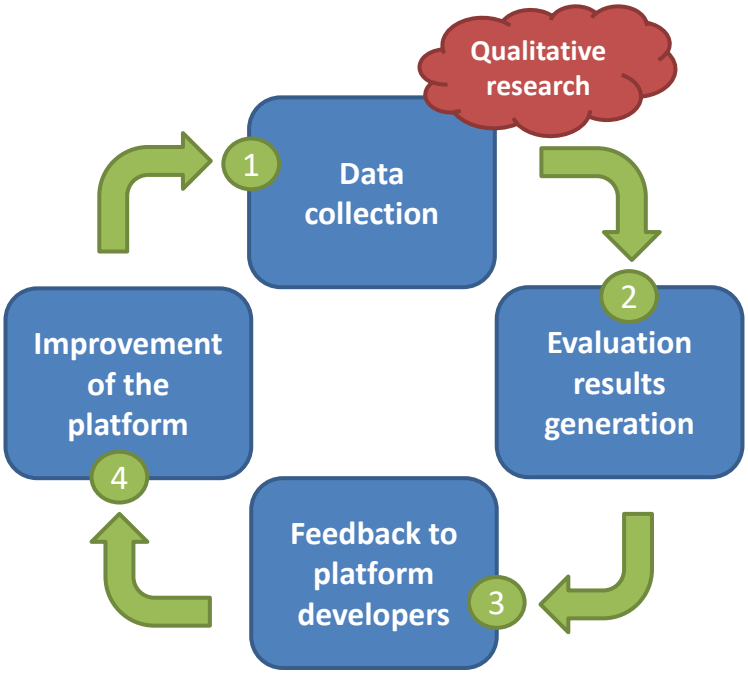


Figure 26: AEGIS Evaluation Framework Implementation

The AEGIS project is scheduled for 30 months (M1-M30). Thereby WP5, which kicked-off in M7, is responsible for a structured demonstrator operation and evaluation. WP5 has been planned for 24 months (M7-M30). This tight AEGIS project implementation plan allows the AEGIS evaluation framework to be applied in total three times within the AEGIS project runtime, as there are three different versions of the AEGIS early community demonstrators envisaged. However, the results of the final evaluation (at M30) cannot be fed back to the AEGIS platform developers within the project runtime. Software implementations or changes will then have to be conducted by the developers after project close out in the project exploitation phase.

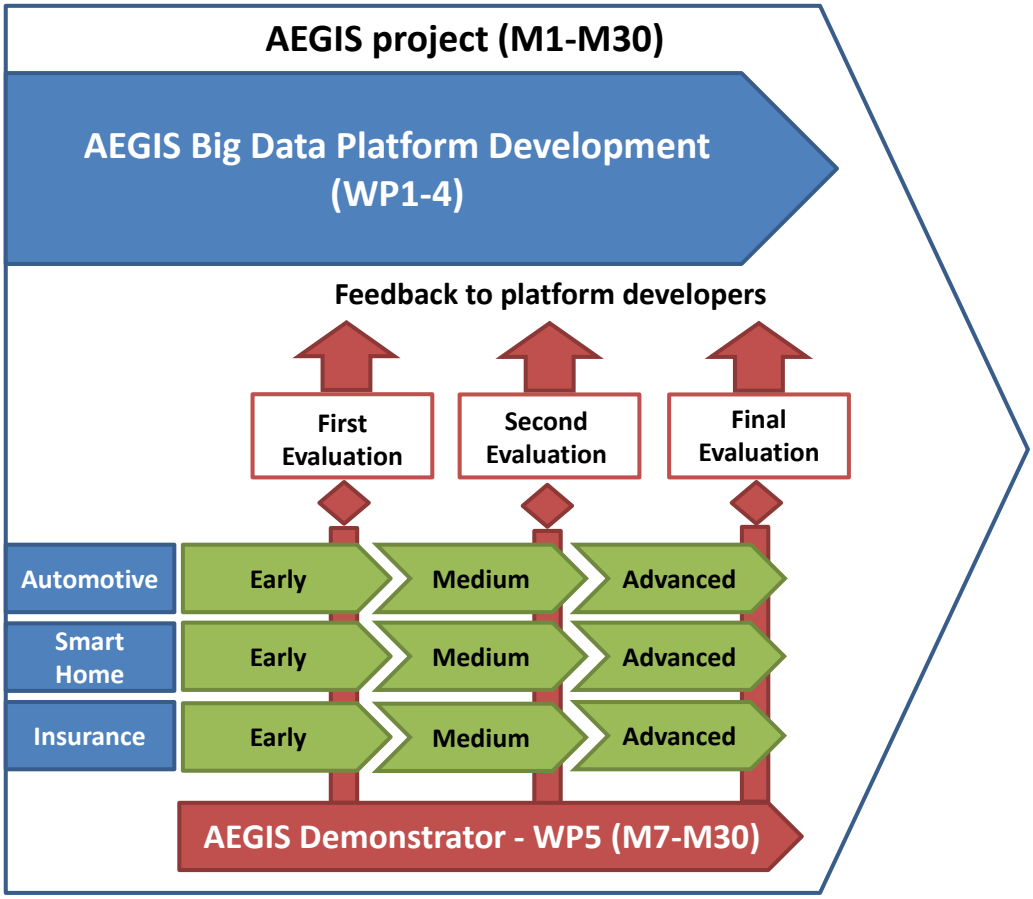


Figure 27: AEGIS demonstrator evaluation and feedback process

# 5. CONCLUSIONS AND OUTLOOK

The success of the AEGIS project heavily depends on effectively evaluating the AEGIS solution and thereby providing constant feedback to the demonstrator owners and to the AEGIS solution developers (data scientists). To meet this goal the AEGIS project plans, executes, and evaluates three different AEGIS Data Value Chain Early Community Demonstrators – (1) Automotive, (2) Smart Home & Assisted Living, and (3) Insurance – in a coordinated and unified manner. This is the main responsibility of *WP5 – AEGIS Data Value Chain Early Community Demonstrators*.

The three AEGIS demonstrators will provide concrete, data-driven innovations in the PSPS – Public Safety and Personal Security domain, which are enabled through the AEGIS platform. Demonstration efforts are complemented with further activities running independently from these three demonstrators thus evolving further non-demonstrator specific participants into the AEGIS evaluation, allowing the generalization of findings to other PSPS scenarios, too.

This deliverable is the first deliverable in WP5 and the result of *T5.1- Project Validation and Evaluation Framework Design.* D5.1 presents an inclusive AEGIS Evaluation Framework, which has its roots in information systems research as well as a general guideline to be used to monitor, evaluate, and align the three demonstrator's phases and progresses. The deliverable also includes an up-to-date description of each of these three AEGIS demonstrators, including a set of evaluation cases per demonstrator, which are relevant for the evaluation process.

The evaluation framework suggests a mix of methods focusing on qualitative methods for evaluating the AEGIS platform. A series of test cases have to be executed by the particular PSPS data scientists involved in demonstrator creation, who will then be interviewed on their expectation and perception of AEGIS platform in general, as well as of the demonstrator development process in particular. Moreover PSPS users of the created services will be interviewed on how they perceive the usage of the services provided by the platform.

Rigorously evaluating the AEGIS platform will lead to many valuable remarks, conclusions, and learnings about the usefulness, usability, quality, viability, and sustainability of the AEGIS platform. A sound evaluation will facilitate the (continuous) improvement of the AEGIS platform.

This deliverable provides the following contributions to the AEGIS project:

- After a comprehensive introduction and motivation in section 1, the scope of the AEGIS framework is deducted from the descriptions in the AEGIS DoW as well as from the AEGIS deliverables already submitted to the European Commission.
- In section 2 this deliverable outlines a series of approaches and methodologies relevant to enable a comprehensive evaluation framework. The AEGIS evaluation framework has its roots in information systems research (treating the AEGIS platform as an information system) and heavily relies on instruments of qualitative data collection (most notably interviews) to find out more about how stakeholders of the AEGIS big data platform perceive its usefulness, usability, and quality.
- Demonstrators are at the core of evaluating the AEGIS platform. Therefore section 3 provides a comprehensive description of the three different AEGIS demonstrators,

automotive, smart home, and insurance, as well as operational scenarios. It includes a set of preliminary evaluation cases, which have been developed by the respective demonstrator owners, and which are especially important for the evaluation.

- Section 4 finally describes the envisaged implementation of the AEGIS evaluation framework within the project, following a four-step procedure. The framework can be applied in total three times in the project, while the results of two evaluations can directly be fed back into the project. The results of the third evaluation will support the commercial exploitation phase following the successful completion of the AEGIS project.

To summarize, the results of this deliverable D5.1 are the AEGIS evaluation framework, the description of the three AEGIS demonstrators including evaluation cases as well as a four steps methodology for framework implementation. Hence, D5.1 provides the baseline for all further activities in WP5 including demonstrators participation and coordination activities (T5.2), demonstrator execution (T5.3, T5.4, T5.5), and finally evaluation, lessons learnt and impact assessment (T5.6).

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